Fall 2026

Introduction to STEM Education

Literature-based Curriculum Projects





Teacher Guide



Pumpkin Gas or Pumpkin Crash!

2nd Grade

Challenge:

Students will design and build a transportation device that can safely move a small pumpkin from a starting point 5 feet away. The pumpkin must stay secure while the device is pushed or pulled. Students may use wheels if they choose. Each team will have $3 budget and must stay at or below the budget.

Standards

Science:

- 2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- 2-PS1-2: Analyze data from testing different materials to determine which materials have the properties best suited for an intended purpose.

Mathematics:

- AR.Math.Content.2.MD.C.8: Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ symbol.

STEL:

- STEL-2C: Explain that materials are selected for use because they posses desirable properties and characteristics.

Scenario:

The students will read “There Was an Old Lady Who Swallowed Some Leaves” by Lucille Colandro. After reading the story, students learn that the old lady wants to take a pumpkin home for halloween, but she os too tired to carry it. Students will become engineers and design a way to transport the pumpkin safely from the pumpkin patch to her home.

Big Ideas & Essential Questions

Big Ideas:

- **Different materials can be grouped by their properties, such as color, texture, hardness, and flexibility.**
- Different materials have different properties, and we can test and compare them to choose the best material for a specific job.
- We can use the value of coins and dollar bills to solve money problems and stay within a budget.

Essential Questions:

- **How can we design and build a device that helps the old lady carry a pumpkin safely and easily?**
- How can we test our design and make it better?
- What materials will work best for our design, and why?
- How can we stay within our $3 budget?
- How can we compare our design with other groups’ designs?

Tools, Materials, & Resources

Tools:

Scissors

Rulers

Mini hack-saws

Hole Punchers

Materials:

Glue/paste- $0.50

Pipe Cleaners- 10= $0.35

Wheels and Axles- 2=$0.75

Chopsticks- 5= $0.25

Construction Paper- 1= $0.10

Cardboard- 1 box= $0.50

Straws- 4=$0.20

Tape- 12 inches=$0.15

String- 12 inches= $0.10

Paper Plates- 2= $0.30

Resources:

The book

Teacher Slideshow

Engineering Design Loop

Student Design Journals

Budget Sheet

STEM Content Information

Science:

Students will learn that materials have different properties. A material is what an object is made of, and a property is a characteristic of a material that can be observed or tested. Students will test materials and collect data, or information from their observations and tests. They will use what they learn to decide which materials are best for their transportation device.

Science Vocabulary:

Material- What something is made of, such as wood, plastic, metal, or cloth.

Property- A characteristic that describes an object or material.

Observe- To use your senses to learn about something.

Classify- To sort things into groups based on how they are alike.

Investigate- To explore or test something to learn more about it.

Compare- To look at two or more things and find how they are alike or different.

Describe- To tell what something looks, feels, or acts like.

Texture- How something feels, such as smooth, rough, soft, or bumpy.

Hard- Not easy to bend, scratch, or change shape.

Soft- Easy to press, squeeze, or change shape.

Flexible- Able to bend without breaking.

Rigid- Stiff and not easy to bend.

Rough- Having a bumpy or uneven surface.

Smooth- Having an even surface that feels nice to touch.

Transparent- Allows light to pass through so you can see clearly through it.

Waterproof- Does not let water pass through easily.

Absorbent- Able to soak up water or other liquids.

Strength- How well a material holds up without breaking or bending.

Purpose- The reason something is made or used.

Test- To try something out to see how well it works.

Data- Information collected during an investigation or test.

Results- What you learn or discover after a test.

Analyze- To look carefully at information to understand what it means.

Evidence- information or observations that help explain an answer.

Suitability- How well something works for a particular job.

Conclusion- What you decide after looking at the results of an investigation.

Technology and Engineering:

Students will follow the engineering design process by creating a design, making a strech, building a prototype, testing it, and making improvements. Students will compare their original idea with their finished product.

Technology and Engineering Vocabulary:

Material- What something is made of, such as wood, plastic, metal, or paper.

Property- A characteristic that describes a material.

Characteristic- Something about a material that makes it special or different.

Desirable Property- A property that makes a material a good choice for a certain job.

Select- To choose something from different options.

Purpose- The reason something is made or used.

Design- A plan for making something.

Engineer- A person who designs and builds things to solve problems.

Strength- How well a material can hold weight without breaking.

Flexibility- How easily a material can bend without breaking.

Hardness- How difficult it is to scratch, bend, or change a material.

Texture- How a material feels, such as smooth, rough, soft, or bumpy.

Durable- Able to last a long time without breaking easily.

Waterproof- Able to keep water from passing through easily.

Absorbent- Able to soak up water or other liquids.

Lightweight- Not heavy; easy to lift or carry.

Heavy- Weighing a lot.

Compare- To look at two or more materials and see how they are alike or different.

Test- To try something out to see how well it works.

Problem- Something that needs to be solved.

Solution- An idea or design that solves a problem.

Improve- To make something better.

Mathematics:

Students will use money to stay within the $3 budget. They will also identify shapes, think about distance, and consider measurements while designing their transportation device.

Mathematics Vocabulary:

Money- Coins and bills that we use to buy things.

Dollar ($)- A unit of money worth 100 cents.

Dollar Bill- Paper money worth $1 or more.

Cent (¢)- A unit used to show the value of coins.

Penny- A coin worth 1 cent.

Nickel- A coin worth 5 cents.

Dime- A coin worth 10 cents.

Quarter- A coin worth 25 cents.

Value- How much something is worth.

Cost- The amount of money needed to buy something.

Total- The amount when all the money is added together.

Equal- Having the same amount or value.

Add- To put amounts together to find the total.

Subtract- To take away an amount from another amount.

Word Problem- A math problem written as a story or situation.

Solve- To find the answer to a problem.

Change- Money given back when you pay more than something costs.

More- A greater amount of money.

Less- A smaller amount of money.

Compare- To decide which amount of money is greater, smaller, or equal.

Combination- Different coins and bills put together to make an amount of money.

Symbol ($)- The sign used to show dollars, such as $1 or $5.

Results/Deliverables

Students will turn in:

1. A sketch of their planned design.
2. Their completed pumpkin transportation device.
3. Their design journal showing planning, testing, changes, and relfections.
4. A short presentationdemonstrating how their device works and explaining their design process.
5. A teammate survery showing how they worked togther.

Limitations:

- The device must fit the provided small pumpkin.
- The pumpkin must stay inside or secured in the device.
- The device must move 5 feet.
- The device must be pushed or pulled.
- The pumpkin should not fall put or break.
- Students must stay within $3 budget.
- Students may only use the provided materials.

Assessment/Evaluation

Students will be assessed on their use of the engineering design process, creativity, problem-solving, materials choices, math skills, teamwork, and attention to detail. The teacher will review the students' design journals, sketches, final transportation devices, and presentations. Students should show that they planned, built, tested, and improved their designs. The teacher will also look for evidence that students understand material properties, use shapes and measurements, and stay within the $3 budget. The goal is not only for the device to work but for students to show learning and improvement throughout the design process.

Directions To The Teacher

1. Read “There was an Old Lady Who Swallowed Some Leaves” to the class.
2. Introduce the scenario and explain that students will become engineers who must help the old lady get her pumpkin home.
3. Review the STEM standards and explain important vocabulary such as material, property, test, data, design, prototype, sketch, build, distance, and budget.
4. Show students the available materials and their prices.
5. Give each group a $3 budget and have students plan what materials they want to purchase.
6. Have students brainstorm and sketch their ideas in their design journals.
7. Allow students to build their prototype.
8. Have students test their devices by moving the pumpkin 5 feet.
9. Give students time to identify problems and make improvements.
10. Have each group complete a final test and present their transportation device to the class.
11. Have students reflect on what worked, what did not work, and what they would change next time.



Pumpkin Gas or Pumpkin Crash

Scenario

There is an old lady who is weak and decides to swallow everything in her way, making her tired and entering a food coma. It's almost halloween and she wants to keep a pumpkin to decorate her home with but she can't carry it from the pumpkin patch by herself. Create a type of transportation for her pumpkin? How can we create a device that will be safe and workable for this old lady?

Your Challenge

- You will need to build a type of transportation to keep the old lady's pumpkin safe!
- We will have a start and end that are five feet away, the object can be given a push or a pull but can not just be dragged across.
- You may use wheels if wanted.
- You will need to find a way to secure the pumpkin and not allow it to fall out when the old lady is walking home (when you push or pull your device). You will be given a 3 dollar budget that they will need to remain under or at.



Our Big Ideas

- Different materials can be grouped by their properties, such as color, texture, hardness, and flexibility.
- Different materials have different properties
- We can test and compare them to choose the best material for a specific job
- We can use the value of coins and dollar bills to solve money problems and find the total amount.

Ask yourself!

- How can we design and build a device that helps the old lady carry a pumpkin safely and easily?
- How can we test or design and then improve? (collaboration?)
- How will this move? Does it have wheels? A slope? A slide?
- How can we meet the budget?
- What materials will you use?



- A sketch of the planned idea, does not need to be identical to the final product as you may need to adjust

What you need to turn in



- The final produc, within a $20 budget

- presentation, demonstrating the mobility of your project and an explanation to your classmates of your process

Materials and the price

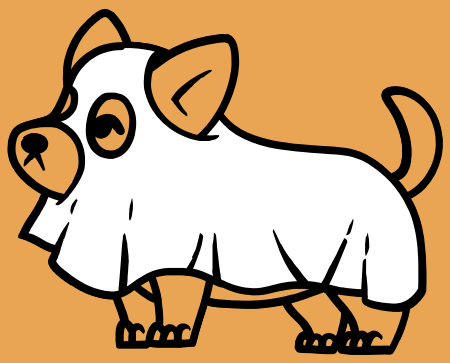
- Glue and paste $2
- Pipe cleaners/Fuzzy sticks 10 pipe cleaners = $3
- Wheels and Axles 2 Wheels and Axles = $4
- Chop sticks 5 Chop Sticks = $2
- Construction paper 1 paper = $1
- Cardboard - sheets, boxes 1 box = $3
- Straws 4 Straws = $2
- Tape 12 inches = $1
- String 12 inches = $1
- Paper plates 2 Plates = $2

Tools available

Scissors
Rulers
Mini Hack-saws
hole puncher

Rubric

Criteria	4 – Excellent	3 – Good	2 – Developing	1 – Beginning
Science & Materials	Chooses materials based on their properties and explains why.	Chooses materials and gives some reasoning.	Chooses materials with little reasoning.	Has difficulty choosing materials.
Math & Budget	Uses shapes, measurements, and stays within the $3 budget.	Uses shapes and measurements and stays close to budget.	Uses some math but needs help.	Has difficulty using math or following the budget.
Engineering Process	Sketches, builds, tests, and makes improvements.	Completes most steps and makes improvements.	Completes some steps.	Shows little evidence of the process.
Design & Mobility	Creative design moves 5 feet and keeps the pumpkin safe.	Design moves and mostly keeps the pumpkin safe.	Design moves but has some problems.	Design does not move or keep the pumpkin safe.
Journal & Presentation	Clearly explains the design, testing, changes, and results.	Explains most of the design and process.	Gives a basic explanation.	Has difficulty explaining the design.
Teamwork	Always participates and works well with others.	Usually works well with others.	Sometimes participates.	Rarely participates or helps.



My Design Journal

THE ENGINEERING DESIGN LOOP

1 ASK

What is the problem?

What do we need to solve?



2 IMAGINE

Think of different ideas and possible solutions.



3 PLAN

Choosethe best idea and make a plan.



4 CREATE

Build your solution.



5 TEST

Try it out!

Does it work?



6 IMPROVE & SHARE

Think and talkwith you peers aboutwhat didn't work. Make changes and try again!

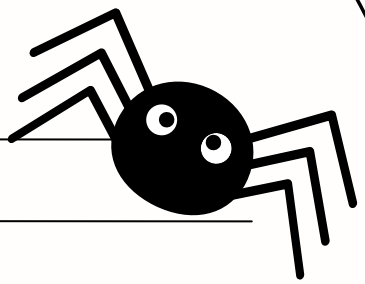


TRY, TEST, AND LEARN!



Ask

What is the problem? What do we need to solve?

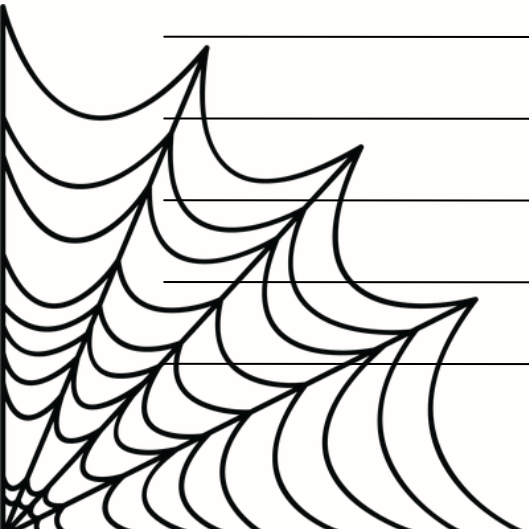


Imagine





What are some different ideas you could try? What materials could you use? What will work best, and why?





$3 Budget

Add up your potential materials in the spaceAnext to the materials

MATERIALS:

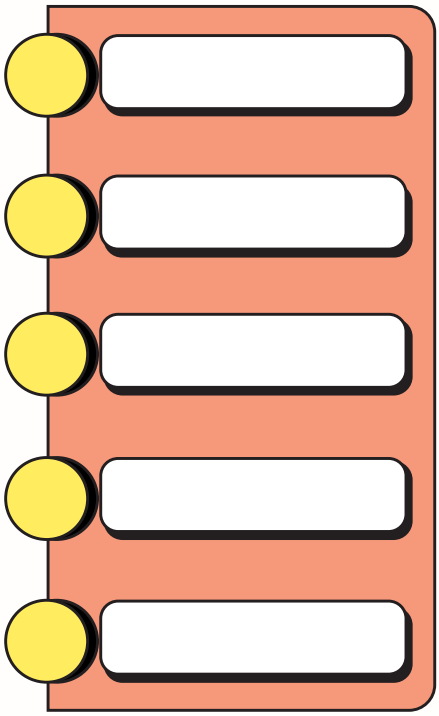
- ○ Glue/paste- $0.50
- ○ Pipe Cleaners- 10= $0.35
- ○ Wheels and Axles- 2= $0.75
- ○ Chopsticks- 5= $0.25
- ○ Construction Paper- 1= $0.10
- ○ Cardboard- 1 box= $0.50
- ○ Straws- 4= $0.20
- ○ Tape- 12 inches= $0.15
- ○ String- 12 inches= $0.10
- ○ Paper Plates- 2= $0.30
- ○ Styrofoam- 1= $0.30

Plan

What materials will you use within your design? Test the properties wihtin yur materials! Will these work in your design, test and check!

Draw a line to the materials you used within your design to their properties

Your materisals used :



Properties:

Strong

Flexible

bendable

Plastic

Sticky

Rigid

Adhesive

Round

Soft

Lightweight

Create

Circle the materials you used. Then draw your design in the box!





Glue/ Paste	Pipe Cleaners	Wheels & Axles	Chopsticks	Straws
Paper Plates	Cardboard	Styrofoam	Construction Paper	Tape
String				

Test!



Answer yes or no on the lines and give a short explanation or follow up to explain.

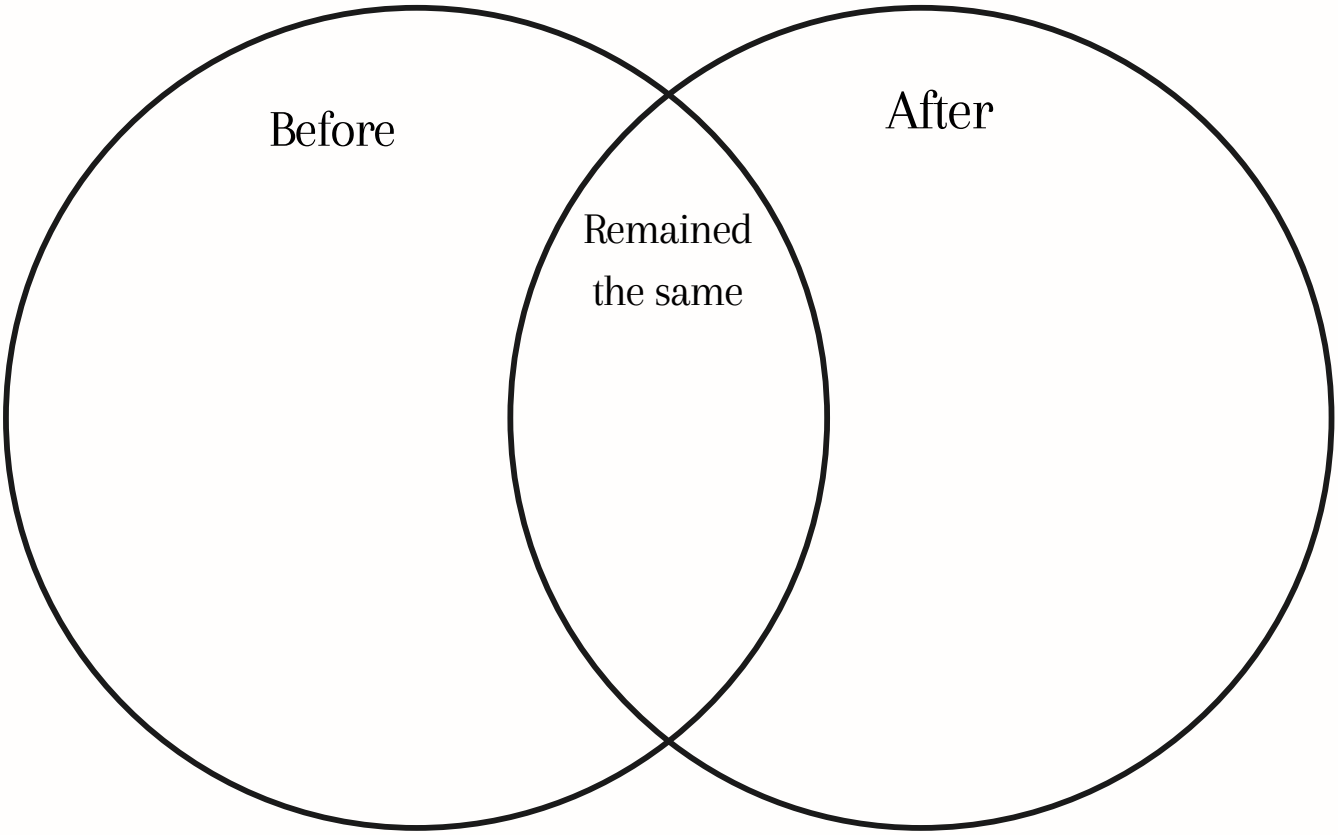
Did your design work?

Reference the rubric on your student guide, does it pass?

Do you want or need improve after testing?

Improve and Share

Compare and contrast before and after you collaborated and improved your design!



Operation Surprise Lou



Grade Level: 2nd Grade

STEM Content Standards:
Science (Life, Earth/Space, or Physical Science)

- 2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- 2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
- 2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.
- 2 PS1-1 - Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
- Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Mathematics

- 2.GM.3: Select appropriate measurement tools to estimate and measure the length of an object to the nearest whole inch or whole centimeters.

Standard for Technological and Engineering Literacy

- Standard 2: Core Concepts of Technology and Engineering
- C. Explain that materials are selected for use because they possess desirable properties and characteristics.
- E. Collaborate effectively as a member of a team.

Additional Standards: Reading Literature

- 2.RC.8.RL: Identify the main story elements (characters, settings, events, problem, and solution) in a text.

Big Ideas:

- Materials have distinct properties and do different jobs.
- Tools help us measure.
- It is important to be able to work as a team to more effectively solve problems.

Essential Question/s:

- What properties influenced your decision in the materials you brought from home?
- How did your recycled materials work together to create your solution?
- How can we test our ideas to make them work better?
- How does measurement help us refine our solutions?

Scenario: You and your friends love to climb the big Oak Tree in your neighborhood, but one of your friends, Lou, is the only one who can't climb a tree. Lou often feels left out and lonely while everyone else is up in the tree, she wishes there was a way for her to be able to play with all her friends while they climb the tree. You and your friends get together and decide to surprise Lou by building a solution to her tree-climbing problem so that she can join in on the fun!

Challenge: Your challenge is to work in teams to build a contraption that safely lifts Lou from the ground up to a tree branch 18 inches above the floor! You may only use recycled materials or other used items from home. Each student may bring one item from home, and the remaining items will be recycled materials available in class. Your contraption must attach securely to the classroom "tree branch" for your presentation.

Materials:

- One used item from home
- Limited class recycled materials (cardboard, paper towel rolls, fabric scraps, round plastic containers, styrofoam egg cartons, paper scraps)
- Glue
- Masking tape
- Yarn
- Popsicle sticks
- Rubber bands

Tools:

- Hole punch
- Scissors
- Ruler
- 3-D printed 3 inch “Lou”

Resources:

- Computer lab for research
- Books from the library

Science:

Observe- To watch, listen, or look at something very closely to learn how it works

Properties- Things you can see, feel, or measure without changing the object EX: hard, flexible, round, soft...

Materials- The physical stuff we use to create products

Classify- To sort things into groups based on what they have in common

Technology and Engineering (STEL):

Collaborate- Working together with other people to finish a task

Exploration- Closely looking at a new place, thing, or idea to learn something new

Characteristics- A special feature that helps describe something that makes it unique

Mathematics:

Measurement tools- special devices used to find out the size, length, or weight of something

One foot- 12 inches

Two feet- 24 inches

Results: Each student will each turn in the STEM plan worksheet along with their solution.

(https://ca.pinterest.com/pin/stem-challenges-can-feel-daunting-and-intimidating-however-theyre-easier-to-set-up-and-carry-out-than-you-think--14496030044692150/

Limitations: Your solution must be at least 18 inches tall and be able to attach to the "tree branch" without a teammate touching it. Each student may bring ONE used item that is commonly found in a home (cannot be electric) and is allowed four materials from the class collection. Your team must include three people. We will work on our solutions in the STEM lab for 30 minutes a day for one week.

Assessment/Evaluation: Students will be evaluated by a clearly explained rubric and will fill out a self and peer evaluation to ensure that all members of the group are participating, sharing ideas, bringing an item from home, and working together. The rubric is scored out of 80 and the evaluations are scored out of 20.

Assessment Category & Target Standard	**4 - Expert Tree-Builder (Advanced)**	**3 - Tree-Climber (Proficient)**	**2 - Helper (Developing)**	**1 - Starter (Beginning)**	**Points**
Story Elements & Problem Definition• *2.RC.8.RL* *2-ETS1-1*	Clearly identifies Lou's problem from the story and explains specifically how the team's contraption solves it.	Explains Lou's problem and gives a basic explanation of how the contraption solves it.	Needs help identifying Lou's problem or how the contraption helps her join her friends.	Cannot identify the story problem or explain how the project solves it.	___ / 20
Material Properties & Selection *PS1-1* *STEL 2.C*	Explains specifically *why* materials were chosen based on observable properties (e.g., strong, flexible, lightweight, sticky).	Names the materials used and identifies at least one observable property.	Describes the materials used, but cannot explain why they were chosen for the design.	Cannot name or describe the properties of the materials used in the build.	___ / 20
Measurement & Constraints *2.GM.3*	Uses a ruler correctly to ensure contraption reaches **18 inches** and attaches securely to the branch independently.	Measures contraption near 18 inches with minor measurement errors; attaches with minimal support.	Measurement is off by several inches OR contraption requires hands-on support to stay on branch.	Contraption does not reach the 18-inch height and cannot attach to the branch.	___ / 20
STEM Plan Worksheet *2-ETS1-1*	The worksheet is completely filled out with detailed drawings, clear labels, material lists, and testing reflections.	The worksheet is mostly filled out with basic drawings, labels, and testing notes.	The worksheet is incomplete, missing labeled drawings or key reflection answers.	The worksheet is incomplete or missing.	___/20

Design Journal:
For my engineering design journal I would have a page dedicated to each step of my design loop with questions to help guide the students through the entire process. I would list each of the standards and explain their requirements for each step. Students could write or draw out ideas.

Think: What is the problem and what do we already know?
Study: Look Closely and Gather Information.
Choose: What materials will I use? Why did I choose my Idea?
Build: Am I following the plan I made? Do I need to make any changes?
Prove: Test it!
Grow: What did I learn through this process? How can I make this better?

Peer Evaluation:

MY DESIGN ADVENTURE

Self-Evaluation - Think about how YOU helped Lou!

Name: _____ **Team:** _____

Our Mission: Build a contraption from recycled or used materials that safely lifts Lou **18 inches** from the floor and attaches securely to the classroom tree branch.

Circle YES, ALMOST, or NOT YET for each statement.

I can say...	YES!	ALMOST	NOT YET
I shared ideas with my team.	YES	ALMOST	NOT YET
I listened to my teammates' ideas.	YES	ALMOST	NOT YET
I helped build or test our contraption.	YES	ALMOST	NOT YET
I helped use recycled or used materials.	YES	ALMOST	NOT YET
I helped make our design safe and secure.	YES	ALMOST	NOT YET
I helped measure to reach the 18-inch goal.	YES	ALMOST	NOT YET
I kept trying when our design did not work.	YES	ALMOST	NOT YET
I helped improve our design after testing.	YES	ALMOST	NOT YET

One thing I am proud of:
_____
_____

One thing I would change or improve next time:
_____
_____

TREE-MENDOUS TEAM FEEDBACK!

Peer Evaluation - Help another team make their design even stronger!

My Name: _____ **Team I Observed:** _____

Be a kind engineer! Look closely, notice what worked, and give one helpful idea. We are helping each other grow - not giving grades.

Circle YES, ALMOST, or NOT YET for what you noticed.

Their design...	YES!	ALMOST	NOT YET
used recycled or used materials.	YES	ALMOST	NOT YET
attached securely to the tree branch.	YES	ALMOST	NOT YET
lifted Lou safely from the ground.	YES	ALMOST	NOT YET
reached the 18-inch goal.	YES	ALMOST	NOT YET
showed creative problem-solving.	YES	ALMOST	NOT YET
looked like the team tested and improved it.	YES	ALMOST	NOT YET
was explained clearly by the team.	YES	ALMOST	NOT YET

A LEAF OF PRAISE! One thing this team did really well:

_____

_____

_____

A GROWING IDEA! One way they could make their design even better:

_____

_____

_____

Something cool I noticed: _____

_____

Operation Surprise Lou!





Big Ideas:

- Materials have distinct properties and do different jobs.
- Tools help us measure.
- It is important to be able to work as a team more effectively .
  solve problems.

Essential Questions:



- What properties influenced your decision in the materials you brought from home?
- How did your recycled materials work together to create your solution?
- How can we test our ideas to make them work better?
- How does measurement help us refine our solutions?

Scenario:



You and your friends love to climb the big Oak Tree in your neighborhood, but one of your friends, Lou, is the only one who can't climb a tree. Lou often feels left out and lonely while everyone else is up in the tree, she wishes there was a way for her to be able to play with all her friends while they climb the tree. You and your friends get together and decide to surprise Lou by building a solution to her tree-climbing problem so that she can join in on the fun!

Challenge:



Your challenge is to work in teams to build a contraption that safely lifts Lou from the ground up to a tree branch 18 inches above the floor! You may only use recycled materials or other used items from home. Each student may bring one item from home, and the remaining items will be recycled materials available in class. Your contraption must attach securely to the classroom "tree branch" for your presentation.

Materials, Tools, Resources:

Materials:

- One used item from home
- Limited class recycled materials (cardboard, paper towel rolls, fabric scraps, round plastic containers, styrofoam egg cartons, paper scraps)
- Glue
- Masking tape
- Yarn
- Popsicle sticks
- Rubber bands



Tools:



- Hole punch
- Scissors
- Ruler
- 3-D printed 3 inch “Lou”

Resources:

- Computer lab for research
- Books from the library



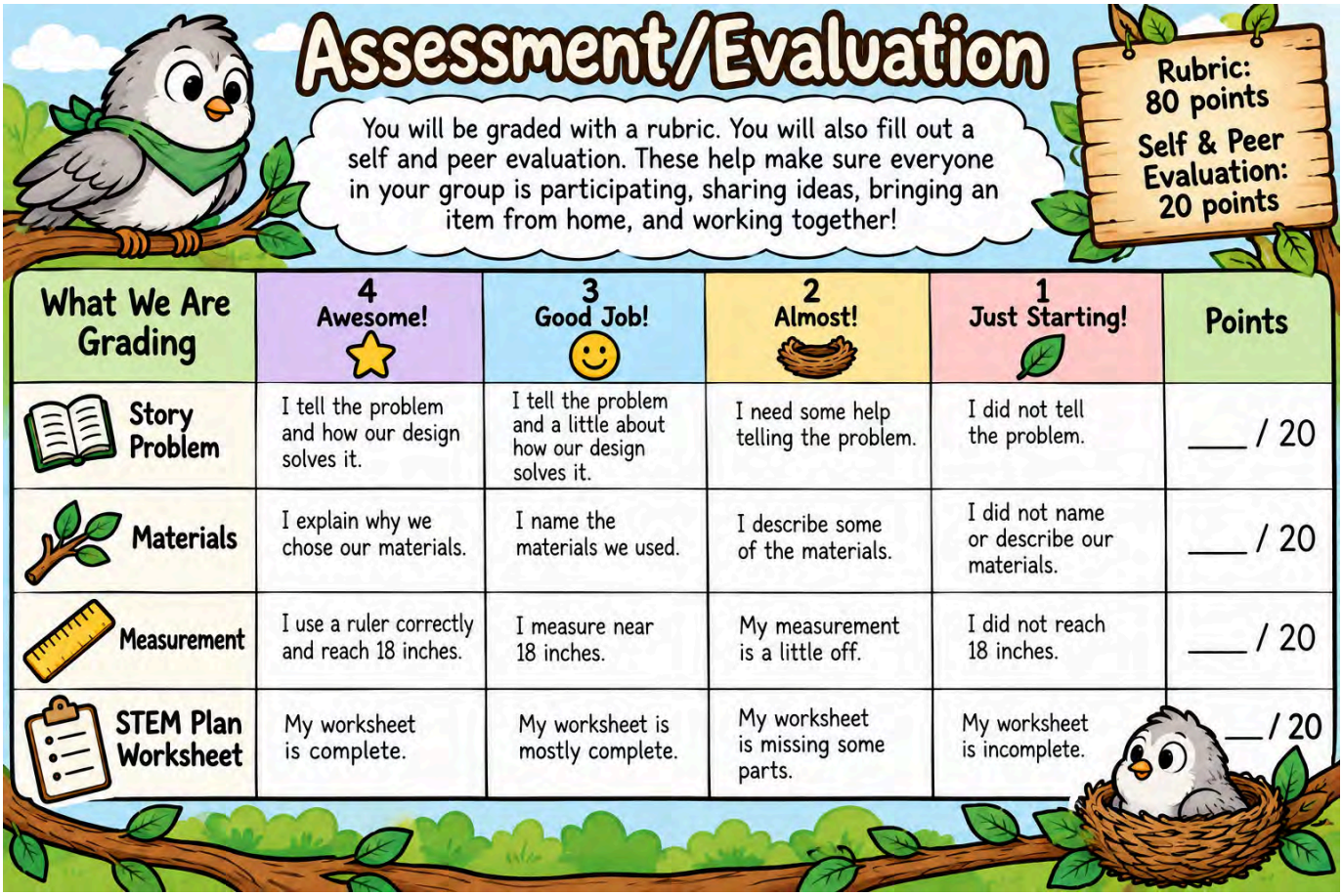
Limitations: Your solution must be at least 18 inches tall and be able to attach to the “tree branch” without a teammate touching it. You may bring ONE used item that is commonly found in a home (cannot be electric) and is allowed four materials from the class collection. Your team must include three people.

Results: Use your Design Journal to show how you built Lou’s solution! Make sure to fill out each page to show your thinking.

Click here for design journal!



Assessment/ Evaluation:



What We Are Grading	4 Awesome!	3 Good Job!	2 Almost!	1 Just Starting!	Points
Story Problem	I tell the problem and how our design solves it.	I tell the problem and a little about how our design solves it.	I need some help telling the problem.	I did not tell the problem.	____ / 20
Materials	I explain why we chose our materials.	I name the materials we used.	I describe some of the materials.	I did not name or describe our materials.	____ / 20
Measurement	I use a ruler correctly and reach 18 inches.	I measure near 18 inches.	My measurement is a little off.	I did not reach 18 inches.	____ / 20
STEM Plan Worksheet	My worksheet is complete.	My worksheet is mostly complete.	My worksheet is missing some parts.	My worksheet is incomplete.	____ / 20

Peer Evaluation:

MY DESIGN ADVENTURE

Self-Evaluation - Think about how YOU helped Lou!

Name: _____ **Team:** _____

Our Mission: Build a contraption from recycled or used materials that safely lifts Lou **18 inches** from the floor and attaches securely to the classroom tree branch.

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I listened to my teammates' ideas.	YES	ALMOST	NOT YET
I helped build or test our contraption.	YES	ALMOST	NOT YET
I helped use recycled or used materials.	YES	ALMOST	NOT YET
I helped make our design safe and secure.	YES	ALMOST	NOT YET
I helped measure to reach the 18-inch goal.	YES	ALMOST	NOT YET
I kept trying when our design did not work.	YES	ALMOST	NOT YET
I helped improve our design after testing.	YES	ALMOST	NOT YET

One thing I am proud of:

_____

_____

One thing I would change or improve next time:

_____

_____

My teamwork today: 1 star 2 stars 3 stars 4 stars 5 stars

(Circle the number of stars you think you earned.)

TREE-MENDOUS TEAM FEEDBACK!

Peer Evaluation - Help another team make their design even stronger!

My Name: _____ **Team I Observed:** _____

Be a kind engineer! Look closely, notice what worked, and give one helpful idea. We are helping each other grow - not giving grades.

Circle YES, ALMOST, or NOT YET for what you noticed.

Their design...	YES!	ALMOST	NOT YET
used recycled or used materials.	YES	ALMOST	NOT YET
attached securely to the tree branch.	YES	ALMOST	NOT YET
lifted Lou safely from the ground.	YES	ALMOST	NOT YET
reached the 18-inch goal.	YES	ALMOST	NOT YET
showed creative problem-solving.	YES	ALMOST	NOT YET
looked like the team tested and improved it.	YES	ALMOST	NOT YET
was explained clearly by the team.	YES	ALMOST	NOT YET

A LEAF OF PRAISE! One thing this team did really well:

_____

_____

_____

A GROWING IDEA! One way they could make their design even better:

_____

_____

_____

Something cool I noticed: _____

_____

Operation Surprise Lou Journal



Think : What is Lou's Problem?





Study: Gather Your Information



Choose: What materials will I use?

What materials will I use?

- Name your material.
- Describe three things about it.
- Draw your material.

Why did I choose my these materials?

- How will this material help me solve the problem?
- What makes this material a good choice?

What material will I bring from home?

- List the material and explain why you will bring it.

How will these materials help Lou?

- Explain how your materials will help Lou in the story.



Material 1:

1) _____
_____
2) _____
_____
3) _____
_____

Material 2:

1) _____
_____
2) _____
_____
3) _____
_____

Material 3:

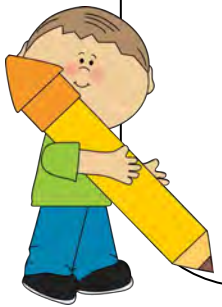
1) _____
_____
2) _____
_____
3) _____
_____

Material 4:

1) _____
_____
2) _____
_____
3) _____
_____

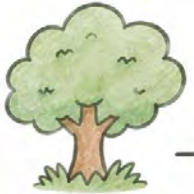
Build: Draw your solution!

Am I following the plan I made?



Prove: What Happened when I tested it?





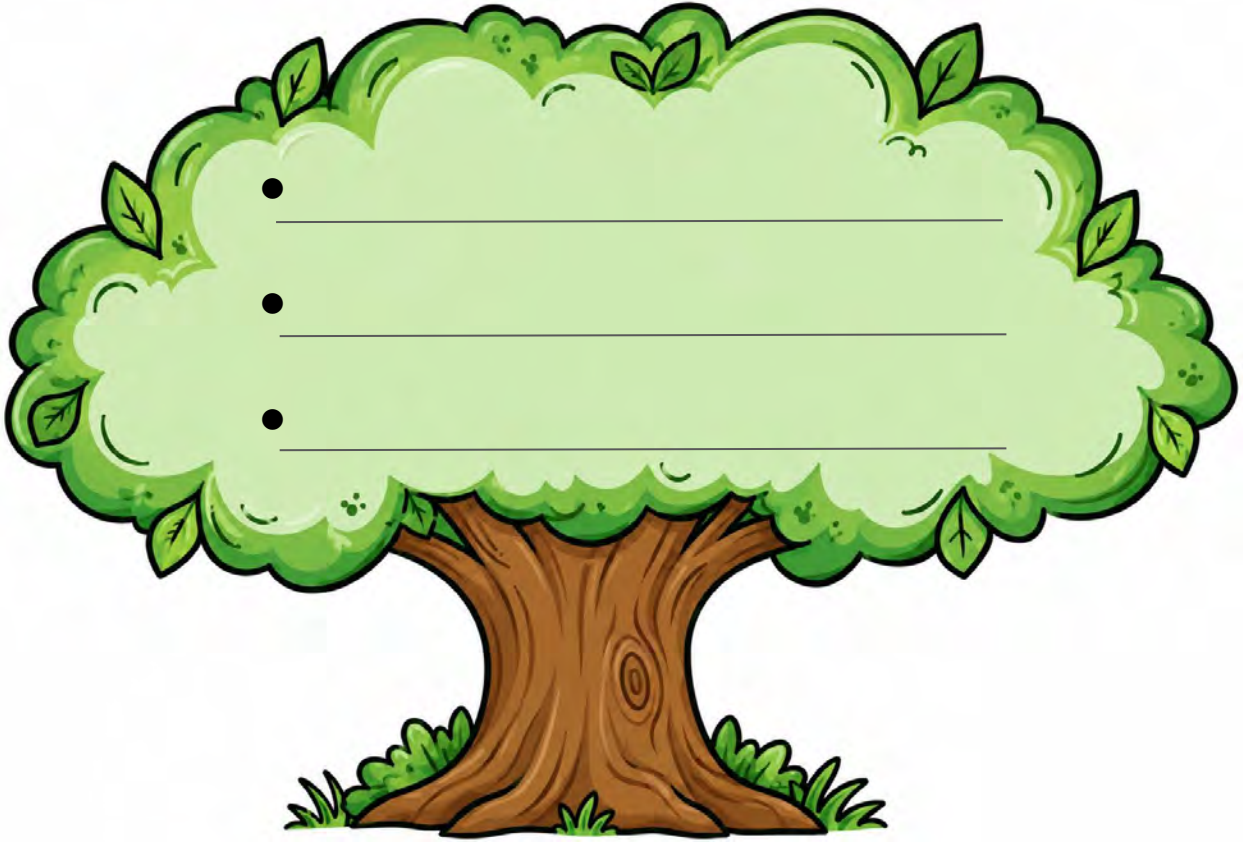


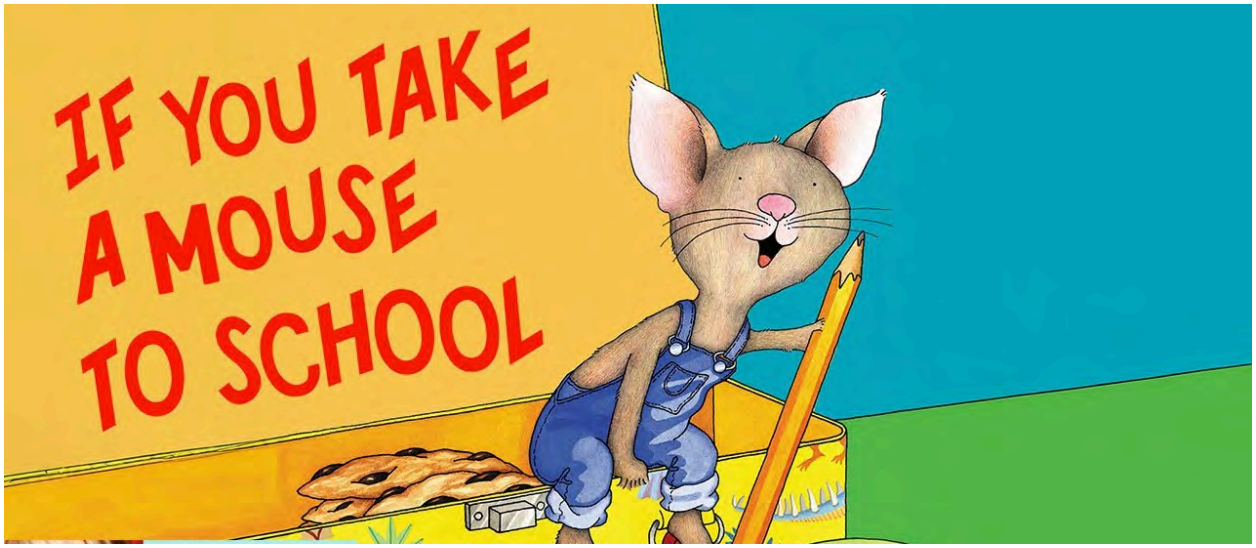


Record 3 measurements you found while building. Put it in inches



Grow: What did I learn through this process? How can I make this better?





If You Build a Mouse a House Third Grade Project
Teacher Guide

STEM Content Standards:
Science:

- 3-PS2-4 Define a simple design problem that can be solved by applying scientific ideas about magnets.*

Mathematics:

- **3.GM.7:** Multiply side lengths to find areas of rectangles with whole number side lengths in the context of solving real-world and mathematical problems.

Standard for Technological and Engineering Literacy:
Standard 2: Core Concepts of Technology and Engineering
K. Describe requirements of designing or making a product or system.

Big Ideas:

1. Magnets can be used to solve problems
   a. Define a problem that magnets can be used to solve
2. Magnetic forces between a pair of objects depend on their properties
   a. Size, distances apart, and forces between two magnets help us understand their properties
3. Scientific inquiry requires planning
   a. Planning and conducting investigations are key steps in the scientific process that help us answer questions and solve problems
4. Understanding the connection between Science, Engineering, and Technology

a. Scientific discoveries about the natural world often lead to new technologies, and these are developed through the Engineering Design Process

5. Applying the Multiplication Formula
   a. Understanding that the formula for area is length x width. Using multiplication strategies, multiplication facts and distributive property to help solve equations.
6. Identifying inches on a ruler
   a. The ability to read a ruler and distinguish inches, and being able to round to the nearest inch

Essential Questions:

1. What properties do we observe in the different materials we used?
2. How can you find the north and south pole in a magnet?
3. Where do you see magnets in everyday life?
4. What is area?
5. Why did you round to that number?
6. What tools can we use to measure?
7. What forms of technology are used in your final project?
8. How did you create your fort?
9. What materials did you use?

Scenario: After reading *If You Bring a Mouse to School,* we saw the house the little mouse made for himself. Pretend that we had a pet mouse in our classroom. This little mouse wants us to build him a house with two floors to play on, while we get to learn in our classroom. He also recently found a pair of magnets in our classroom while we were at recess that he thought were interesting. One problem he has had recently is the door not opening and the window not closing. Do you think we could use magnets to help him figure out a way to open and close the door or the window?

Challenge:

You are going to have limited supplies to build this Mouse House. There will be a 3D printed mouse that is three inches tall and he needs to fit in all parts of the house. I am going to provide you with a box that you can choose from a pile but after that you get a budget of $20 to use materials I provide from the classroom. There needs to be one item in your house that uses magnets to move an object(s) (I will provide this for you as well).

At the end you will measure your house. You get to present your house to the class, what you used your magnet for, how it moves, and tell us the area of the sides of your house.

Tools, Materials, and Resources:

Material	Cost	Quantity	Total Cost
Box	Provided		
10 Paperclips	Provided		
Magnets	Provided		
10 Craft sticks	$2.00		
5 Sheets of Cardstock Paper	$1.00		
3 Balloons	$2.00		
4 Cups	$1.00		
Scrap Fabric	$5.00		
Extra piece of cardboard	$1.00		
4 Pipe Cleaners	$2.00		
5 extra paperclips	$3.00		

Final cost: _____

Tools: Scissors, tape, glue, ruler, chomp saw, special scissors for pipecleaners, monitored hot glue gun

Resources: teacher (find a video on magnets and how to use them in the way we want)

Content information:

Science

- • Non-Contact Forces: Magnetic forces between a pair of objects do not require the objects to touch each other.
- • Factors Affecting Force Strength: The size of a magnetic force depends on the material properties of the objects, the distance between them, and their orientation relative to one another.
- • Attraction and Repulsion: Magnets can pull objects closer (attract) or push objects away (repel) depending on how the poles are aligned.
- • Defining a Design Problem: Students identify a practical problem (e.g., building a latch to keep a door or container shut, or creating a barrier to keep moving toy cars/marbles

apart) and establish successful criteria and limits (constraints like cost, time, and materials).

- Essential Vocabulary
    - Magnet: An object that pulls certain types of metal (like iron or steel) toward it.
    - Magnetic Force: The push or pull exerted by magnets.
    - Attract: To pull closer together.
    - Repel: To push away from each other.
    - Contact: Touching; magnetic forces work without direct contact.
    - Distance: The space or gap between two objects, which changes how strong the magnetic pull or push is.
    - Orientation: The direction or way a magnet is turned or pointed.
    - Pole: The ends of a magnet (north and south) where the magnetic force is strongest.
    - Latch: A device used to hold a door, lid, or gate closed.
    - Design Problem: A challenge or need that can be fixed by making or improving a tool.
    - Criteria: The goals or features that make a design successful.
    - Constraints: The limits on a design project, such as cost, available materials, or time.

Technology and Engineering (STEL)
Essential Content

- **Wants and Needs:** Designs start by solving a problem or making something people need or want.
- **Design Rules (Requirements):** Every design has specific rules or features it must follow to work right.
- **Different Solutions:** There is more than one way to solve a problem, and no design is completely perfect.
- **Shape and Function:** How an object is shaped helps decide what it can do or how stable it is.

Essential Vocabulary

- **Design:** A plan or drawing made to show how something works or how it will look.
- **Need:** Something required to live or do a task (like water or a safe shelter).
- **Want:** Something someone would like to have, but can live without.
- **Requirement:** A rule or a need that a design must have to be successful.
- **Solution:** An answer or a built object that fixes a problem.
- **Model:** A simple copy or drawing of an object to show its shape and how it works.

Mathematics

- Essential Content
- • Multiplication for Area: Transitioning from counting individual unit squares inside a grid to multiplying the row length by the column length • Real-World Application: Solving word problems involving physical spaces like rooms, gardens, carpets, or tile floors with rectangular dimensions.
- • Missing Side Problems: Finding an unknown side length when the total area and one side length are provided.
- • Mathematical Reasoning: Representing a whole-number multiplication product as an actual physical rectangular area.
- Essential Vocabulary
    - Area: The amount of flat space inside a 2D shape, measured in square units.
    - Rectangle: A four-sided flat shape with straight sides where all interior angles are right angles and opposite sides are equal.
    - Side Length: The measure of how long a side of a shape is.
    - Length: The longer side of a rectangle, or a designated horizontal/vertical dimension.
    - Width: The shorter side of a rectangle, or the second dimension multiplied by the length.
    - Whole Number: Counting numbers starting from zero without fractions or decimals.
    - Square Unit: A standard unit used to measure area (such as square centimeters, square inches, or square feet), represented as a square with side lengths of 1 unit.
    - Product: The answer you get when you multiply two or more numbers together.

Results:
I would like to see a mouse house with one interactive element in some way. There should be a magnet being used and students need to have found the area for each side of the house. Students should have completed the design journal that shows their design process through the entire process of planning and building their mouse house.

Limitations:
I am nervous there is not enough materials given, but I think that over the course I can add in materials to help if needed. I can also give them more time to finish this project. I was thinking this could be a project over the course of two weeks in class. That way they will not have to work outside of class.

- Students are limited to one box for the frame of their house

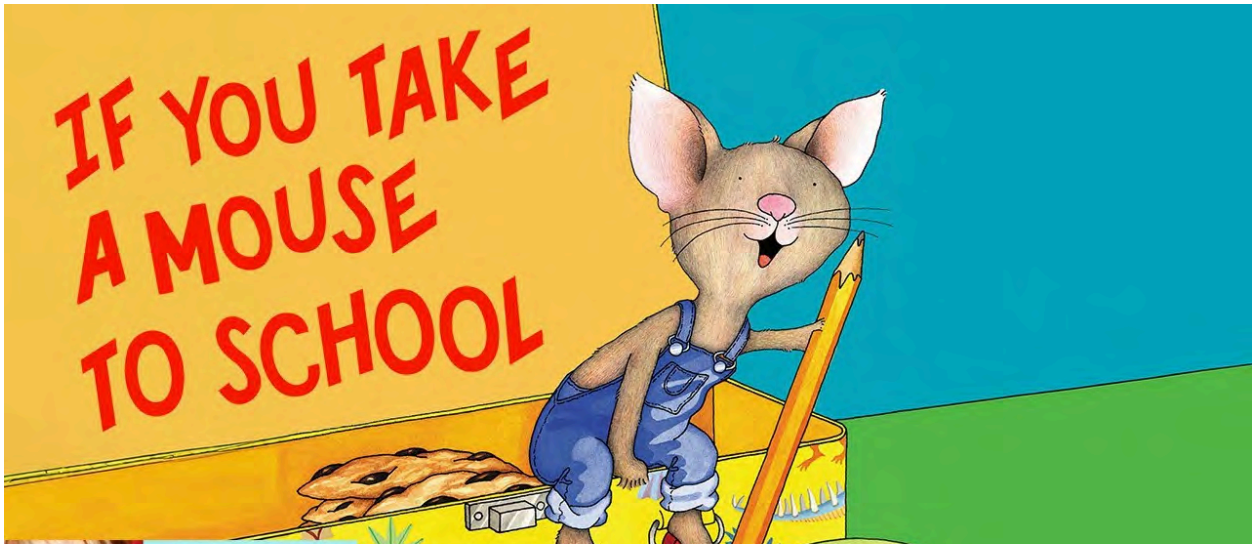
- They have a two week period to create
- Only using materials from their budget sheet and not bringing in items from home

Assessment/Evaluation:

What I am graded on	⭐ 5 – Amazing!	4 – Great Job!	3 – Getting There!	2 – Keep Working!	1 – Not Yet
📚 **What I Learned**	I showed what I learned about magnets, area, and designing. My magnet works, and my area math is correct.	I showed what I learned with only a few small mistakes.	I showed some of what I learned, but I made a few mistakes or errors.	I met some of the requirements and I did not ask for help.	I did not show what I learned about magnets, area, or designing yet.
✏️ **Design Journal**	I completed every part of my journal. I included my ideas, drawings, plans, changes, and what I learned.	I completed almost all of my journal and explained some of my ideas.	I completed most of my journal, but I am missing some details.	I completed only a few parts of my journal.	I did not complete my journal.
🏠 **Mouse House Challenge**	My Mouse House follows all the rules! I stayed on budget, used a magnet, added something that moves, and completed my house.	My house follows almost all of the rules.	My house follows some of the rules, but I am missing something.	My house is missing several parts of the challenge.	My house is not finished or does not follow the challenge rules.

🤝 **Teamwork**	I was a great teammate! I shared ideas, listened to others, helped my group, did my part, and used my time wisely.	I worked well with my team and did my part most of the time.	I worked with my team but sometimes needed reminders to help or stay on task.	I needed lots of reminders to help my team and do my part.	I did not do my part or work well with my team.

Design Journal:
Design Journal will be a packet with designated spots for each part of the design process. Over the course of the two weeks, each day we will spend a certain amount of time going through each part of the design process. This will allow students to plan and prepare their final design.



If You Build a Mouse a House Third Grade Project
Student Guide

Big Ideas:

1. Magnets can be used to solve problems
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2. Magnetic forces between a pair of objects depend on their properties
   a. Size, distances apart, and forces between two magnets help us understand their properties
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Essential Questions:

1. What properties do we observe in the different materials we used?
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3. Where do you see magnets in everyday life?
4. What is area?
5. Why did you round to that number?
6. What tools can we use to measure?
7. What forms of technology are used in your final project?
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At the end you will measure your house. You get to present your house to the class, what you used your magnet for, how it moves, and tell us the area of the sides of your house.

Tools, Materials, and Resources:

Tools: Scissors, tape, glue, ruler, chomp saw, special scissors for pipecleaners, monitored hot glue gun

Resources: teacher (find a video on magnets and how to use them in the way we want)

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Final cost: _____

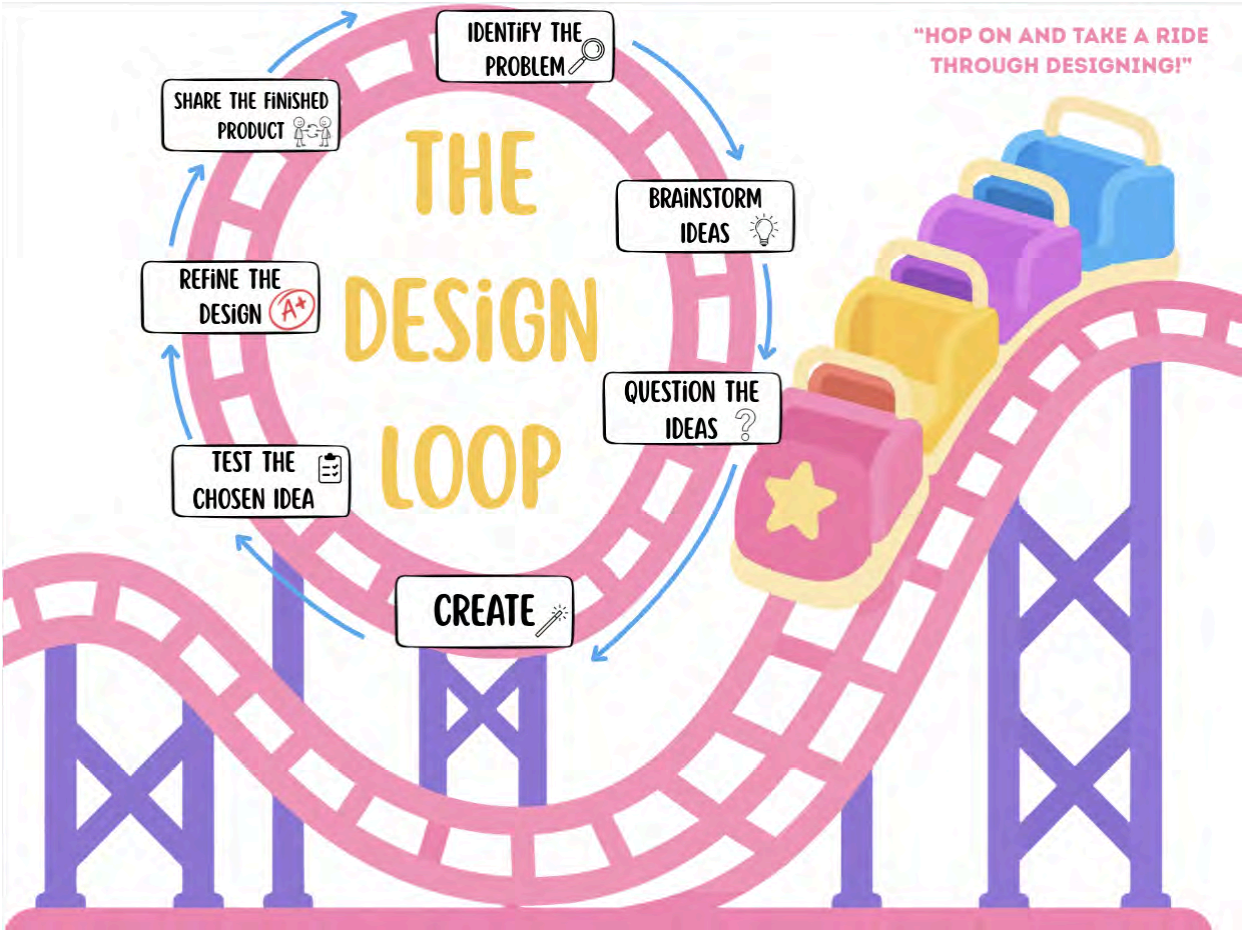
Results:
There should be something in your house that moves by magnets, area of the sides, and clear explanation of the design process. You will turn in your final creation, material budget sheet, and completed design process packet.

Limitations:

- Teams are limited to one box for the frame of their house
- There will be a two week period to create
- Only using materials from their budget sheet and not bringing in items from home

Rubric:

What I am graded on:	⭐ 5 – Amazing!	4 – Great Job!	3 – Getting There!	2 – Keep Working!	1 – Not Yet
📚 **What I Learned**	I showed what I learned about magnets, area, and designing. My magnet works, and my area math is correct.	I showed what I learned with only a few small mistakes.	I showed some of what I learned, but I made a few mistakes or errors.	I met some of the requirements and I did not ask for help.	I did not show what I learned about magnets, area, or designing yet.
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If You Build a Mouse a House Third Grade Project Student Design Journal

Identify the Problem:

1. What are we doing/building?

Brainstorm Your Ideas:

1. Plan and draw some ideas for your design that you will build.

Question the Ideas:

1. Is your design reasonable?

2. Can you actually create and build it?

3. Does your design meet the requirements and limitations?

4. Where does your magnet fit into the design?

5. Can you build your idea with your $20 budget?

6. How did you and your team choose your design?

😀CREATE🎉

Test the Chosen Idea:

1. Does the magnet move within your design?

2. Does your mouse fit in the house?

3. Were you able to measure and collect the area of all sides of the mouse house? Provide all measurements below.

Refine the Design:

1. Is there anything you would change or add if you had the time? Why?

2. What was your favorite part of your mouse house design?

Share Your Design with the Class!

1. Where did you use your magnet in the mouse house? How does it work?

2. How did you find the area of all sides of the house?

3. What is something you and your team learned throughout this process?

Operation Chicken Trap!
Teachers Guide

Grade Level: 3rd grade

STEM Content Standards:

Science: 3-PS2-2 Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Math: 3.GM.11: Solve word problems involving addition and subtraction of time intervals in minutes.

Standard for Technological and Engineering Literacy: Standard 7: Design in Technology and Engineering Education-I: Apply the technology and engineering design process

Big Ideas:

- Patterns in motion help us predict future outcomes in the movement of an object
- Time can be measured and compared in minutes
- Start/end times can be found using addition and subtraction
- Building, testing, and improving a design can help solve a problem

Essential Questions:

- How can we use the patterns in an object's motion to predict its future movements?
- How can we use time to compare how well different solutions work?
- What materials and mechanisms can we use and create to build a solution for a problem?
- How can we make improvements to an original design to make it better?

Content Information:

Science:

Essential content/ideas:

-Past motion that follows a regular, repeating pattern can be measured and used to predict future motion.

-Planning and carrying out simple investigations to collect data and make observations.

-Identifying patterns of change to make predictions.

Common Examples: A child on a swing, a ball rolling back and forth inside a bowl, or children moving up and down on a see-saw. (But today's lesson revolves around forward running movements)

Essential Vocabulary:

- Motion: A change in an object's position over time.
- Pattern: Something that happens in a repeated and predictable way.
- Observe: To watch and notice details about an object or event using your senses.
- Measure: To find the size, length, or time of something using a tool (like a ruler or stopwatch).
- Predict: To guess what will happen next based on evidence or past data

Technology and Engineering (STEL):

Essential content/ideas:

The Stages of the Design Process

- Clarify and Analyze- Analyze the problem, and what needs to be solved

- Identify- Identify the values, principles, and resources involved
- Envision- Take notes, research, make sketches, and come up with multiple solutions, collaborate as a group, combine ideas
- Question- Ask questions about the solution you have come up with before testing, consider if there is anything that needs to be changed or fixed about your blueprint before testing
- Build and Test- build/create most suitable solution and test it
- Share- Share your solution, what you learned and results with the class, take advice from students on ways to improve
- Evaluate and Improve- Analyze results of the solution tested, make improvements, then revisit other steps

Essential Vocabulary:

- Engineering Design Process (EDP): A structured, cyclical, and iterative inquiry method used to develop and test tangible solutions to real-world problems
- Criteria: The specific requirements, desired qualities, or success parameters that a design must meet (e.g., must fit in a backpack, must hold 5 pounds)
- Constraints: The limitations or restrictions imposed on the design process, such as available funding, space, materials, time
- Brainstorming: A spontaneous group technique used to generate a wide range of creative and unconstrained ideas for potential solutions.
- Prototype: A basic, functioning, or physical test version of a product built with accessible materials to evaluate its performance.

Mathematics:

Essential content/ideas:

-Finding the Elapsed Time (Unknown Interval): Given a start time and an end time, students subtract to find the duration.

-Finding the End Time (Unknown Result): Given a start time and an interval, students add to find when the event finishes.

-Finding the Start Time (Unknown Change/Start): Given an end time and an interval, students subtract (count backward) to find the beginning.

Essential Vocabulary:

- Elapsed Time: The amount of time that passes from the start of an event to the end of the event.
- Time Interval: A distinct span or block of time measured in minutes (e.g., a 15-minute recess).
- Start Time: The specific time at which an activity begins.
- End Time (or Finish Time): The specific time at which an activity concludes.

Scenario: In "Catch that Chicken", Lami wasn't being careful while trying to catch her chickens and fell out of a tree resulting in a sprained ankle! Since Lami can no longer run to catch chickens, it's your job to help her! Today you will become an engineer and help solve this problem by building a trap that helps Lami catch chickens quickly while she recovers from her injury.

Challenge: Working in teams, you will design, build, and test a chicken trap to help Lami catch her chickens. Your goal is to design and build a trap that is able to catch and hold a wind up chicken in one minute. You must find out where to accurately place your trap on the table so that the chicken enters the trap in the given time interval, and figure out how your design can keep the chicken trapped so it doesn't escape.

Tools, Materials and Resources:

Materials: $25 to spend

-cardboard 6 in x6in - cost: $3 (per piece)
-popsicle sticks (small or large)- cost: Small: $1 Large: $2 (per piece)
-tape (1 foot) -cost: $4 (per piece)
-straws -cost: $1 (per straw)
-string (1 foot) -cost: $2 (per piece)
-brass brads- -cost: $1 (per piece)
-paper towel rolls--cost: $1 (per piece)
-rubber bands--cost: $1 (per piece)
-dixie cups--cost: $1 (per cup)
- binder clips--cost: $3 (per piece)
-index cards--cost: $1 (per piece)
-grocery bags--cost: $1 (per bag)
-plastic bottles--cost: $3 (per bottle)
-bottle caps-cost: $1 (per piece)

Tools:

-cardboard cutter
-hot glue gun
-scissors
-hole puncher
-safety glasses/goggles
-tape measure
-timer

Resources:

- The book "Catch that Chicken"
- Counters
- Timers
- Tape measure
- Engineering Design Journal
- Wind up chicken
- Material budget sheet/poster

Results:

Each group will turn in their finished and improved chicken trap that successfully catches and holds the wind up chicken model in one minute's time. Each group will also individually turn in a completed design journal, which answers all essential questions, and accurately shows their notes, research, results, and modifications throughout each step of the design process. At the end of the challenge, students will share their final design and their testing results with the class.

Limitations:

- You may only use the materials provided
- You must build your original design in 1 hour
- Trap must be able to hold/keep the chicken trapped
- Trap must catch the chicken in 1 minute

- You CAN NOT physically move the chicken out of the barrier, but you CAN activate elements of your trap (like a lever or door to help catch it)

Assessment/ Evaluation:

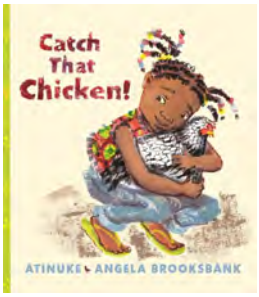
Criteria	4 – Exceeds Expectations	3 – Meets Expectations	2 – Approaching Expectations	1 – Needs Improvement
Engineering Design Process & Final Product	Completes all stages of the engineering design process, creates an effective trap that catches and holds the chicken within 1 minute, and makes thoughtful improvements based on testing results.	Completes the engineering design process and creates a trap that catches and holds the chicken within 1 minute. Makes improvements based on testing.	Completes most stages of the design process, but the trap needs improvement or does not consistently catch and hold the chicken within 1 minute.	Completes few stages of the design process, and the trap does not successfully catch and hold the chicken.
Science: Motion & Prediction	Accurately records detailed observations and measurements of the chicken's motion, identifies patterns using evidence, and uses those patterns to make accurate predictions about future movement.	Records observations and measurements, identifies a pattern in the chicken's motion, and uses the pattern to make a prediction.	Records some observations or measurements but has difficulty identifying a pattern or using evidence to make a prediction	Provides few observations or measurements and does not identify a pattern or make a prediction.
Math: Time & Results	Correctly solves all time problems, accurately calculates elapsed time, and uses multiple testing results to compare designs and determine specific improvements.	Correctly solves the time problems, calculates elapsed time, and compares testing results to determine how the design can be improved.	Solves some time problems correctly but makes errors calculating elapsed time or comparing testing results.	Has difficulty solving time problems, calculating elapsed time, or using testing results to compare designs.
	Thoroughly			

Design Journal & Evidence	documents each stage of the design process, clearly answers all essential questions, and provides detailed sketches, observations, testing results, and explanations of improvements.	Completes the design journal, answers the essential questions, and includes sketches, observations, testing results, and design changes.	Journal is partially complete or missing important evidence, explanations, or essential questions.	Journal is incomplete and provides little evidence of the design process, testing, or learning.

Total: _/16 points

Teacher notes:

- Before beginning/explaining the challenge, read "Catch That Chicken" and discuss the problem Lami is facing and how an engineer could create something to help solve it.
- Introduce project and what we will be doing, pass out student guides and read together. Answer any questions students may have about requirements for this project
- Have a wind up chicken, barrier, timer, tape measure for each group, and an engineering design journal for each student set up at each station
- Have materials and tools students can use organized at back table
- Review engineering design loop/process with students. Explain what is to happen for each step before they start building their traps
- Demonstrate how the wind up chicken moves. Students can observe and record this to help with their initial design
- Monitor groups as they use tools to build their traps, help with the hot glue gun, ask questions, ask about their thought process and how they are using the design loop process to help them
- When its time to test, one group goes at a time, have other students watch and take notes when they are not testing.
- When its time to share, have students come up and present their designs, observations, and testing results.
- Students will finish by answering essential questions in their design journal, and making improvements to their design.



Operation Chicken Trap!

HELP! In "Catch that Chicken", Lami wasn't being careful while trying to catch her chickens and fell out of the tree resulting in a sprained ankle! Since Lami can no longer run to catch chickens, it is now your job to help her! Today you will become an engineer, and help solve this problem by building a trap that helps Lami catch her chicken while she's recovering from her broken ankle.

Big Ideas:

1. Patterns in motion help us predict future outcomes in the movement of an object
2. Time can be measured and compared in minutes
3. Start/end times can be found using addition and subtraction
4. Building, testing, and improving a design can help solve a problem

Essential Questions:

1. How can we use the patterns in an object's motion to predict its future movements?
2. How can we use time to compare how well different solutions work?
3. What materials and mechanisms can we use and create to build a solution for a problem?
4. How can we make improvements to an original design to make it better?

You will work in teams to design, build, and test a chicken trap to help Lami catch her chickens! Your goal is to plan, design, and create a trap to catch and secure Lami's chickens in one minute. For our real life experimentation, you will trap a toy, wind-up chicken. You must find out where to accurately place your trap, within the barrier, so the chicken enters the trap in the given time (1 minute), and figure out how your design can keep the chicken trapped, ensuring it doesn't escape.

Budget:

You must complete this project using the provided materials. Students will spend no more then $25.

Materials:

6in x 6in Cardboard: $3	Small Craft Sticks: $1	Large Craft Sticks: $2	12 in Tape: $4
Straws: $1	Brass Brads: $1	Paper Towel Rolls: $1	Rubber Bands: $1
Dixie Cups: $1	Binder Clips: $3	Index Cards: $1	Grocery Bags: $1
Plastic Bottles: $3	Bottle Caps: $1	Ziploc bag $2	12 in string: $2

*All prices are per piece

Tools:

Cardboard Cutters	Hot Glue Gun	Scissors	Hole Puncher
Safety Glasses/Goggles	Tape Measure	Timer	Ruler

Resources:

Catch That Chicken Book	Materials and Tools	Engineering Design Journal	Wind-Up Chicken

Limitations:

1. Students may only use materials provided
2. Students must begin and complete building in 1 hour
3. Trap must be able to hold/keep the chicken trapped
4. Trap must catch the chicken in 1 minute
5. Students CAN NOT physically move the chicken out of the barrier, but you CAN activate elements of your trap (like a lever or door to help catch it)

Rubric:

Criteria	4 – Exceeds Expectations	3 – Meets Expectations	2 – Approaching Expectations	1 – Needs Improvement
Engineering Design Process & Final Product	I completed all steps of the design process. My traps catches and holds the chicken in 1 minute or less. I testes it and made smart changes to make it better.	I completed the design process. My trap catches and holds the chicken in 1 minute or less. I tested it and made changes.	I completed most of the design steps, but my trap needs more work or does not always catch the chicken in 1 minute.	I completed only a few design steps. My trap does not successfully catch and hold the chicken.
Science: Motion & Prediction	I wrote down detailed observations and measurements about how the chicken moves. I found a pattern and used evidence to make a good prediction about what it will do next.	I wrote down observations and measurements. I found a pattern and used it to make a prediction.	I wrote down some observations or measurements, but I had trouble finding a pattern or making a prediction.	I wrote down very few observations or measurements. I did not find a pattern or make a prediction.
Math: Time & Results	I solved all the time problems correctly. I found elapsed time correctly and used my test results to compare my designs and make specific improvements.	I solved the time problems and found elapsed time correctly. I compared my test results and used them to improve my design.	I solved some time problems correctly, but I made mistakes with elapsed time or comparing my test results.	I had difficulty solving time problems, finding elapsed time, or using my test results to compare designs.
	My journal is complete and detailed. I answered all the important	My journal is complete. I answered the	My journal is partly complete. I	My journal is incomplete and

Design Journal & Evidence	questions and included sketches, observations, test results, and explanations of how I improved my trap.	important questions and included sketches, observations, test results, and changes I made.	am missing some important information, explanations, or questions.	has very little information about my design, testing, or learning.

Total: _/16 points

Results:

Each group will turn in their finished and improved chicken trap that successfully catches and holds the wind up chicken model in one minute's time. Each group will also individually turn in a completed design journal, which answers all essential questions, and accurately shows their notes, research, results, and modifications throughout each step of the design process. At the end of the challenge, students will share their final design and their testing results with the class.

Engineering Design Journal:



Identify Problem, Analyze:

What exactly is the problem that needs to be solved?

What information do we already know?

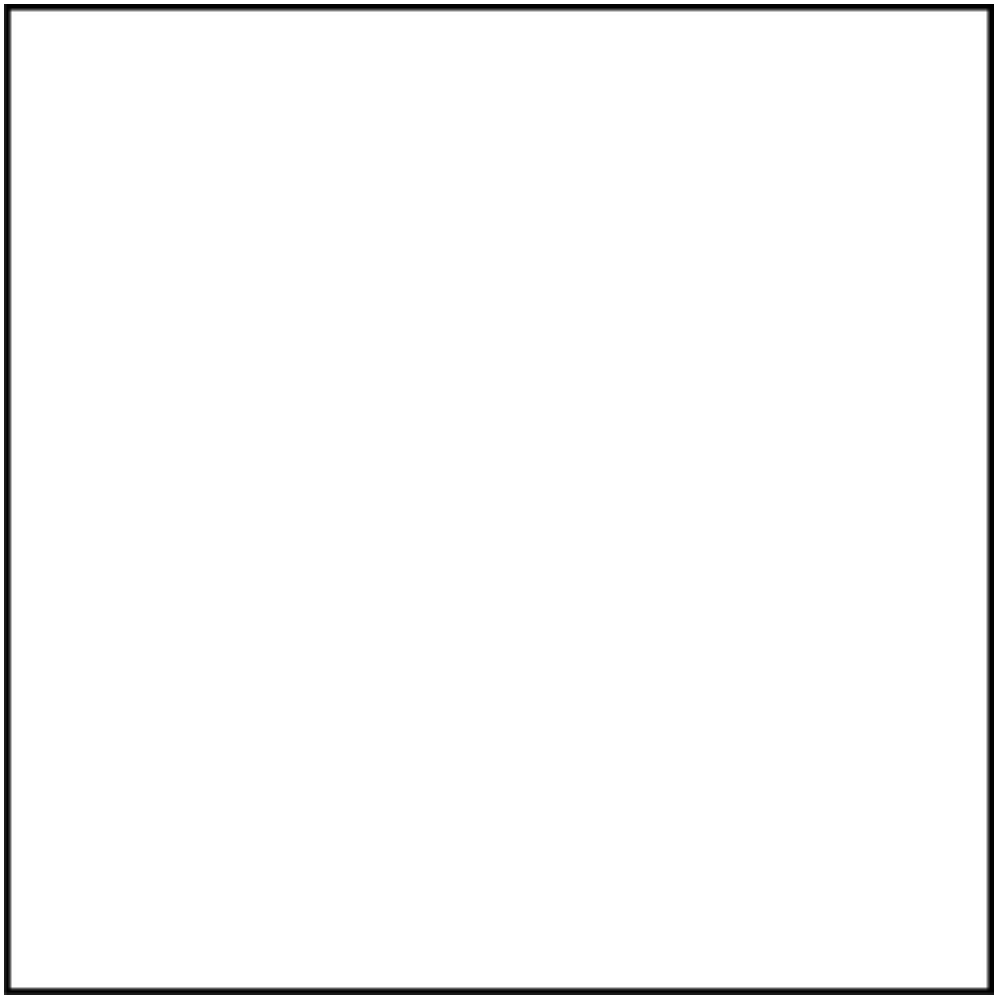
Are there any limitations?

Brainstorm, Invent, Design:

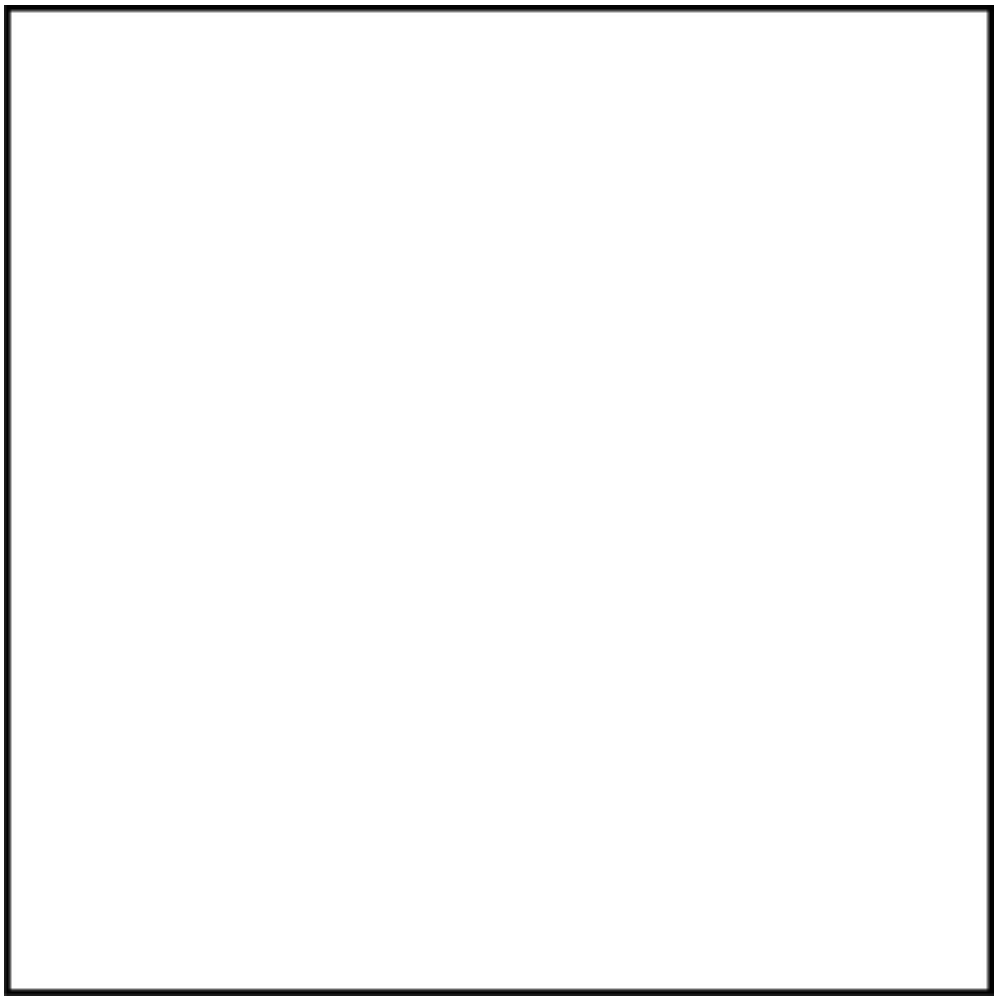
Things to think about:

- What are some possible solutions?
- Can we combine some of our ideas?
- Which idea seems most efficient?

Design 1



Design 2



Create a plan, build, develop:

Write out the steps needed in order to build your trap.

Budget:

Materials:	Amount Used:	Total:
6in x 6in Cardboard: $3		
Small Craft Sticks: $1		
Large Craft Sticks: $2		
12 in. Tape: $4		
Straw: $1		
Brass Brads: $1		
Paper Towel Roll: $1		
Rubber Bands: $1		
Dixie Cup: $1		
Binder Clip: $3		
Index Card: $1		
Grocery Bags: $1		
Plastic Bottles: $3		
Bottle Caps: $1		
Ziploc Bags: $2		
String: $2		
		Total Amount: /$25

Test, Assess, Experiment:

Record Data:

	Test #1	Test #2	Test #3
How far trap is place from chicken (inches)			
Time it took chicken to enter trap (seconds)			
Did it stay? (Yes or no)			
Other comments.			

What was the difference, in time, between test 1 and 2? What does this data tell you? Did your improvements effect your results?

What was the difference, in time, between test 2 and 3? What does this data tell you? Did your improvements effect your results?

Share, Results, Evaluate:

What feedback did you receive? What feedback do you plan on implementing in your improved design?

Essential Questions: (Answer individually)

How can we use the patterns in an object's motion to predict its future movements?

How can we use time to compare how well different solutions work?

What materials and mechanisms can we use and create to build a solution for a problem?

How can we make improvements to an original design to make it better?

Teacher Guide:

Title:

Operation: Save the Trees!! An engineering Challenge Inspired by The Lorax

Book:

The Lorax by Dr. Seuss



Grade Level:

3rd grade

STEM Content Standards:

Science (Life, Earth/Space, or Physical Science):

- 3-LS4-4: Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Mathematics:

- 3.GM.4: Measure lengths of objects; length and width

Standard for Technological and Engineering Literacy (include both standard and benchmark):

- Standard 2: Core Concepts of Technology and Engineering
- K - Describe requirements of designing or making a product or system

Big Ideas:

- **Science:** Humans can affect plants and animals. Humans can create solutions to help the environment.
- **Math:** Measurements can length and width accurately can help us design a product.
- **STEL:** When we create a product there are requirements/rules that we have to follow.

Essential Question/s:

- How can environmental changes affect trees and the animals that need them?
- How can we think of something to help protect the trees?
- How can we use measurements to help create and improve a design?
- How can we test to make use of our design to protect the trees?

Scenario:

In the Lorax we saw that the Once-ler wants to cut down all the trees. We are going to learn about how the Once-ler's actions caused many of the trees in the forest to disappear. The Lorax wants you all to become environmental engineers and help him to protect the remaining trees. The forest is facing changes that could damage the trees, so let's think of a way to create a protective structure around a tree. Your design needs to protect the tree while still allowing it to grow. What happens when we don't have trees or if our trees get cut down? How would that affect the Lorax or the town of people if they didn't have any trees?

Challenge:

Now that we have discussed the different ways, we can make this challenge come to life, working in teams, will construct a structure that protects a model tree from an environmental change while allowing the tree to continue growing. We need to make sure that we are using the materials provided, measure the length and width of your structure, test your design, and make improvements based on what y'all are observing.

Tools, Materials, and Resources:

Materials:

- Cardboard
- Scotch Tape/duct tape
- Construction paper
- Craft sticks
- Yarn
- String

- Straws
- Rubber Bands
- Glue and Paste

Tools:

- Ruler
- Canary cutters
- Scissors
- Tape measure
- Safety Goggles
- Crayons/marker

Resources:
The Lorax book and videos. Videos about the environment
(https://www.youtube.com/watch?v=Unn8fiLCHNE)

Content information:

Science

- Environment: Everything surrounding a living thing, including air, water, land, and other organisms
- Environmental Change: A shift in an ecosystem, such as a change in land, water supply, temperature, or food availability
- Claim: A statement or conclusion about what a solution does or whether it works well
- Merit: How good, useful, or effective a solution is at solving a specific problem
- Solution: A proposed action, design, or device intended to fix a problem caused by an environmental change.

"We will learn that changes in the environment can affect plants and animals. In *The Lorax*, the trees are removed, which causes problems for the animals that depend on them. We will learn that people can create solutions to help protect plants and animals."

Mathematics

- Length: The measurement of how long an object is from one end to the other. It typically represents the longest horizontal dimension.
- Width: The measurement of an object from side to side (distance across)
- Distance: The amount of space between two distinct objects or points.
- Ruler: A physical tool marked with standard units used to measure exact lengths and straight lines.

"While doing this assignment, I will practice measuring the length and width of their structures using a ruler or tape measure."

Technology and Engineering (STEL)

- Design: A plan or drawing produced to show the look and function of an object before it is built
- Requirements: A rule, need, or necessary feature that a design must have to work properly.
- Product: Something that is made or built by people to solve a problem.
- System: A group of working parts that fit together to do a job.

"We will become engineers and identify a problem, think of possible solutions, create a design, test the design, and make improvements. We will also learn that designs have requirements and limitations, such as using certain materials and staying within a certain size."

Results:

At the end of the challenge, each group will turn in:

- The completed tree protection structure
- The design worksheet that I provided to them showing their thought process, materials used, measurements etc.
- A short explanation of what worked and what changed over the days it took to complete the challenge

Limitations:

- Students must work in groups and must all work together
- Only use the materials/tools provided by me according to the assignment
- The structure must fit around the item I give them to represent the tree
- The structure cannot completely cover the tree because the tree needs room to grow
- Students must measure the length and width of the structure
- The students must test their design to make sure it fits and follows the requirements
- Students must record their thoughts and what they are doing on the STEM worksheet provided throughout their time working on the assignment
- Students must present it for the whole class

Assessment/Evaluation:

To assess my students I will be walking around each day during our work time to make sure they are working as a team, answering any questions, and are staying on task. They must be able to answer any of my questions I have while walking around and explain to me what they are doing. They will be given this rubric for them to read and understand. This will be filled out by me in front of the class when they presenting but while completing the assignment they can use it as a check list.

TEACHERS NOTE: You will be assessing in a group setting. You will walk around to assess the students as well as reading their design journals. When the students are presenting, they will discuss their design and then I will go point by point of what they needed to complete to get 100% and we will assess as a group. (ex. "Did they give the tree room to grow?" And then students will answer and if they

Directions for Teacher:

- Read book to students
- Talk about how they can help the lorax
- Explain/talk about what would happen if we didn't have trees
- Talk about how that would affect us and the animals

- Students will brainstorm what they are going to do in groups
- Talk about the requirements of challenge
- Talk about measurement and measuring our materials
- Explain how we are going to measure our materials
- Talk about the design journal and what is expected of them
- Give them the student guide
- Answer students questions as needed
- Group them off (3-4 per group)
- Walk around to make sure everyone is on task and that they understand what to do.

Student Guide:

Title:

Operation: Save the Trees!! An engineering Challenge Inspired by The Lorax



Big Ideas:

- **Science:** Humans can affect plants and animals. Humans can create solutions to help the environment.
- **Math:** Measurements can length and width accurately can help us design a product.
- **STEL:** When we create a product there are requirements/rules that we have to follow.

Essential Question/s:

- How can environmental changes affect trees and the animals that need them?
- How can we think of something to help protect the trees?
- How can we use measurements to help create and improve a design?
- How can we test to make use of our design to protect the trees?

Scenario:

After we read The Lorax, we are going to learn about how the Once-ler's actions caused many of the trees in the forest to disappear. The Lorax wants you all to become environmental engineers and help him to protect the remaining trees. The forest is facing changes that could damage the trees, so let's think of a way to create a protective structure around a tree. Our design needs to protect the tree while still allowing it to grow. What happens when we don't have trees or if our trees got cut down? How would that effect the Lorax or the town of people if they didn't have any trees?

Challenge:

Now that we have discussed the different ways, we can make this challenge come to life, working in teams, will construct a structure that protects a model tree from an environmental change while allowing the tree to continue growing. We need to make sure that we are using the materials provided, measure the length and width of your structure, test your design, and make improvements based on what y'all are observing.

Tools, Materials, and Resources:

Materials:

- Cardboard:4 pieces per group
- Scotch Tape/duct tape:1 foot per group
- Construction paper:5 pieces per group
- Craft sticks: 10 per group
- Yarn:2 strands of each
- String:2 strands of each
- Straws: 5 per group
- Rubber Bands: 5 per group
- Glue and Paste: 1 bottle per group

Tools:

- Ruler
- Canary cutters
- Scissors
- Tape measure
- Safety Goggles
- Crayons/marker

Resources:

The Lorax book and videos. Videos about the environment
(https://www.youtube.com/watch?v=Unn8fiLCHNE)

Results:

At the end of the challenge, each group will turn in:

- The completed tree protection structure
- The design worksheet that I provided to them showing their thought process, materials used, measurements etc.
- A short explanation of what worked and what changed over the days it took to complete the challenge

Limitations:

- Students must work in groups and must all work together
- Only use the materials/tools provided by me according to the assignment
- The structure must fit around the item I give them to represent the tree
- The structure cannot completely cover the tree because the tree needs room to grow
- Students must measure the length and width of the structure
- The students must test their design to make sure it fits and follows the requirements
- Students will work on this assignment for about 30 minutes every day for about a week or two
- Students must record their thoughts and what they are doing on the STEM worksheet provided throughout their time working on the assignment
- Students must present it for the whole class

Assessment/Evaluation:

To assess my students I will be walking around each day during our work time to make sure they are working as a team, answering any questions, and are staying on task. They must be able to answer any of my questions I have while walking around and explain to me what they are doing. They will be given this rubric for them to read and understand. This will be filled out by me in front of the class when they presenting but while completing the assignment they can use it as a check list.

Design Journal:

Each student will have a design journal to record their work throughout the engineering challenge. The journal will follow the engineering design process.

1. Find the Problem:
Students will write or draw what problem they are trying to solve and explain why the trees need protection.

2. Research and Brainstorm:
Students will write or draw different ideas for how they could protect the tree.

3. Design and Refine:
Students will choose their best idea and draw a picture of their design. They will label the materials they plan to use and record the expected length and width.

4. Create:
Students will build their structure using the materials provided.

5. Test:
Students will test their structure to see if it protects the tree and still allows the tree to grow. They will record what happened.

6. Share:
Students will take some time before presenting to write about their final design and explain what worked, what did not work, and what they changed. Then they will present their final product with the class where we will all ask questions and make sure they followed the requirements of the challenge.

Additional Materials:

Student Rubric:
Operation: Save the Trees! Student Rubric

Name: _____ **Group:** _____

Your goal: Build a structure that protects your tree while still giving it room to grow. Work with your group, use your materials carefully, measure your design, test it, and make improvements.

What I Need to Do	5 Points	4 Points	3 Points	2 Points	1 Point
Science	I can clearly explain the environmental problem and how my design protects the tree.	I can explain the problem and how my design helps.	I can explain some of the problem and solution.	I need help explaining the problem or solution.	I cannot explain the problem or solution yet.
Measurements	I correctly measure and record the length and width of my structure.	I measure both with a small mistake.	I measure the structure but have some mistakes.	I complete only one measurement.	I do not complete my measurements.
My Design	My structure follows all the rules, protects the tree, and gives it	My structure follows most of the rules and protects the tree.	My structure follows some of the rules.	My structure needs several changes to follow the rules.	My structure does not follow the rules yet.

	room to grow.				
Test & Improve	I test my design, explain what happened, and make a good improvement.	I test my design and make an improvement.	I test my design but make a small improvement.	I do very little testing or improving.	I do not test or improve my design.
My STEM Worksheet	I complete all parts and show my ideas, materials, measurements, and changes.	I complete most parts of my worksheet	I complete some parts of my worksheet.	I leave many parts blank.	I do not complete my worksheet.
Teamwork & Sharing	I work well with my group and clearly share what we made, what worked, and what we changed.	I work well with my group and share our design.	I participate and share some information.	I need reminders to participate and work with my group.	I do not participate or share.

My Score

Science: ____ / 5

Measurements: ____ / 5

My Design: ____ / 5

Test & Improve: ____ / 5

My STEM Worksheet: ____ / 5

Teamwork & Sharing: ____ / 5

Total: ____ / 30

Engineering Design Journal Inspired by *The Lorax* :OPERATION: SAVE THE TREES!

Name: _____

Group Members:

1. _____
2. _____
3. _____
4. _____

Date Started: _____

Our Engineering Challenge:

Your Mission:

The Lorax needs your help!

The trees in the forest are in danger because the environment is changing. Your team will become **environmental engineers** and design and build a structure that protects a model tree.

Your structure must:

- Protect the tree from an environmental change.
- Fit around the model tree.
- Give the tree room to grow.
- Use only the materials provided.

- Be measured for length and width.
- Be tested.
- Be improved after testing if needed.

Our Big Question

How can we design a structure that protects a tree while still allowing it to grow?

STEP 1: FIND THE PROBLEM

What is the Problem?

Think about what happened to the trees in *The Lorax*.

The problem we are trying to solve is:

Why are trees important?

What could happen to animals or people if there were not enough trees?

Think About the Environment

An **environment** includes things around living things, such as air, water, land, and other organisms.

An **environmental change** is a change in an ecosystem that can affect plants and animals.

What environmental change could hurt our tree?

STEP 2: RESEARCH & BRAINSTORM

Before we build, we need to think of different solutions.

Remember: **Engineers do not always get the perfect idea the first time!**

What could we build?

Idea #1

How could this design protect the tree?

Draw Idea #1:

Idea #2

How could this design protect the tree?

Draw Idea #2:

Idea #3

How could this design protect the tree?

Draw Idea #3:

Compare Our Ideas

Which idea do you like best?

I like **Idea # _____** best.

Why?

What could make this idea better?

STEP 3: DESIGN & REFINE

Now your team will choose its best idea and make a more detailed plan.

Our Final Design

Draw your team's design **before you build it**.

Label the different parts of your design.

Our Materials

The materials your teacher gives your group are limited. Your team needs to plan how many of each material you will use.

Materials We Have

Material	How Many We Have	How Many We Plan to Use
Cardboard	___4___	_____

Construction paper	___5___	_____
Craft sticks	___10___	_____
Yarn	___2___	_____
String	___2___	_____
Straws	__5____	_____
Rubber bands	___5___	_____
Tape	___1 foot___	_____
Glue/Paste	__1 bottle____	_____

How many do we have? _____

How many will we use? _____

Why did your team choose these materials?

Measuring Our Materials

Some materials can be measured by **length**. Use a ruler or tape measure when your teacher tells you to.

Cardboard

Length: _____

Width: _____

Construction Paper

Length: _____

Width: _____

Craft Sticks

Length of 1 craft stick: _____

Number of craft sticks we will use: _____

Straws

Length of 1 straw: _____

Number of straws we will use: _____

Yarn

Length of 1 piece: _____

Number of pieces we will use: _____

String

Length of 1 piece: _____

Number of pieces we will use: _____

Tape

Length of tape we plan to use: _____

Rubber Bands

Number of rubber bands we will use: _____

Glue/Paste

Amount we plan to use: _____

Our Design Requirements

A **requirement** is something your design must have or do.

Our structure must:

☐ Protect the tree.

☐ Fit around the model tree.

☐ Give the tree room to grow.

☐ Use the materials provided.

☐ Be measured.

☐ Be tested.

☐ Be improved if needed.

How will our design meet these requirements?

_____

_____

_____

_____

STEP 4: CREATE

Now it is time to build your design!

Remember: **Your first design does not have to be perfect. Engineers make changes as they build.**

What are we working on this week?

_____

_____

How many materials did we actually use?

Cardboard: _____

Construction paper: _____

Craft sticks: _____

Straws: _____

Yarn: _____

String: _____

Rubber bands: _____

What changes did we make to our original design?

If yes, what did we change?

Why did we make this change?

How did our group work together to make those changes?

Our Structure So Far

Draw what your structure looks like right now.

STEP 5: TEST

Now it is time to test your structure!

Your goal is to find out if your structure:

1. Protects the tree.
2. Fits around the tree.
3. Gives the tree room to grow.
4. Follows the challenge requirements.

Our Test

What happened when we tested our design?

Did our structure protect the tree?

☐ Yes
☐ No
☐ Partly

How do you know?

Did the structure give the tree room to grow?

☐ Yes
☐ No

How do you know?

Did our structure fit around the tree?

☐ Yes
☐ No

What happened?

Measure Our Finished Design

Now measure your **completed structure**.

Length: _____

Width: _____

Did our measurements match what we expected?

☐ Yes
☐ No

If not, why were they different?

Did we use more or fewer materials than we planned?

☐ More

☐ Fewer

☐ About the same

What changed?

What Worked?

What part of your design worked well?

What Did Not Work?

What part of your design did not work the way you expected?

Improve Our Design

Engineers use the results of their tests to make their designs better.

What should we change?

We should change _____

Why should we make this change?

How will this change make our design better?

Will we need to change our materials?

☐ Yes
☐ No

If yes, what material will we add, remove, or change?

Our Improved Design

If you improved your design:

Draw your design **after making your improvement**.

What did we change from our first design?

How did our measurements change with the improvements?

STEP 6: SHARE

Your team will present your final structure to the class.

Before presenting, complete the questions below.

Our Final Design

What did we build?

How does our design protect the tree?

How does our design allow the tree to grow?

What materials did we use?

How many materials did we use?

Cardboard: _____

Construction paper: _____

Craft sticks: _____

Straws: _____

Yarn: _____

String: _____

Rubber bands: _____

What are the measurements of our final structure?

Length: _____

Width: _____

What worked best?

What did we change?

What did we learn?

Our Team Reflection

How did we work together?

☐ We listened to each other.

☐ We shared materials.

☐ We shared ideas.

☐ We helped each other.

☐ We stayed on task.

☐ We solved problems together.

What did your team do well?

What was difficult for your team?

How did your team solve the problem?

My Final Reflection

Answer in complete sentences.

1. What did you learn about trees and the environment?

3. What did you learn about using materials and measurements?

4. What is one thing you are proud of?

5. If you could build your structure again, what would you change?

Final Engineering Checklist

Before we turn in our journal, make sure we completed everything.

Science

☐ I can explain the environmental problem.

☐ I can explain how my design protects the tree.

Materials & Measurements

☐ I recorded how many materials we had.

☐ I recorded how many materials we planned to use.

☐ I measured materials when needed.

☐ I measured the length of my structure.

☐ I measured the width of my structure.

☐ I recorded my measurements.

My Design

☐ My structure follows the requirements.

☐ My structure protects the tree.

☐ My structure gives the tree room to grow.

Test & Improve

☐ I tested my design.

☐ I recorded what happened.

☐ I made an improvement.

☐ I explained what I changed.

My Design Journal

☐ I recorded my ideas.

☐ I recorded my materials.

☐ I recorded my measurements.

☐ I recorded my changes.

Teamwork & Sharing

☐ I worked with my group.

☐ I participated in building.

☐ I helped my group solve problems.

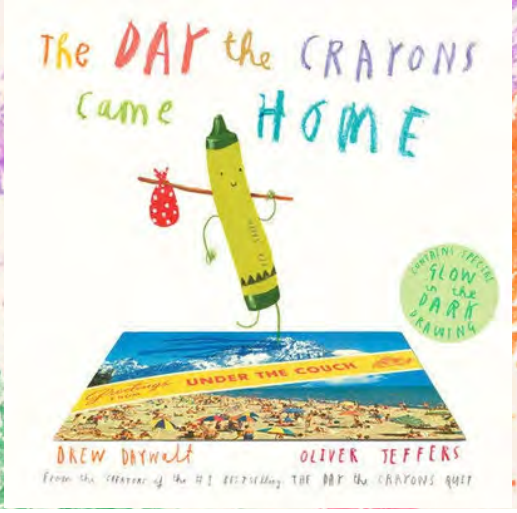
☐ I am ready to explain our design to the class.

I am ready to be an environmental engineer!

NEON RED'S ROAD TRIP

Teacher Guide

2nd Grade Literature Based Curriculum Project



Standards and Content Information

- **Science**
  - **2-PS1-1:** Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
  - **2-PS1-2:** Analyze data obtained from testing different materials to determine which materials have properties that are best suited for an intended purpose

- **Mathematics**
  - **2.GM.12:** Count collections of mixed coins and solve real-world problems involving quarters, dimes, nickels, and pennies within 99¢ and whole dollar amounts.

- **Standard for Technological and Engineering Literacy**
  - **Standard 2: Core Concepts of Technology and Engineering**
  - Explain that materials are selected for use because they possess desirable properties and characteristics.
  - Develop a plan in order to complete a task.
  - Collaborate effectively as a member of a team.

Content Information:

Science:

- **Property:** A characteristic or trait used to describe an object or material (e.g., color, size, shape).
- **Texture:** How a surface feels to the touch (rough, smooth, bumpy, soft).
- **Flexibility:** How easily a material bends or twists without breaking (flexible vs. stiff).
- **Absorbency**: How well a material soaks up liquid (absorbent vs. waterproof).
- **Strength:** How much weight or force a material can hold or withstand before breaking.
- **Data:** Information or measurements collected during an investigation.

Technology and Engineering (STEL):

- Material Selection (Properties & Characteristics): Students learn that different materials (such as wood, paper, metal, plastic, and cloth) have unique physical and chemical traits.
- Developing a Plan: Students understand that completing a technological task or design requires forethought.
- Collaboration: Students practice working cooperatively in small groups or teams.

Mathematics:

Essential Content

- Real-World Problem Solving:
  - Add and subtract money values within 99¢ and up to whole dollar amounts.
  - Determine if a given collection of coins is enough to buy an item of a specific price.
  - Use the cent symbol (¢) and dollar symbol ($) appropriately.

Essential Vocabulary

- Coin Identification & Values:
  - Penny: 1¢ or $0.01
  - Nickel: 5¢ or $0.05
  - Dime: 10¢ or $0.10
  - Quarter: 25¢ or $0.25
  - Dollar Bill: $1.00
- Total – The final amount when coin values are added together.

Scenario & Challenge

Scenario:

Oh no Neon Red needs our help! He is trying to get home but he has to travel through hot weather, rain, and a bumpy camel ride! We need to get Neon Red home safe and sound!

Challenge:

Your challenge is to work with your team and create a solution that will protect our friend Neon Red and get them home safely! The only problem is that you have just $4.00 to buy the materials that you want to use to protect Neon Red. Before we start to plan and build, you are going to test and observe the different materials and decide what will work best for your design.

To complete this challenge you must:

- Understand materials and their different properties
- Create a plan for your solution
- Buy materials and stay in your $4.00 budget
- Work as part of a team
- Test your solution to keep Neon Red safe from rain, heat, and a bumpy camel ride

BIG IDEAS

- Materials have many properties that make them good for different jobs
- We can choose materials based on what we need them to do
- We have to think about how much money we use when we have a budget
- By creating a plan, we can complete our tasks
- We can create good solutions if we work as a team
- Testing helps us find out how to make our solutions better

Essential Questions

- What materials can we use to protect Neon Red?
- What materials are good for certain jobs?
- How can we make a plan based on what we have learned?

Materials

- Tape
- Pipe Cleaner
- Felt
- Cotton Ball
- Plastic Wrap
- Cardboard
- Straws
- Paper
- Cardstock

Tools

- Scissors
- Ruler
- Pencil

Resources

- Red Crayon
- Design Journal
- $4.00 in money
  - $1.00 bill (x2)
  - 25 pennies
  - 10 nickles
  - 5 dimes
  - 3 quarters
- Materials Shop
- 3 Testing Centers:
  - Station(#1 Rain)
  - Station #2(Sunny pool)
  - Station #3 (Camel Ride)

Results/Deliverables & Limitations

- Their design journal
  - Contains their material investigation/research
  - Plan for solution
  - Budget for materials using $ and ¢, using mixed coins and numbers to purchase materials
  - Results from tests and listed improvements
  - Peer/Team Evaluation
- Each group will present in front of the class
  - What their crayon solution was, what they discovered, and share one of their improvements

Limitation: $4.00 materials budget

Setup Needed Before Class

- Printed student guide and design journals
- Supply Shop
  - With materials ready and change on hand
- Have many crayons on hand for testing and crayon disfunctions
- 3 Testing Centers(Look below for more information)
  - Water
  - Heat
  - Camel(Staircase)
- Student Group Setup
  - Material Investigation Bucket(1 at each table/group)
    - All of the materials in the bucket ready to be tested
  - A Red crayon
  - All of their tools
    - $4.00 in “cash”
    - Pencil
    - Scissors
    - Ruler

Supply Store Prices

- Tape: 50¢
- Pipe Cleaner: 25¢
- Felt: 35¢
- Cotton Ball: 35¢
- Plastic Wrap: 50¢
- Cardboard: 50¢
- Straw: 35¢
- Paper:25¢
- Cardstock: 50¢

Teacher Direction

1. Read: *The Day the Crayons Came Home* by Drew Daywalt.
2. Hand out the student guides, and introduce the project.
3. Direct the students to their tables where they have their supplies.
4. Explain the supply shop and how they will use a budget to purchase the materials they want to use for their design.
    a. The teacher will be providing change for students as they purchase materials.
5. They are going to get to test and investigate these materials and their different uses.
6. Students will get into their groups and start by working in their design journals.
7. After they complete the identify questions, you will do a short demonstration on how they will do the Materials investigation.
8. Show the students how the different testing stations work.
9. Then the groups will test their materials and record their findings and observations.
10. Then they will continue following their design journals.
11. When they finish the test and improve section: have the students individually fill out the team talk area.
12. After students have completed all of the above steps, each group will take turns presenting their neon red creation to the class:
    a. Show the creation and discuss the materials used
    b. What they discovered
    c. 1 of their improvements

Testing Procedures

Each station needs to be set up before class begins and will have a laminated directions card with clear instructions for students:

Safety Warning:

Heat from the Lamp
Water and electrical wires
Wet floors

Water Station

- Materials:
  - Tray or Container to place crayon on that will take excess water
  - Spray bottle filled with water
  - Paper Towels for cleanup
  - Timer
- Students will arrive at the station with their crayon, protection, and design journal
- They will place the protection over the crayon and place the now protected crayon on the tray/container.
- One student will set the 30 second timer as another student continuously sprays the crayon
- Once their time is up, they will observe, share, and record their results, then move to the next station

Heat Station

- Materials:
  - Lamp with bulb, or low heat source
  - Timer
- Students will arrive at the station with their crayon, protection, and design journal
- They will place the protection over the crayon and place the now protected crayon in the designated area by the lamp/heat source
- The students will set a timer for 1 minute
- Once their time is up, they will observe, share, and record their results, then move to the next station

Camel Ride Station:

- Materials:
  - Blocks or a Cardboard staircase creation (The only requirement is that it is descending and has “bumps”)
- Students will arrive at the station with their crayon, protection, and design journal
- They will place the protection over the crayon and place the now protected crayon at the top of the staircase
- The students will then drop the crayon and let it fall down to the bottom
- Once it reaches the bottom, they will observe, share, and record their results, then move to the next station

Assessment/Evaluation

Team Talk:

Our Team.....	Yes!	Sometimes	Not Really
Had everyone participate	☐	☐	☐
Listened to each other's ideas	☐	☐	☐
Created a plan as a team	☐	☐	☐
Worked with different materials	☐	☐	☐
Worked together to create a solution	☐	☐	☐
Followed Directions	☐	☐	☐

Teacher Rubric

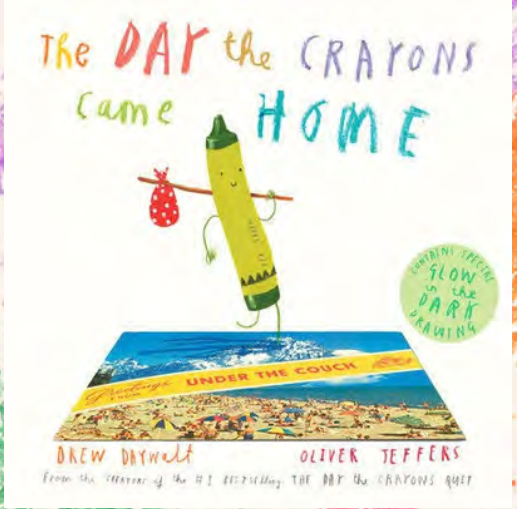
I can...	🖍🖍🖍 3 — Yes!	🖍🖍 2 — Almost	🖍 1 — Not Yet
Choose good materials (2-PS1-1, 2-PS1-2, STEL)	Describes and sorts materials in the investigation using vocabulary. Picks materials for rain, heat, and bumps, and explains each choice.	Describes some properties and sorts some materials. Picks materials with a general reason.	Needs help describing properties. Picks materials by color or preference, or does not provide a reason.
Make a plan (STEL)	Plan is completed. There is a labeled drawing and description of materials. The final design matches the plan, and any improvements are noted.	Plan is complete, but the final design only partly matches the plan. Only describes some of the materials.	Plan is incomplete or missing. The design doesn't connect to the plan. No description of materials used.
Stay within the budget (2.GM.12)	Counts mixed coins correctly. Records prices with ¢ and $ and adds them correctly. Total is $4.00 or less, and remaining money or change is correct.	Stays within $4.00 with some help, and/or has small errors in counting coins, adding totals, or using ¢/$.	Went over the $4.00 budget. Needs help counting coins, adding totals, and/or using correct symbols.
Work as a team (STEL)	Takes a role at the stations (timer, sprayer, recorder), listens to others' ideas, and shares materials and jobs fairly. Team Talk is mostly "Yes!" and matches what you observed.	Participates and listens with some reminders. Roles or sharing are uneven. Team Talk shows a mix of "Yes!" and "Sometimes."	Needs frequent support to participate, listen, or share. Team Talk is mostly "Not Really."
Test and improve (2-PS1-2)	Tests at all 3 stations and records observations for each. Names 3 improvements tied to the results (material + why). Explains what the team discovered in the presentation.	Test observations and results are incomplete. Improvement is vague ("make it better"). Shares only part of what they discovered. Only 1-2 improvements listed.	Incomplete results and observations. No improvement named, or needs help connecting results to the design.
		Total Score	/15

Student Given Rubric

I can...	🖍🖍🖍 3 — Yes!	🖍🖍 2 — Almost	🖍1 — Not Yet
Choose good materials	I chose materials based on what they can do.	I chose some materials based on what they can do.	I need help choosing materials.
Make a plan	I made and followed a plan.	I made a plan with some help.	I need help making a plan.
Stay within my budget	My team stayed within our $4.00 budget.	My team needed a little help with our budget.	My team went over our budget.
Work as a team	I listened, shared, and helped my team.	I worked with my team with some reminders.	I needed help working with my team.
Test and improve	Our design passed the tests and we identified future improvements.	Our design passed some tests or we made some improvements.	I need more practice testing and identifying improvements.
		Total Score	/15

NEON RED'S ROAD TRIP

Student Guide



Scenario

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Rubric

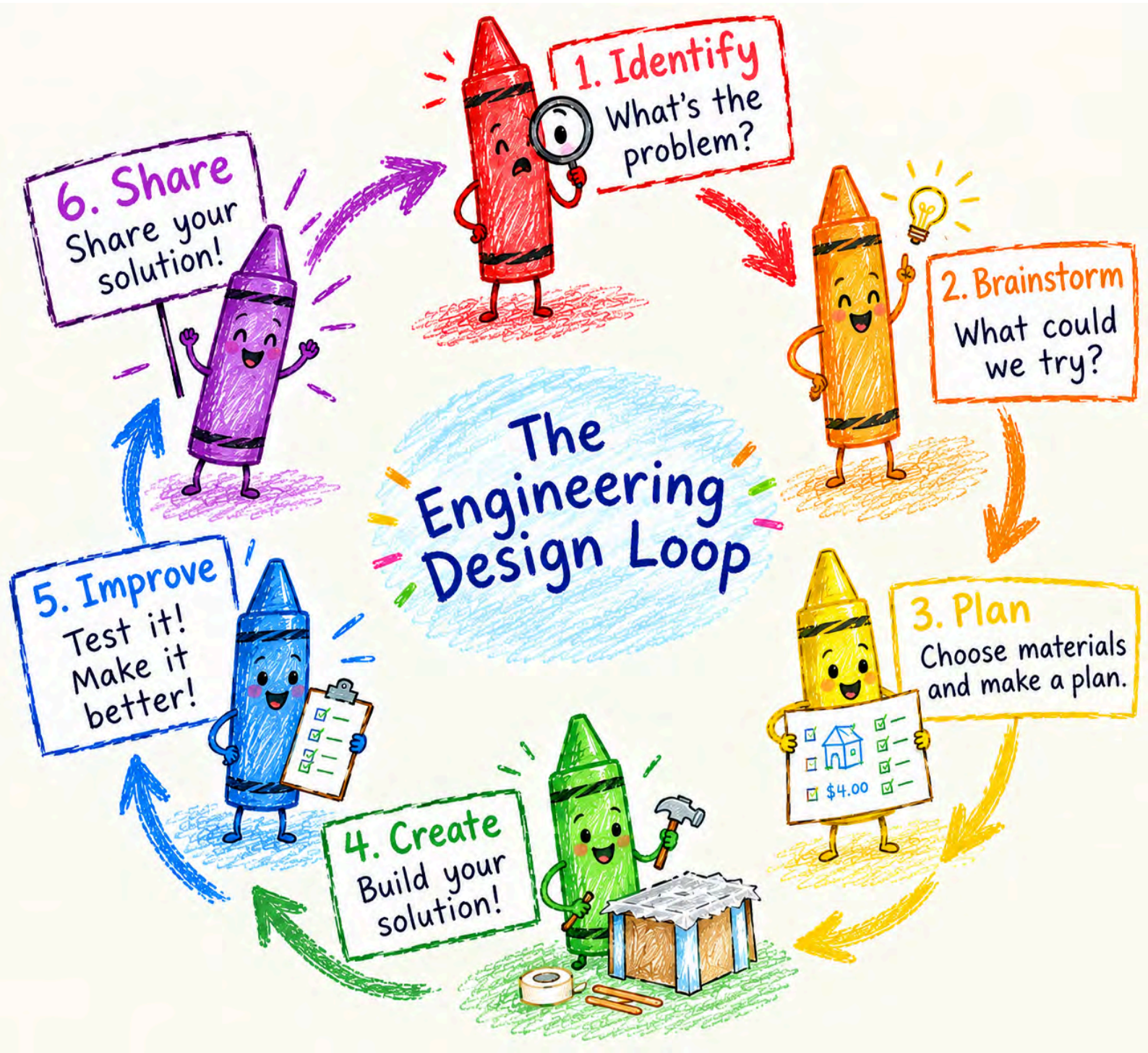
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Test and improve	Our design passed the tests and we identified future improvements.	Our design passed some tests or we made some improvements.	I need more practice testing and identifying improvements.
		Total Score:	/15



My Engineering Design Journal

NEON RED'S ROAD TRIP

Name:_____


The Engineering Design Loop
1. Identify
What's the problem?
2. Brainstorm
What could we try?
3. Plan
Choose materials and make a plan.
$4.00
4. Create
Build your solution!
5. Improve
Test it! Make it better!
6. Share
Share your solution!

Identify



- **What are the 3 challenges/tests that Neon Red needs to get through?**

- **What should the protection that you create do?**

Materials Investigation

We are going to conduct an investigation to help us learn more about the materials we may use in our solution. Using the materials on the list, we are going to test them at each station and record the data (the information we get from the investigation) in our table!

Material	Properties (Color, size, shape)	What is the texture? (smooth, rough, soft, bumpy)	Is it flexible or stiff?	Is it strong? (Hard to break)	How does it react to water? (absorbent or waterproof)
Tape					
Pipe Cleaner					
Felt					
Cotton Ball					
Plastic Wrap					
Cardboard					
Straws					
Paper					
Cardstock					

Brainstorm



- **What materials are you thinking about using? Why?**
  - Look back at your investigation notes

Plan



Sketch your design ideas here! Be sure to label the materials you plan on using in your design.

Supply Store Budget

Your team has a budget of $4.00 to spend at the Supply Store. You will use this sheet to help you and your team keep track of what materials you are using and how much you have left to spend.

Our Budget Is: $_____

Material	Price	Quantity	Total
Tape (1 inch)	50¢		
Pipe Cleaner(1)	25¢		
Felt(1 small piece)	35¢		
Cotton Ball(1 ball)	35¢		
Plastic Wrap (1 small piece)	50¢		
Cardboard (1 small piece)	20¢		
Straw (1)	35¢		
Paper (1 small sheet)	25¢		
Cardstock (1 small sheet)	50¢		
		TOTAL PRICE:	$

Create Your Solution!



Now it is time to work with your team and build protection for Neon Red!

Test and Improve



Now that you have created your protection for our friend Neon Red, it is time to put it to the test! After each test be sure to record your findings in the tables!

Test:	Did it protect Neon Red?	What happened?	What material worked best?
Heat Test🔥	Yes or No		
Water Test💧	Yes or No		
Camel Ride Test🐫	Yes or No		

- What material(s) worked best? And what evidence from your tests makes you think so?
  - Think about their properties and how they worked in our investigation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

- What are 3 things you would change for next time?
  - Think about your tests, what worked? What did not work? What materials did you use?
  - Even if your protection passed all of the tests there is always something new you can try or improve on in the future!

1:_____

_____

_____

_____

2:_____

_____

_____

_____

3:_____

_____

_____

_____

Share



Next, we will share our findings with the class. Feel free to write notes so that you remember everything for when you share with the class!

- **Meet Neon Red:**
  - Share your creation, talk about what materials you used and why

_____

_____

_____

- **Our Discovery:**
  - How did the tests go?

_____

_____

_____

_____

- **A Future Change We Would Make**
  - Share one of your improvements with the class

_____

_____

_____

Team Talk

Our Team.....	Yes!	Sometimes	Not Really
Had everyone participate	☐	☐	☐
Listened to each other's ideas	☐	☐	☐
Created a plan as a team	☐	☐	☐
Worked with different materials	☐	☐	☐
Worked together to create a solution	☐	☐	☐
Followed Directions	☐	☐	☐

Is there anything else that you want to add?

_____

_____

_____

_____

Keep the Cows Cozy! (Teacher Guide)



Grade Level: 3rd

STEM Content Standards:

Science:

3-ESS3-1 Make a claim about the merit of a design solution that reduces the impacts of a weather-related hazard

Mathematics:

3.NPV.7: Partition squares, regular hexagons, and equilateral triangles into parts with equal shares, explaining the shares of each part as a unit fraction of the whole.

Technological and Engineering Literacy:

Standard 5: Influence of Society on Technological Development

Grade 3

E. Explain how technologies are developed or adapted when individual or societal needs and wants change.

Big Ideas:

1. Changes in weather can cause hazards.
2. Objects around us can be divided into equal fractions.
3. Technology adapts when needs change.

Essential Questions:

1. How does the weather affect the way we survive?
2. How does each equal part work together for your design?
3. How did we adapt our technology because of the change in weather?

Book: Click Clack Moo Cows That Type

Title:

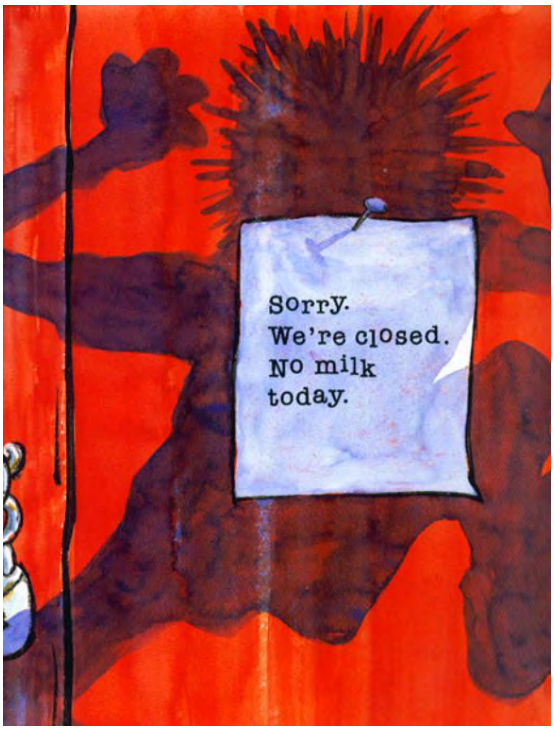
Keep the Cows Cozy!

Scenario:

Barns get so cold at night! You are the farmer next door to Farmer Brown. Farmer (insert students names here)! You hear that Farmer Brown's cows are demanding electric blankets. Before your cows start making the same demands, you want to build them a warmer shelter for the cold nights! You can't risk your cows going on strike and not giving you milk!

Challenge:

Your challenge is to build a warm shelter that can fit your 3 cows. Make sure your barn is split into 3 equal parts for each cow. I am going to give you a bunch of supplies in class to use so that your cows can stay warm at night! The cows that need to fit inside are approximately 5 in wide and 4 in tall. We are going to put a handwarmer inside your cow shelter and measure the temperature change at 0, 2, 5, and 10 minutes to see the overall change in temperate, and how well your shelter worked at keeping the cows warm.



Tools, Materials, and Resources: Identify all the tools, materials, and resources that will be available to the students as they attempt to solve the challenge. Try to keep the list small, students need to know that in the work world, unlimited supplies are rarely available, and there are benefits to solving problems as efficiently as possible.

Materials:

Materials	Unit	Price
Note Card	4	3 credits
Kleenex box	1	Free
Cardboard	6x6in	3 credits
Construction paper	1 sheet	3 credits
Cardstock	1 sheet	3 credits
Glue	1 bottle	Free
Pipe Cleaner	4	3 credits
Paper Plate	1	3 credits
Tissue Paper	1 sheet	3 credits

Masking Tape	6in	3 credits
Fabric	6x6in	3 credits
Rubber Band	4	3 credits
Craft Sticks	4	3 credits
Plastic Wrap	1 sheet	3 credits
Aluminum Foil	1 sheet	3 credits
Cotton Ball	4	3 credits
Felt	6x6in	3 credits
Bubble Wrap	6x6in	3 credits
News Paper	1 sheet	3 credits
String	6in	3 credits
2 found or repurposed items from home	2 per team	Free

Teacher note: Students are going to have 60 credits in total and each material is worth 3 credits.

Tools:

Scissors	Hole punch	Chomp Saw	Ruler	Lasor Thermometer	Timer

Resources:

Classmates	Cow Toy/ Replica	Book about weather change	Educational Book about cows

Content information:

Science

Essential Content

- Natural Hazards: Severe weather events (like floods, high winds, lightning, and heavy snow) happen because of natural earth processes.
- Human Limitations: People cannot stop or eliminate natural weather hazards completely.
- Impact Reduction: Humans can design and build structures to decrease the damage and risks to people and property.
- Evaluating Solutions: Students must look at specific engineering solutions (like flood barriers or lightning rods) and judge their merit (how well they work) using evidence.

Essential Vocabulary

- Weather-Related Hazard: A severe or dangerous weather event that can cause harm (e.g., floods, hurricanes, tornadoes, lightning storms).
- Design Solution: A human-made invention, structure, or improvement built to solve a problem (e.g., a seawall, storm shelter, or wind-resistant roof).
- Claim: A statement or conclusion answering *how well* a design solution works.
- Evidence: Facts, data, or observations used to support a claim.
- Merit: The value, usefulness, or effectiveness of a design solution.
- Criteria: The requirements or goals that a design solution must meet to be successful (e.g., "must keep water out of the house").
- Constraints: The limitations or restrictions on a design solution, such as cost, materials, or time.
- Cause and Effect: The crosscutting concept showing how a hazard causes damage (cause), and how a design solution prevents or lowers that damage (effect).

Technology and Engineering (STEL)

Essential Content

- Needs vs. Wants as Drivers: Students must distinguish between survival needs (e.g., clean water, food, shelter, safety) and societal wants (e.g., faster entertainment, convenience, luxury) and see how both prompt engineering solutions.
- The Concept of "Adapting": Technologies are frequently redesigned rather than invented from scratch. For example, when societal habits changed from sitting at desks to working on the go, engineers adapted desktop computers into laptops and smartphones.
- Changing Trends Shape Solutions: As communities shift their values-such as prioritizing environmental sustainability-technologies must adapt (e.g., transitioning from gas-powered cars to electric vehicles to satisfy a societal want for cleaner air).

Essential Vocabulary

• Technology	• Anything human-made that is designed to solve a problem, do a job, or make life easier.
• Need	• Something absolutely necessary for human survival or basic public health (e.g., clean water, medicine, shelter).
• Want	• Something people desire to make life more comfortable, entertaining, or efficient, but is not required for survival.

• Develop	• To build, create, or invent a brand-new technology to solve an emerging problem.
• Adapt	• To change, modify, or update an existing technology so that it works better or meets a new purpose.
• Society	• A community or group of people living together who share similar laws, values, and challenges.
• Innovation	• An improvement or modification made to an existing product, process, or system.
• Demand	• The collective desire or requirement of consumers or society for a particular product or solution.

Mathematics

Essential Content

To fully satisfy this standard, students must develop both the physical ability to split shapes and the conceptual ability to explain those parts mathematically.

- Target Shapes & Specific Partitions: Students work beyond basic circles and rectangles. They must accurately divide:
  - Squares into halves, thirds, fourths, sixths, and eighths.
  - Regular Hexagons into equal parts (most naturally sixths using equilateral triangles).
  - Equilateral Triangles into equal parts (most naturally halves or fourths).
- Understanding "Equal Areas" over Visual Appearance: Students must learn that parts do not always have to look identical in shape to be considered equal, but they must cover the same amount of space (area). For example, a square can be partitioned into four equal fourths using columns, a grid cross, or diagonal lines.
- Defining the Unit Fraction: Students must transition from naming parts with words ("one-third") to explaining that if a whole is divided into ¥(b¥) equal parts, each part represents the unit fraction.
- Recomposing the Whole: Students must understand that combining all equal unit parts recreates the entire single object

Essential Vocabulary

Vocabulary Word	Definition
Partition	To split, cut, or divide a whole shape into smaller pieces.
Whole	The entire unbroken shape or complete geometric figure before it is divided.
Equal Shares / Equal Parts	Pieces of a whole that are exactly the same size (area), ensuring fairness if shared.

Unit Fraction	A fraction that names exactly one part of a partitioned whole. It always has a ¥(1¥) as its top number (numerator)
Numerator	The top number in a fraction that tells how many parts are being counted or shaded (for a unit fraction, this is always.
Denominator	The bottom number in a fraction that tells the total number of equal parts the whole was split into.
Equilateral Triangle	A triangle where all three sides are equal in length and all angles are equal.
Regular Hexagon	A six-sided shape where all six sides are equal in length and all angles are equal.

Results:
At the end of the design challenge, the students need to have their initial, individual brainstorming pages, their completed cow shelter, and their temperature measurements for how warm the handwarmer (cow) was at 0, 2, 5, and 10 minutes.

Limitations:
The cow shelter must be large enough to fit THREE of the cow tows that are 4in tall and 5in long. It must only be made out of materials that we have in class. The shelter must also have some sort of opening for the cows to get in and out.

Assessment/Evaluation:
The students will be evaluated first by if the 3 cows can fit and have equal space inside the shelter and second by how well the shelter is at keeping the cows warm. I will provide cow toys/figurines that we are going to put inside the cow shelter to see how well they fit and use a ruler to see if each cow space is an equal fraction. We are also going to run an experiment! I am going to provide hand warmers and a thermometer, and we are going to evaluate how well the shelter does at keeping the handwarmer (cow) warm. We are going to take the temperature of the handwarmer before it goes in (so at 0 minutes), at 2 minutes, 5 minutes, and 10 minutes, and look at the overall change in temperature to determine if the cow shelter was successful at keeping the handwarmer warm. The students will also turn in their initial brainstorming ideas that they worked on individually to show how each person's ideas contributed to the final design.

Design Journal: https://canva.link/i0k835od592pi6e

KEEP THE COWS COZY! (STUDENT GUIDE)

Barns get so cold at night! You are the farmer next door to Farmer Brown. Farmer (insert students' names here)! You hear that Farmer Brown's cows are demanding electric blankets. Before your cows start making the same demands, you want to build them a warmer shelter for the cold nights! You can't risk your cows going on strike and not giving you milk!



Your challenge is to build a warm shelter that can fit your 3 cows. Make sure your barn is split into 3 equal parts for each cow. I am going to give you a bunch of supplies in class to use so that your cows can stay warm at night! The cows that need to fit inside are approximately 5 in wide and 4 in tall. We are going to put a handwarmer inside your cow shelter and measure the temperature change at 0, 2, 5, and 10 minutes to see the overall change in temperate, and how well your shelter worked at keeping the cows warm.

On the next page, you will find a material bank! Each item costs 3 credits, and your group has 60 credits to spend.

The cow shelter must be large enough to fit THREE of the cow toys that are 4in tall and 5in long. It must only be made from materials that we have in class. The shelter must also have some sort of opening for the cows to get in and out.

Throughout this project, you will be working with your Engineering Design Journal to keep track of your progress!

At the end, you will submit your model, design journal, and student guide to the teacher!

Material Bank

Materials	Unit	Price	Quantity	Total Cost
Note Card	4	3 credits		
Kleenex box	1	Free		
Cardboard	6x6in	3 credits		
Construction paper	1 sheet	3 credits		
Cardstock	1 sheet	3 credits		
Glue	1 bottle	Free		
Pipe Cleaner	4	3 credits		
Paper Plate	1	3 credits		
Tissue Paper	1 sheet	3 credits		
Masking Tape	6in	3 credits		
Fabric	6x6in	3 credits		
Rubber Band	4	3 credits		
Craft Sticks	4	3 credits		
Plastic Wrap	1 sheet	3 credits		
Aluminum Foil	1 sheet	3 credits		
Cotton Ball	4	3 credits		
Felt	6x6in	3 credits		
Bubble Wrap	6x6in	3 credits		
News Paper	1 sheet	3 credits		
String	6in	3 credits		
2 found or repurposed items from home	2 per team	Free		

Total Spent: _____

Tools:

Scissors	Hole punch	Chomp Saw	Ruler	Lasor Thermometer	Timer

Resources:

Classmates	Cow Toy/ Replica	Book about weather change	Educational Book about cows

Wrapping Up

Changes in weather can cause hazards. How does the weather affect the way we survive?

Objects around us can be divided into equal fractions. How does each equal part work together for your design?

Technology adapts when needs change. How did we adapt our technology because of the change in weather?

KEEP THE COWS COZY!

Engineering Design Journal





UNDERSTAND



WHAT PROBLEM ARE WE TRYING TO SOLVE?

WHAT DOES OUR SHELTER NEED TO DO?

WHAT ARE THE RULES AND LIMITATIONS?

DRAW OR WRITE YOUR IDEAS HERE:

PLAN

What design did our group choose?
What materials will we use?
How will we divide the shelter into three equal parts?
How much will our materials cost? Do we have enough credits?



DRAW AND LABEL YOUR GROUP'S DESIGN HERE:

CREATE

What materials did we use?
How did each group member help?
Did we follow our design plan?
Did we make any changes while building?

DRAW AND LABEL YOUR GROUP'S DESIGN HERE:



TEST

Does our shelter fit all three cows?
Does each cow have an equal amount of space?
Does our shelter help keep the handwarmer warm?
What could we improve?



Time (minutes)	Temperature (°C or °F)
0 minutes	_____
2 minutes	_____
5 minutes	_____
10 minutes	_____

IMPROVE

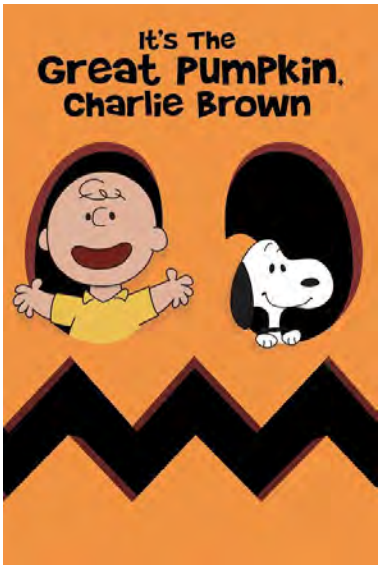
What worked well?
What did not work as expected?
What changes could make our shelter warmer or give the cows more space?

DRAW YOUR IMPROVED DESIGN OR DESCRIBE THE CHANGES HERE:



By: Shelby Mayer and Marin Nordenstam

Student Guide: Pumpkin Protection Pavilion (PPP)



Scenario: In *It's the Great Pumpkin, Charlie Brown*, Linus believes that the Great Pumpkin will come to the most sincere pumpkin patch on Halloween night. Linus goes to the pumpkin patch and waits all night for the Great Pumpkin.

But it is a cold, windy, and rainy night! Linus and the pumpkins need our help!

What can we do to protect the pumpkins from the wind and rain?

You and your team will become engineers!

Your job is to design and build a shelter to protect a pumpkin from the wind and rain. You will use the materials your teacher gives you to build your shelter.

Next, you will test your shelter to see if it can keep the pumpkin safe and dry. If your shelter does not work, you can improve it and share it with the class.

How can your team build a shelter that will protect the pumpkin while Linus waits for the Great Pumpkin?

Challenge:
It is time to become engineers!

You will work with your table team to design and build a shelter for a pumpkin over the next 3 days. Your shelter must protect the pumpkin from wind and rain.

You may only use the materials your teacher gives you.

First, make a plan. Talk with your team and draw a picture of your shelter.

Next, build your shelter. Use a ruler to measure your shelter. Make sure it is big enough for your pumpkin.

Then, test your shelter! We will use wind and rain to see if your shelter can protect the pumpkin.

Your team will have 40 minutes during the first 2 days to make and test your shelter.

By: Shelby Mayer and Marin Nordenstam

Did your shelter keep the pumpkin safe and dry?

If it did not work, don't give up! Engineers learn from their tests. Talk with your team about what you can change. Then, improve your design!

On the last day your team will share the shelter and why your team chose those materials to the class.

Can your team build a shelter that keeps the pumpkin safe from the wind and rain?

Big Ideas:

- ★ Different materials have different properties that make them useful for specific purposes.
- ★ Structures can be designed and built to protect people, objects, or land from weather conditions such as wind and rain.
- ★ Engineers can compare, test, and improve different solutions to solve a problem.
- ★ Measurement can be used to describe and compare the size and length of objects and structures.

Essential Questions:

- ★ How can we use different materials and measurements to design, build, and improve a shelter that protects a pumpkin from wind and rain?

Tools/ Materials: (These materials are per table group, you can use the assigned amount)

Materials:

(Students do not need to use all the materials provided if they do not wish to)

- ★ Pencils (2)
- ★ Craft sticks (10)
- ★ Paper (3)
- ★ Cardboard (12 in by 12 in)
- ★ Masking tap (24 inches)
- ★ Aluminum foil (24 inches long sheet)
- ★ Plastic solo cups (6)
- ★ Grocery bags (2)



- ★ Fabric scraps (12 in by 12 in)
- ★ String (yarn) (12 inches)
- ★ Rocks (4)

Tools:

- ★ Scissors
- ★ Rulers
- ★ Chomp-Saw
- ★ Sand Paper
- ★ Safety goggles
- ★ Quick cutters
- ★ Crop-a-Dile

Limitations:

- ★ Students must work with their table group.
- ★ Students can only use the materials given to them by the teacher.
- ★ Students can only build one shelter for their team.
- ★ The shelter must be big enough to fit a 3-inch tall by 4-inch wide plastic pumpkin.
- ★ Students must measure their shelter using a ruler.
- ★ Students must use the materials safely.
- ★ Students will have a set amount of time to design, build, test, and improve their shelter.
- ★ The shelter must stand during the wind and rain tests.
- ★ Students may change their shelter after testing if their first design does not protect the pumpkin.

Rubric:

Category	**4-Excellent**	**3-Meets Expectations**	**2-Developing**	**1-Beginning**
Science	Shelter protects the pumpkin from wind and rain. The students can explain how their design provides protection.	The shelter protects the pumpkin from most wind and rain.	Shelter provides some protection but has weaknesses.	Shelter has little or no protection.

By: Shelby Mayer and Marin Nordenstam

Engineering/STEL	Students carefully select materials based on their properties and explain why they chose them.	Students select the correct materials and can explain their choices.	Students select materials but have a hard time explaining why.	Students cannot explain their material choices.
Math	Students estimate and measure the shelter to the nearest whole inch and compare it to the pumpkin's size.	Students measure the shelter with minor errors.	Students need some help with measurement.	Students have difficulty measuring the shelter.
Design Process	Students clearly ask, imagine, plan, create, test, improve, and share.	Students complete most steps of the design process.	Students complete some steps with help.	Students need a lot of help completing the design process.
Teamwork	All team members build, talk, and share ideas.	Most team members share and work together.	Some team members work more than others.	One or two students complete most of the work.
Final Product	The shelter is stable, the correct size, and protects the pumpkin during testing.	Shelter meets most needs.	Shelter meets some needs.	Shelter does not meet the major needs.

Total Score:___/24

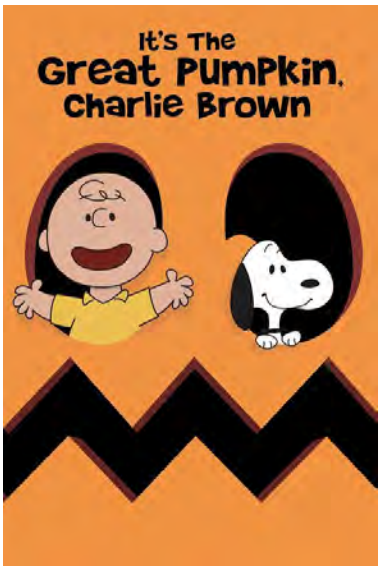
By: Shelby Mayer and Marin Nordenstam

Teacher Guide: 2nd grade Design Challenge *It's the Great Pumpkin: Charlie Brown*
Pumpkin Protection Pavilion (PPP)

STEM Content Standards:

Science (Life, Earth/Space, or Physical Science):

- 2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
- 2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.* [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]



Mathematics:

- 2.GM.3: Select appropriate measurement tools to estimate and measure the length of an object to the nearest whole inch or whole centimeters.

Standard for Technological and Engineering Literacy:

- Standard 2: Core Concepts of Technology and Engineering C - Explain that materials are selected for use because they possess desirable properties and characteristics.

Big Ideas:

- Different materials have different properties that make them useful for specific purposes.
- Structures can be designed and built to protect people, objects, or land from weather conditions such as wind and rain.
- Engineers can compare, test, and improve different solutions to solve a problem.
- Measurement can be used to describe and compare the size and length of objects and structures.

Essential Question:

- How can we use different materials and measurements to design, build, and improve a shelter that protects a pumpkin from wind and rain?

Scenario:

- In *It's the Great Pumpkin: Charlie Brown,* Linus believes that the Great Pumpkin will come to the most sincere pumpkin patch on Halloween night. Linus goes to the pumpkin patch and waits all night for the Great Pumpkin. But it is a cold, windy, and rainy fall night! Linus and the pumpkins need our help! What can we do to protect the pumpkins from the wind and rain? You and your team are going to become engineers! Your job is to design and build a shelter that will protect a pumpkin from the wind and rain. You will use the materials I give you to create your shelter. Then, you will test your shelter to see if it can keep the pumpkin safe and dry. How can your team build a shelter strong enough to protect the pumpkins while Linus waits for the Great Pumpkin?

Challenge:

- It is time to become engineers! You will work with your table team to design and build a shelter for a pumpkin. Your shelter must protect the pumpkin from the wind and rain. You may only use the materials I give you. Before you build, work with your team to make a plan. Then, build your shelter and use a ruler to measure it to make sure it is big enough for your pumpkin. When your shelter is finished, we will test it

with wind and rain. Did your shelter protect the pumpkin? If it did not work, don't worry! Engineers learn from their tests. Your team can change your design and try again. Can your team build a shelter that keeps the pumpkin safe from the wind and rain?

Tools, Materials, and Resources: (Buy a few plastic pumpkins that are 3 inches tall and 4 inches wide. The students will have to create a shelter that will fit this size pumpkin.)

Materials: These materials are per table group

- Pencils (2)
- Craft sticks (10)
- Paper (3)
- Cardboard (12 in by 12 in)
- Masking tap (24 inches)
- Aluminum foil (24 inches long sheet)
- Plastic solo cups (6)
- Grocery bags (2)
- Fabric scraps (12 in by 12 in)
- String (yarn) (12 inches)
- Rocks (4)

Tools:

- Scissors
- Rulers
- Chomp-Saw
- Sand Paper
- Safety goggles
- Quick cutters
- Crop-a-Dile
- Hot glue gun

Resources:

- Charlie Brown: It's the Great Pumpkin picture book

Teacher Notes:

- Teacher/Instructor will walk around and observe groups as they design, construct, and finish their models
- Teacher will assist students by hot gluing their models if students need (students will **not** use the hot glue gun by themselves
- The teacher/Instructor will walk around and offer aid and assistance if students need it.
- Teacher will also aid with using tools for testing model
- This project will be done over the course of 3 days. For the first 2 the students will have 40 minutes to create and test their shelters. Students will test their shelter at the beginning of the second day with their groups and make adjustments as needed. On the 3rd day the students will present their project to the class and share why they chose the materials that they did.

Content information:

Science:

- **Property:** A special feature or characteristic used to describe an object (like color or texture).

- **Observable:** Something you can notice using your five senses (sight, touch, smell, hearing, taste).
- **Texture:** How a surface feels to the touch (e.g., rough, smooth, bumpy, soft).
- **Hardness:** How firm or solid a material is; whether it resists scratching or bending (e.g., hard rock vs. soft sponge).
- **Flexibility:** How easily a material can bend without breaking (e.g., flexible rubber band vs. stiff wooden ruler).
- **Classify:** To sort or group objects together based on how they are similar.
- **Pattern:** Something that repeats or is shared among different objects (e.g., noticing all metal objects are hard)

Technology and Engineering (STEL):

- **Material**: What an object is made from.
- **Property**: A quality or feature of a material.
- **Characteristic**: A feature that describes a material.
- **Material selection**: Choosing a material based on its properties.
- **Desirable property**: A property that makes a material useful for a specific purpose.
- **Strength**: How well a material can hold up without breaking.
- **Flexibility**:How easily a material can bend without breaking.
- **Waterproof**: A characteristic that helps keep water out.

Mathematics:

- **Length:** The distance from one end of an object to the other end.
- **Measure:** To find the size, length, or amount of something using standard units.
- **Estimate:** To make an educated guess about the length of an object before actually measuring it.
- **Inch (in)**: A customary unit of length used to measure smaller objects (about the length of a paperclip).
- **Centimeter (cm):** A metric unit of length used to measure smaller objects (about the width of a fingernail).
- **Ruler:** A tool marked with inches and centimeters used to measure short, straight objects

Results:

- A shelter that will protect a plastic 3 by 4 inch pumpkin against wind and rain. The students will present their shelters and we will test it with a water spray bottle and fan to act as the wind and the rain.

Limitations:

- Students must work with their assigned table team.
- Students may only use the materials provided by the teacher.
- Students must build one shelter for their team.
- The shelter must be large enough to fit a 3-inch tall by 4-inch wide plastic pumpkin.
- Students must measure their shelter using a ruler.
- Students must use the materials safely and appropriately.
- Students will have a set amount of time to design, build, test, and improve their shelter.
- The shelter must remain standing during the wind and rain tests.

- Students may modify their shelter after testing if their first design does not adequately protect the pumpkin.

Assessment/Evaluation:

Category	**4-Excellent**	**3-Meets Expectations**	**2-Developing**	**1-Beginning**
Science	Shelter effectively protects the pumpkin from wind and rain and students can explain how their design provides protection.	The shelter protects the pumpkin from most wind and rain.	Shelter provides some protection but has weaknesses.	Shelter provides little or no protection.h
Engineering/ STEL	Students carefully select materials based on their properties and explain why they chose them.	Students select appropriate materials and can explain some choices.	Students select materials but have difficulty explaining why.	Students cannot explain their material choices.
Math	Students accurately estimate and measure the shelter to the nearest whole inch and compare it to the pumpkin's size.	Students measure the shelter accurately with minor errors.	Students need some assistance with measurement.	Students have significant difficulty measuring the shelter.
Design Process	Students clearly ask, imagine, plan, create, test, improve, and share.	Students complete most steps of the design process.	Students complete some steps with assistance.	Students need significant assistance completing the design process.
Teamwork	All team members participate, communicate, and contribute ideas.	Most team members participate and work together.	Some team members participate more than others.	One or two students complete most of the work.
Final Product	Shelter is stable, appropriately	Shelter meets most requirements.	Shelter meets some requirements.	Shelter does not meet the major requirements.

	sized, and successfully protects the pumpkin during testing.			

Total Score:____/24

By: Shelby Mayer and Marin Nordenstam



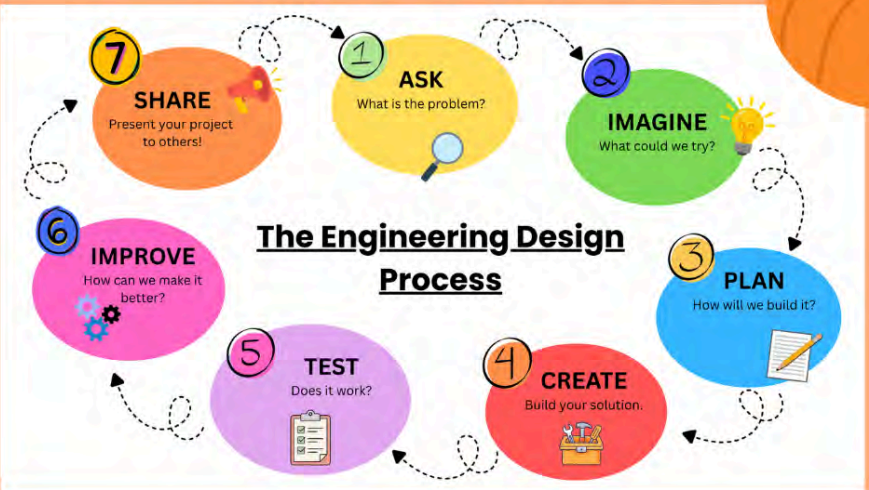
DESIGN JOURNAL

Pumpkin Protection Pavilion (PPP) Challenge



By: Shelby Mayer and Marin Nordenstam

DESIGN LOOP



Challenge:

It is time to become engineers!
You will work with your table team to design and build a shelter for a pumpkin. Your shelter must protect the pumpkin from wind and rain.
You may only use the materials your teacher gives you.
First, make a plan. Talk with your team and draw a picture of your shelter.
Next, build your shelter. Use a ruler to measure your shelter. Make sure it is big enough for your pumpkin.
Then, test your shelter! We will use wind and rain to see if your shelter can protect the pumpkin.

1.ASK- What is the Problem?

By: Shelby Mayer and Marin Nordenstam

2.IMAGINE- Brainstorm with the group.

Properties of Objects:

- **Property:** A special feature or characteristic used to describe an object (like color or texture).
- **Observable:** Something you can notice using your five senses (sight, touch, smell, hearing, taste).
- Texture: How a surface feels to the touch (e.g., rough, smooth, bumpy, soft).
- **Hardness:** How firm or solid a material is; whether it resists scratching or bending (e.g., hard rock vs. soft sponge).
- **Flexibility:** How easily a material can bend without breaking (e.g., flexible rubber band vs. stiff wooden ruler).
- **Classify:** To sort or group objects together based on how they are similar.
- **Pattern:** Something that repeats or is shared among different objects (e.g., noticing all metal objects are hard)

3. PLAN- How are we going to build it?

Draw/Sketch your Idea:

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Please list your materials here (that you plan to use):

Material Property Investigation:

Please list your materials in the table and list their properties and why you chose that material

Vocabulary:

- **Property:** A special feature or characteristic used to describe an object (like color or texture).
- **Observable:** Something you can notice using your five senses (sight, touch, smell, hearing, taste).
- **Texture:** How a surface feels to the touch (rough, smooth, bumpy, soft).
- **Hardness:** How firm or solid a material is; whether it resists scratching or bending (hard rock vs. soft sponge).
- **Flexibility:** How easily a material can bend without breaking (flexible rubber band vs. stiff wooden ruler).
- **Classify:** To sort or group objects together based on how they are similar.
- **Pattern:** Something that repeats or is shared among different objects (noticing all metal objects are hard)

Material:	Properties of Material:	Why you used this material/ purpose of material:

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4.Create- Build your solution

Please use this space for any additional notes or planning:

Measurement

- **Length:** The distance from one end of an object to the other end.
- **Measure:** To find the size, length, or amount of something using standard units.
- **Estimate:** To make an educated guess about the length of an object before actually measuring it.
- **Inch (in):** A customary unit of length used to measure smaller objects (about the length of a paperclip).
- **Centimeter (cm):** A metric unit of length used to measure smaller objects (about the width of a fingernail).
- **Ruler:** A tool marked with inches and centimeters used to measure short, straight objects

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Measurement Investigation:

Please use a ruler to measure your materials using the centimeter (cm.) and inch (in.) sides of the ruler and record the lengths of your materials

Material:	Centimetres measured (cm.)	Inches measured (in.)

After completing both your material properties investigation and measurement investigation, start building your design using your materials!

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5.Test- Does it work?

Please use this space to share if your design works or not:

6.Improve- How can we make it better?

Please use this space to share what improvements you could make for your shelter:

By: Shelby Mayer and Marin Nordenstam

7.Share- Show your shelter to the class!

Reflection:

Please use this space to share your overall thoughts about the project:

Final Reflection Question:

My team's shelter was successful because _____. One thing I would change about our design is _____. The material that worked best was _____ because _____.

Teacher Guide

Operation Lighthouse Rescue Mission!



Book: Bella Lost and Found by Ryan O'Rourke

Grade Level: 4th Grade

STEM Content Standards:

Science (Life, Earth/Space, or Physical Science)

4-PS4-2: Develop a model to describe that light reflecting from objects and entering the eye allows objects to be seen.

Mathematics

4.GM.10: Solve real-world problems involving addition and subtraction of money, including the ability to make change.

Standard for Technological and Engineering Literacy

Standard 1: Nature and Characteristics of Technology and Engineering

H. Design solutions by safely using tools, materials, and skills.

Big Ideas:

1. Light is constantly reflecting off things around us that make us able to see.
2. Adding and subtracting money helps us learn to find total costs, figure out correct change, and give us real-world budgeting experience.
3. Being safe with tools and materials allows us to create meaningful solutions.

Essential Questions:

1. Which materials help us see light most effectively? How do different materials reflect light differently?
2. How do we figure out how much change/money we have leftover from our budget if any? How do we decide if we have enough money to buy the materials that we need?
3. How do we choose the right tools/materials for our solution? What properties of our materials change what they can be used for?

Scenario:

Our Mission: Bella the lighthouse cat went on another adventure and needs our help to get back to her home safely. But, the lighthouse is broken! And without the light, Bella can't see the lighthouse at all. The lighthouse keeper is asking for our help and it's our mission to design and build a new lighthouse that helps guide Bella back home.

In order to complete our mission we have to follow the budget of the lighthouse keeper. Each team will have $10 to buy materials from Lighthouse Repair Shop for the brand new lighthouse. As a team, you'll have to plan carefully and make sure you get the correct change from Lighthouse Repair Shop. Remember, once you've spent all your money, it's gone so choose carefully! Once your lighthouse is built, we'll test it and see if Bella can find her way home. Bella's counting on us!

Challenge:

In your group, build a freestanding lighthouse that shines a light for Bella to make it home in the dark using only the materials you purchased from the Lighthouse Repair Shop within your $10 budget.

Make sure your lighthouse:

1. Is freestanding, taller than 6" and no more than 12".
2. Uses at least 1 reflective material to shine the light towards Bella
3. Stay within the $10 budget from the lighthouse keeper and use the budget sheet to record the item's price, total spent, and how much change was received from the shop.
4. Use all tools/materials safely

Tools, Materials, and Resources:

Materials:

Materials	**Price**	**How Many Purchased:**	**Total:**
Aluminum Foil Sheet (6x6)	**$1**		**$**
Plastic Container	**$1**		**$**
Plastic Bottle	**$1**		**$**
Cardboard (12x12)	**$1**		**$**
Paper towel roll	**$1**		**$**
Pipe Cleaners (3)	**.50 c**		**$**

Craft sticks (3)	**.50 c**		**$**
Construction Paper	**.25 c**		**$**
Paper Plate	**$1**		**$**
Straw	**.50 c**		**$**
Duct Tape	**$2**		**$**
Compact Mirror	**$2**		**$**
Large Gem	**$2**		**$**
Sparkly Item	**$2**		**$**
Light Source	Free		
Tape	Free		
		Total Amount Spent $_____	

Students get $10

Tools:
Safety googles, scissors, rulers, wire cutters, hot glue gun with teacher assistance.

Resources:
Bella Lost and Found
Video over light:
https://www.generationgenius.com/videolessons/light-reflection-and-vision-video-for-kids/
https://www.youtube.com/watch?v=XPasvQNzrGo
Chromebook if needed to look into lighthouses

Content information:
Science:

- **Light Source:** An object that produces its own light energy, such as the sun or a lamp.
- **Reflection:** The bouncing of light off a surface or object.
- **Absorb:** To take in light energy rather than reflecting it back.
- **Opaque:** A material that blocks light completely and may reflect all the light that hits its surface.
- **Transparent:** A material that lets light pass right through it with very little reflection.
- **Translucent:** A material that lets some light pass through while scattering or reflecting some of it.

Technology and Engineering (STEL):

- **Tool:** An instrument or device used to do work or perform a specific physical task.
- **Material:** A physical substance (e.g., plastic, cardboard, metal) used to construct or make objects.
- **Skill:** The ability to use techniques, procedures, and manual dexterity effectively during the building or creation process.
- **Safety:** The condition of being protected from potential harm, danger, or injury in a workspace.
- **Resource:** Available supplies, materials, or assets that can be drawn on to accomplish a goal

Mathematics:

- **"Making Change":** Students must calculate the difference between an amount given (the paid value) and the actual cost of a purchase.
- **Cost / Price:** The amount of money required to purchase an item.
- **Spend / Expense:** An action or scenario where money is subtracted from an existing total.
- **Total / Subtotal:** The combined cost of all items before or after calculating tax or applying discounts.
- **Change:** The money returned to a buyer when they pay with an amount larger than the total cost of the purchase.

Results:

Upon completion, students turn in their design journal and their lighthouse model. In their design journal, students will be writing prompts for each step where students write out their thinking, their sketches/model ideas, brainstorming, etc.

Limitations:

Boundaries for their lighthouse include being a freestanding structure, standing taller than 6 inches but no higher than 12 inches, including at least 1 reflective material, and staying within the $10 budget.

Assessment/Evaluation:

Students will be evaluated by their lighthouse reflecting light for Bella to find her way home, staying within their budget and accurately solving how much change they received/how much money they spent, being safe with the tools and materials, and by filling out a team member reflection survey.

Rubric:

Operation Lighthouse Rescue Mission – Assessment Rubric

Criteria	4 – Exceeds Expectations	3 – Meets Expectations	2 – Developing	1 – Beginning
Science: Light & Reflection	Explains and demonstrates how light reflects off materials and successfully directs light toward Bella.	Demonstrates that light reflects by using a reflective material to direct light toward Bella.	Uses a reflective material but has difficulty directing light or explaining reflection.	Does not demonstrate an understanding of light reflection.
Mathematics: Budget & Money	Accurately calculates all costs and change, stays within the $10 budget, and completely records purchases.	Calculates costs and change with minor errors and stays within the $10 budget.	Has several calculation or recording errors but attempts to stay within the budget.	Does not accurately calculate costs/change or does not follow the $10 budget.
STEL: Tools, Materials & Safety	Selects appropriate tools/materials and uses them safely and effectively throughout the entire challenge.	Uses appropriate tools/materials safely with few reminders.	Needs several reminders to use tools/materials safely or appropriately.	Uses tools/materials unsafely or does not demonstrate appropriate use.
Lighthouse Design Challenge	Lighthouse is freestanding, 6–12 inches tall, uses a reflective material, directs light toward Bella, and meets all challenge requirements.	Lighthouse meets the major requirements and successfully functions as intended.	Lighthouse meets some requirements but has difficulty functioning or misses one or more requirements.	Lighthouse does not meet multiple requirements or does not function as intended.
Design Journal & Engineering Thinking	Thoroughly documents questions, brainstorming, sketches, planning, testing, changes, and reasoning throughout the design process.	Documents ideas, sketches/plans, testing, and reflection on the design.	Journal is partially completed and provides limited evidence of design thinking.	Journal is incomplete and provides little evidence of the design process.
Peer Review & Reflection	Provides thoughtful feedback and clearly explains what worked, what could improve, and how the team worked together.	Provides feedback and reflects on the design and teamwork.	Provides limited feedback or reflection.	Provides little or no meaningful feedback or reflection.

Peer Evaluation Rubric:

Peer Contribution Rating

How did my teammate contribute?	⭐ 4 – Always	👍 3 – Most of the Time	💡 2 – Sometimes	🌱 1 – Not Yet
Shared ideas	☐	☐	☐	☐
Listened to teammates	☐	☐	☐	☐
Helped build the lighthouse	☐	☐	☐	☐
Helped solve problems	☐	☐	☐	☐
Stayed focused and participated	☐	☐	☐	☐
Used tools and materials safely	☐	☐	☐	☐
Was kind and respectful	☐	☐	☐	☐

Overall Peer Rating:

My teammate's overall contribution was...	Circle One
Excellent Team Member	**4**
Good Team Member	**3**
Developing Team Member	**2**
Needs More Practice	**1**

One thing my teammate did really well:

One thing my teammate could work on next time:

Teacher Notes: The teacher will be walking around and monitoring creating and the team interactions throughout the process. The teacher will print and staple design journals to be a book. The teacher will also set up a small supply store and will serve as a cashier monitoring what the students are purchasing, but also having the student complete the math of what they are spending, and ask for the right amount of change back.

Deliverables: Lighthouse, design journal, peer review.

Design Journal:
Students will fill out a design journal with writing prompts and questions for each step of my design journal. For example, for step 1 of my design loop, students will write down any questions they identify about the project and they will identify the “what, who, how, where, and why.” Intentional practice of my identified standards could be a safety tool lesson where as a class we look into the tools and how to safely use them.

LINK :https://canva.link/d6s9vriiapasava Link to design journal if needed, if not found below.

Student Guide

Operation Light House Rescue Mission!



Big Ideas:

1. Light is constantly reflecting off things around us that make us able to see.
2. Adding and subtracting money helps us learn to find total costs, figure out correct change, and give us real-world budgeting experience.
3. Being safe with tools and materials allows us to create meaningful solutions.

Essential Questions:

1. Which materials help us see light most effectively? How do different materials reflect light differently?
2. How do we figure out how much change/money we have leftover from our budget if any? How do we decide if we have enough money to buy the materials that we need?
3. How do we choose the right tools/materials for our solution? What properties of our materials change what they can be used for?

Scenario:

Our Mission: Bella the lighthouse cat went on another adventure and needs our help to get back to her home safely. But, the lighthouse is broken! And without the light, Bella can't see the lighthouse at all. The lighthouse keeper is asking for our help and it's our mission to design and build a new lighthouse that helps guide Bella back home.

In order to complete our mission we have to follow the budget of the lighthouse keeper. Each team will have $10 to buy materials from Lighthouse Repair Shop for the brand new lighthouse. As a team, you'll have to plan carefully and make sure you get the correct change from Lighthouse Repair Shop. Remember, once you've spent all your money, it's gone so choose carefully! Once your lighthouse is built, we'll test it and see if Bella can find her way home. Bella's counting on us!



Challenge:

In your group, build a freestanding lighthouse that shines a light for Bella to make it home in the dark using only the materials you purchased from the Lighthouse Repair Shop within your $10 budget.

Make sure your lighthouse:

5. Is freestanding, taller than 6” and no more than 12”.
6. Uses at least 1 reflective material to shine the light towards Bella
7. Stay within the $10 budget from the lighthouse keeper and use the budget sheet to record the item's price, total spent, and how much change was received from the shop.
8. Use all tools/materials safely

Tools, Materials, and Resources:

Materials	**Price**	**How Many Purchased:**	**Total:**
Aluminum Foil Sheet (6x6)	**$1**		**$**
Plastic Container	**$1**		**$**
Plastic Bottle	**$1**		**$**
Cardboard (12x12)	**$1**		**$**
Paper towel roll	**$1**		**$**
Pipe Cleaners (3)	**.50 c**		**$**
Craft sticks (3)	**.50 c**		**$**
Construction Paper	**.25 c**		**$**
Paper Plate	**$1**		**$**
Straw	**.50 c**		**$**
Duct Tape	**$2**		**$**
Compact Mirror	**$2**		**$**
Large Gem	**$2**		**$**
Sparkly Item	**$2**		**$**
Light Source	Free		

Tape	Free		
			Total Amount Spent $_____

Tools:
Safety googles, scissors, rulers, wire cutters, hot glue gun with teacher assistance.

Resources:
Bella Lost and Found
Video over light:
https://www.generationgenius.com/videolessons/light-reflection-and-vision-video-for-kids/
Chromebook if needed to look into lighthouses

Results:
When completed, turn in your design journal and your lighthouse model. In the design journal, Fill out the answer prompts to explain your thinking, brainstorm, and sketch ideas.

Deliverables: Lighthouse, design journal, peer review.

Limitations:
Boundaries for your lighthouse include:

- being a freestanding structure
- stand taller than 6 inches but no higher than 12 inches
- include at least 1 reflective material
- staying within the $10 budget

Assessment/Evaluation:
Rubric:

Operation Lighthouse Rescue Mission – Assessment Rubric

Criteria	4 – Exceeds Expectations	3 – Meets Expectations	2 – Developing	1 – Beginning
Science: Light & Reflection	Explains and demonstrates how light reflects off materials and successfully directs light toward Bella.	Demonstrates that light reflects by using a reflective material to direct light toward Bella.	Uses a reflective material but has difficulty directing light or explaining reflection.	Does not demonstrate an understanding of light reflection.
Mathematics: Budget & Money	Accurately calculates all costs and change, stays within the $10 budget, and completely records purchases.	Calculates costs and change with minor errors and stays within the $10 budget.	Has several calculation or recording errors but attempts to stay within the budget.	Does not accurately calculate costs/change or does not follow the $10 budget.
STEL: Tools, Materials & Safety	Selects appropriate tools/materials and uses them safely and effectively throughout the entire challenge.	Uses appropriate tools/materials safely with few reminders.	Needs several reminders to use tools/materials safely or appropriately.	Uses tools/materials unsafely or does not demonstrate appropriate use.
Lighthouse Design Challenge	Lighthouse is freestanding, 6–12 inches tall, uses a reflective material, directs light toward Bella, and meets all challenge requirements.	Lighthouse meets the major requirements and successfully functions as intended.	Lighthouse meets some requirements but has difficulty functioning or misses one or more requirements.	Lighthouse does not meet multiple requirements or does not function as intended.
Design Journal & Engineering Thinking	Thoroughly documents questions, brainstorming, sketches, planning, testing, changes, and reasoning throughout the design process.	Documents ideas, sketches/plans, testing, and reflection on the design.	Journal is partially completed and provides limited evidence of design thinking.	Journal is incomplete and provides little evidence of the design process.
Peer Review & Reflection	Provides thoughtful feedback and clearly explains what worked, what could improve, and how the team worked together.	Provides feedback and reflects on the design and teamwork.	Provides limited feedback or reflection.	Provides little or no meaningful feedback or reflection.

Peer Evaluation Rubric: Peer evaluation will be in the Design Engineering Journal.

Peer Contribution Rating:

How did my teammate contribute?	⭐ 4 – Always	👍 3 – Most of the Time	💡 2 – Sometimes	🌱 1 – Not Yet
Shared ideas	☐	☐	☐	☐
Listened to teammates	☐	☐	☐	☐
Helped build the lighthouse	☐	☐	☐	☐
Helped solve problems	☐	☐	☐	☐
Stayed focused and participated	☐	☐	☐	☐
Used tools and materials safely	☐	☐	☐	☐
Was kind and respectful	☐	☐	☐	☐

Overall Peer Rating:

My teammate's overall contribution was...	Circle One
Excellent Team Member	**4**
Good Team Member	**3**
Developing Team Member	**2**
Needs More Practice	**1**

One thing my teammate did really well:

One thing my teammate could work on next time:

OPERATION LIGHT HOUSE RESCUE MISSION

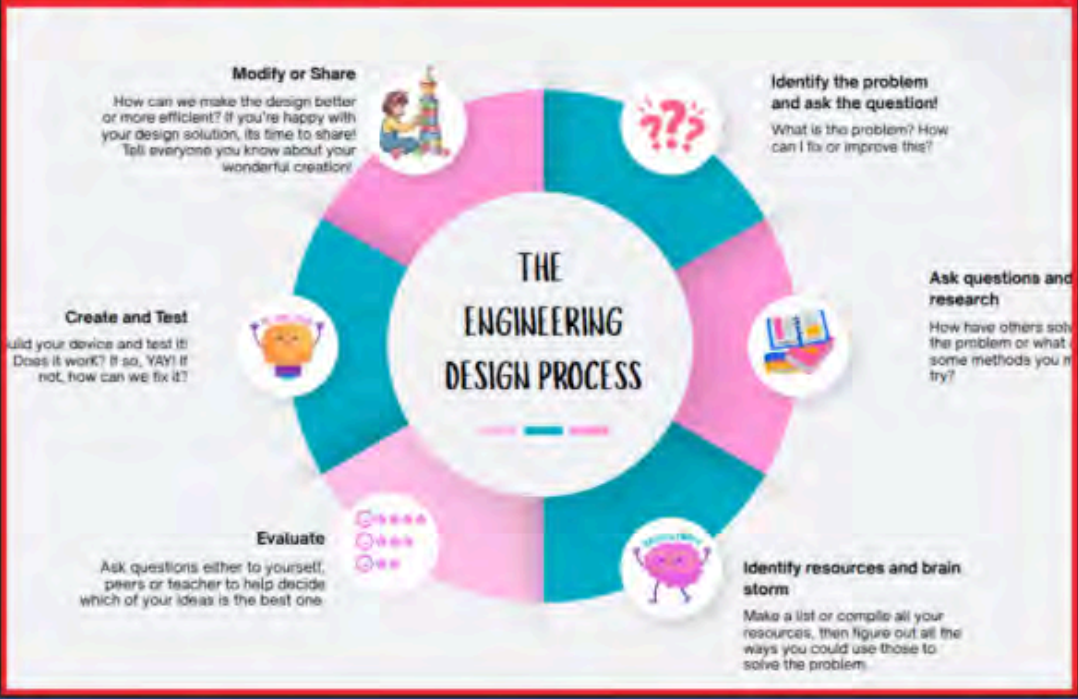
Light Reflection Challenge



Name:

CLASSROOM DESIGN PROCESSS

- IDENTIFY THE PROBLEM AND ASK HOW YOU CAN HELP?
- ASK QUESTIONS AND RESEARCH
- IDENTIFY RESOURCES AND BRAINSTORM
- EVALUATE
- CREATE AND TEST
- MODIFY OR SHARE



IDENTIFY THE PROBLEM AND ASK THE QUESTION



What is our mission?

How can a lighthouse help Bella?

The Challenge

In your group, build a freestanding lighthouse that shines a light for Bella to make it home in the dark using only the materials you purchased from the Lighthouse Repair Shop within your $10 budget. Make sure your lighthouse:

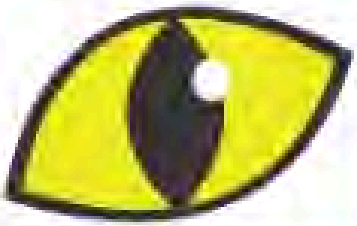
1. Is freestanding, taller than 6" and no more than 12".
2. Uses at least 1 reflective material to shine the light towards Bella
3. Stay within the $10 budget from the lighthouse keeper and use the budget sheet to record the item's price, total spent, and how much change was received from the shop.
4. Use all tools/materials safely

Brainstorm: Sketch some possible design ideas

HOW DOES LIGHT REFLECT?

LABEL THE DIAGRAM TO SHOW HOW LIGHT REFLECTS





SHOPPING LIST

MATERIALS	PRICE	HOW MANY PURCHASED	TOTAL	
Aluminum Foil Sheet (6X6)	$1			
Plastic Container	$1			
Plastic Bottle	$1			
Cardborad (12X12)	$1			
Paper Towel Roll	$1			
Pipe Cleaners (3)	.50c			
Craft Sick (3)	.50c			
Construction Paper	.50c			
Paper Plate	$1			
Straw	.50c			
Compact Mirror	$2			
Large Gem	$2			
Sparkly item	$2			
Light Source	$2			
Tape	$2			
		GRAND TOTAL		

Light Reflection Challenge

Materials:

Make a list of materials used

Lighthouse Recipt:

Write at 3 math equations that you used when shopping within your budget

Sketch and Evaluate

Method: Draw and label your lighthouse

Evaluate

Why did your team chose to build your lighthouse this way?



Final Results

Test Results: Does your lighthouse work?

Suggested Improvements:



What are some ways you could make your lighthouse better?

Final Questions

What was your favorite part of the challenge?

What are two things you learned during this challenge?

Good job! You saved Bella!

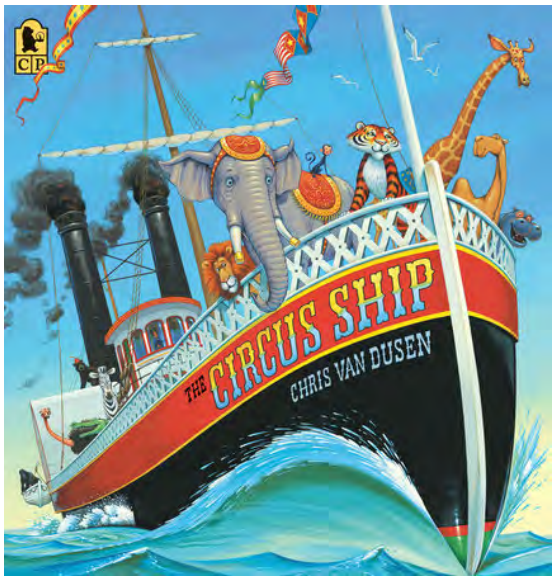


The Circus Animal Rescue

Teacher Guide

Book Title: The Circus Ship by Chris Van Dusen
Grade Level: 3rd Grade

Learning Objectives: By the end of the lesson we will be able to explain how balanced and unbalanced forces affect the movement of an object. We will be able to calculate and use the area to determine if their boat has enough space for all four circus characters. We will be able to evaluate their boat design based on the criteria and constraints of the challenge. We will be able to work with a group to plan, build, test, and improve an engineering design.



STEM Content Standards:
Science: 3-PS2-1 Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
Mathematics: 3.GM.5: Describe area as the number of unit squares that cover a plane figure without gaps and overlaps.
Standard for Technological and Engineering Literacy:
Standard 7: Design in Technology and Engineering Education
J. Evaluate designs based on criteria, constraints, and standards.

Vocabulary to explain to students before the start of lesson:

Force: A push or pull on an object

Balanced Forces: Forces that are equal and do not change the motion of an object

Unbalanced Forces: Forces that cause an object to change its motion

Motion: A change in the position of an object

Area: The amount of space inside a flat shape

Square Unit: A unit used to measure area

Criteria: Things a design must be able to do

Constraint: A limit or rule that must be followed

Evaluate: To decide how well something worked

Prototype: A model that is created and tested

Redesign: To make changes to improve a design

Introduction and Demonstration

Begin the lesson by reading *The Circus Ship* by Chris Van Dusen aloud to the class. While reading, stop at important parts of the story and ask students questions that make them think about the ship, the storm, and the forces acting on the animals.

Questions to ask while reading:

- Why do you think the ship is able to float even though it is carrying so many heavy animals?
- What forces do you think are acting on the ship during the storm?
- How do you think the wind and waves change the way the ship moves?
- What could make a boat tip over?
- What might engineers need to think about when designing a boat that carries heavy passengers?

Demonstrate before introducing the challenge:

Purpose:
To help students understand that a floating object can still be affected by outside forces like wind and waves without automatically sinking.

Materials:

- Clear bin or kiddie pool filled with water
- 1 unpeeled orange
- Leaf blower

Teacher Directions:

1. Place the unpeeled orange in the water and allow students to observe that it floats.
2. Ask students what they think will happen if a strong wind pushes against it.
3. Turn on the leaf blower and blow air toward the orange from the front.
4. Have students observe how the orange moves across the water but continues to float.
5. Repeat with the wind coming from the side.
6. Gently create small waves in the water and allow students to observe how the orange moves up and down with the waves.
7. Ask students to describe what changed and what stayed the same.

Explain to students: The orange stays floating because the water is pushing upward on it. This upward force is called buoyancy. The wind and waves can still push the orange and change its motion. The orange may move, turn, or rock, but it can continue to float. This is similar to what can happen to a boat. A boat may float, but strong wind and waves can still make it move or become unstable. Engineers have to think about both floating and stability when designing a boat.

Big Ideas:

1. Scientific Inquiry Requires Planning
2. Objects Move Depending on the Forces Acting Upon Them
3. Area Measures the Space Covered by a Shape
4. There are Multiple Solutions to an Engineering Problem
5. The Size and Shape of a Design Will Affect its Function

Essential Questions:

How does drafting a plan before we build help us create a more successful solution?
How do the forces acting upon an object affect the way it moves?
How can we calculate area and use it to determine how much space we need?
How can different designs solve the same problem?
How do the dimensions of an object affect the way that it works?

Scenario:
The circus animals were loaded up on the ship, ready to sail to the circus. The clear sky turned grey, and the waves began to grow in size. It was getting harder and harder for the captain to steer the ship, but the ringleader insisted he kept going. They HAD to make it to the show. All of a sudden there was a big "CRASH". The animals and circus crew flew into the water. How were they going to get to the circus now?

Challenge:
Using the materials provided to you, the our job is to build a boat that will be able to rescue the animals and transport them to the circus. The boat must be able to fit 3 circus animals and the ringleader (dimensions of figures below), and it must be able to float in the water. We will begin by sketching their design for their boat individually. Once the sketches are completed, we will get into groups of 3-4, and each student will present their design. Once all the designs have been presented to the group, we will compare each design and either pick the design they like the best or create a new design they think will be the most effective. Once the team has submitted their sketch of their design, they will have one afternoon to build their boat. They must only use the materials and tools found in the classroom (listed below), and they will have a budget of $20. Once the afternoon is complete, the teams are going to grab their boats, and the class will head outside to test their boats. Outside, we will gather around a kiddie pool, and each team will take turns presenting their designs and placing their boats in the water. Once their boats are in the water, we will be conducting 3 tests:

Test 1- Placing the boat in the calm water to see if it will float and hold all the animals.

Test 2- An outside force will be acting upon the boat. I will point a leaf blower at the kiddie pool to create waves and wind to see if the boat will still float. The wind will be coming head on towards the front of the boat.

Test 3- An outside force will be acting upon the boat. I will point a leaf blower at the kiddie pool to create wind and waves to see if the boat will still float. The wind will be coming at the side of the boat.

We will record their results for the three tests in their engineering notebooks, and brainstorm how they could possibly improve their design in the future.

Dimensions of characters:

Elephant (2in x 4in)
Lion (2in x 2in)
Monkey (1in x 1in)
Ringleader (2in x 1in)

Students can use any of these up to $20:

Materials:

- Popsicle sticks $2
- Plastic cups $2
- Tape $3
- Rubber bands $1
- Pipe cleaners $1
- Cardboard $2
- Yarn $1
- Bubble wrap $2
- Newspaper $1
- Egg cartons $2
- Paper towel tubes $1
- Bottle caps $1
- Sponge pieces $2
- Cling wrap $2
- Craft foam $4
- Plastic spoons $1

Tools:

- Ruler
- Small tape measure
- Hole punch
- Stapler
- Scissors
- Canary cutters
- Chomp saw
- Safety goggles

Resources:

- Textbook
- Science/math/engineering notebook
- Educational websites (.org, .edu, etc.)

Results: For students to have completed the design challenge, they must have created a boat with enough surface area to hold the 3 circus animals and the ringleader, and the boat must also float. Students will need to turn in sketches of their original design, the design they selected with their team, and calculations for the area of the figures going on the boat as well as the boat itself.

Limitations: Boundaries for this project include a budget, materials found inside the classroom, and an afternoon allotted to complete the project. There is no maximum size for the boat, however, it must have enough surface area to fit the 3 circus animals and ringleader listed above.

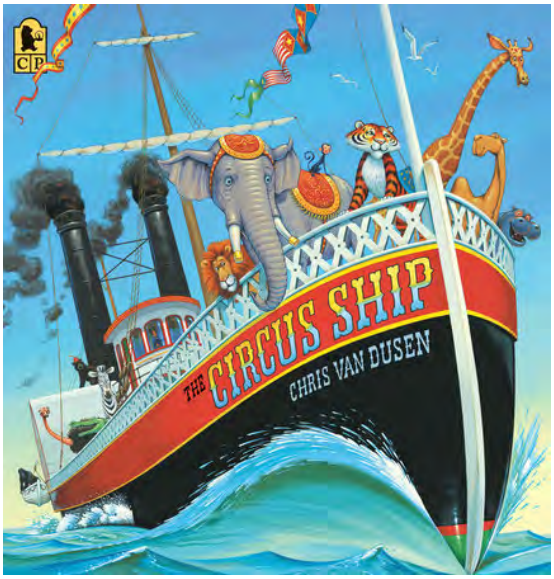
Criteria	4 – Excellent	3 – Good	2 – Developing	1 – Beginning
Science: Buoyancy & Forces	Clearly explains buoyancy and how wind and waves affect the boat using evidence from all tests.	Explains buoyancy and forces using some test results.	Shows some understanding but gives little evidence.	Shows little understanding of buoyancy or forces.
Science: Testing & Observations	Records and compares all 3 tests, explaining how forces affect movement.	Records all 3 tests and makes comparisons.	Records some results with limited comparisons.	Records little data or makes no comparisons.
Math: Area	Correctly calculates area and ensures all characters fit.	Most calculations are correct, and characters fit.	Some calculations are incorrect or space is limited.	Calculations are mostly incorrect or missing.
Engineering Design	Plans, builds, tests, and improves the boat using test results.	Follows the design process and suggests improvements.	Completes some steps but needs more testing or planning.	Shows little planning, testing, or improvement.
Criteria & Constraints	Meets all requirements, including budget, materials, size, and space.	Meets most requirements and stays within budget.	Meets some requirements but has several issues.	Does not meet most requirements.
Teamwork	Actively participates, listens, shares, and helps the group.	Participates and works well with others.	Sometimes participates but needs support.	Rarely participates or works with the group.

Design Journal:
We will utilize their engineering design journal to document their design process for their boat. First, we will analyze the problem and identify the criteria and constraints, including fitting all four figures, floating, using classroom materials, staying within the $20 budget, and completing the boat within the given time. We will then create an individual sketch of their boat and label the materials they plan to use. They will also calculate the area of the circus animals and ringleader to determine how much space their boat needs. After sharing their individual designs with their groups, we will compare their ideas and select or create a final group design. In the journals we will record the materials they plan to purchase and their total cost. After testing their boats, we will record whether their boat floated, whether all of the figures fit, and what forces they observed during the test. They will then evaluate their design and describe what they would change if they had another opportunity to build.

The Circus Animal Rescue

Student Guide

Big Ideas:



1. Scientific Inquiry Requires Planning
2. Objects Move Depending on the Forces Acting Upon Them
3. Area Measures the Space Covered by a Shape
4. There are Multiple Solutions to an Engineering Problem
5. The Size and Shape of a Design Will Affect its Function

Essential Question/s:

1. How does drafting a plan before we build help us create a more successful solution?
2. How do the forces acting upon an object affect the way it moves?
3. How can we calculate area and use it to determine how much space we need?
4. How can different designs solve the same problem?
5. How do the dimensions of an object affect the way that it works?

Scenario:

The circus animals were loaded up on the ship, ready to sail to the circus! The clear sky turned grey, and the waves began to grow in size. It was getting harder and harder for the captain to steer the ship, but the ringleader insisted he kept going. They HAD to make it to the show! All of a sudden there was a big “CRASH”. The animals and circus crew flew into the water. How were they going to get to the circus now?

Challenge:

Your challenge is to design and build a boat that can float in ocean waves while rescuing and transporting 3 circus animals and 1 ringleader to the circus.

Your boat must:

- Fit an elephant (2 in × 4 in)

- Fit a lion (2 in × 2 in)
- Fit a monkey (1 in × 1 in)
- Fit a ringleader (2 in × 1 in)
- Float in calm water
- Stay floating when wind and waves push against the **front** of the boat
- Stay floating when wind and waves push against the **side** of the boat
- Stay within the **$20 budget**
- Use only the materials and tools provided in the classroom

Can you design a boat that will keep everyone safe and make it to the circus?

Tools, Materials, and Resources:

Materials:

- Popsicle sticks $2
- Plastic cups $2
- Tape $3
- Rubber bands $1
- Pipe cleaners $1
- Cardboard $2
- Yarn $1
- Bubble wrap $2
- Newspaper $1
- Egg cartons $2
- Paper towel tubes $1
- Bottle caps $1
- Sponge pieces $2
- Cling wrap $2
- Craft foam $4
- Plastic spoons $1

Tools:

- Ruler
- Small tape measure
- Hole punch
- Stapler
- Scissors
- Canary cutters
- Chomp saw
- Safety goggles

Resources:

- Textbook
- Science/math/engineering notebook
- Educational websites (.org, .edu, etc

Results/Deliverables:

In order to complete the design challenge, you must:

- Build a boat with enough surface area to hold the 3 circus animals and the ringleader
- Build a boat that floats

What you are turning in:

- A sketch of your original design
- The design your team selected
- Calculations for the area of the figures going on the boat as well as the boat itself
- Data collected from the boat testing

Limitations:
Boundaries for this project include working in a team, a budget, materials found inside the classroom, and an afternoon allotted to complete the project. There is no maximum size for the boat, however, it must have enough surface area to fit the 3 circus animals and ringleader listed above.

Student Rubric:
Use this rubric while you work to check your understanding and make sure you are not missing any steps!

What am I checking?	4 – I Did It!	3 – Almost There	2 – Keep Working	1 – I Need Help
Science: Balanced/ Unbalanced Forces	☐ My boat floats and holds all 4 passengers in calm water, front waves, and side waves. ☐ I can explain that the waves are an unbalanced force that can push or move my boat.	☐ My boat floats and holds all 4 passengers in most tests. ☐ I can explain that waves can push or move my boat.	☐ My boat floats in some tests, but the waves cause problems. ☐ I am still learning how waves can push or move my boat.	☐ My boat does not float or hold all 4 passengers. ☐ I need help explaining how waves affect my boat.
Math: Area	☐ I correctly find the area of my boat and the animals. ☐ My boat has enough space for everyone.	☐ Most of my area measurements are correct. ☐ My boat has enough space.	☐ Some of my area measurements are correct. ☐ My boat may not have enough space.	☐ I need help finding area or making enough space.
Engineering Design	☐ I followed all the design steps. ☐ I made a good plan, tested my boat, and made improvements.	☐ I followed the design steps and made some improvements.	☐ I followed some of the design steps. ☐ I need more planning or testing.	☐ I did not use the design steps yet.
Requirements & Budget	☐ My boat meets all the requirements. ☐ I stayed under	☐ My boat meets most requirements. ☐ I stayed under	☐ My boat meets some requirements. ☐ I had a small	☐ My boat does not meet most requirements. ☐ I went over the

	the $20 budget. ☐ I used my materials wisely.	$20.	budget or material problem.	$20 budget.
Teamwork	☐ I shared materials, listened to others, shared ideas, and helped my team.	☐ I worked well with my team and participated.	☐ I helped my team sometimes, but I could participate more.	☐ I had trouble working with my team or participating

Directions:
Follow each step carefully as you work through the engineering process!

1. Listen to the story.
Your teacher will read *The Circus Ship* to the class. Make sure you are actively listening and thinking about the problem in the story!

2. Learn about forces.
After the story, we will use fruit to learn about balanced and unbalanced forces and how they can affect objects in water. Complete the table in your engineering design journal as you observe the lesson.

3. Design your boat.
Independently, sketch a boat design in your engineering notebook. Your boat must be able to:

- Float in water
- Carry 3 animals and 1 ringleader
- Withstand the unbalanced force of wind and waves

4. Join your team.
You will be placed into a team of 3–4 students.

5. Share your design.
Take turns presenting your boat sketch to your team. Explain how your design will meet the challenge.

6. Choose your team design.
Work together to choose the sketch your team wants to use as your boat design. You may also combine ideas from different sketches to create your final design.

7. Submit your design and plan your budget.
Turn in your team's selected sketch. Your team will receive a budget sheet to help you plan which materials you can utilize and afford.

8. Build your boat.
Use the materials, tools, and resources provided in the classroom to build your boat. Your team will have one afternoon to complete your boat.

9. Get ready to test!
When building time is complete, gather your boat, engineering notebook, and a pencil to bring outside. Get ready to see if your design can complete the challenge!

10. Test 1: Calm Water
Place your boat in the calm water.

Record in your engineering notebook:

- Did your boat float?
- Did it hold all 3 animals and the ringleader?
- What happened to your boat?

11. Test 2: Wind and Waves from the Front
Your teacher will use a leaf blower to create wind and waves moving toward the front of your boat.

Record what happens in your engineering notebook.

12. Test 3: Wind and Waves from the Side
Your teacher will use a leaf blower to create wind and waves moving toward the side of your boat.

Record what happens in your engineering notebook.

13. Reflect like an engineer!
After all three tests, look at your results and think about your design.

In your engineering notebook, answer:

- What worked well?
- What did not work well?
- How did the wind and waves affect your boat?
- What would you change to make your boat better?

CIRCUS SHIP BUDGET

MATERIALS LIST

Item	Picture	Cost	How much you can buy
Popsicle sticks		$2	1 pack (20 sticks)
Plastic cups		$2	5 cups
Tape		$3	1 roll
Rubber bands		$1	1 pack (20 bands)
Pipe cleaners		$1	1 pack (10 pipe cleaners)
Cardboard		$2	2 sheets
Yarn		$1	1 roll (10 ft)
Bubble wrap		$2	1 sheet
Newspaper		$1	10 sheets
Egg cartons		$2	1 carton
Paper towel tubes		$1	3 tubes
Bottle caps		$1	5 caps
Sponge pieces		$2	3 pieces
Cling wrap		$2	1 roll
Craft foam		$4	3 sheets
Plastic spoons		$1	5 spoons

TOOLS YOU CAN USE


Ruler


Tape Measure


Hole Punch


Stapler


Scissors


Canary Cutters


Chomp Saw


Safety Goggles

You can use these tools for free. They do not cost any money.

RESOURCES YOU CAN USE



The Circus Ship by Chris Van Dusen


Educational websites (.org, .edu, etc.)


Science/Math/ Engineering Notebook

You can use these resources for free. They do not cost any money.

BUDGET RULES

1. Your team has a budget of $20.
2. You can only buy the materials on the list.
3. You must follow the amount allowed for each item.
4. You can buy more than one type of item as long as you do not spend more than $20.
5. Tools and resources are free.
6. Plan your purchases before you start building.
7. If you change your mind, you must update your budget.

OUR TEAM BUDGET PLAN

Material	Price	How many will we buy?	Total Cost (price x amount)

Total Spent: $_____ Money Remaining: $_____





The Engineering Design Journal:

The Circus Animal Rescue

Engineering Design Process Journal

Name: _____

Team Name: _____

Team Members: _____

Part 1: Understand the Problem

What is our problem?

The circus animals need our help! We need to design and build a boat that can rescue 3 animals and 1 ringleader and get them safely to the circus.

What does our boat need to do?

Check each box.

☐ **Float in water**
☐ **Hold the elephant**
☐ **Hold the lion**
☐ **Hold the monkey**
☐ **Hold the ringleader**
☐ **Stay floating when waves push toward the front**
☐ **Stay floating when waves push toward the side**
☐ **Stay within the $20 budget**
☐ **Use only the materials provided**
☐ **Be completed in the time given**

What are the criteria?

Write two criteria for your boat:

1.

2.

What are the constraints?

Write two constraints for this project:

1.

2.

Part 2: Learn About Forces

What Did We Observe?

During our class investigation, we will observe what happens when forces act on an object in water.

Before the demonstration

What do you think will happen when a force pushes an object in water?

During the demonstration

What happened to the object?	What force caused it?
_____	_____
_____	_____

_____ _____
_ _

Vocabulary from today's lesson:

A force is:

A balanced force is:

An unbalanced force is:

Connect It to Our Boat

How could wind and waves affect our boat? What can we do to make sure our boat stays afloat when unbalanced forces are acting upon it?

Part 3: Imagine and Plan

My Boat Idea

Draw your first boat design below.

Be sure to show:

- **The shape of your boat**
- **Where the animals will go**
- **Where the ringleader will go**
- **Materials you might use**
- **Any special parts that will help your boat float or handle waves**

My First Design

[DRAWING SPACE]

Label Your Design

Materials I might use:

1. _____
2. _____
3. _____

Why did you choose this design?

_____

_____

How will my design handle the waves?

_____

_____

_____

Part 4: Use Math

We need to make sure our boat has enough space for everyone.

Find the Area of Each Character

Elephant

Length: 4 in.
Width: 2 in.

Area = _____ × _____ = _____ square inches

Lion

Length: 2 in.
Width: 2 in.

Area = _____ × _____ = _____ square inches

Monkey

Length: 1 in.
Width: 1 in.

Area = _____ × _____ = _____ square inch

Ringleader

Length: 2 in.
Width: 1 in.

Area = _____ × _____ = _____ square inches

Total Space Needed

Add all four areas:

_____ + _____ + _____ + _____ = _____ square inches

Our boat needs at least _____ square inches of space.

My Boat's Area

Length: _____ inches

Width: _____ inches

Area = _____ × _____ = _____ square inches

Does my boat have enough space?

☐ Yes

☐ No

How do you know?

Part 5: Share and Compare

Now share your design with your team.

One thing I like about my design:

One thing I like about a teammate's design:

How were the designs different?

How could different designs solve the same problem?

Part 6: Choose Our Team Design

As a team, choose one design or combine ideas to create a new design.

Our Team's Design

[DRAWING SPACE]

Why did our team choose this design?

What ideas did we combine?

How will our design meet the challenge?

Part 7: Plan Our Materials and Budget

You will be given this budget sheet to track your spending.



CIRCUS SHIP BUDGET

MATERIALS LIST

Item	Picture	Cost	How much you can buy
Popsicle sticks		$2	1 pack (20 sticks)
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Tape		$3	1 roll
Rubber bands		$1	1 pack (20 bands)
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Yarn		$1	1 roll (10 ft)
Bubble wrap		$2	1 sheet
Newspaper		$1	10 sheets
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Bottle caps		$1	5 caps
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Craft foam		$4	3 sheets
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TOOLS YOU CAN USE

Ruler, Tape Measure, Hole Punch, Stapler, Scissors, Canary Cutters, Chomp Saw, Safety Goggles

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BUDGET RULES

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5. Tools and resources are free.
6. Plan your purchases before you start building.
7. If you change your mind, you must update your budget.

OUR TEAM BUDGET PLAN

Material	Price	How many will we buy?	Total Cost (price x amount)

Total Spent: $_____ Money Remaining: $_____

Part 8: Build Our Prototype

A prototype is a model that we build and test.

Building Checklist

☐ **We followed our team design.**

☐ **We used only classroom materials.**

☐ **We stayed within our $20 budget.**

☐ **We made enough space for all four passengers.**

☐ **We worked safely.**

☐ **Everyone helped the team.**

Did we change anything from our original design?

☐ **Yes**

☐ **No**

If yes, what did we change?

Why did we make the change?

Part 9: Test 1 — Calm Water

Before the Test

What do you predict will happen?

Test Results

Did our boat float?

☐ **Yes**

☐ **No**

Did our boat hold all 4 passengers?

☐ **Yes**

☐ **No**

What happened to our boat?

What did we learn from Test 1?

Part 10: Test 2 — Waves From the Front

The wind and waves will push toward the front of the boat.

Before the Test

What do you predict will happen?

Test Results

Did our boat stay floating?

☐ **Yes**

☐ **No**

Did all 4 passengers stay in the boat?

☐ **Yes**

☐ **No**

Did the boat move?

☐ **Yes**

☐ **No**

What happened?

Think About Forces

The waves pushed against our boat.

Was this force balanced or unbalanced?

☐ **Balanced**

☐ **Unbalanced**

How do you know?

Part 11: Test 3 — Waves From the Side

The wind and waves will push against the side of the boat.

Before the Test

What do you predict will happen?

Test Results

Did our boat stay floating?

☐ **Yes**

☐ **No**

Did all 4 passengers stay in the boat?

☐ **Yes**

☐ **No**

Did the boat move?

☐ **Yes**

☐ **No**

What happened?

Think About Forces

The waves pushed against our boat.

Was this force balanced or unbalanced?

☐ **Balanced**

☐ **Unbalanced**

How do you know?

Part 12: Compare Our Test Results

Look at the results from all three tests.

Test	Did It Float?	Did It Hold Everyone?	What Happened?
Calm Water	☐ Yes ☐ No	☐ Yes ☐ No	_____
Front Waves	☐ Yes ☐ No	☐ Yes ☐ No	_____
Side Waves	☐ Yes ☐ No	☐ Yes ☐ No	_____

Which test was the hardest for our boat?

Why?

How did the direction of the waves affect our boat?

Part 13: Evaluate Our Design

What worked well?

What did not work well?

Did our boat meet all of the criteria?

☐ **Yes**

☐ **No**

If not, what did we need to improve?

Part 14: Redesign

Engineers do not give up when a design does not work. They use what they learned to make it better.

Redesign means to make changes to improve a design.

What would we change about our boat?

Why would this change make our boat better?

Draw Your Improved Design

[DRAWING SPACE]

Part 15: Final Reflection

1. How did wind and waves affect the motion of our boat?

2. What is an unbalanced force?

3. How did area help us design our boat?

4. Why can different designs solve the same problem?

5. How did the size and shape of our boat affect how it worked?

6. What did you learn about being an engineer?

Cool Spot for Hot Dog!

TEACHER GUIDE:

Title: Cool Spot for Hot Dog!
Book: HOT DOG
Grade Level: 2nd



STEM Content
Standards:
2-PS1-1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties
2-PS1-2 Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose

Mathematics:
2.DA.1 Use bar graphs, picture graphs, and line plots to organize and represent data, interpreting data with up to four categories. (2-LS2-2, 2-LS4-1)

Standard for Technological and Engineering Literacy:
STEL 7 – Design in Technology and Engineering Education.
STEL 7B: Demonstrate that design have requirements

Additional Standards:
4.CC.1.OL: Participate in collaborative conversations following class-created guidelines to expand upon conversations.

Big Ideas:

- Students will explore which materials work best for creating shade and keeping the shelter cool.
- Students will record and compare the temperatures inside and outside the shelter. Compare results from different materials
- Students will design a shelter that can stand on its own, provide shade, and help keep Hot Dog cool.
- Students will work together to identify a weakness in their shelter, make a change, and test their improved design.

Essential Questions:

- ➢ How can we design a shelter for Hot Dog that will protect him from the heat?
- ➢ How do different materials affect how hot or cool a space can be?
- ➢ How can we use the story to have collaborative conversations to complete the challenge?

Cool Spot for Hot Dog!

Scenario:

Hot Dog is miserable because the city is sooo hot. He travels to the beach to catch a break from the heat. Now imagine Hot Dog must stay another day outside in the city before he can get to the beach. You have the task of helping Hot Dog! You have been hired to create a small, portable shelter that gives Hot Dog a cooler place to rest.

Challenge:

Construct a small portable cooling shelter for Hot Dog using only the materials the teacher gives you. The shelter must stand on its own and provide shade. Teams will measure the temperature inside the shelter and compare it with the outside temperature. Students will measure the length, width, and area, making sure it stays within the guidelines. They will test and record their data. After testing they will identify one weakness and make a change.

Tools, Materials, and Resources:

Materials: Aluminum foil(3 per group), Plastic cups(5 per group), Tape, Scissors, Cardboard pieces(4 per group), packing materials
Tools: Scissors, rulers, thermometers, measuring tapes, pencils
Resources: Hot Dog Book, 3D print of Hot Dog for each group, student planning sheet, bar graph or picture graph template, design checklist with the shelter requirements

Content information:

Science:

Students will investigate different materials and describe them based on their observable properties. They will look at, touch, and compare materials to decide which one might work best for building a shelter that provides shade and helps keep Hot Dog cool. Students will test different materials and use what they observe to help make decisions about their shelter design.

Vocabulary:

- **Materials** – what something is made of
- **Property** – a characteristic of a material that we can observe
- **Describe** – to tell what something is like

Technology and Engineering (STEL):

Students will learn that engineers design solutions to solve problems. A good design has requirements that it needs to meet. Students will plan, build, test, and improve their shelters.

Vocabulary:

- **Design** – a plan for how something will be made.
- **Challenge** – a problem that needs to be solved.
- **Solution** – an idea or way to solve a problem.
- **Test** – to try something out to see if it works.
- **Improve** – to make something better.

Cool Spot for Hot Dog!

Mathematics:
Students will learn how to collect, organize, and represent data using graphs. For this STEM project, students will record the temperature inside and outside their Hot Dog shelter. They will compare the temperatures and use the information to create a simple bar graph. Students will practice reading the graph to identify which temperature is higher, lower, or if the temperatures are the same.

Vocabulary:

- **Data** – Information that we collect.
- **Bar graph** – A graph that uses bars to compare amounts.
- **Record** – To write down information or data.
- **Compare** – To look at two or more things to see how they are alike or different.

Results:

- ➔ Completed shelter for Hot Dog.
- ➔ Design Plan
- ➔ Data sheet with bar graph of their temperature
- ➔ Engineering Design journal
- ➔ PowerPoint presentation on challenge

Limitations:

- ➔ Only using the materials given by the teacher
- ➔ Each group (3-4 per group) will only have a certain amount of materials
- ➔ Shelter must fit within the guidelines of size (6inx6in)
- ➔ The shelter must stand on its own and provide shade for Hot Dog

Cool Spot for Hot Dog!

Hot Dog Cooling Shelter STEM Project Rubric				
Criteria	**1 – Beginning**	**2 – Developing**	**3 – Meets Expectations**	**4 – Exceeds Expectations**
Science: Materials & Properties (2-PS1-1)	Has difficulty describing the materials.	Describes some materials but needs help explaining their properties.	Describes and compares the properties of materials used.	Clearly compares 3 or more materials and explains which may work best for shade or cooling.
Science: Temperature Testing	Does not record or compare the inside and outside temperatures.	Records some temperatures but needs help comparing them.	Records and compares the temperatures inside and outside the shelter.	Accurately records, compares, and uses temperature results to explain how well the shelter works.
Math: Measurements & Graphs (2.DA.1)	Has difficulty measuring the shelter or recording data.	Completes some measurements or graph information with help.	Measures length and width, records temperature data, and makes a graph.	Completes measurements and creates an accurate graph that clearly compares the temperatures.
Engineering Plan & Design (STEL 7B)	Has little or no plan, and the shelter does not meet the requirements.	Makes a partial plan but needs help following the requirements.	Makes a plan and builds a shelter that stands on its own, provides shade, and meets size rules.	Makes a clear plan and builds a sturdy shelter that meets all requirements using the given materials.
Testing & Improving the Design	Does not test the shelter or make changes.	Tests the shelter but needs help finding a problem or making a change.	Tests the shelter, identifies a weakness, makes a change, and tests again.	Uses test results to make a thoughtful improvement and explains how the change helped.
Teamwork & Collaboration (4.CC.1.OL)	Has difficulty working with the group and needs frequent reminders.	Sometimes works well with the group but needs reminders to listen or take turns.	Shares ideas, listens to others, and takes turns during group work.	Consistently shares ideas, listens respectfully, takes turns, and helps the group solve problems.
Design Drawing & Plan	Drawing or plan is missing or does not show the shelter clearly.	Drawing shows part of the shelter but is missing labels or details.	Creates a labeled drawing that clearly shows the shelter design.	Creates a detailed, labeled drawing that clearly matches the finished shelter.
Data Sheet & Reflection	Data sheet or reflection is incomplete or missing.	Records some data but needs help explaining what happened.	Completes the data sheet and explains what worked and what needed improvement.	Clearly explains the results, what worked or did not work, and how the shelter was improved.

Notes for Teacher:

1. Read the Hot Dog story to introduce the project.
2. Put students into groups of 3–4.
3. Explain the rules and size limits before students start.
4. Go over the materials and vocabulary words.
5. Have students draw their shelter before building it.
6. Remind students to only use the materials given.
7. Help students measure their shelter and check the temperatures.
8. Have students record their data and make a graph.
9. Remind students to find one problem with their shelter, fix it, and test it again.
10. Walk around and help groups when needed.
11. Have each group show their shelter and explain what worked and what they changed.

Cool Spot for Hot Dog!

STUDENT GUIDE:



Big ideas:

1. Different materials have different properties.
2. Some materials work better for making shade.
3. We can measure and compare temperatures.
4. Engineers make plans, test ideas, and improve their designs.
5. Working together helps us solve problems.

Essential Questions:

★ How can we help Hot Dog stay cool?
★ Which materials work best for our shelter?
★ How can we make our shelter better?

Scenario:

Hot Dog is miserable because the city is sooo hot. He travels to the beach to catch a break from the heat. Now imagine Hot Dog must stay another day outside in the city before he can get to the beach. You have the task of helping Hot Dog! You have been hired to create a small, portable shelter that gives Hot Dog a cooler place to rest.

Challenge:

Your job is to design and build a small shelter to help Hot Dog stay cool.
Your shelter must:

- Stand up on its own.
- Provide shade for Hot Dog.
- Fit within the size limits your teacher gives you.
- Be made only with the materials your teacher provides.

You will test your shelter, record the temperatures, find one problem, and try to make your shelter better!

Cool Spot for Hot Dog!

🧰 Tools

These are the things you will use to build and test your shelter.

- ✂️ Scissors
- 📏 Rulers and measuring tapes
- 🌡️ Thermometers
- ✏️ Pencils

🏗️ Materials

Your teacher will give your team these supplies.

- Aluminum foil
- Plastic cups
- Tape
- Cardboard pieces
- Packing materials

📚 Resources

These will help you plan, build, and test your shelter.

- The Hot Dog book
- Your design journal

Results/Deliverables:

Your finished shelter for Hot Dog, ready to be tested! Your drawings, plans, measurements, temperature results, graph, and notes about the changes you made. Explain what worked, what did not work, and how your team improved the shelter to help Hot Dog stay cool.

Limitations:

1. Only using the materials given by the teacher
2. Each group(3-4 per group) will only have a certain amount of materials
3. Shelter must fit within the guidelines of size
4. The shelter must stand on its own and provide shade for Hot Dog



Engineering Design Journal

Name: _____ Date:_____

Activity Title:_____

Group Names:_____

Vocabulary

• Data	
• Bar graph	
• Record	
• Compare	
• Design	
• Materials	
• Describe	
• Property	
• Design	
• Challenge	
• Solution	
• Test	
• Improve	

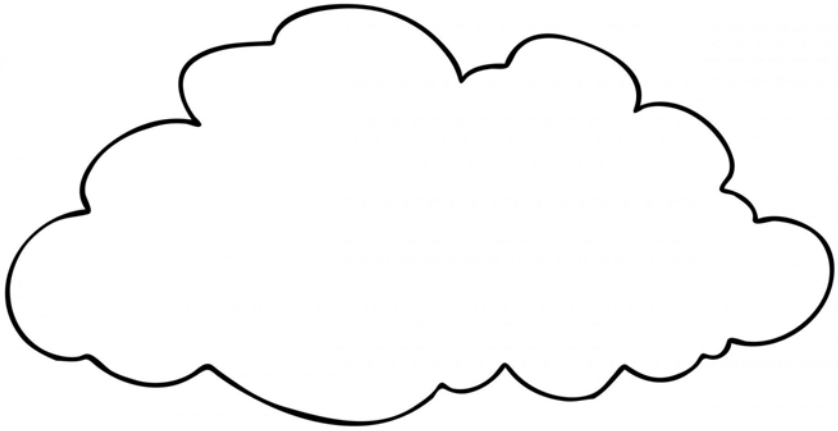
Cool Spot for Hot Dog!

Materials	Properties
- Aluminum foil	
- Plastic cups	
- Tape	
- Packing materials	
- Cardboard pieces	

What problem are we trying to solve?
How can we help Hot Dog stay cool in the hot city?



What ideas do you have for a shelter?
Draw your ideas below!



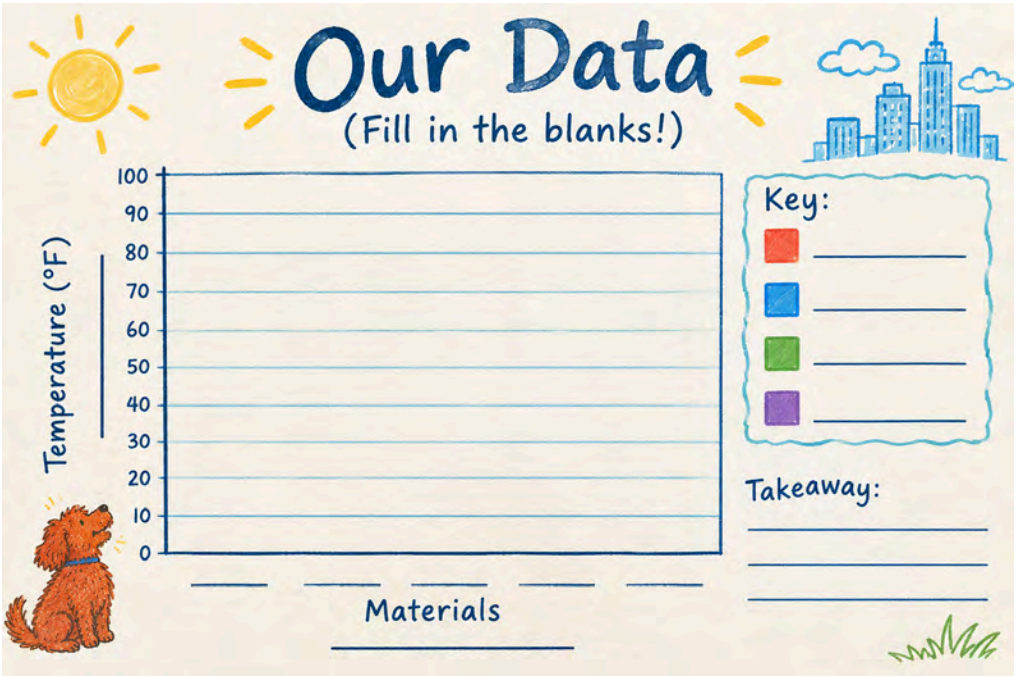
Draw and label your shelter design.

Draw down below



What is one problem with your shelter? What could you change to make it better?

Data Graph:



Group reflections:
Each group member: _____

1. What worked well when your group designed and built your shelter?

2. What challenges did your group face?

3. How did your group work together to solve problems?

4. What did your temperature tests tell you about your shelter?

5. What changes did your group make to improve your shelter?

7. What did your group learn about engineering and teamwork?

Cool Spot for Hot Dog!



Hot Dog's Cool Shelter

Design Challenge Rubric

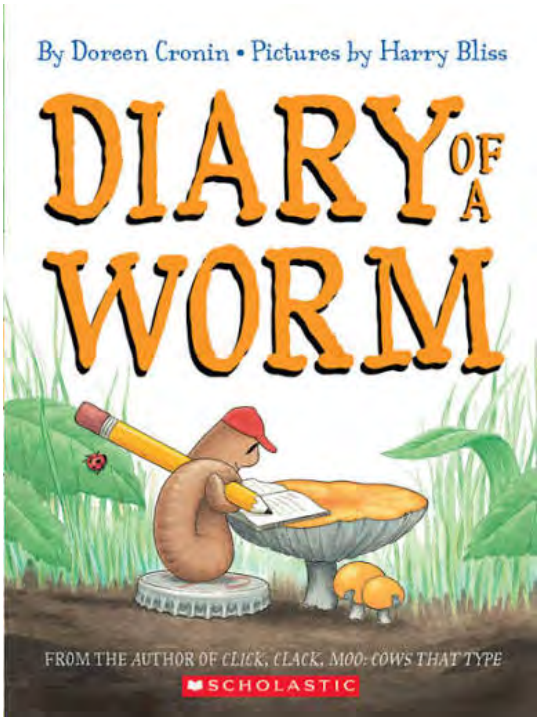
Build • Test • Improve



What I Am Being Graded On	1 – Beginning	2 – Almost There	3 – Meets Expectations	4 – Exceeds Expectations
My Plan	I need help making a plan or drawing.	My plan is missing some details or labels.	I made a clear plan and labeled my drawing.	I made a clear, detailed plan and labeled my drawing to show how my shelter will help Hot Dog stay cool.
My Materials	I need help identifying or describing the materials.	I can name some materials but need help explaining their properties.	I used the materials correctly and can tell about their properties.	I can explain how 3 or more materials helped my shelter work and describe their properties.
My Shelter Design	I need help designing my shelter.	My shelter has some parts but needs more planning.	My shelter stands on its own and provides shade.	My shelter stands on its own, provides shade, and uses materials thoughtfully.
Testing My Shelter	I need help testing my shelter.	I tested my shelter but need more information or details.	I tested my shelter and recorded the temperatures.	I tested my shelter, recorded and compared temperatures, and explained what I learned.
Improving My Design	I did not make changes or needed help improving my shelter.	I made a small change but need help explaining it.	I made a change to improve my shelter.	I made a change based on my test results and explained how it helped.
Working With My Team	I needed help working with my team.	I sometimes worked with my team but needed reminders.	I worked well with my team and shared the work.	I shared ideas, listened, took turns, and helped my team throughout the challenge.
My Design Journal & Reflection	My journal or reflection is mostly incomplete.	My journal or reflection is missing some information.	My journal and reflection explain what I did and how I improved my shelter.	My journal is complete, and my reflection explains what worked, what did not work, and how I improved my shelter.

Emma Garrison and Adalyn Staton

Worms Don't Have Legs



Big Ideas:

1. Using Patterns to Predict Outcomes

Observations, measurements, and patterns of an object's motion can be used to predict future motion.

2. Using Tools for Solutions

Tools, materials, and skills, when used safely, can help design solutions to problems.

3. Measuring to Assist in Design

Measuring lengths of objects using a ruler to the nearest half and quarter inch can help predict patterns of an object's motion

Essential Questions:

- How can observations, measurements, and patterns of an object's motion be used to predict future motion?
- What elements of a transportation device are needed to move the device from one spot to another?
- How can we use data to predict future motion of an object?
- How do measurements help to identify patterns?
- What tools can be used to craft a transportation device out of recycled and non-recycled materials?

Scenario:

In *Diary of A Worm* by Doreen Cronin, Worm and his friend Spider got into a fight. Spider told Worm that you needed legs to be cool, and started running to beat Worm in a race. Worm could not keep up, and lost the race. Spider and Worm plan to have a re-match, and Worm is determined to prove spider wrong and win the race. Today, you are an engineer who will help Worm win.

Challenge:

Let's help Worm win the race! Working in groups, you will design a transportation device for Worm to use in his re-match race against Spider. You will construct a transportation device made out of recycled materials and select other materials that you may purchase with a $15 budget. Students are encouraged to resource materials from home, but not required. Limit one recycled item per student.

Additionally, Worm needs to figure out how to predict how fast his transportation device will move before the race. He knows that Spider moves at 1ft per 2 seconds, and the entire length of the race track is 10ft. Once the transportation device is completed, students will test their device, record measurements, and use patterns to predict if the device will be able to beat Spider and win in the actual race. To win the race, the device must move faster than 1ft per 2 seconds. Students will test and race their transportation device with the teacher launch device (modified leaf blower) on a flat, even surface.

Tools, Materials, and Resources:

Materials Available for Purchase ***Budget: $15***	
Material	**Cost (Per 1)**
Masking Tape	(free)
Rubber Band	50 cents
Bottle Cap	50 cents
Craft Stick	$1
Tooth Pick	$1
Plastic Bottle	$1
Paint	$1
Cardboard (3 x 3)	$2
Plastic Straw	$2
Cardboard Tube	$3

Tools Available for Use	
Rulers	Safety Glasses/Goggles
Small Tape Measure	Hole Punch
Scissors	Crop-a-Dile

Results:

- ☐ A completed transportation device
- ☐ A completed data chart that clearly shows three trial runs and the length they traveled
- ☐ A completed engineer design journal with all the parts filled out

Limitations:

- ☐ $15 budget
- ☐ Must be 7x7 or smaller
- ☐ Must move faster than 1ft/2seconds

Assessment/ Evaluation:

Student Project Checklist

Name:
Date:

Before I turn In my Project:

- ☐ My device is 7x7 inches or smaller
- ☐ We stayed within the $15 budget
- ☐ We tested our device 3 times and recorded the data
- ☐ We have a completed chart with our trial data
- ☐ Our device is faster than 1ft per 2 seconds
- ☐ I have completed my design journal
- ☐ I have a written explanation of how I made my design, my testing results, and if my design could beat Spider in a race

Design Journal:

Name:_____

Team Members:

_____

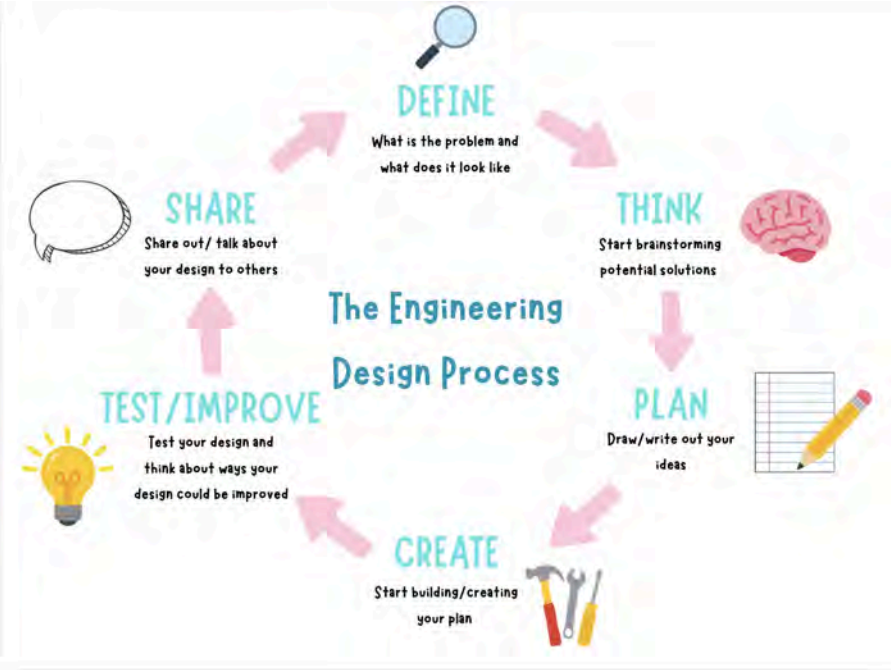
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Design Challenge:_____

_____

_____

_____



DEFINE:

What is the problem?

What does Worm need help with?

What does the transportation need to do?

What are our design requirements?

Our design must:

☐ Help Worm move
☐ Be made from available materials provided or recycled materials from home
☐ Be safe to use
☐ Move faster than Spider
☐ Work on a flat surface

THINK:

What could we build? Start brainstorming ideas!

Idea #1:

Idea #2:

Idea #3:

What materials would you need to use?

Your BEST idea:_____

PLAN:

Draw your design!

What materials are you bringing from home? (Limit 1 per person)

What materials will you buy at school with your budget of $15?

What tools do you plan to use?

Materials Available for Purchase ***Budget: $15***	
Material	**Cost (Per 1)**
Masking Tape	(free)
Rubber Band	50 cents
Bottle Cap	50 cents
Craft Stick	$1
Tooth Pick	$1
Plastic Bottle	$1
Paint	$1
Cardboard (3 x 3)	$2
Plastic Straw	$2
Cardboard Tube	$3
MATERIALS SELECTED: (Circle)	TOTAL COST:

CREATE:

Now start building. As you start building, use your plan that you made!

Building checklist:

☐ We used our plan.
☐ We used our materials and tools safely.
☐ Everyone helped our team.
☐ Our device is ready to test.

Draw out your completed design!

What did you change from your original plan while building?

TEST:

Test your design and predict!

Based on our tests and the pattern we noticed, do we predict that our device will beat Spider?

- ☐ Yes we will beat Spider!
- ☐ No, not yet

Trial Data Tables

(Record your results here!)

Name:
Date:

	Speed	Distance
Trial #1		
Trial #1		
Trial #3		

How far did your design go?

How long did it take?

What did you notice after you tested your design?

Did your device take the same amount of time each test?

IMPROVE:

What could we change to improve our design?

How will this improve your design?

How much money did you have leftover of your budget?

Draw your improved design!

SHARE: Tell us about your design!

Transportation device name:_____

One problem our team ran into was…

We solved it by…

Did we beat Spider?

- ☐ YES!
- ☐ No, we need to improve our design

Team Reflection:

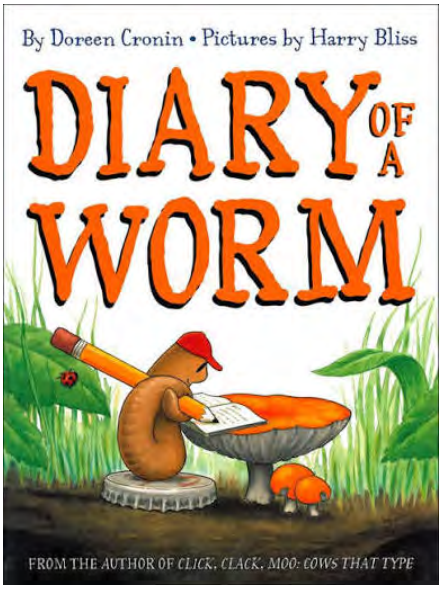
What did you do to help your team?

What would you do differently next time ?

TEACHER GUIDE

Worms Don't Have Legs (A Worm Racing Engineering Design Challenge)
Grade Level: 3rd
Book Title: Diary of A Worm, by Doreen Cronin

STEM Content Standards		
Science	3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
Mathematics	3.GM.4	Measure lengths of objects to the nearest half and quarter inch, using a ruler.
STEL	Standard 1: Nature and Characteristics of Technology and Engineering Grades 3-5 H	Design solutions by safely using tools, materials, and skills.



Scenario:
In *Diary of A Worm* by Doreen Cronin, Worm and his friend Spider got into a fight. Spider told Worm that you needed legs to be cool, and started running to beat Worm in a race. Worm could not keep up, and lost the race. Spider and Worm plan to have a re-match, and Worm is determined to prove spider wrong and win the race. Today, you are an engineer who will help Worm win.

Challenge:
Let's help Worm win the race! Working in groups, you will design a transportation device for Worm to use in his re-match race against Spider. You will construct a transportation device made out of recycled materials and select other materials that you may purchase with a $15 budget. Students are encouraged to resource materials from home, but not required.

Additionally, Worm needs to figure out how to predict how fast his transportation device will move before the race. He knows that Spider moves at 1ft per 2 seconds, and the entire length of the race track is 10ft. Once the transportation device is completed, students will test their device, record measurements, and use patterns to predict if the device will be able to beat Spider and win in the actual race. To win the race, the device must move faster than 1ft per 2 seconds. Students will test and race their transportation device with the teacher launch device (modified leaf blower) on a flat, even surface.

Big Ideas:

1. Using Patterns to Predict Outcomes
   Observations, measurements, and patterns of an object's motion can be used to predict future motion.
2. Using Tools for Solutions
   Tools, materials, and skills, when used safely, can help design solutions to problems.
3. Measuring to Assist in Design
   Measuring lengths of objects using a ruler to the nearest half and quarter inch can help predict patterns of an object's motion

Essential Questions:

- How can observations, measurements, and patterns of an object's motion be used to predict future motion?
- What elements of a transportation device are needed to move the device from one spot to another?
- How can we use data to predict future motion of an object?
- How do measurements help to identify patterns?
- What tools can be used to craft a transportation device out of recycled and non-recycled materials?

Tools, Materials, and Resources

Materials Available for Purchase ***Budget: $15***	
Material	**Cost (Per 1)**
Masking Tape	(free)
Rubber Band	50 cents
Bottle Cap	50 cents
Craft Stick	$1
Tooth Pick	$1
Plastic Bottle	$1
Paint	$1
Cardboard (3 x 3)	$2
Plastic Straw	$2
Cardboard Tube	$3

Tools Available for Use	
Rulers	Safety Glasses/Goggles
Small Tape Measure	Hole Punch
Scissors	Crop-a-Dile

Limitations:

- [ ] $15 budget
- [ ] Must be 7x7 or smaller
- [ ] Must move faster than 1ft/2seconds

Results:

- [ ] A completed transportation device
- [ ] A completed data chart that clearly shows three trial runs and the length they traveled
- [ ] A completed engineer design journal with all the parts filled out

Content:

Science: ***Observe regular movement to forecast what an object will do next***
Motion: The act or process of moving or changing position **Pattern:** Something that happens in a repeated and predictable way **Predict:** To say what is likely to happen in the future based on past evidence or observation **Measurement:** Finding the size, length, speed, or time of an object's motion using a tool (like a ruler or stopwatch

Math: ***Measure physical objects using a customary ruler***
Ruler: A flat tool marked with units of length used to measure lines or objects **Inch (in)**: A standard customary unit of length **Half Inch ($\frac{1}{2}$)**: One of two equal parts that make up a whole inch **Quarter Inch ($\frac{1}{4}$)**: One of four equal parts that make up a whole inch (also called a **fourth**)

STEL: ***Build tangible problem-solving skills using real-world tools and resources***
Tool: An instrument or device (like a wrench, scissors, or computer program) used to do a task or make work easier **Material:** A physical substance (such as wood, metal, plastic, or fabric) used to build or make things **Design Solution:** A created object, tool, process, or system built to solve a specific problem or meet a need **Safety:** Following rules and using caution to keep yourself and others free from harm while working **Prototype:** A simple or working model of a design used to test if an idea works

Teacher Rubric

Student/Group: _____
Total: _____ / 20 points

Criteria	4 — Exceeds Expectations	3 — Meets Expectations	2 — Approaching	1 — Beginning
Engineering Design & Challenge (STEL)	Design is creative, functional, safely constructed, and meets all challenge constraints.	Design is functional, safely constructed, and meets the challenge constraints.	Design is partially functional or meets some constraints.	Design is incomplete, unsafe, or does not address the challenge.
Measurement (3.GM.4)	Accurately measures and records lengths to the nearest ½ or ¼ inch and uses measurements effectively in the design.	Accurately measures and records lengths to the nearest ½ or ¼ inch.	Measurements contain some errors or are incomplete.	Measurements are mostly missing or inaccurate.
Motion, Data & Patterns (3-PS2-2)	Accurately records all 3 trials, identifies a clear pattern, and uses evidence to make a prediction about future motion.	Records all 3 trials, identifies a pattern, and uses the data to make a prediction.	Records some data and attempts to identify a pattern or make a prediction.	Provides little or no usable data, pattern, or prediction.
Results & Deliverables	Device, data chart, drawing, and journal are complete and clearly communicate results and learning.	Device, data chart, drawing, and journal are complete and communicate the results.	Some required deliverables are incomplete or unclear.	Several required deliverables are missing or incomplete.
Reflection & Explanation	Clearly explains the design, testing results, whether the device could beat Spider, and what was learned, using specific evidence.	Explains the design, results, race performance, and learning.	Provides a limited explanation of the design or results.	Provides little or no explanation of the design or results.

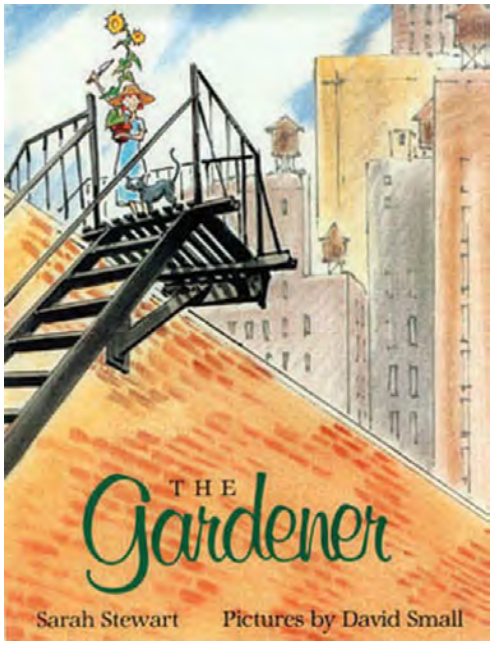
Engineering Design & Challenge: _____ / 4
Measurement: _____ / 4
Motion, Data & Patterns: _____ / 4
Results & Deliverables: _____ / 4
Reflection & Explanation: _____ / 4

Total: _____ / 20

Teacher Comments:

Ally Bernas & Hailey Mayse
Teacher's Guide
3rd Grade

The Great Garden Rescue Design Challenge!



Scenario:
Lydia Grace has created a beautiful garden on the roof of Uncle Jim's bakery, but there is a problem! Strong winds on the rooftop could knock over her plants and damage her beautiful garden. Your team of engineers has been hired to design a structure that protects Lydia's plants from the wind while still allowing the plants to receive proper sunlight and water.

Standards:
Science: (3-LS4-4) Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
Mathematics: (3.GM.B.5) Describe area as the number of unit squares that cover a plane figure without gaps and overlaps.
STEL: Standard 7: Design in Technology and Engineering Education: STEL-7I: Apply the technology and engineering design process.

Big Ideas:
Science: Changes in an environment can affect the plants and animals that live there, and solutions can be designed to help organisms survive these changes.
Mathematics: Area helps us measure and understand the amount of space available for designing and solving real-world problems.
STEL: Engineers use the design process to create, test, and improve solutions to real-world problems.

Essential Questions:

1) How can changes in an environment affect living things, and how can we design solutions to help?
2) How can engineering help us solve real-world problems?
3) How do our choices and limitations influence the way we design solutions?

Challenge:
After reading *The Gardener* by Sarah Stewart, your team has been asked to help protect Lydia's rooftop garden from strong winds!
Your challenge is to design and build a structure that protects Lydia's plant from the wind while still allowing it to receive sunlight and water.

Your design must:

- Fit inside the 20 cm × 15 cm rooftop garden space.
- Keep the plant standing during the wind test.
- Allow sunlight to reach the plant.
- Allow water to reach the plant.
- Cost no more than $15.

Before you build, measure the garden space and find its area. Then, work with your group to brainstorm ideas, draw a plan, and choose materials from the class material store. Be sure to keep track of your spending!

After building, your team will test your design, make improvements if needed, and test it again. At the end, you will share your final design and explain how it protects Lydia's garden.

(Teacher's Note: Students will work in small groups to design and build a structure that protects Lydia's rooftop garden from wind while still allowing the plant to receive sunlight and water!

- Give each group a model rooftop with a 20 cm × 15 cm garden space and a model plant.
- Have students measure the garden space and calculate its area before designing.
- Give each group a $15 budget and material price list. Students must plan their purchases and stay within budget.
- Students will brainstorm, draw a design, purchase materials, and build their structure.
- Test each structure for 10 seconds using a classroom fan placed the same distance from each design.
- Use a flashlight and spray bottle to check that sunlight and water can still reach the plant.
- yAllow students to make improvements and retest their designs while remaining within the $15 budget.
- Have each group present its final design and explain how it protects the plant and meets the challenge requirements.

Teacher-provided materials: classroom fan, ruler/measuring tape, spray bottle, and flashlight.)

Materials:
$15 Budget

Material	Costs
Craft Sticks	$0.25 each
Straws	$0.25 each
Pipe Cleaners	$0.25 each
Construction paper/cardstock	$0.50 per sheet
Mesh/tulle	$1.00 per piece
Masking tape	$0.50 per 30cm
Cardboard	$1.00 per piece
String/yarn	$0.25 per 30cm
Aluminum foil	$0.50 per sheet
Plastic wrap	$0.50 per sheet

Tools: Scissors, Ruler, Pencil, Measuring Tape, Fan for wind test, Spray bottle for water testing, and Flashlight for sunlight testing!

Resources:

- *The Gardener* by Sarah Stewart
- Engineering design journal/planning sheet
- Information provided by the teacher about plant habitats, what plants need to survive, area, and the engineering design process

Content Information:
Science: Students will need to understand that when an environment changes, the plants and animals living there can be affected. Some environmental changes can make it harder for organisms to get what they need to survive. In this challenge, students will consider how strong winds on Lydia's rooftop create a problem for the plants in her garden. They will use what they know about plants' needs to design a solution and then use evidence from their testing to make a claim about how well their solution protects the plants while still allowing them to receive sunlight and water.

Key Concept: Environmental changes and their effects on plants and animals; evaluating solutions to environmental problems.
Vocabulary:
Environment: The surroundings and conditions where a plant or animal lives.
Environmental change: A change in an environment that can affect the organisms living there.
Organism: A living thing, such as a plant or animal.
Survive: To continue living and having basic needs met.
Solution: A way to solve or improve a problem.
Claim: A statement that tells what you believe or have concluded based on information.
Evidence: Information or observations used to support a claim.
Merit: How well or successfully a solution solves a problem.
Needs: Things an organism must have to survive, such as water, sunlight, air, and space.

Mathematics: Students will need to understand that area tells us how much space is inside of a shape. They will use unit squares to understand and find the area of the designated garden space. Students will use the area of the garden to help them plan a design that fits within the space they are given.
Key Concept: Understanding and measuring area using unit squares without gaps or overlaps.
Vocabulary:
Area: The amount of space inside a flat shape.
Unit square: A square used to measure area.
Length: How long something is.
Width: How wide something is.
Square unit: A unit used to measure area.
Rectangle: A shape with four sides and four right angles.
Space: The amount of room available for something.

STEL: Students will need to understand the basic steps of the engineering design process. They will identify the problem, brainstorm different solutions, plan and build a design, test their design, and make improvements if needed. Students will use this process to create a solution that helps the plants survive in the rooftop garden.
Key Concept: Applying the engineering design process to identify problems, design solutions, build, test, and improve.
Vocabulary:
Engineer: A person who designs and creates solutions to problems.
Design: A plan for how something will be made or work.
Problem: Something that needs to be solved.
Solution: An idea or design that solves a problem.
Criteria: Things a design needs to do to be successful.
Constraints: Limits or rules that a design must follow.

Prototype: A model of a design that can be built and tested.
Test: To try out a design to see how well it works.
Improve: To make changes to a design so it works better.

Results/Deliverables: At the end of the challenge, each group will turn in:

- A completed rooftop garden design
- A completed engineering design journal
- A labeled drawing of their original design plan
- Their area calculations for the designated garden space
- Notes and results from testing their design
- Any changes they made to improve their design after testing
- A short group presentation where students show their final design, explain how it creates a good habitat for the plants, provide evidence for why the plants could survive there, and share what worked well or what they would change next time

Limitations:

- The rooftop garden design must stay within the 20 cm × 15 cm designated garden space.
- Students must stay within their $15 budget
- Students may only use the materials and tools provided by the teacher.
- Students will have a limited amount of each material, so they will need to use their supplies wisely.
- The design must allow the plants to still receive the sunlight and water they need to survive.
- Students must consider the needs of the plants and create a design that makes the rooftop a suitable habitat.
- Students must complete their design within the given class time.
- All group members must participate in the planning, building, testing, and presentation of the final design.

Assessment Rubric:

Criteria	4- Exemplary	3- Proficient	2- Developing	1- Beginning
Science: Habitat & Plant Survival ***(3-LS4-4)***	Makes a clear claim with detailed, evidence-based reasoning explaining how design choices adapt to environmental changes and fulfill plant survival needs (sunlight, water, soil space).	Explains how the design creates a suitable habitat and uses valid evidence to explain why plants can survive.	Identifies plant needs, but the explanation of how the habitat meets them lacks clear evidence or detail.	Mentions plants or habitat, but does not explain how the design supports plant survival or addresses needs.
Mathematics: Garden	Correctly calculates area using unit squares without gaps or overlaps;	Accurately finds and uses the area of the designated garden space	Calculates area with minor errors in unit square counting, or finds	Does not calculate area or uses incorrect concepts of area (e.g., confuses length

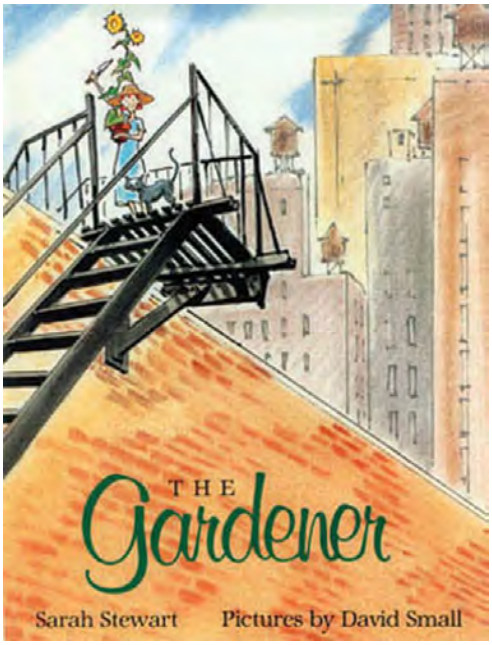
Area ***(3.GM.B.5)***	applies area measurements to optimize plant layout and spacing.	(counting/tiling unit squares without gaps or overlaps).	area but does not use it in layout planning.	or perimeter for area).
Technology & Engineering ***(STEL-7I)***	Thoroughly executes every phase of the engineering design process (Plan, Create, Test, Improve) and documents design iterations.	Follows all main steps of the engineering design process by planning, creating, testing, and improving the design.	Follows some steps of the engineering design process, but skips testing or lacks evidence of improvements.	Builds a design without evidence of planning, testing, or systematic improvement.
Final Design & Budget	The final design fully functions within spatial limits, stays under the $15 budget with complete cost accounting, and meets all plant needs.	Design fits entirely within designated boundaries, stays at or under $15, and provides essential plant needs.	Design exceeds spatial boundaries slightly, goes over the $15 budget, or misses a core plant need.	Design exceeds space constraints, breaks the budget significantly, and fails to provide basic plant needs.
Design Journal	Journal is systematically organized with detailed sketches, accurate calculations, test data logs, and reflective notes for every step.	Journal clearly records initial ideas, drawings, calculations, test results, and design improvements throughout the challenge.	Journal is incomplete; missing specific calculations, testing data, or key design iteration notes.	Journal entries are minimal, disorganized, or missing major components of the design process.
Presentation	Delivers an engaging, well-organized presentation; articulates design rationale using strong evidence from calculations and testing.	Clearly presents the final design and explains design choices using evidence from design journal work.	Presents the design, but explanations of choices are vague or lack supporting evidence from testing/math.	Presentation is unclear or incomplete, with little to no explanation of design choices.
Teamwork	All team members actively collaborate, share responsibilities equally, and support each other during planning, building, testing, and presenting.	Every group member participates and contributes meaningfully across planning, building, testing, and presentation.	Group participation is uneven; one or two members carry most of the work during building or presenting.	Minimal teamwork; members work in isolation or refuse to contribute to shared responsibilities.

Total Points: ___/28

Name:

Student Guide

The Great Garden Rescue Design Challenge!



Scenario: Lydia Grace has created a beautiful garden on the roof of Uncle Jim's bakery, but there is a problem! Strong winds on the rooftop could knock over her plants and damage her beautiful garden. Your team of engineers has been hired to design a structure that protects Lydia's plants from the wind while still allowing the plants to receive proper sunlight and water.

Big Ideas:

Science: Changes in an environment can affect the plants and animals that live there, and solutions can be designed to help organisms survive these changes.

Mathematics: Area helps us measure and understand the amount of space available for designing and solving real-world problems.

STEL: Engineers use the design process to create, test, and improve solutions to real-world problems.

Essential Questions:

1. How can changes in an environment affect living things, and how can we design solutions to help?
2. How can engineering help us solve real-world problems?
3. How do our choices and limitations influence the way we design solutions?

Challenge:

After reading *The Gardener* by Sarah Stewart, your team has been asked to help protect Lydia's rooftop garden from strong winds!

Your challenge is to design and build a structure that protects Lydia's plant from the wind while still allowing it to receive sunlight and water.

Your design must:

- Fit inside the 20 cm × 15 cm rooftop garden space.
- Keep the plant standing during the wind test.
- Allow sunlight to reach the plant.
- Allow water to reach the plant.
- Cost no more than $15.

Before you build, measure the garden space and find its area. Then, work with your group to brainstorm ideas, draw a plan, and choose materials from the class material store. Be sure to keep track of your spending!

After building, your team will test your design, make improvements if needed, and test it again. At the end, you will share your final design and explain how it protects Lydia's garden.

Limitations:
Remember these rules while designing:

- Your structure must fit inside the 20 cm × 15 cm garden space.
- Your team has a $15 budget. Spend wisely!
- You may only use the materials and tools provided.
- You have a limited amount of materials, so use them carefully.
- Your plants must still be able to receive sunlight and water.
- Your structure should help protect the plants from the strong rooftop winds.
- You must finish your design during the time provided.

- Everyone on your team must help plan, build, test, improve, and present the design.

Materials:
$15 budget

Material	Costs
Craft Sticks	$0.25 each
Straws	$0.25 each
Pipe Cleaners	$0.25 each
Construction paper/cardstock	$0.50 per sheet
Mesh/tulle:	$1.00 per piece
Masking tape	$0.50 per 30cm
Cardboard	$1.00 per piece
String/yarn	$0.25 per 30cm
Aluminum foil	$0.50 per sheet
Plastic wrap	$0.50 per sheet

Tools: Scissors, Ruler, Pencil, Measuring Tape, Fan for wind test, Spray bottle for water testing, and Flashlight for sunlight testing!

Resources:

- *The Gardener* by Sarah Stewart
- Engineering design journal/planning sheet
- Information provided by the teacher about plant habitats, what plants need to survive, area, and the engineering design process

What you will turn in:
At the end of the challenge, your team will:

- Turn in your completed rooftop garden structure.
- Turn in your completed Engineering Design Journal.

- Include a labeled drawing of your original design.
- Show your area calculations for the garden space.
- Record what happened when you tested your design.
- Record any changes you made after testing.
- Give a short group presentation showing your final design and explaining:
    - How well your solution protects the plants from the changing environment.
    - Evidence from your testing that shows how well your solution worked.
    - What worked well and what you would improve next time.

Grading Rubric:

What is being graded?	4 - Excellent	3 - Great Job	2 - Getting there	1- Keep Working
Science	We clearly explain how well our solution protects the plants from the environmental change and use evidence from our test.	We explain how our solution helps the plants and give some evidence	We give a simple explanation but need more evidence.	We need help explaining how our solution helps the plants.
Math	We correctly find and use the area of our garden space when planning.	We found the area with only a small mistake.	We need some help finding or using the area.	We need help finding the area of our garden space.
Engineering Design	We complete all the steps of the design process and use testing to improve our design.	We complete most of the design steps and make an improvement.	We complete some of the design steps.	We need help following the design process.
Final Design	Our design works, fits in the space, stays within our $15 budget, and allows the plants to receive sunlight and water.	Our design meets most of the challenge rules.	Our design meets some of the challenge rules.	Our design needs changes to meet the challenge rules.
Design Journal	Our journal clearly shows our ideas, drawings, math, budget, testing, and improvements.	Our journal includes most of our work.	Our journal is missing some important parts.	Our journal needs more information.
Presentation	We clearly explain our design, our test	We explain our design and most of our	We share some information about our	We need help explaining our design

	results, and what we learned.	results.	design.	and results.
Teamwork	Everyone participates, shares ideas, and works together.	Everyone participates most of the time.	Some team members participate more than others.	We need to work on participating as a team.

TOTAL POINTS ___/28

The Great Garden Rescue!

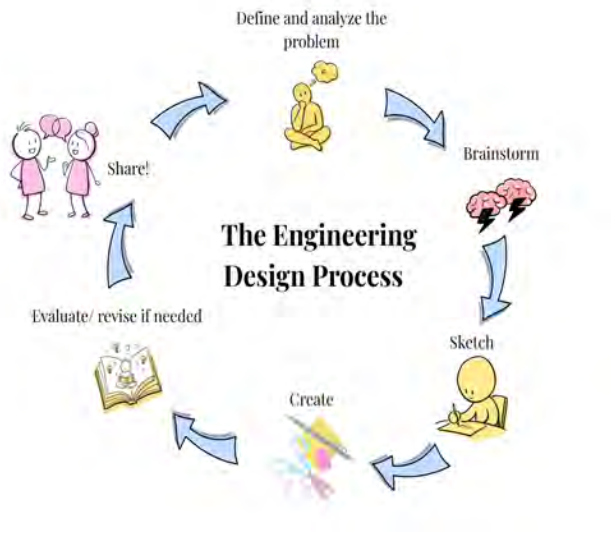
Engineering Design Journal



Name:

Identify Problem and Define Goal

Directions: Think about Lydia's rooftop garden and the problem she is facing. Answer the questions below!



1. What problem is Lydia having with her rooftop garden?

_____

_____

2. How could strong winds affect her plants?

_____

_____

3. What is your team's goal for this design challenge?

Our group's engineering goal is….

_____

_____

Identify Constraints

Think about: What rules or limits do we need to follow?
Directions: Check off each rule as your team moves through the challenge!

- ☐ Our structure must fit inside the 20 cm × 15 cm garden space.
- ☐ We cannot spend more than $15.
- ☐ We can only use the materials provided.
- ☐ Our plant must receive sunlight and water.
- ☐ Our plant must stay standing during the wind test.

Predict: What do you think the hardest rule or limit to follow is going to be and why?

Research & Learn

What can we learn to help solve the problem?

Directions: Think about what plants need to survive and how changes in their environment can affect them.

1. What do plants need to survive?

---

2. How might strong winds change Lydia's garden environment?

---

3. What could we do to help protect her plants?

---

4. How can changes in the environment affect the health and growth of plants?

---

5. How can designing a protective structure help plants survive while still getting the sunlight and water they need?

Brainstorm

What different solutions can we think of?

Directions: Work with your team to think of at least two different ways to protect Lydia's plants. Draw your ideas below.

Idea #1	Idea #2

Which idea does your team like best? Why?

Plan Your Design

Part A: Find the Area

Our garden is 20 cm long and 15 cm wide.

1. Draw or use a grid of unit squares to show the garden's area.
2. How many square centimeters cover the garden without gaps or overlaps?

Area = _____ square centimeters

Part B: Draw Your Final Plan

Draw and label the structure your team plans to build.

Plan Your Budget

Directions: Track what materials, how many of material, and the cost of each material here! Remember your group of engineers has a **budget** of $15

Material	Price	How Many?	Cost $
Craft Sticks	$0.25 each		
Straws	$0.25 each		
Pipe Cleaners	$0.25 each		
Construction paper/cardstock	$0.50 per sheet		
Mesh/tulle	$1.00 per piece		
Masking Tape	$0.50 per 30 cm		
Carboard	$1.00 per piece		
String/yarn	$0.25 per 30 cm		
Aluminum foil	$0.50 per sheet		
Plastic wrap	$0.50 per sheet		

Amount of budget used: $ _____

Build your Design

Use your plan to create a solution!

Directions: It's time to build! Work together and follow your design plan.

Our Building Checklist:

- ☐ We followed our design plan.
- ☐ We stayed within our $15 budget.
- ☐ Our structure fits in the garden space.
- ☐ Our plant can still receive sunlight and water.
- ☐ Everyone helped build our structure.

Did you change anything from your original plan while building?

Why did you make that change?

Test, Collect Data & Evaluate

Test it! What worked and what didn't?

Directions: Test your structure using the classroom fan for 10 seconds. Watch closely and record what happens!

Test Question	Yes or No
Did the plant stay standing for 10 seconds?	
Did the structure stay in place?	
Could sunlight reach the plant?	
Could the plant still receive water?	

What worked well during your test?

What did not work as well as you hoped?

What evidence did you collect about how well your design protects the plant?

Improve, Retest, & Share

Make it better! Test again and share what you learned!

Part A: Improve Your Design

1. What changes did your team make to improve your structure?

2. Draw or describe your improved design.

Part B: Retest

Did your plant stay standing during the second 10-second wind test?

☐ Yes ☐ No

Did your changes help? How do you know?

Get Ready to Present!

Complete these sentences to help your team prepare for its final presentation.

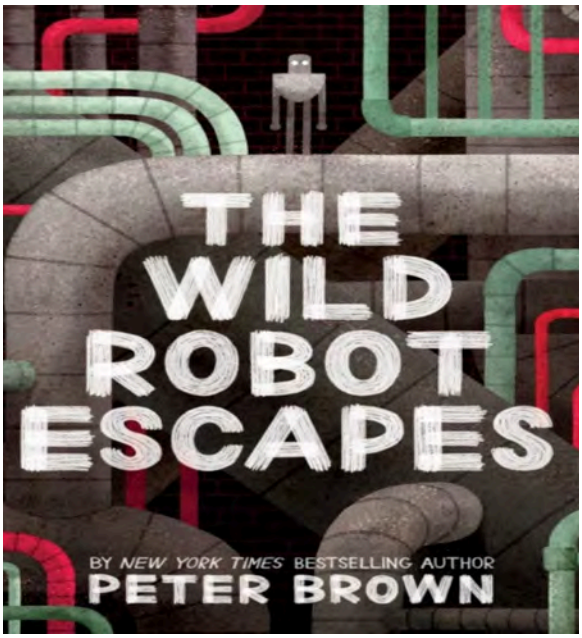
Our claim: We think our design is a good solution to help Lydia Grace protect Uncle Jim's garden because…

Our evidence: During our testing, we observed…

What we learned: If we could improve our design again, we would...

LITERATURE BASED CURRICULUM PROJECT

No way, No escape habitat!



THIRD GRADE - TEACHER GUIDE

STEM CONTENT STANDARDS

Science

3-LS4-3: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

Mathematics

3.GM.4: Measure lengths of objects to the nearest half and quarter inch, using a ruler.

Standard for Technological and Engineering Literacy

STEL Standard 2: Core Concepts of Technology and Engineering

Benchmark K: Describe requirements of designing or making a product or system.

BIG IDEAS

Measurement helps us design things with precision.

Living things survive best in habitats that meet their needs, while some may struggle to survive or may not survive at all.

Designing and making something means knowing what it needs to do, choosing the right materials, and making sure it works.

ESSENTIAL QUESTIONS

1. How did your team decide which materials and design ideas to use?
2. When you are measuring how will you know your measurements are correct?
3. How will you know your animals have all they need to survive within their habitats?

DESIGN BRIEF

Book: *The Wild Robot Escapes*

Title:

No Way, No Escape Habitat! Can You Stop the Great Farm Escape?

Scenario:

Imagine you are an engineer working on Roz's farm. The farm dad does not have enough time to rebuild the pasture habitat because he is busy taking care of the crops and his kids. There is just one problem. The cows, goats, and chickens have discovered that their current fence in their habitat is not strong enough to hold them, and they keep escaping!

Roz and the farm dad need your help before the animals wander too far away from the farm. You will work in a team of 2–3 engineers to brainstorm ideas, choose materials, create a design, and test your habitat. Remember that the cows, goats, and chickens have different needs and abilities. If your animals escape during testing, do not give up! Engineers learn from their mistakes and improve their designs.

CHALLENGE

Design and construct an animal habitat that safely holds a cow, goat, and chickens while still allowing Roz to enter and exit through a working opening or gate. Your team will use the materials provided to plan and build your habitat. Your pen must be at least 1 foot by 1 foot but cannot be larger than your classroom table. You will use rulers to measure parts of your design to the nearest half or quarter inch. Your team will have 75 Farm Bucks to spend on building materials. You will need to plan carefully and decide which materials are most important before you begin building. After building, your team will test the habitat to see if it keeps all three types of animals contained. You will record your results, make at least one improvement to your design, and test it again.

TESTING

Each team will use the same model cow, goat, chickens, and Roz figure during testing so the test is fair for everyone. The cow, goat, and chickens will be placed inside the completed habitat. Students will test whether the habitat keeps all of the animals contained. Students will also test the opening or gate to make sure Roz can enter and exit without taking apart the habitat. Teams will record whether their design met each requirement and identify any problems they noticed. Students will record their results before changing their designs. After the first test, each team will make at least one improvement based on its testing results. The team will then test the animal pen again to see if the change made the design better.

TOOLS, MATERIALS, AND RESOURCES

Each engineering team will receive 75 Farm Bucks to spend on building materials. Teams cannot spend more than 75 Farm Bucks, students will need to plan their design and decide which materials are most important before they begin building. Tools and resources are free and do not count toward the team budget.

MATERIALS

Material	Cost
Cardboard piece	10 Farm Bucks
5 Popsicle sticks	8 Farm Bucks
2 Wooden dowels	10 Farm Bucks
3 Straws	5 Farm Bucks
3 Pipe cleaners	5 Farm Bucks
12 inches of string or yarn	5 Farm Bucks
2 Index cards	4 Farm Bucks
1 Paper cup	5 Farm Bucks
1 Plastic cup	8 Farm Bucks
1 Small paper plate	5 Farm Bucks
2 Cardboard tubes	8 Farm Bucks
1 Small box	10 Farm Bucks
2 Rubber bands	3 Farm Bucks
1 Sheet of construction paper	3 Farm Bucks
1 Sheet of cardstock	4 Farm Bucks
1 Sheet of aluminum foil	5 Farm Bucks
12 inches of tape	5 Farm Bucks
Glue	5 Farm Bucks

Once a material has been cut, taped, glued, or changed, it cannot be returned. Teams will record their purchases and subtract the cost from their 75 Farm Bucks.

TOOLS

- Rulers
- Measuring tape
- Pencils
- Scissors
- Hole punch
- Stapler
- Teacher provided hand drill

RESOURCES

- *The Wild Robot Escapes* - Book
- Cow, goat, and chicken informational texts or articles
- Animal needs reference sheet
- Engineering Design Loop reference
- Design and planning worksheet
- Testing and recording sheet
- Ruler and measurement guide
- Student Engineering Design Journal

CONTENT INFORMATION

Science

Before beginning the challenge, students will learn about the needs of cows, goats, and chickens and how a habitat can affect an animal's ability to survive. Students will research the basic needs of each animal, including food, water, shelter, space, and protection from weather and other dangers. Students will consider how the farm environment could meet or fail to meet these needs. They will use evidence from their research to explain how their designed habitat could help the animals survive. They will also consider what could happen if important needs were not met.

Important Vocabulary

Habitat: The place where an organism lives and gets what it needs to survive.

Adaptation: A trait or behavior that helps an organism survive in its environment.

Shelter: A place that protects an animal from weather, predators, or other dangers.

Environment: The surroundings and conditions where an organism lives.

Survival: The ability of a living thing to stay alive and meet its needs.

Organism: A living thing.

Evidence: Information or observations that can be used to support an idea.

Technology and Engineering (STEL)

Students will learn how engineers identify problems and create solutions. Their animal habitat will have specific requirements that must be considered when designing and building. Students will

identify the requirements before beginning their design. They will create a plan, build their solution, test it, and determine whether the finished product meets those requirements. If it does not, students will make changes to improve the design.

Important Vocabulary

Engineer: A person who uses science, math, and creativity to solve problems.

Design: A plan for how something will be created and how it will work.

Requirement: Something a design must have or be able to do.

Constraint: A limit or restriction placed on a design.

Prototype: A first version of a design that is created for testing and improvement.

Test: To try a design to determine if it works.

Evaluate: To determine how well a design meets its requirements.

Improve: To make changes to a design so it works better.

Mathematics

Students will use rulers throughout the challenge to measure the materials used to construct their habitat. They will practice measuring to the nearest half and quarter inch. Students will record measurements on their original design plan and continue measuring as they construct their habitat. Students will also measure their completed animal habitat to make sure it meets the required minimum size of 1 foot by 1 foot.

Important Vocabulary

Length: The distance from one end of an object to another.

Inch: A standard unit used to measure length.

Half Inch: One half of an inch.

Quarter Inch: One fourth of an inch.

Measure: To find the length or size of something using a measuring tool.

Ruler: A tool used to measure length.

RESULTS

At the end of the design challenge, each team will turn in a completed animal habitat that safely contains the model cow, goat, and chickens and includes an opening that allows Roz to enter and exit. Each team will also turn in its original design plan. The plan will include a labeled drawing of the animal habitat, planned measurements, materials selected, and the team's Farm Bucks budget. Each student will complete an individual Engineering Design Journal. The journal will include research

about the animals, measurements, testing results, what worked and did not work, improvements made after testing, and a final reflection. The final reflection will explain the most successful part of the design, a problem the team had to solve, what the team changed after testing, and evidence explaining how the finished habitat helps meet the needs of the animals.

LIMITATIONS/CONSTRAINTS

- Students will work in teams of 2–3.
- Each team will have a maximum budget of 75 Farm Bucks.
- The animal habitat must be at least 1 foot by 1 foot.
- The completed habitat cannot be larger than the classroom table.
- Students may only use materials and tools provided by the teacher.
- The habitat must contain a model cow, goat, and chickens.
- The design must include an opening or gate that allows Roz to enter and exit.
- The habitat must stay together during testing.
- Students must include measurements to the nearest half or quarter inch.
- Students must complete the project within the amount of time provided.
- Each team must test its design.
- Students must record their first testing results before changing their design.
- Each team must make at least one improvement after testing.
- Each team must test its improved design again.
- All team members must participate.

ASSESSMENT/EVALUATION

Students will be evaluated using a 100 point rubric. The rubric directly assesses the Science, Mathematics, and STEL standards along with the engineering process and teamwork. Students will receive the rubric before beginning the challenge so they know what is expected.

No Way, No Escape! Student Rubric

What I Need to Do	4 – I Got It!	3 – Almost There!	2 – I Need a Little Help	1 – I Need More Practice
Science: Habitat & Survival (3-LS4-3)	I use evidence to explain how our habitat helps the animals survive and what could happen if their needs are not met.	I explain how our habitat helps the animals survive and give some evidence.	I name some things the animals need but need help using evidence to explain why.	I need help identifying and explaining what the animals need to survive.
Math: Measurement (3.GM.4)	I accurately measure to the nearest half and quarter inch and record my measurements.	Most of my measurements are accurate.	Some of my measurements are accurate but I need more practice.	I need help measuring to the nearest half and quarter inch.
Engineering: Requirements (STEL 2K)	I can identify the requirements and our final design meets all of them.	I can identify the requirements and our design meets most of them.	I can identify some requirements but our design is missing important parts.	I need help identifying and meeting the requirements.
Build & Test	Our fence keeps all animals inside, Roz can enter and exit, and we carefully record our testing results.	Our fence meets most of the testing requirements.	Our fence meets some requirements but still has problems.	Our fence does not yet meet the testing requirements or we did not complete our test.
Improve Our Design	We use our testing results to make a change and explain why our new design is better.	We make a change after testing and explain some of our thinking.	We make a change but need help explaining why.	We do not use our testing results to improve our design.

Engineering Journal	My journal clearly shows my research, plan, measurements, evidence, testing, and improvements.	My journal has almost all of the required information.	My journal is missing several important parts.	My journal is mostly incomplete.
Teamwork	I share ideas, listen to others, help build and measure, and participate in testing and improving.	I participate and work well with my team most of the time.	I participate sometimes but need reminders.	I need to participate more and work with my team.

Points

Science: Habitat & Survival (3-LS4-3): _____ / 20

Math: Measurement (3.GM.4): _____ / 20

Engineering: Requirements (STEL 2K): _____ / 20

Build & Test: _____ / 15

Improve Our Design: _____ / 10

Engineering Journal: _____ / 5

Teamwork: _____ / 10

Total: _____ / 100

DESIGN JOURNAL

Each student will complete their own Engineering Design Journal throughout the project. The journal will follow the Engineering Design Loop and give each student a place to show their individual understanding even though the building portion is completed as a team.

The journal will include:

- The problem/ challenge
- Requirements and constraints
- Research about cows, goats, and chickens
- Evidence about what the animals need to survive
- Proof of brainstorming

- A labeled original design sketch
- Planned measurements
- Materials selected
- Farm Bucks budget
- Measurements taken during construction
- First testing results
- What worked and what did not work
- Feedback from testing
- At least one planned improvement
- Second testing results
- Final design drawing
- Individual reflection

The journal will give students intentional practice with each target standard. Students will demonstrate 3-LS4-3 standard by using evidence to explain how the habitat affects the animals' ability to survive. Students will demonstrate 3.GM.4 standard by recording measurements to the nearest half and quarter inch. Students will demonstrate STEL 2K standard by identifying the requirements of the design and showing how their solution meets those requirements.

NOTES FOR THE TEACHER

Groups

-Students will work in teams of 2–3. Make sure each student has opportunities to plan, research, measure, build, test, and improve the design.

-Each student will complete their own Engineering Design Journal so individual understanding can still be assessed.

Before Starting

-Read or review the sections of *The Wild Robot Escapes* that connect to Roz and the farm. Introduce the problem and ask students what the farm animals might need in order to survive safely in their habitat.

-Review how to measure to the nearest half and quarter inch. Introduce the challenge requirements, constraints, 100 Farm Bucks budget, rubric, and Engineering Design Loop.

-Review important vocabulary before students begin.

Preparing Materials

-Set up the building materials like a small classroom store. Display the Farm Bucks prices from the Materials section where students can easily see them.

-Give each team 75 Farm Bucks. Teams must complete their initial plan and decide which materials they want before they begin building.

-Have model cows, goats, chickens, and Roz ready for testing. Every team should use the same models so testing is fair.

Planning

-Students should not immediately begin building. They will first research the animals, identify the problem, review the requirements and constraints, brainstorm possible solutions, draw and label their design, add measurements, choose materials, and complete their Farm Bucks budget.

-I should check each team's plan before students begin construction.

Building

-Remind students that the pen must be at least 1 foot by 1 foot but cannot be larger than their classroom table.

-Students should measure throughout the building process instead of waiting until the end. Ask students to compare what they are building to their original plan and record any major changes.

Testing

-Use the same model cow, goat, chickens, and Roz for every team.

-Place the animals inside the pen and test whether the habitat keeps them contained. Then test the gate or opening to make sure Roz can enter and exit without taking the habitat apart.

-Students should not immediately fix their design during the first test. Have them record what happened in their Engineering Design Journal first.

-After recording the results, teams will discuss what worked and what did not work. They will choose at least one improvement, make the change, and test the design again.

Questions to Ask Students

- What does this animal need to survive in its habitat?
    - What evidence supports that?
- Why did your team choose this material?
- What requirement are you working on?
- How do you know your measurement is accurate?
- What do you predict will happen during testing?
- What worked during your first test?
    - What did not work?

Assessment

-Give students the rubric before beginning the project so they understand what they are expected to demonstrate.

-Use the finished animal pen, Engineering Design Journal, design plan, testing results, student explanations, and observations of teamwork when assessing students.

-The final habitat does not have to work perfectly on the first attempt. Students will receive credit for identifying problems, using evidence from testing, and improving their solution.

Make sure each target standard is assessed:

3-LS4-3: Students use evidence to explain how a habitat can help or prevent an organism from surviving well.

3.GM.4: Students accurately measure to the nearest half and quarter inch.

STEL 2K: Students identify the requirements of the design and create a solution that attempts to meet those requirements.

Safety

-Review safe use of scissors, staplers, hole punches, and other classroom tools before building.

-Any hand drill should only be used with direct teacher supervision or by the teacher.

Schedule

Day 1: Read/review the book, introduce the problem, research animal needs, and introduce vocabulary.

Day 2: Review measurement, requirements, and constraints. Brainstorm, create design plans, and complete the Farm Bucks budget.

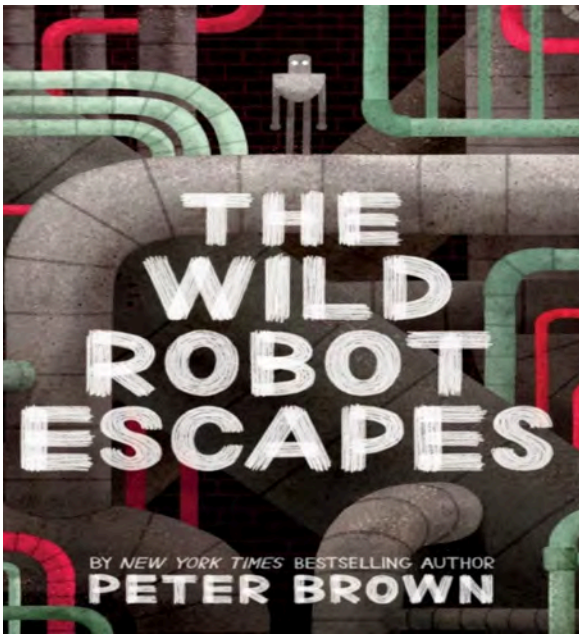
Day 3: Get materials, build, and measure the animal pens.

Day 4: Finish building, complete the first test, record results, and make improvements.

Day 5: Retest improved designs, share final solutions with the class, and complete individual reflections.

LITERATURE BASED CURRICULUM PROJECT

No way, No escape habitat!



STUDENT GUIDE

BIG IDEAS

Measurement helps us design things with precision.

Living things survive best in habitats that meet their needs, while some may struggle to survive or may not survive at all.

Designing and making something means knowing what it needs to do, choosing the right materials, and making sure it works.

ESSENTIAL QUESTIONS

1. How did your team decide which materials and design ideas to use?
2. When you are measuring how will you know your measurements are correct?
3. How will you know your animals have all they need to survive within their habitats?

DESIGN BRIEF

Book: *The Wild Robot Escapes*

Title:

No Way, No Escape Habitat! Can You Stop the Great Farm Escape?

Scenario:

Imagine you are an engineer working on Roz's farm. The farm dad does not have enough time to rebuild the pasture habitat because he is busy taking care of the crops and his kids. There is just one problem. The cows, goats, and chickens have discovered that their current fence in their habitat is not strong enough to hold them, and they keep escaping!

Roz and the farm dad need your help before the animals wander too far away from the farm. You will work in a team of 2–3 engineers to brainstorm ideas, choose materials, create a design, and test your habitat. Remember that the cows, goats, and chickens have different needs and abilities. If your animals escape during testing, do not give up! Engineers learn from their mistakes and improve their designs.

CHALLENGE

Design and build an animal habitat that safely holds a cow, goat, and chickens while still allowing Roz to enter and exit through a working opening or gate. Your team will use the materials provided to plan and build your habitat. Your pen must be at least 1 foot by 1 foot but cannot be larger than your classroom table. You will use rulers to measure parts of your design to the nearest half or quarter inch. Your team will have 75 Farm Bucks to spend on building materials. You will need to plan carefully and decide which materials are most important before you begin building. After building, your team will test the habitat to see if it keeps all three types of animals contained. You will record your results, make at least one improvement to your design, and test it again.

TOOLS, MATERIALS, AND RESOURCES

Each of your engineering teams will receive 75 Farm Bucks to spend on building materials. Your team cannot spend more than 75 Farm Bucks, you will need to plan your design and decide which materials are most important before you begin building. Tools and resources are free and do not count toward your team budget.

MATERIALS

Material	Cost
Cardboard piece	10 Farm Bucks
5 Popsicle sticks	8 Farm Bucks
2 Wooden dowels	10 Farm Bucks
3 Straws	5 Farm Bucks
3 Pipe cleaners	5 Farm Bucks
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1 Sheet of construction paper	3 Farm Bucks
1 Sheet of cardstock	4 Farm Bucks
1 Sheet of aluminum foil	5 Farm Bucks
12 inches of tape	5 Farm Bucks
Glue	5 Farm Bucks

Once a material has been cut, taped, glued, or changed, it cannot be returned. Your team will record your purchases and subtract the cost from your 75 Farm Bucks.

TOOLS

- Rulers
- Measuring tape
- Pencils
- Scissors
- Hole punch
- Stapler
- Teacher provided hand drill

RESOURCES

- *The Wild Robot Escapes* - Book
- Cow, goat, and chicken informational texts or articles
- Animal needs reference sheet
- Engineering Design Loop reference
- Design and planning worksheet
- Testing and recording sheet
- Ruler and measurement guide
- Student Engineering Design Journal

RESULTS

At the end of the design challenge, your team will turn in a completed animal habitat that safely contains the model cow, goat, and chickens and includes an opening that allows Roz to enter and exit. Your team will also turn in its original design plan. The plan must include a labeled drawing of the animal habitat, planned measurements, materials selected, and your team's Farm Bucks budget. You will complete an individual Engineering Design Journal. Your journal will include research about the animals, measurements, testing results, what worked and did not work, improvements made after testing, and a final reflection. The final reflection will explain the most successful part of your design, a problem your team had to solve, what your team changed after testing, and evidence explaining how the finished habitat helps meet the needs of the animals.

LIMITATIONS/CONSTRAINTS

- You will work in teams of 2–3.
- Each team will have a maximum budget of 75 Farm Bucks.
- The animal habitat must be at least 1 foot by 1 foot.
- The completed habitat cannot be larger than the classroom table.
- You may only use materials and tools provided by the teacher.
- The habitat must contain a model cow, goat, and chickens.
- The design must include an opening or gate that allows Roz to enter and exit.
- The habitat must stay together during testing.
- You must include measurements to the nearest half or quarter inch.
- You must complete the project within the amount of time provided.
- Each team must test your design.
- You must record your first testing results before changing your design.
- Each team must make at least one improvement after testing.
- Each team must test its improved design again.
- All team members must participate.

ASSESSMENT/EVALUATION

You will be evaluated using a 100 point rubric. The rubric directly assesses the Science, Mathematics, and STEL standards along with the engineering process and teamwork. You will receive the rubric before beginning the challenge so you know what is expected!

No Way, No Escape! Student Rubric

What I Need to Do	4 – I Got It!	3 – Almost There!	2 – I Need a Little Help	1 – I Need More Practice
Science: Habitat & Survival (3-LS4-3)	I use evidence to explain how our habitat helps the animals survive and what could happen if their needs are not met.	I explain how our habitat helps the animals survive and give some evidence.	I name some things the animals need but need help using evidence to explain why.	I need help identifying and explaining what the animals need to survive.
Math: Measurement (3.GM.4)	I accurately measure to the nearest half and quarter inch and record my measurements.	Most of my measurements are accurate.	Some of my measurements are accurate but I need more practice.	I need help measuring to the nearest half and quarter inch.
Engineering: Requirements (STEL 2K)	I can identify the requirements and our final design meets all of them.	I can identify the requirements and our design meets most of them.	I can identify some requirements but our design is missing important parts.	I need help identifying and meeting the requirements.
Build & Test	My habitat keeps all animals inside, Roz can enter and exit, and we carefully record our testing results.	My habitat meets most of the testing requirements.	My habitat meets some requirements but still has problems.	My habitat does not yet meet the testing requirements or we did not complete our test.
Improve Our Design	We used our testing results to make a change and explain why our	We made a change after testing and explain some of our thinking.	We made a change but need help explaining why.	We did not use our testing results to improve our design.

	new design is			
Engineering Journal	My journal clearly shows my research, plan, measurements, evidence, testing, and improvements.	My journal has almost all of the required information.	My journal is missing several important parts.	My journal is mostly incomplete.
Teamwork	I shared ideas, listened to others, helped build and measure, and participated in testing and improving.	I participated and worked well with my team most of the time.	I participated sometimes but needed reminders.	I needed to participate more and work with my team.

Science: Habitat & Survival (3-LS4-3): _____ / 20

Math: Measurement (3.GM.4): _____ / 20

Engineering: Requirements (STEL 2K): _____ / 20

Build & Test: _____ / 15

Improve Our Design: _____ / 10

Engineering Journal: _____ / 5

Teamwork: _____ / 10

Total: _____ / 100

DESIGN JOURNAL

You will complete your own Engineering Design Journal throughout this project. The journal will follow the Engineering Design Loop and give you a place to show your individual understanding even though the building portion is completed as a team.

NO WAY, NO ESCAPE!

The Wild Robot Escapes | Engineering Design Journal



MY ENGINEERING JOURNAL

Name:

_____

My design team:

_____

Our challenge:
Build a farm animal habitat that keeps the cow, goat,
and chickens safe while letting Roz enter and exit.

Our engineering question:
How can we build a safe pen that meets the animals' needs?

Draw or write one thing you already know about farm animals.

NO WAY, NO ESCAPE!

The Wild Robot Escapes | Engineering Design Journal



1. DISCOVER

What problem does Roz need us to solve?

What must our animal habitat be able to do?

What are our limits? Think about size, materials, and Farm Bucks.

My checklist:

- [ ] At least 12 inches by 12 inches
- [ ] No larger than our classroom table
- [ ] Keep the cow, goat, and chickens inside
- [ ] Let Roz enter and exit
- [ ] Spend no more than 75 Farm Bucks



2. IMAGINE

What do cows, goats, and chickens need to survive?

What did you learn from your animal research? Give evidence.

Sketch two possible ideas for your animal habitat.

Idea 1

Idea 2



3. DECIDE + PLAN

Choose your best idea. Draw and label your design.

What measurements will you use? Include half or quarter inches.

Why did you choose this design?



3. DECIDE + PLAN: FARM BUCKS

Our team has 75 Farm Bucks. Plan what you will buy.

Material	How many?	Cost

Total Farm Bucks spent: _____

Farm Bucks left: _____

Did we stay within 75 Farm Bucks? YES / NO



4. CREATE

What materials did you use to build your habitat?

Record three measurements to the nearest half or quarter inch.

Did you change anything while building? What and why?

Draw your completed first model.



5. TEST + ANALYZE

Test your habitat. Check what happened.

- [ ] Cow stayed inside the habitat
- [ ] Goat stayed inside the habitat
- [ ] Chickens stayed inside the habitat
- [ ] Roz could enter and exit
- [ ] Pen stayed together
- [ ] Pen met the size rule

What worked well? Use evidence from your test.

What did not work? What needs to change?



6. REDESIGN + 7. COMMUNICATE

What did your team change to improve the habitat?

After retesting, did your change help? How do you know?

How does your habitat help the animals survive? Use evidence.

What will you tell the class about your design?

One thing I learned as an engineer:

Operation Clear Waters:
Designing a Medical-Waste Collection Device

Last week, a surfer spotted what he thought was a giant jellyfish… but nope. It was a floating blob of **face masks**, tangled like spaghetti. A few days later, a fisherman reeled in what he swore was "**a wild sea-glove**." And yesterday, a seagull tried to steal a **plastic test kit** because it thought it was a snack. (It was not.)



You and your classmates have officially been recruited as **Junior Ocean Engineers**. Your mission is to design and build a real mechanism that can collect pandemic medical waste from the ocean *before* it becomes a seagull fashion accessory.

Big Ideas

- Human activities affect Earth's systems, and science-based design can reduce negative impacts.
- Good data starts with good questions; statistical thinking is essential for evidence-based design.
- Engineering design must consider sustainability, resource use, and waste reduction.

Essential Questions

- How do statistical questions change the designs we create?
- How can we design a solution that reduces human impact on our local environment?
- What data do we need to collect to understand the environmental problem we're trying to solve?

The Challenge

You and your fellow Junior Ocean Engineers will work in teams of **4** to invent and construct a mechanism to collect *floating* medical waste from the ocean. Your design must be made entirely of recycled material and must fit within a **6”x 6”x 6”** area and be able to store the waste in or on itself.

Tools, Materials, and Resources

For creating your mechanism, you may use the following:

Materials-

- **4** Plastic Bottles
- **2** Plastic Containers
- **2** Sheets of Cardboard
- **10** Zipties
- **1** recycled item from home (per group)

Tools-

- Hot Glue Gun
- Rulers
- Scissors
- Safety Glasses

Resources-

- Water Bin for design testing
- The Article: *“How much plastic from the pandemic ends up in the ocean?”*

Requirements and Limitations

- Must float or remain stable in water.
- Must be able to collect at least two types of “medical waste” (simulated masks, gloves, plastic pieces)
- Must not trap or harm imaginary marine life. (no tight nets or sharp edges)
- Must fit inside a 6”x6”x6” area.
- Must store collected waste in or on itself.
- Must include at least 1 kinetic feature. (moving part)

Results

- The design or invention you have created that demonstrates how your device collects pandemic-related medical waste from the ocean.
- Notes on peers' designs.
- Short reflection.

Student Checklist

Science

☐ I explained how pandemic waste affects ocean ecosystems.
☐ I described how my design helps reduce human impact.
☐ I used correct science vocabulary (ecosystem, pollution, currents, etc.).

Mathematics & Data

☐ I wrote a statistical question that has many possible answers.
☐ I collected data during testing (how much waste, how fast, etc.).
☐ I organized my data clearly (chart, table, or graph).
☐ I explained what my data shows about how well my design works.

Engineering & Technology

☐ My mechanism floats or stays stable in water.
☐ My design can collect at least two types of waste.
☐ I used recycled or safe materials.
☐ I tested my design and made improvements.
☐ My final design is safe for marine life.

Design Notebook / Documentation

☐ I included sketches and diagrams of my design.
☐ I wrote down my ideas, materials, and planning steps.
☐ I recorded my testing results and changes I made.
☐ I reflected on what worked and what I would improve.

Teamwork & Participation

☐ Everyone in my group helped with the project.
☐ We shared responsibilities fairly.
☐ We communicated respectfully and solved problems together.
☐ No one was left doing all the work.

Operation Clear Waters Teacher Guide **(6th Grade)**

Material: medical_waste_article.pdf

Content Standards:

Science

6-ESS3-3

Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

Mathematics

6.SP.1

Identify the difference between statistical and non-statistical questions and write simple statistical questions that allow variable responses.

Technological and Engineering Literacy

Standard 1 Benchmark J

Develop innovative products and systems that solve problems and extend capabilities based on collective needs and wants

RI.6.2 Examine a grade-appropriate informational text.

- Provide an objective summary
- Determine a central idea and how it is conveyed through particular details.

Big Ideas and Essential Questions:

Big ideas

- Human activities affect Earth's systems, and science-based design can reduce negative impacts.
- Good data starts with good questions; statistical thinking is essential for evidence-based design.
- Engineering design must consider sustainability, resource use, and waste reduction.

Essential Questions

- How do statistical questions change the designs we create?
- How can we design a solution that reduces human impact on our local environment?
- What data do we need to collect to understand the environmental problem we're trying to solve?

Scenario:

Last week, a surfer spotted what he thought was a giant jellyfish… but nope. It was a floating blob of face masks, tangled like spaghetti. A few days later, a fisherman reeled in what he swore was “a wild sea-glove.” And yesterday, a seagull tried to steal a plastic test kit because it thought it was a snack. (It was not.)

You and your classmates have officially been recruited as Junior Ocean Engineers. Your mission is to design and build a real mechanism that can collect pandemic medical waste from the ocean *before* it becomes a seagull fashion accessory.

Design Challenge:

Work in teams of (group size) to invent and construct a mechanism to collect *floating* medical waste from the ocean. Your design must be made entirely of recycled material and must fit within a 6”x6”x6” area and be able to store the waste in or on itself. Include one kinetic feature.

As you work, think about:

How will your design collect the waste?

What unintentional problems may your design create?

How do statistical questions shape the choices you make in your design?

Design Requirements

Your Design-

- Must float or remain stable in water.
- Must be able to collect at least two types of “medical waste” (fake masks, gloves, etc)
- Must not trap or harm imaginary marine life. (no tight nets or sharp edges)
- Must fit inside a 6”x6”x6” area.
- Must store collected waste in or on itself.
- Must include at least 1 kinetic feature. (moving part)

Useful Vocabulary:

Science

Marine debris**:** Trash that ends up in the ocean.
Microplastics**:** Tiny plastic pieces formed when larger plastics break down.
Ecosystem impact**:** How pollution affects plants, animals, and habitats.
Currents**:** Large movements of ocean water that carry debris long distances.
Human impact**:** How people's actions change the environment.

Technology and Engineering (STEL)

Buoyancy**:** The ability of an object to float.
Sustainability**:** Designing in ways that reduce harm to the environment.
Waste **reduction:** Strategies to reuse, recycle, or minimize trash.

Mathematics

Statistical question**:** A question that has many possible answers and requires data.
Data set**:** A collection of measurements or observations.
Variable**:** Something that can change or vary (like the number of masks collected).
Trend**:** A pattern in the data over time.
Analysis**:** Making sense of data to support decisions.

Results:

- The design or invention you have created that demonstrates how your device collects pandemic-related medical waste from the ocean.
- Notes on peers' designs.
- Short reflection.

Assessment / Evaluation:

Student Checklist

Science

☐ I explained how pandemic waste affects ocean ecosystems.
☐ I described how my design helps reduce human impact.
☐ I used correct science vocabulary (ecosystem, pollution, currents, etc.).

Mathematics & Data

☐ I wrote a statistical question that has many possible answers.
☐ I collected data during testing (how much waste, how fast, etc.).
☐ I organized my data clearly (chart, table, or graph).
☐ I explained what my data shows about how well my design works.

Engineering & Technology

☐ My mechanism floats or stays stable in water.
☐ My design can collect at least two types of waste.
☐ I used recycled or safe materials.
☐ I tested my design and made improvements.
☐ My final design is safe for marine life.

Design Notebook / Documentation

☐ I included sketches and diagrams of my design.
☐ I wrote down my ideas, materials, and planning steps.
☐ I recorded my testing results and changes I made.
☐ I reflected on what worked and what I would improve.

Teamwork & Participation

☐ Everyone in my group helped with the project.
☐ We shared responsibilities fairly.
☐ We communicated respectfully and solved problems together.
☐ No one was left doing all the work.

Category	Exemplary (9-10)	Proficient (7-8)	Developing (5-6)	Beginning (0-4)
Science Application	Clearly explains human impact on ocean ecosystems; connects design to environmental improvement with strong scientific reasoning.	Explains human impact and connects design to reducing pollution with mostly accurate science.	Shows partial understanding; explanation is vague or missing key scientific ideas.	Shows little or no understanding of human impact or scientific principles.
Engineering & Technology	Mechanism is creative, functional, stable in water, and collects multiple waste types; strong evidence of testing and revision; uses sustainable materials thoughtfully.	Mechanism works and collects some waste; shows testing and revision; uses appropriate materials.	Mechanism partially works or is unstable; limited testing or revision; materials used without clear purpose.	Mechanism does not function; little to no testing; unsafe or inappropriate materials.
Mathematics & Data	Statistical question is well-formed; data is accurate, organized, and clearly analyzed; explanation shows strong understanding of trends and effectiveness.	Statistical question is valid; data is mostly accurate; analysis is clear but may lack depth.	Statistical question is weak or unclear; data incomplete or inconsistently recorded; analysis minimal.	No statistical question; little or no data; no meaningful analysis.
Design Notebook	Thorough notes, detailed sketches, clear planning, and thoughtful reflections; shows full design process from start to finish.	Complete notes and sketches; planning is clear; reflections present.	Some notes or sketches missing; planning unclear; reflections brief or incomplete.	Minimal or missing documentation; unclear or absent design process.
Final Presentation	Presentation is organized, engaging, and clear; explains problem, solution, data, and revisions confidently; visuals are polished.	Presentation is organized and clear; covers main points; visuals support explanation.	Presentation is somewhat unclear or incomplete; visuals minimal or confusing.	Presentation missing major components; unclear explanation; visuals absent
Teamwork & Participation	All team members contribute equally; strong collaboration, communication, and shared responsibility.	Most team members contribute; collaboration generally positive.	Uneven participation; some collaboration issues.	One or two students do most of the work; poor teamwork or communication.

Questions to ask during lesson:

Kickoff / Introducing the Problem

- What surprised you most about pandemic medical waste ending up in the ocean?
- How do you think a face mask travels from a city to the middle of the ocean?
- Why should we care about medical waste in the ocean if we don't live near a beach?
- What kinds of animals might be affected by this type of pollution?
- If the ocean could talk, what do you think it would say about all this trash?

Science Understanding (6-ESS3-3)

- How does human activity change ocean ecosystems?
- What scientific evidence would help us understand the size of this problem?
- What environmental impacts might happen if we *don't* solve this issue?
- How could monitoring ocean waste help us design better solutions?

Brainstorming & Engineering Design

- What features would a good waste-collecting mechanism need?
- How can we make sure our design is safe for marine life?
- What real-world machines or tools could inspire your design?
- If you could only change one part of your design to make it better, what would it be?
- What's the simplest way your device could collect floating debris?

Math & Data (6.SP.1)

- What statistical question could help you measure how well your design works?
- What data do you need to collect during testing?
- How will you know if your device is "successful"?
- What patterns do you notice in your test results?

Materials & Constraints

- Given our limited materials, what's the smartest way to use them?
- Which materials will help your device float?
- Which materials will help your device collect debris?
- How can you stay within the size limits but still make your design effective?

Design Journal Prompts

- What did you learn from your first test?
- What part of your design changed the most?
- What problem did you run into today, and how did you solve it?
- What would you do differently if you had more time?

Teamwork & Collaboration

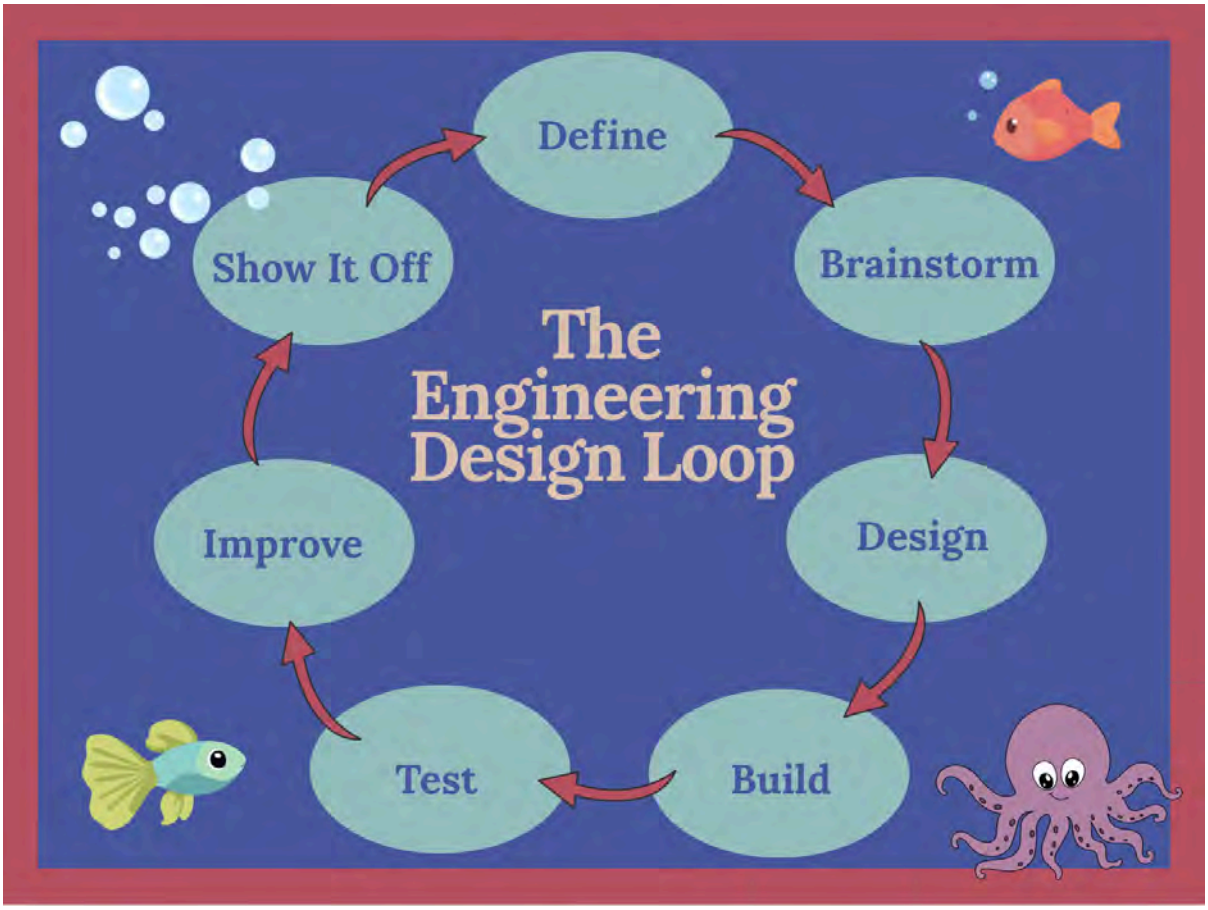
- How can you make sure everyone in your group has a role?
- What strengths does each team member bring to the project?
- How can you disagree respectfully while designing?
- What's one thing your team did well today?

Final Reflection / Presentation Prep

- What makes your design unique?
- How does your device help reduce human impact on the ocean?
- What evidence (data) shows your design works?
- What would you improve if you built a second version?

Operation Clear Waters: Design Journal

Name:_____



After Reading The Article:

What problem does the article describe, and what evidence shows why it matters?

_____

_____

_____

_____

_____

How can masks, gloves, and other pandemic waste harm ocean animals and their habitats?

_____

_____

_____

_____

_____

Based on what you learned, what features should your device have to collect floating medical waste and help keep the ocean clean?

_____

_____

_____

_____

_____

Plan Your Investigation:

What do you need to find out to determine whether your device works?

_____

_____

_____

_____

_____

What question could you answer by testing how much waste your device collects?

_____

_____

_____

_____

_____

What factors, such as the type of waste or how your device moves through the water, might affect how well it works?

_____

_____

_____

_____

_____

Design Your Solution:

What features did your team include to collect and store medical waste?

_____

_____

_____

_____

_____

Why did you choose these materials and features? What challenges or limitations did you consider when planning your design?

_____

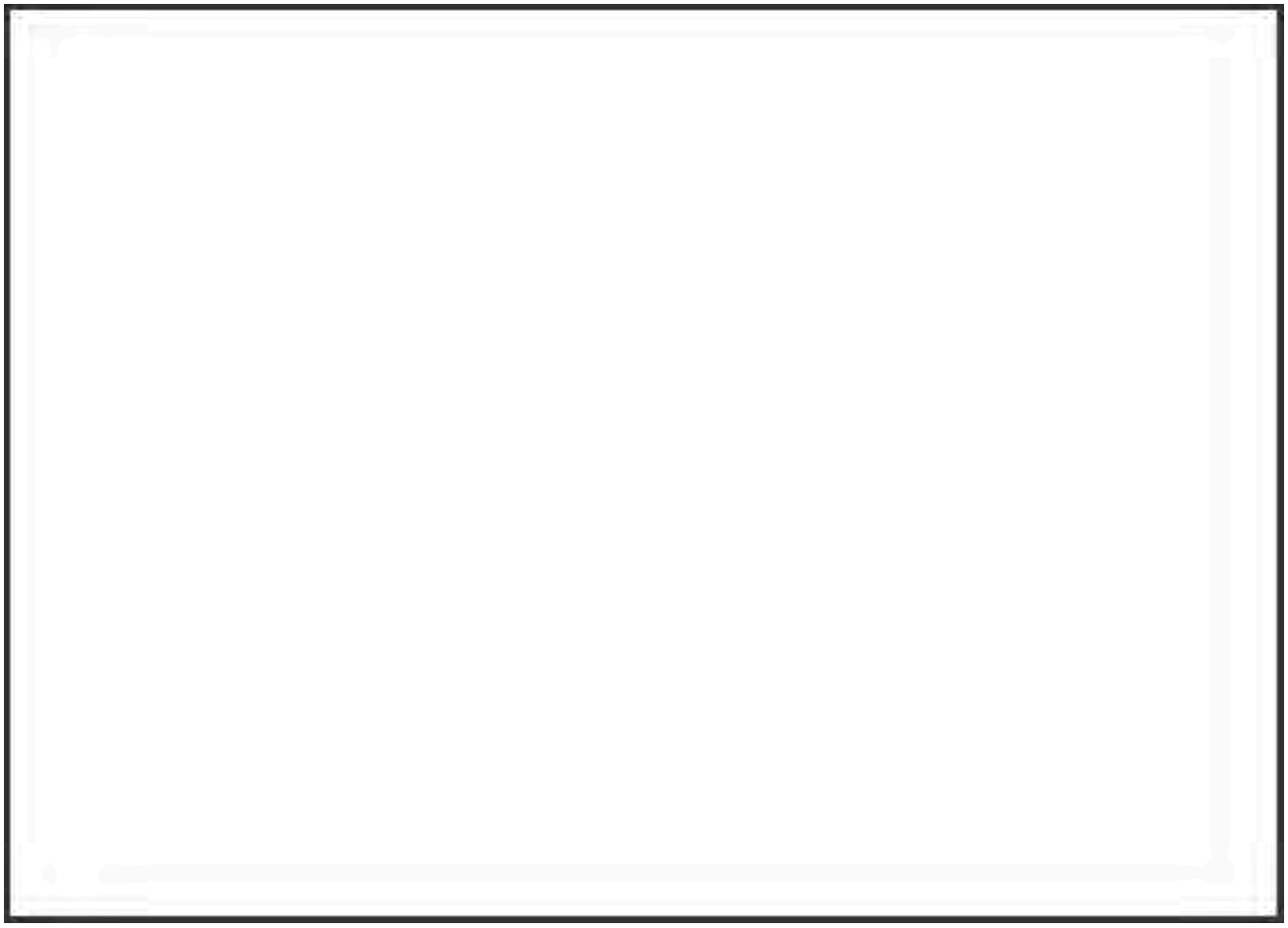
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Draw and label your original design:



Test and Record Findings:

Trial	Waste collected	What happened during testing?
1	_____	_____
2	_____	_____
3	_____	_____

What patterns or differences did you notice across your trials?

_____

_____

_____

_____

_____

How did your results compare with your original prediction?

_____

_____

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_____

Improve Your Design

What change did your team make, or would you make, to address it, and why?

_____

_____

_____

_____

_____

Evaluate Your Results

How successful was your final design at collecting waste? Use your data as evidence.

_____

_____

_____

_____

_____

What did your findings teach you about reducing human impact on the ocean?

_____

_____

_____

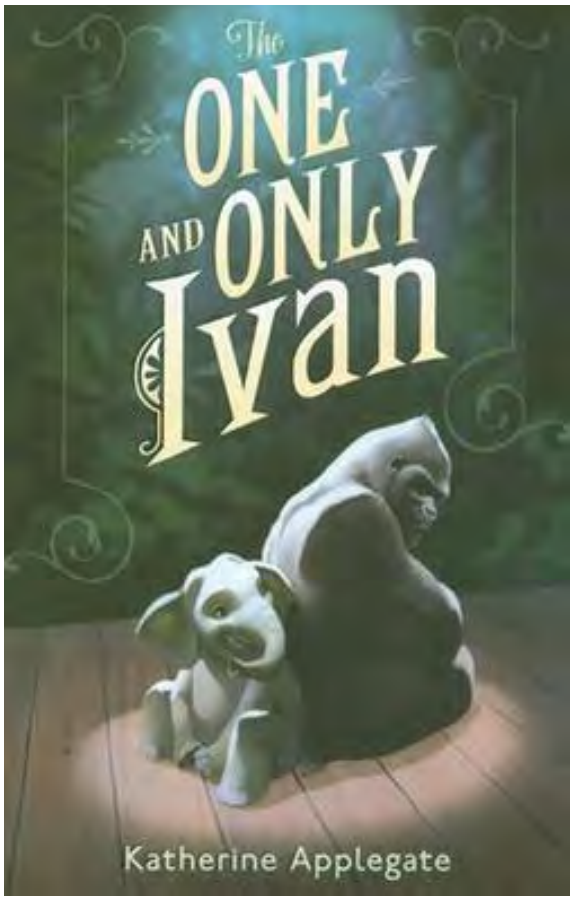
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Domain Oasis Engineering Design Challenge

Student Guide

Scenario



Ivan used to live in “Central Africa, in a dense rain forest.” He lived with 9 other silverback gorillas who taught him how to make “nests of branches and how to go vining from tree to tree.” He described his life as “a perfect life” until the humans came and his life of captivity at the Big Top Mall began.

Now, Ivan lives alone in a “domain made of thick glass and rusty metal and rough cement” with “a jungle scene that is painted on one of the domain walls,” instead of a “lush forest and (real) grass”.

Ivan wants to leave the Big Top Mall, to have a better life for not only himself but also for Ruby, the new baby elephant at the mall.

Big Ideas

- Animals require different environments for their needs to be met.
- The measurements each of the sides of a polygon can vary while being the same perimeter.
- We can create a budget and use coins to purchase desired materials.
- By communicating with a partner, we can effectively create a plan to meet a desired end goal.

Essential Questions

- What type of food does ___ animal eat, so would that make them an omnivore, carnivore, or herbivore?
- Where in the world does your animal live? What makes that area a good environment for that animal?
- What type of land features are in the area that your animal lives in?
- What plants and animals do we observe in different habitats? What is similar? What patterns do you notice?
- How can we measure and figure out the perimeter of a shape?
- Observing your peers’ projects did you create a shape the same or different measurements on each side?
- How many ways can you make a polygon that has a perimeter of 30in?
- How can we use addition and subtraction skills to determine the total amount of money left?
- How do the values of each coin differ?

- How can we effectively listen to our peers and voice our ideas in a kind and respectful way?

Challenge

Today your challenge is to work in pairs to build a domain oasis, with a 30in perimeter, for your assigned animal that they wouldn't want to leave. You will work with your partner to do background research and create a $2.00 budget to purchase supplies and materials.

Materials

Material	Price	How Many?	Total
Dowel Rod	25¢	____	____¢
Cardboard	15¢	____	____¢
Pipe Cleaner	10¢	____	____¢
Cotton Ball	5¢	____	____¢
Fabric/Felt	20¢	____	____¢
Craft Stick	10¢	____	____¢
Masking Tape	15¢	____	____¢
Balsa Stick	25¢	____	____¢
Styrofoam Packaging	20¢	____	____¢

Limitations and Requirements

Your completed domain must be:

- 30 inches in parameter.
- You have a limit of $2.00 for materials

Your available tools include:

- [ ] Rulers
- [ ] Canary cutters
- [ ] Scissors
- [ ] Safety glasses
- [ ] Saws
- [ ] C clamps
- [ ] Sanding sponges



Resources

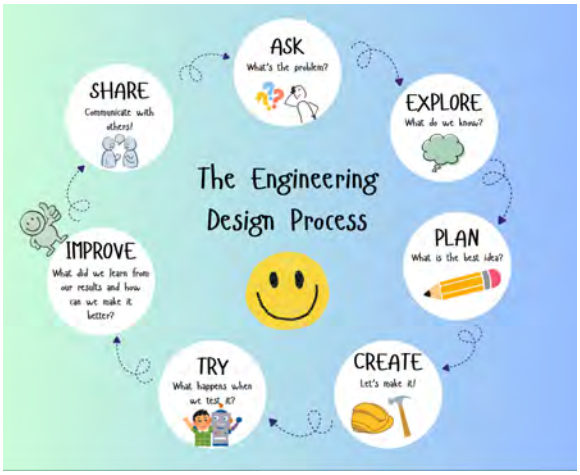
Books available from teacher for more information.

Rubric: ___/15

Criteria / Deliverable	1 - Needs Improvement	2 - Developing	3 - Meets Standard	Score
1. Design Journal & Research	• Journal is missing key design steps or background research. • No clear plan developed before building.	• Journal includes partial design steps and basic research on the animal. • Plan is incomplete or only partially followed.	• Journal documents the design process (research, sketch, build, reflect). • Research clearly identifies the assigned animal's habitat needs. • Includes a completed plan used to guide the build.	/3
2. Built Environment Domain & Teamwork	• Domain does not meet habitat needs of the assigned animal. • Partners did not collaborate effectively to build the domain.	• Domain meets some habitat needs, but key essential features are missing. • Partners collaborated occasionally but had difficulty sharing tasks.	• Domain provides a complete oasis that meets all habitat needs for the assigned animal. • Partners collaborated effectively as a team throughout the build.	/3
3. Perimeter Measurement	• Perimeter measurement is inaccurate or missing. • Domain perimeter deviates significantly from 30 inches.	• Perimeter calculation has minor errors or is close to 30 inches. • Shows partial understanding of finding the perimeter.	• Domain boundary measures exactly 30 inches in perimeter. • Correctly calculates and records the perimeter of the polygon shape.	/3
4. Budget Sheet	• Budget sheet exceeds $2.00 or contains incorrect coin additions. • Total cost is inaccurate or unrecorded.	• Budget sheet is at or under $2.00, but contains minor coin calculation errors. • Incomplete tracking of purchased items.	• Budget sheet stays within the $2.00 limit. • Accurately calculates total cost using mixed coins and whole dollar amounts.	/3

5. Peer Comparison Sheet	• Compares fewer than 3 peer domains or lacks habitat observations. • Fails to identify differences between domains.	• Compares 3 peer domains, but observations are superficial or missing key habitat details.	• Compares 3 peer environment domains accurately. • Records clear observations on how each peer's domain differs and supports different animal habitats	/3

Design Journal



Ask:

What is the problem that Ivan and the other animals in the Big Top Mall experience?

Explore:

Different animals require different environments and diets in order for their needs to be met.

- What type of food does your animal eat, so would that make them an omnivore, carnivore, or herbivore?
- Where in the world does your animal live? What makes that area a good environment for that animal?
- What type of land features are in the area that your animal lives in?

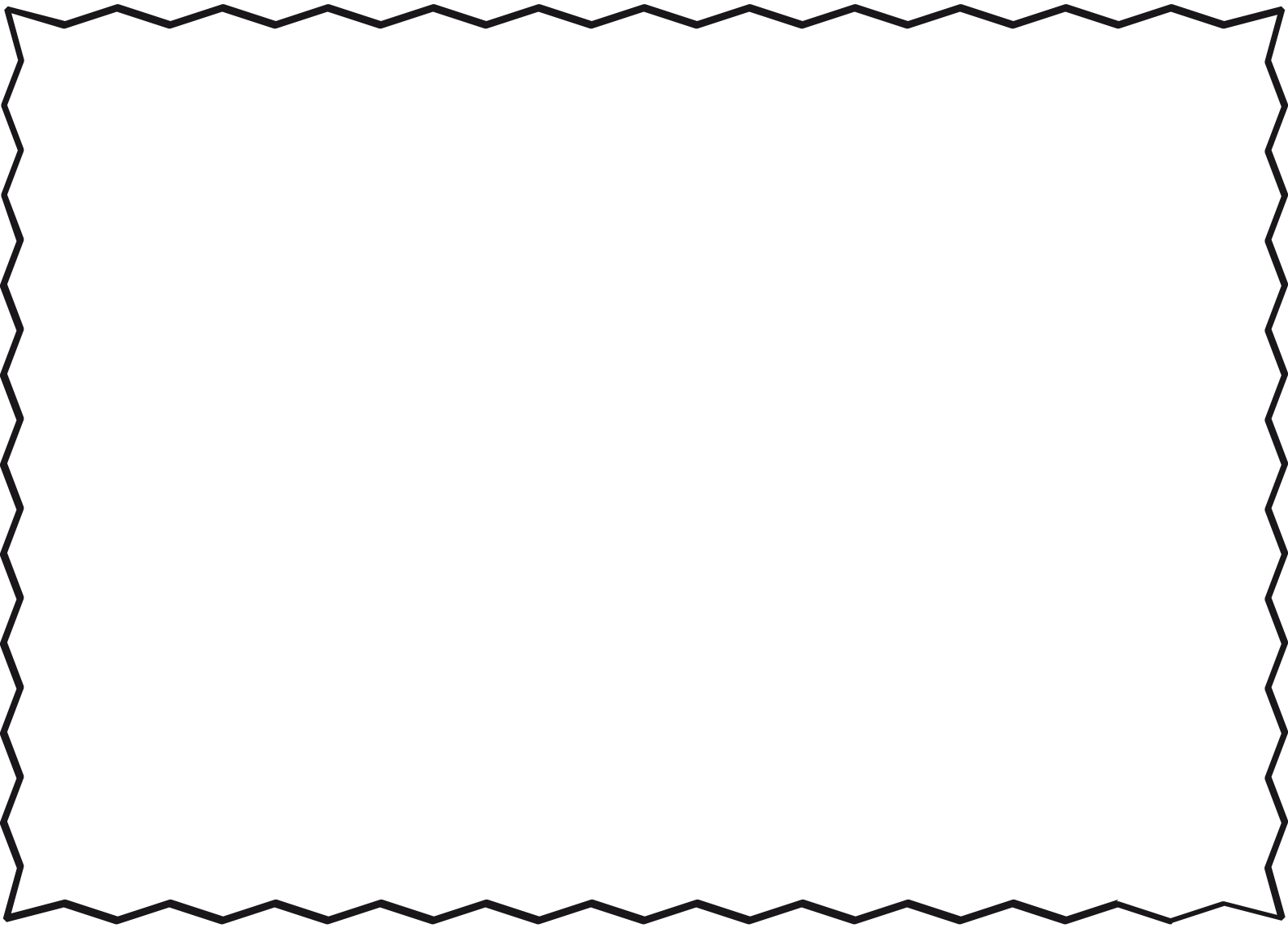
Use this space to write down what you find in your research:

Plan:

Plan and sketch out 3 potential ideas for your domain design:

IDEA 1

Draw your first idea!



What will you put in your oasis?

Materials I might use:

One thing I like about this idea:

IDEA 2

Draw your second idea!

What will you put in your oasis?

Materials I might use:

One thing I like about this idea:

IDEA 3

Draw your third idea!

What will you put in your oasis?

Materials I might use:

One thing I like about this idea:

Share ideas with your partner!

What idea did you and your partner like best and want to choose to create?

Before we start building, we must complete our budget to figure out what we can and want to purchase for our materials.

Budget: $2.00

Material	Price	How Many?	Total
Dowel Rod	25¢	____	____¢
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Create:

Gather your supplies and start creating your domain!

Improve:

Does your domain have everything your animal needs to live? If not, what can you add?

How can you make improvements to your domain to make your animal love it even more?

Share: Gallery Walk

Peer Domain Comparison Worksheet

My Animal: _____ My Habitat: _____

Habitat Explorer Checklist

Walk around the room and inspect **3 different peer domains**. Look closely at what each animal needs to survive!

Peer Domain 1

- **Student/Group Name: _____**
- **Animal: _____ Habitat: _____**

Check off what you see in their domain (3 Observation Spots):

- Spot 1 (Shelter/Home): [ ] Nest [ ] Cave [ ] Trees/Plants [ ] Other: _____
- Spot 2 (Food/Water): [ ] Water Dish/River [ ] Plants/Leaves [ ] Meat/Prey [ ] Other: _____
- Spot 3 (Environment): [ ] Sand/Dirt [ ] Rocks [ ] Ice/Snow [ ] Other: _____

Peer Domain 2

- **Student/Group Name: _____**
- **Animal: _____ Habitat: _____**

Check off what you see in their domain (3 Observation Spots):

- Spot 1 (Shelter/Home): [ ] Nest [ ] Cave [ ] Trees/Plants [ ] Other: _____
- Spot 2 (Food/Water): [ ] Water Dish/River [ ] Plants/Leaves [ ] Meat/Prey [ ] Other: _____
- Spot 3 (Environment): [ ] Sand/Dirt [ ] Rocks [ ] Ice/Snow [ ] Other: _____

Peer Domain 3

- **Student/Group Name: _____**
- **Animal: _____ Habitat: _____**

Check off what you see in their domain (3 Observation Spots):

- Spot 1 (Shelter/Home): [ ] Nest [ ] Cave [ ] Trees/Plants [ ] Other: _____
- Spot 2 (Food/Water): [ ] Water Dish/River [ ] Plants/Leaves [ ] Meat/Prey [ ] Other: _____
- Spot 3 (Environment): [ ] Sand/Dirt [ ] Rocks [ ] Ice/Snow [ ] Other: _____

Comparing My Findings

Use these sentence starters to write sentences comparing your domain to your peers' domains!

One way a peer's domain was DIFFERENT from mine was...

One way a peer's domain was the SAME as mine was...

Different animals need different habitats because...

Domain Oasis Engineering Design Challenge

Teacher Guide

Grade Level: 2nd Grade

Standards

STEM Content Standards:

Science:

2-LS4-1 Make observations of plants and animals to compare the diversity of life in different habitats.

Mathematics:

2.GM.12: Count collections of mixed coins and solve real-world problems involving quarters, dimes, nickels, and pennies within 99¢ and whole dollar amounts.

STEL:

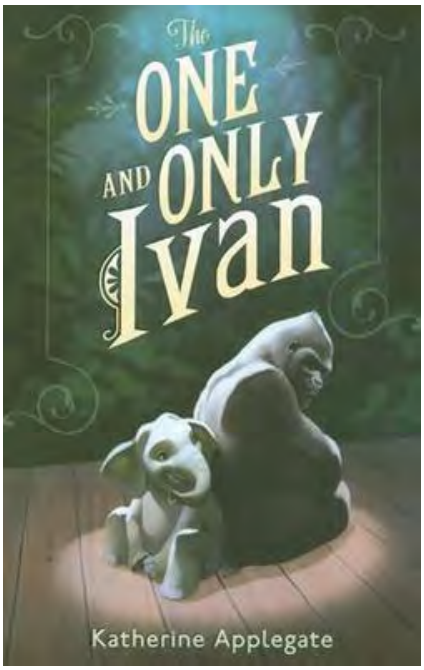
Standard 2: Core Concepts of Technology and Engineering

A. Develop a plan in order to complete a task.

B. Collaborate effectively as a member of a team.

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Stem Background Content Information

Background Information:

- **What is a Habitat?** A **habitat** is the natural home or environment where a plant, animal, or other organism lives. It provides the four basic needs for survival: **food**, **water**, **air**, and **shelter**.
- **Understanding Biodiversity: Biodiversity** (or the diversity of life) means the wide variety of different plants and animals found in a specific area or across the whole planet. Different habitats support different communities of living things because organisms are adapted to specific conditions.
- **Land vs. Water Habitats:** Habitats are broadly split into land (terrestrial) and water (aquatic) environments.
    - *Land examples:* **Forests** (lots of trees and shade), **Grasslands** (wide open areas with tall grasses and few trees), **Deserts** (hot or cold, very dry places), and the **Arctic** (cold, icy, and frozen).
    - *Water examples:* **Ponds**, **Lakes**, **Rivers** (freshwater), and **Oceans** (saltwater).
- **Scientific Practices:** Students do not need to memorize specific scientific names of obscure species. Instead, they use **observations** (looking closely at pictures, videos, or real outdoor spaces) to collect data and find patterns about which plants and animals live where.

Vocabulary:

- **Habitat**: The natural place where a plant or animal lives, grows, and finds what it needs to survive.
- **Diversity (or Biodiversity)**: Having many different types or a great variety of plants and animals living in one area.
- **Shelter**: A safe place or natural structure where an animal can hide, rest, and protect itself from weather or predators.
- **Forest**: A land habitat filled with many tall trees, shrubs, and bushes.
- **Grassland**: A wide, open land habitat covered mostly in grasses and wildflowers with very few trees.
- **Desert**: A very dry land habitat that gets very little rain, featuring extreme temperatures and specialized plants like cacti.
- **Arctic**: A freezing, icy, and cold polar habitat found at the top of the Earth.
- **Pond** (or freshwater habitat): A small, shallow body of fresh water filled with algae, water plants, fish, and insects.
- **Ocean**: A massive, salty saltwater habitat that covers most of the Earth's surface.
- **Food Chain**: The path of how energy moves from plants to animals that eat plants, and then to other animals that eat other animals.

- **Predator**: An animal that hunts and eats other animals for food.
- **Prey**: An animal that is hunted and eaten by a predator.

Background Knowledge

In technology and engineering, **planning is a systematic process** used to turn an idea into a functional solution. Before building a product or executing a system, engineers and technologists create a clear, step-by-step roadmap to ensure efficiency, safety, and success.

Developing a plan involves:

- Identifying the goals and requirements of the task.
- Recognizing constraints (such as limited time, budget, and materials).
- Anticipating potential problems and scheduling testing phases.
- Breaking down large, complex projects into smaller, manageable milestones.

Without a well-structured plan, engineering projects often suffer from wasted resources, missed deadlines, or structural failure.

Essential Vocabulary

- **Constraints**: The limitations or restrictions placed on a project, such as time, budget, material availability, or environmental rules.
- **Criteria**: The requirements or specifications that a final product or solution must meet to be successful..
- **Optimization**: The process of making a design, system, or plan as effective, functional, and efficient as possible within its constraints.
- **Prototype**: A preliminary, working model of a product used to test concepts, gather feedback, and refine the plan.

Background Knowledge

- **Clear Roles**: Every member needs an assigned role so everyone knows their specific duties and confusion is reduced.
- **Shared Objectives**: Setting clear, shared goals helps keep the whole group motivated and moving in the same direction.
- **Open Communication**: Continuous updates and transparent conversations prevent misunderstandings and build mutual trust.

Essential Vocabulary

- **Active Listening**: Paying close attention to a speaker, asking clarifying questions, and trying to understand their point without judgment.
- **Accountability**: Taking personal ownership of your assigned tasks, deadlines, and mistakes.
- **Brainstorming**: A group discussion where members freely share and record many creative ideas to solve a problem.
- **Constructive Feedback**: Helpful, specific comments meant to improve a teammate's work rather than criticize the person.
- **Conflict Resolution**: The process of addressing disagreements calmly, listening to all sides, and finding a fair compromise.
- **Delegation**: Assigning specific duties to different people based on their individual strengths and workload capacity.

Background Knowledge

At this stage, students are transitioning from understanding shapes by their appearance to analyzing them by their attributes (sides and vertices).

- **The Core Concept:** Perimeter is the total distance *around* the outside of a two-dimensional shape. A simple analogy to use with 2nd graders is thinking of perimeter as the length of a fence needed to enclose a yard, or a string wrapped tightly around a shape.

- **Prior Skills Needed:** Students must already know how to identify basic shapes (triangles, squares, rectangles, hexagons) and possess strong addition skills, including adding multiple 1-digit and 2-digit numbers together (e.g., 5+5+5+5 or 12+8+12+8).
- **Real-World Application:** At the 2nd-grade level, problems should involve concrete, relatable scenarios. Examples include finding the distance around a picture frame, a playground, a desk, or a garden plot.
- **Measurement Units:** Problems will typically use standard units like **inches (in)**, **centimeters (cm)**, **feet (ft)**, or **meters (m)**. Students must remember to always include the unit of measurement in their final answer.

Essential Vocabulary

To master this standard, students need to understand and use the following terms:

- **Perimeter:** The total distance around the outside edge of a flat, 2D shape. It is found by adding the lengths of all its sides together.
- **Polygon:** A closed, flat (2D) shape made entirely of straight line segments that do not cross each other. (Examples: triangles, rectangles, pentagons).
- **Side:** One of the straight line segments that makes up a polygon.
- **Length:** The measurement of how long a side is from one end to the other.
- **Attribute:** A characteristic or feature of a shape, such as its number of sides, vertices, or side lengths.
- **Sum:** The total amount you get when you add two or more numbers together. (To find perimeter, you find the *sum* of the sides).

Background Knowledge

- **Counting Strategies (Greatest to Least Value):** Students learn to group and count coins by starting with the highest value coin (quarter) and moving down to the lowest value coin (penny).
- **Skip Counting:** Students apply skip-counting skills learned in earlier grades—counting by 25s for quarters, 10s for dimes, and 5s for nickels—to total mixed groups efficiently.
- **Equivalent Values:** Students understand that different combinations of coins can equal the same total amount (e.g., two dimes and a nickel equal the same 25¢ value as one quarter).
- **Real-World Application:** Students solve simple shopping or money-exchange word problems, determining if they have enough money to buy an item or calculating correct totals using the **¢** (cent) and **$** (dollar) symbols.

Essential Vocabulary

- **Penny:** A bronze-colored US coin worth 1 cent ($0.01).
- **Nickel:** A thicker silver-colored US coin worth 5 cents ($0.05).
- **Dime:** A small silver-colored US coin worth 10 cents ($0.10).
- **Quarter:** The largest common silver-colored US coin worth 25 cents ($0.25).
- **Cent Symbol (¢):** A math symbol used to show an amount of money less than one dollar.
- **Dollar Symbol ($):** A math symbol placed before a number to show whole dollar amounts or combined dollar-and-cent values.
- **Value:** How much a coin or group of coins is worth.
- **Skip Counting:** Counting forward by a number other than 1 (such as counting by 5s, 10s, or 25s).

Additional materials:

Books on Tundra Animals:

- Polar Bears
- Penguins
- Seals

Books on Rainforest Animals:

- Tigers
- Sloths
- Pandas

Books on Savanna Animals:

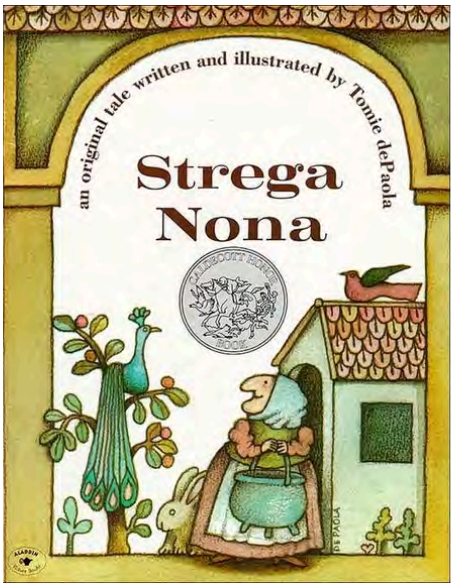
- Lions
- Giraffes
- Zebras

Books on Wetland Animals:

- Alligators and Crocodiles
- Sea Otters
- Turtles

The Magic Pasta Delivery Challenge!

TEACHER GUIDE:



Title: The Magic Pasta Delivery Challenge!

Book: Strega Nona by Tommy de Paola

Grade Level: 2nd

STEM Content Standards: Science (Life, Earth/Space, or Physical Science):

2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

Mathematics:

2.GM.2: Identify and describe three-dimensional shapes based on the shape, number of faces, number of edges, and number of vertices.

- Shapes include: rectangular prisms, cubes, and square-based pyramids

Standard for Technological and Engineering Literacy (STEL): 2nd Grade 2: Core Concepts of Technology and Engineering:

D. Develop a plan in order to complete a task.
E. Collaborate effectively as a member of a team.

Big Ideas:
Math:

1. Shapes have different features - Shapes have different features, like sides, faces, edges, and corners that help us identify and describe them.
2. Shapes are all around us - We see and use 2D & 3D shapes in things we build & use every day.
3. Shapes help us build: We can use different shapes to design and build things that work.

Science:

1. Materials are different - Materials have different properties, like color, size, texture, etc.
2. We can learn about materials - We can observe and group materials by what they look and feel like.
3. Testing helps us choose - We can test materials to find out which ones work best for a job.

STEL:

1. Planning helps us build - Engineers make a plan before they start building.

2. Teamwork helps us solve problems - We can share ideas, listen, and work together to solve a problem.
3. We can create and improve - We can build, test, and improve our plan/designs to make them work better.

Essential Question/s:

- How can we describe different shapes?
- How can we identify and compare materials?
- How can we work together to plan and build a design?
- How can we test and improve our designs?

Scenario: Uh oh! Big Anthony cannot stop the pasta from overflowing from Strega Nona's magic pot! He wants to give all the extra pasta to people in the town so none of it goes to waste. He needs help getting it from the pot to the townspeople without spilling it. Big Anthony needs a team to help him solve this problem and get rid of all the pasta before Strega Nona finds out!

Challenge: Big Anthony needs your help! Work with a partner (2 people) to plan, design, and build a way to help Big Anthony deliver pasta from Strega Nona's magic pot to the people in the town without spilling. Use only the materials and tools given to plan, build, test, and improve your design.

Tools, Materials, and Resources:
Materials: Craft sticks, cardstock paper, paper plates, paper cups, small cardboard boxes, small plastic containers, pipe cleaners, string, rubber bands, aluminum foil, masking tape, dry pasta
Tools: Pencils, paper, scissors, Chomp-Saw, hole punch
Resources: 2D and 3D shape reference sheet, materials properties chart, Engineering design process chart

Content information:
Science:
2-PS1-1: Describe and Classify Materials

- **Core Idea:** Different kinds of matter exist (such as wood, metal, plastic, and stone), and they can be described and sorted by what they look and feel like.
- **Action:** Students plan and run simple, collaborative tests to observe traits like color, texture (rough or smooth), hardness, and flexibility (bending without breaking).
- **Big Concept:** Finding **patterns**—noticing that different objects can share the same properties and be grouped together.

2-PS1-2: Test and Compare for a Purpose

- **Core Idea:** Materials have specific traits that make them good or bad for specific jobs.
- **Action:** Students look at data from testing different items to see which material works best for an intended design or goal.

2D & 3D shape reference sheet:

2D SHAPES: 2D shapes are FLAT.

Shape	Visual	Properties
Triangle		• 3 sides • 3 vertices/corners
Square		• 4 sides • 4 vertices/corners
Rectangle		• 4 sides • 4 vertices/corners
Circle		• 0 sides • 0 vertices/corners

3D SHAPES: 3D shapes are SOLID. They have length, width, and height

Shape	Visual	Properties
Cube		• 6 faces (faces are squares) • 12 edges • 8 vertices
Rectangular Prism		• 6 faces (faces are rectangles) • 12 edges • 8 vertices
Square-Based Pyramid		• 5 faces (4 triangle faces, 1 square face) • 8 edges • 5 vertices • 1 square base

Shape Vocabulary:
Face: a flat surface of a 3D shape
Edge: where two faces meet
Vertex (corner): where two sides meet
Base: the face a 3D shape can stand on
Side: a straight line around a 2D shape

- **Big Concept:** Matching a material's physical traits (like strength, absorbency, or flexibility) to a real-world use.

Essential Vocabulary:

- **Property:** A special feature or trait used to describe an object (like color, shape, or size).
- **Observable:** Something you can notice using your five senses (sight, touch, hear, smell, taste).
- **Classify:** To sort or group items based on how they are similar.
- **Texture:** How a surface feels when you touch it (rough, smooth, soft, hard).
- **Hardness:** How firm a material is or how easily it can scratch or dent.
- **Flexibility:** How easily a material bends without breaking (flexible vs. stiff).
- **Strength:** How well a material holds up against force, pushing, or pulling.
- **Data:** Information or facts gathered during an investigation or test

<u>Technology and Engineering (STEL):</u>

2nd Grade - D. Develop a plan in order to complete a task and E. Collaborate effectively as a member of a team.

- **Structured Action (2D):** Students learn that goals are achieved more successfully when steps are thought out ahead of time rather than done randomly. For 2nd graders, this means sequencing simple actions (e.g., drawing a design before building, listing steps to assemble a simple craft or model).
- **Shared Effort and Communication (2E):** Students learn what it means to be a positive group contributor. This involves sharing materials, listening to peers, taking turns, and helping a partner accomplish a shared technological or engineering goal.

Essential Vocabulary:

- **Plan:** A sequence of steps or a simple drawing created before starting work to show how a task will be done.
- **Task:** A specific job, activity, or mini-challenge to complete.
- **Team:** A small group of people working together to share ideas and finish a common goal.
- **Collaborate:** Working together, sharing materials, and listening to others to create or build something.
- **Goal:** What the team is trying to make, do, or figure out.

<u>Mathematics:</u>

2.GM.2: Identify and Describe 3D Shapes

- **Core Idea:** Solid, three-dimensional shapes (specifically rectangular prisms, cubes, and square-based pyramids) exist all around us and can be identified and sorted by counting their unique geometric parts.
- **Action:** Students look at, handle, and describe 3D shapes to physically count and record their specific traits: the number of flat faces, the shape of those faces, the number of straight edges, and the number of corner vertices.
- **Big Concept:** Defining attributes—learning that a shape is classified by its mathematical rules (like the exact number of edges or vertices) rather than its size, color, or the direction it is facing.

Essential Vocabulary:

- **Three-Dimensional (3D):** A solid shape that takes up physical space and has length, width, and height—unlike a flat 2D drawing.
- **Face:** A flat, 2D shape that makes up the outside surface of a solid object (like the square sides of a block).
- **Edge:** The straight line where two flat faces meet together.
- **Vertex (Vertices):** The sharp corner point where three or more edges connect.

- **Base:** The specific flat face on the bottom that a 3D shape stands on (like the square at the bottom of a pyramid).

Results: At the end of the challenge, each pair will provide:
1) their final pasta delivery design, 2) a labeled drawing of their design, 3) their design journal, 4) a short reflection explaining what worked, what didn't work, and how they improved their design.

Limitations: Challenge Rules
- Work with one partner.
- Only use the materials and tools you are given.
- Use at least 3 different materials.
- Use at least 2 different 3D shapes.
- Get the pasta from the pot to the people in the town without spilling!

Assessment/Evaluation:

The Magic Pasta Delivery Challenge Grading Rubric

Criteria	1 – Beginning	2 – Developing	3 – Meets Expectations	4 – Exceeds Expectations
Science: Materials & Properties 2-PS1-1	Has difficulty describing or comparing material properties.	Describes some properties but needs help comparing or explaining them.	Describes properties of the materials used and identifies how they are different.	Clearly describes and compares the properties of **3+ materials** and uses observations/testing to explain how they are different.
Science: Testing & Choosing Materials 2-PS1-2	Does not use test results to explain material choices.	Uses some test results but has difficulty explaining how they helped the design.	Uses test results to explain why materials were chosen for the design.	Uses test results/data to clearly explain why materials were chosen and how they helped the design work better.
Math: 3D Shapes 2.GM.2	Has difficulty identifying or describing the 3D shapes used.	Identifies some 3D shapes but makes some errors describing their features.	Correctly identifies and describes the 3D shapes used, including their faces, edges, and vertices.	Correctly identifies and describes **2 & 3D shapes**, including faces, edges, and vertices, with strong accuracy.
Engineering Plan & Design STEL 2D	Has little or no plan before building.	Creates a partial plan but needs help using it to build or improve the design.	Creates a labeled plan and uses it to build and test the design.	Creates a detailed, labeled plan and uses it to successfully build, test, and improve the design.
Design & Problem Solving	Design does not successfully transport the pasta and shows little evidence of improvement.	Design transports some pasta but has difficulty preventing spills or making improvements.	Design transports pasta with little or no spilling and shows evidence of testing and improvement.	Design successfully transports pasta **without spilling** and is thoughtfully improved based on testing.
Teamwork & Collaboration STEL 2E	Has difficulty working with their partner and needs frequent support.	Sometimes works well with their partner but needs reminders to share, listen, or take turns.	Works well with their partner, shares, listens, and takes turns.	Consistently shares ideas/materials, listens, takes turns, and works positively with their partner.
Labeled Design Drawing	Drawing is incomplete or does not clearly show the design.	Drawing is partially labeled or missing some important details.	Drawing is labeled and clearly shows the final design.	Drawing is detailed, clearly labeled, and accurately shows the final design and its 3D shapes.
Design Journal & Reflection	Journal or reflection is incomplete or missing important information.	Journal or reflection is partially complete and needs more explanation.	Journal and reflection explain what worked, what did not work, and how the design was improved.	Journal is complete and reflection clearly and thoughtfully explains what worked, what did not work, and how the design was improved.

Additional Directions/Notes for Teacher:

1. Read Strega Nona by Tomie dePaola before beginning the challenge/review the relevant parts of the story.
2. Introduce the pasta delivery problem and explain the challenge rules and limitations before students begin.
3. Review the 2D and 3D shape reference sheet and briefly review faces, edges, and vertices.
4. Review the materials properties students will be observing and testing, such as flexibility, hardness, texture, and strength.
5. Model how to make a labeled design plan before building.
6. Place students in pairs of two and provide each pair with the required materials and tools.
7. Allow students time to plan, build, test, and improve their designs.
8. During testing, remind students to observe what happens and record their results in their design journal.
9. Make sure each pair completes the final pasta delivery test and submits all required work.
10. Use the rubric to assess each student's understanding and participation

Materials Needed:

- *Strega Nona* by Tomie dePaola (book)
- 2D & 3D Shape Reference Sheet (1 per student and display in classroom)
- Engineering Design Process Chart (display or 1 per student/pair)
- Design Journal (1 per student)
- Challenge Rules/Limitations (display or 1 per student/pair - in Design Journal)
- Grading Rubric (1 per student/pair or teacher copy)
- Dry pasta for testing
- A “magic pot” and designated “town”/delivery area for the final test

STUDENT GUIDE:



The Magic Pasta Delivery Challenge!

Big Ideas:

Math:

1. Shapes have different features, like sides, faces, edges, and corners that help us identify and describe them.
2. We see and use 2D & 3D shapes in things we build & use every day.
3. We can use different shapes to design and build things that work.

Science:

1. Materials have different properties, like color, size, texture, etc.
2. We can observe and group materials by what they look and feel like.
3. We can test materials to find out which ones work best for a job.

STEL:

1. Engineers make a plan before they start building.
2. We can share ideas, listen, and work together to solve a problem.
3. We can build, test, and improve our plans/designs to make them work better.

Essential Questions:

1. How can we describe different shapes?
2. How can we identify and compare materials?
3. How can we work together to plan and build a design?
4. How can we test and improve our designs?

Scenario:

Uh oh! Big Anthony cannot stop the pasta from overflowing from Strega Nona's magic pot! He wants to give all the extra pasta to people in the town so none of it goes to waste. He needs help getting it from the pot to the townspeople without spilling it. Big Anthony needs a team to help him solve this problem and get rid of all the pasta before Strega Nona finds out!

Challenge:

Big Anthony needs your help! Work with a partner (2 people) to plan, design, and build a way to help Big Anthony deliver pasta from Strega Nona's magic pot to the people in the town without spilling. Use only the materials and tools given to plan, build, test, and improve your design.

Tools	Materials	Resources
☐ Pencils ☐ Paper ☐ scissors ☐ Chomp-Saw ☐ Hole punch	☐ Craft sticks ☐ cardstock paper ☐ paper plates ☐ paper cups ☐ small cardboard boxes ☐ small plastic container ☐ pipe cleaners ☐ string ☐ rubber bands ☐ aluminum foil ☐ masking tape ☐ dry pasta	☐ 2D and 3D shape reference sheet ☐ Materials properties chart ☐ Engineering design process chart

Results/Deliverables

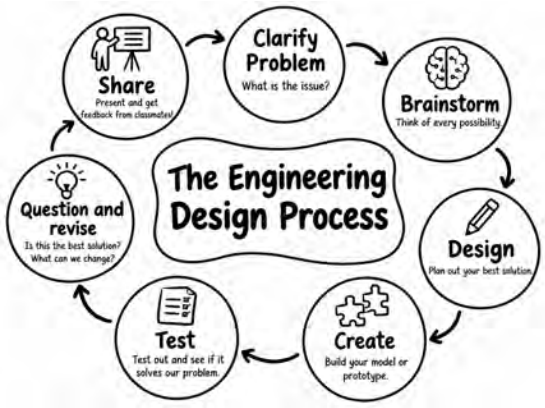
At the end of the challenge, you and your partner will turn in

1. Your Final Pasta Delivery Design: Your completed design ready for testing!
2. Your Design Journal: Your notes, ideas, measurements, and changes from throughout the challenge.
3. A Short Reflection: Explain what worked, what didn't work, and how you improved your design.

Rules/Limitations for this Design Challenge:

1. Work with one partner.
2. Only use the materials and tools you are given.
3. Use at least 3 different materials.
4. Use at least 2 different 3D shapes.
5. Get the pasta from the pot to the people in the town without spilling!

Engineering Design Journal



Name:_____ **Date:**_____

Activity Title:_____

Group Members:_____

Part 1: Vocabulary

Directions: Learn these words before you begin.

Write what you think each word means. Your teacher may help you.

Property: _____

Observable: _____

Classify: _____

Texture: _____

Hardness: _____

Flexibility: _____

Strength: _____

Data: _____

Part 2: Investigation

Directions: Engineers test and compare materials before choosing which ones to use. Look closely at each material. Touch it when your teacher says it is okay. Describe its properties using words like hard, soft, smooth, rough, flexible, stiff, strong, or weak.

Think about these questions:

- What does the material look and feel like?
- Can it bend easily?

- Does it seem strong enough to help deliver pasta?
- Would it be a good choice for your design? Why?

Material	**Describe its properties**
Craft Sticks	
Cardstock Paper	
Paper Plates	
Paper Cups	
Small Cardboard Boxes	
Small Plastic Container	
Pipe Cleaner	
String	

Rubber Bands	
Aluminum Foil	
Masking Tape	
Dry Pasta	

Think about it!

1. Which material do you think would be best for holding or moving pasta? Why?

2. Which material bends or changes shape easily?

3. Which material seems strong enough to support your design?

Part 3: Explore 2D and 3D Shapes

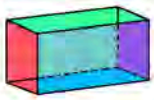
Directions: Use the 2D and 3D Shape Reference Sheet to help you answer the questions. Remember, a 2D shape is flat, and a 3D shape is solid.

2D and 3D Reference Sheet for Students:

2D SHAPES: 2D shapes are FLAT.

Shape	Visual	Properties
Triangle		• 3 sides • 3 vertices/corners
Square		• 4 sides • 4 vertices/corners
Rectangle		• 4 sides • 4 vertices/corners
Circle		• 0 sides • 0 vertices/corners

3D SHAPES: 3D shapes are SOLID. They have length, width, and height

Shape	Visual	Properties
Cube		• 6 faces (faces are squares) • 12 edges • 8 vertices
Rectangular Prism		• 6 faces (faces are rectangles) • 12 edges • 8 vertices
Square-Based Pyramid		• 5 faces (4 triangle faces, 1 square face) • 8 edges • 5 vertices • 1 square base

Shape Vocabulary:
Face: a flat surface of a 3D shape
Edge: where two faces meet
Vertex (corner): where two sides meet
Base: the face a 3D shape can stand on
Side: a straight line around a 2D shape

3D Shape Check 🔎

Directions: Fill in the chart to describe each 3D shape.

3D Shape	Faces	Edges	Vertices
Cube			
Rectangular Prism			
Square-Based Pyramid			

Which two 3D shapes will you use in your pasta delivery design?

1. _____
2. _____

Part 4: Understand the Problem

Directions: Read the challenge with your partner. Talk about the problem before you start designing.

The Challenge: Big Anthony has made too much pasta with Strega Nona's magic pot! He needs help delivering the pasta to the townspeople without spilling it. Your job is to design and build something that helps him deliver the pasta.

Answer these questions with your partner.

1. **What problem does Big Anthony need us to solve?**

2. **What does our design need to do?**

3. **What rules do we need to follow?**

4. **What materials and tools are we allowed to use?**

Part 5: Brainstorm Ideas

Directions: Engineers think of many ideas before choosing one. With your partner, come up with at least three different ideas to help Big Anthony deliver the pasta. Draw or write each idea. Your ideas do not have to be perfect!

Idea 1:

Idea 2:

Idea 3:

Talk with your partner.

Which idea do you want to try first? Why?

Part 6: Plan Your Design

Directions: Choose your favorite idea. Before you build, draw a picture of your design in the space below. Label the materials and shapes you plan to use.

Remember:

- Your design must help deliver pasta without spilling it.
- You must use at least three different materials.
- You must include at least two different 3D shapes from your shape reference sheet.
- You may only use the materials and tools provided.
- You cannot carry the pasta directly in your hands.

Draw and Label Your Design

Label the materials and the two or more 3D shapes you plan to use.

Plan Your Build

1. **What materials will you use?**

2. **What properties make these materials good choices?**

3. **Which 3D shapes will you include?**

4. **How will your design move the pasta from the magic pot to the townspeople?**

5. **What is the first thing you and your partner will build?**

Part 7: Create Your Design

Directions: Work with your partner to build your design. Use your drawing to help you. Share the work and listen to each other's ideas.

While you build, think about these questions:

1. Are you following your plan?

   ☐ Yes ☐ We made some changes

2. Are both partners helping?

☐ Yes ☐ We need to share the work more

3. **Did you have to change anything while building? Explain.**

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4. **Draw or describe what your design looks like after building.**

Part 8: Test Your Design

Directions: It is time to test! Use your design to move pasta from the magic pot to the townspeople. Watch carefully and record what happens.

Test 1

Did your design deliver the pasta without spilling?

☐ Yes, no pasta spilled. ☐ Some pasta spilled. ☐ A lot of pasta spilled.

What happened during your test?

What worked well?

What did not work well?

What did you notice about the materials you used?

Part 9: Improve Your Design

Directions: Engineers use what they learn from testing to make their designs better. Talk with your partner about what you could change. Make at least one improvement.

1. **What part of your design needs to change?**

2. **What will you change to help deliver the pasta without spilling?**

3. **Why do you think this change will make your design better?**

Draw Your Improved Design. ***Show what you changed. Label the part you improved.***

Test 2

Directions: Test your improved design again. Record what happens.

☐ No pasta spilled. ☐ Some pasta spilled. ☐ A lot of pasta spilled.

Did your change help? Why or why not?

Part 10: Improve & Share

Directions: Get ready to share your design with the class. Both partners should help explain the project.

Be ready to explain:

- What your design does.
- Which materials you used and why you chose them.
- Which 3D shapes you included.
- What happened when you tested your design.
- What you changed and whether it helped.

What is one thing you want the class to know about your design?

Part 11: Big Question Recap

Directions: Answer each question in 2–3 sentences. Use at least one vocabulary word in each answer. You can use your vocabulary list to help you.

1. How can you describe different shapes and their features?

2. How did you identify and compare materials to choose the best ones for your design?

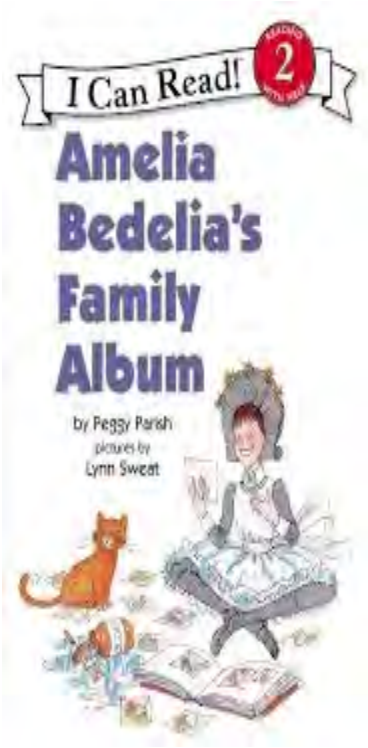
3. How did you and your partner work together to plan and build your design?

4. How did testing help you improve your design?

The Magic Pasta Delivery Challenge Grading Rubric

What I Am Being Graded On	1 – Beginning 🌱	2 – Almost There 🙂	3 – Meets Expectations 👍	4 – Exceeds Expectations 🌟
My Plan	I need help making a plan or drawing.	My plan is missing some details or labels.	I made a clear plan and labeled my drawing.	I made a clear, detailed plan and labeled my drawing to show how my design will deliver the pasta.
My Materials	I need help identifying or describing my materials.	I can name some materials but need help explaining their properties.	I used the materials correctly and can tell about their properties.	I can explain how **3 or more materials** helped my design work and describe their properties.
My 3D Shapes	I need help naming 3D shapes and counting their faces, edges, and vertices.	I can name some 3D shapes but need help counting their faces, edges, and vertices.	I can name cubes, rectangular prisms, and square-based pyramids and count their faces, edges, and vertices.	I can name all three 3D shapes and tell how many faces, edges, and vertices each one has.
Testing My Design	I need help testing my design.	I tested my design but need more information or details.	I tested my design and recorded what happened.	I tested my design more than once, recorded what happened, and used what I learned to make it better.
Improving My Design	I did not make changes or need help improving my design.	I made a small change but need to explain how it helped.	I made a change to improve my design.	I made changes that clearly helped my design work better.
Delivering the Pasta	My design was not yet able to deliver the pasta.	My design delivered some pasta but spilled some.	My design delivered the pasta with little or no spilling.	My design successfully delivered the pasta **without spilling**.
Working With My Partner	I needed help working with my partner.	I sometimes worked with my partner but needed reminders.	I worked well with my partner and shared the work.	I shared ideas, listened, took turns, and helped my partner throughout the challenge.
My Design Journal & Reflection	My journal or reflection is mostly incomplete.	My journal or reflection is missing some information.	My journal and reflection explain what I did and how I improved my design.	My journal is complete, and my reflection clearly explains what worked, what did not work, and how I improved my design.

Title: Checks Gone Wobbly!
Grade Level: 3rd Grade
Literacy Connection: Amelia Bedelia's Family Album



STEM Content Standards:
Science: (Physical Science):
- 3-PSI2-1: Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Mathematics: (Measurement and Data):
- 3.GM.4: Measure lengths of objects to the nearest half and quarter inch, using a ruler.

Standard for Technological and Engineering Literacy:
- Standard 7: Design in Technology and Engineering Education
  Graded 3-5:
  I. Apply the Technology and Engineering Design Process

Big Ideas:
Science:
- Forces can affect the way an object moves or stays in place.

Mathematics:
- Measurements help us plan, build, and improve structures.

Standard for Technological and Engineering Literacy:
- We can test our designs and make changes to make them work better.

Essential Questions:
Science:
- How can changing where weight is placed affect the movement and stability of a structure?

Mathematics:
- How can we use measurements to plan and improve our designs?

Standard for Technological and Engineering Literacy:
- How can we use the design process to create a structure that can safely hold 20 checkbooks?

Scenario: Oh no! Amelia Bedelia needs your help! Her aunt has 20 checkbooks, but there is nowhere safe to keep them. Amelia tried to stack them up, but they kept on tipping and falling over!

Challenge: Amelia needs a team of engineers to help her solve the problem. Your challenge is to design and build a structure that can hold all 20 checkbooks for 10 seconds without falling over. Can you create a strong and stable design that will save Amelia's checkbooks?

Tools:

- Masking Tape
- Clear Tape
- Scissors
- Rulers

Materials: Students have 15 credits to spend

- Checkbooks – 1 credit each
- Cardstock – 1 credit per sheet
- Construction Paper – 1 credit per sheet
- Index Cards – 1 credit each
- Craft Sticks – 1 credit each
- Straws – 1 credit each
- Paper Cups – 2 credits each
- Popsicle Sticks – 1 credit each
- Pipe Cleaners – 1 credit each
- Paper Plates – 2 credits each
- String – 1 credit per foot

Resources:

- Amelillia Bedelia's Family Album by Peggy Parish
- Rulers for measuring and comparing lengths
- Engineering Design Process/Loop Visual
- Student Design Journal
- Anchor Chart for the Engineering Design Process
- Vocab list for students to look at

- Material Credit Chart

Teacher Notes:

- Review the Engineering Design Process with students before they begin planning.
- Explain the 15-credit material budget and allow students to choose which materials they want to use,make sure they know to get creative!
- Remind students that they must **test their structure with the checkbooks placed in different ways** and record their observations.
- Encourage students to use evidence from their tests to explain why their structure was stable or unstable.
- Remind students to measure parts of their structure to the nearest **½ or ¼ inch** using a ruler.
- Do not give students a specific design. Allow them to plan, test, and redesign their own structures.
- Before the final test, check that each structure follows all of the challenge limitations.
- For the final test, place all 20 checkbooks on the structure and use a timer to make sure it remains standing for 10 seconds.

Additional Materials/Directions:

- Timer or stopwatch for the 10-second final test
- Copies of the student design journal/force investigation worksheet
- Engineering Design Process visual or anchor chart displayed for students
- Material Credit Chart displayed where all teams can see it

Content Information:

Science:

- **Force:** A push or pull that can change an object's motion
- **Motion:** A change in an object's position
- **Balanced Forces:** Equal forces acting in opposite directions
- **Unbalanced Forces:** Forces that are not equal and cause a change in motion
- **Direction:** The path an object is moving toward
- **Friction:** A force that slows down or stops motion when two surfaces rub together

- **Investigation:** A test or experiment used to gather evidence

Mathematics:

- **Measure:** To find the length of an object
- **Half inch:** One of two equal parts of an inch
- **Quarter Inch:** One of four equal parts of an inch
- **Nearest:** The measurement an object is closest to
- **Endpoint:** The exact place where an object begins or ends with measuring
- **Accurate Measurement:** Measuring and correctly using a ruler

Technology and Engineering (STEL):

- **Design Process:** Steps used to solve a problem and create a solution
- **Criteria:** What the design needs to do
- **Constraints:** Limits or rules for the design
- **Prototype:** A first version of a design to see how well it works
- **Test:** Trying a design to see how well it works
- **Improve:** Making changes to make a design work better
- **Redesign:** Changing a design after testing

Results: Students will submit:

- Completed structure that holds all 20 checkbooks for 10 seconds without falling.
- Completed design sheet that includes:
- A sketch of their original design
- Measurements of their structure to the nearest half or quarter inch
- Notes about their testing and any changes they made
- A short reflection explaining how their final design works and how forces affected it.
- Students will also demonstrate their final structure which must hold all 20 checkbooks for 10 seconds without falling.
- Completed force investigation worksheet with observations and evidence from both tests.

Limitations:

- Students may only use the materials provided.
- Each team has a 15-credit material budget.
- The structure must fit within a 12-inch by 12-inch base area.
- The structure must be freestanding and cannot be taped down to the floor, table, wall, or another surface.
- The structure must hold all 20 checkbooks for at least 10 seconds.
- The checkbooks must be supported by the structure and cannot simply be placed inside a tray, box, or container.
- Students must use their ruler to measure parts of their design to the nearest half or quarter inch.
- Students must test their structure with the checkbooks distributed in different ways.

Assessment/Evaluation: Students will be evaluated using a rubric based on their final structure, design process, and teamwork.

Name:
Team Members Names:

1. Science: Forces: _/4
   - **4:** Clearly explains how forces affected the structure's movement and stability.
   - **3:** Explains how forces affected the structure.
   - **2:** Shows some understanding of forces but explanation is incomplete.
   - **1:** Shows little understanding of forces.
2. Mathematics: Measurement: _/4
   - **4:** Accurately measures parts of the structure to the nearest ½ or ¼ inch and uses measurements to improve the design.
   - **3:** Measure parts of the structure to the nearest ½ or ¼ inch.
   - **2:** Measurements have some errors or are not consistently used.
   - **1:** Does not accurately measure the structure.
3. Engineering Design Process: _/4
   - **4:** Plans, builds, tests, and makes thoughtful changes to improve the structure.
   - **3:** Plans, builds, tests, and makes changes to the structure.

- **2:** Completes some parts of the design process but needs support.
- **1:** Does not consistently participate in the design process.

4. Final Structure: _/4
    - **4:** Hold all 20 checkbooks for 10 seconds and remain stable.
    - **3:** Hold all 20 checkbooks for 10 seconds with minor instability.
    - **2:** Holds some of the checkbooks but does not meet the full challenge.
    - **1:** The structure does not successfully support the checkbooks.
5. Teamwork: _/4
    - **4:** Consistently contributes ideas, listens to others, shares materials, and helps with building and testing.
    - **3:** Participates and works cooperatively with the team.
    - **2:** Participates inconsistently or needs reminders to work with the team.
    - **1:** Rarely contributes or allows others to do most of the work.

CHECKS GONE WOBBLY DESIGN CHALLENGE

OH NO! AMELIA BEDELIA NEEDS YOUR HELP! HER AUNT HAS 20 CHECKBOOKS, BUT THERE IS NOWHERE SAFE TO KEEP THEM. AMELIA TRIED TO STACK THEM UP, BUT THEY KEPT ON TIPPING AND FALLING OVER!



The Big Ideas:

- Forces can affect the way an object moves or stays in place.
- Measurements help us plan, build, and improve structures.
- We can test our designs and make changes to make them work better.

Essential Questions:

- How can changing where weight is placed affect the movement and stability of a structure?
- How can we use measurements to plan and improve our designs?
- How can we use the design process to create a structure that can safely hold 20 checkbooks?

Challenge: Amelia needs a team of engineers to help her solve the problem. Your challenge is to design and build a structure that can hold all 20 checkbooks for 10 seconds without falling over. Can you create a strong and stable design that will save Amelia's checkbooks?

Materials: You have 15 Credits to spend!

- Cardstock – 1 credit per sheet
- Construction Paper – 1 credit per sheet
- Index Cards – 1 credit each
- Craft Sticks – 1 credit each
- Straws – 1 credit each
- Paper Cups – 2 credits each
- Popsicle Sticks – 1 credit each
- Pipe Cleaners – 1 credit each
- Paper Plates – 2 credits each
- String – 1 credit per foot

Tools:

- Checkbooks
- Masking Tape
- Clear Tape
- Scissors
- Rulers

Resources:

- Amelillia Bedelia's Family Album by Peggy Parish
- Rulers for measuring and comparing lengths
- Engineering Design Process/Loop Visual
- Student Design Journal
- Anchor Chart for the Engineering Design Process
- Vocab list for students to look at
- Material Credit Chart

Students will submit:

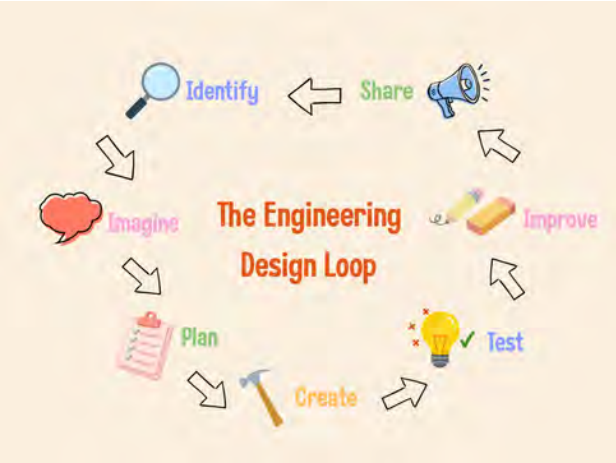
- Completed structure that holds all 20 checkbooks for 10 seconds without falling.
- Completed design sheet that includes:
- A sketch of their original design
- Measurements of their structure to the nearest half or quarter inch
- Notes about their testing and any changes they made
- A short reflection explaining how their final design works and how forces affected it.
- Students will also demonstrate their final structure which must hold all 20 checkbooks for 10 seconds without falling.
- Completed force investigation worksheet with observations and evidence from both tests.

Limitations:

- Students may only use the materials provided.
- Each team has a 15-credit material budget.
- The structure must fit within a 12-inch by 12-inch base area.
- The structure must be freestanding and cannot be taped down to the floor, table, wall, or another surface.
- The structure must hold all 20 checkbooks for at least 10 seconds.
- The checkbooks must be supported by the structure and cannot simply be placed inside a tray, box, or container.

- Students must use their ruler to measure parts of their design to the nearest half or quarter inch.
- Students must test their structure with the checkbooks distributed in different ways.

Engineering design Journal:



Name:

Team Members:

Identify:

What is the problem that needs to be solved?

How are you limited?

What does your design need to do?

Imagine:

Make a list of multiple ideas to solve the problem:

Which of these ideas seem to work best?

Plan:

Pick the idea that you think will fix the solution the best and make a sketch of it:

Create:

Fill out the budget sheet based on the materials you used:

Material	**Cost per Item**	**# of Items**	**Total Cost**
Cardstock	1 credit per sheet		
Construction Paper	1 credit per sheet		
Index Cards	1 credit each		
Craft Sticks	1 credit each		
Straws	1 credit each		
Paper Cups	2 credits each		
Popsicle Sticks	1 credit each		
Pipe Cleaners	1 credit each		
Paper Plates	2 credits each		
String	1 credit per foot		

Total Credits Spent: _____

Credits Left: _____

Is your design turning out how you planned? Why or why not?

Test:

Test your design: does it hold 20 checkbooks for 10 seconds without falling over?

Where were the checkbooks placed?

Did the structure stay stable or did it tip over?

What happened to the structure's motion?

Were the forces balanced or unbalanced and what happened to the structure?

How were you able to tell these things?

Improve:

What are the ways that you can improve your design?

How do you plan to improve it?

Reflect:

How did I do?

4 = I did it really well!
3 = I did it!
2 = I am still learning.
1 = I need help.

Skill	4 – I Did It Really Well!	3 – I Did It!	2 – I'm Still Learning	1 – I Need Help
Science:	I can clearly explain how forces made my structure move or stay stable.	I can explain how forces affected my structure.	I understand a little about how forces affected my structure.	I need help understanding how forces affected my structure.
Math:	I measured carefully to the nearest ½ or ¼ inch and used my measurements to make my design better.	I measured parts of my structure to the nearest ½ or ¼ inch.	Some of my measurements were incorrect or I did not always use them.	I need help measuring my structure accurately.
Engineering Design Process	I planned, built, tested, and made thoughtful changes to make my structure better.	I planned, built, tested, and made changes to my structure.	I completed some steps but needed help.	I need help following the engineering design process.
Final Structure	My structure held **all 20 checkbooks for 10 seconds** and stayed stable.	My structure held **all 20 checkbooks for 10 seconds** with a little wobbling.	My structure held some checkbooks but did not complete the challenge.	My structure did not successfully hold the checkbooks.

Teamwork	I shared ideas, listened, shared materials, and helped my team build and test.	I participated and worked well with my team.	I sometimes worked with my team but needed reminders.	I need to work on contributing and cooperating with my team.

My Score

Skill	My Score
Science: Forces	_____ / 4
Math: Measurement	_____ / 4
Engineering Design Process	_____ / 4
Final Structure	_____ / 4
Teamwork	_____ / 4
TOTAL	**_____ / 20**

One thing I did well:

One thing I would change next time:

I am proud of:

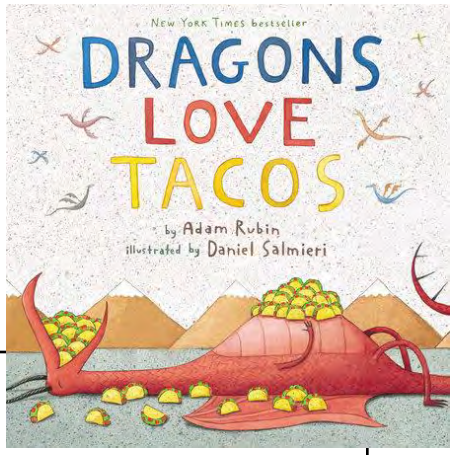
Share:

Work together as a team to present your designs and explain how they solve the problem.

Literature-Based Curriculum Project

Lauren Andrews and Abby Price

Grade Level: 2nd grade



TEACHER GUIDE

STEM Content Standards

Science (Life, Earth/Space, or Physical Science)
2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties
2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose

Mathematics
2.GM.12: Count collections of mixed coins and solve real-world problems involving quarters, dimes, nickels, and pennies within 99 cent and whole dollar amounts.

Standard for Technological and Engineering Literacy (include both standard and benchmark)
Standard 2: K-2: Core Concepts of Technology and Engineering
Explain that materials are selected for use because they possess desirable properties and characteristics.

Big Ideas:

- Materials can be classified by their differences and similarities
- Materials have an intended purpose based on their properties
- Coins can be used to buy things
- Budgets are useful because they help keep track of money
- Characteristics of a material determine how it is used

Teacher Guide: Go over these big ideas with students. Does not need to be in depth, but an overview will help guide them in their learning throughout the design challenge. It could be helpful to have them on the board somewhere for students to look back on.

Essential Questions:
What differences and similarities do we classify materials by?
How do the properties of a material help determine what we use it for?
Why is it important to keep track of a budget?
How many pennies/nickels/dimes/quarters equal one dollar?
How can we make the best decision for what materials we use?

Teacher Guide: Same with big ideas, introduce design challenge by going over essential questions. Having around the classroom will again be helpful.

Book: Dragons Love Tacos
Title: Dragons love tacos and so does our class! Can we save the Taco Party?

Scenario: As we have seen, two things are true about dragons.
1) They LOVE tacos!
2) They do NOT like spicy salsa!
The class is going to plan a party to celebrate our school, and of course we need to invite the dragons! BUT we know what happened at our last party, the dragons encountered spicy salsa and exploded the party!

We can't predict how the dragons will act at this next party, so today we need to get prepared for them. We need to make sure the dragons can enjoy the party while also keeping the tacos safe.

Teacher Guide: Have book out and read beforehand so students have more connection to the text.

Challenge:
Working together in your teams you will design a solution that protects the tacos from the dragons while also making the tacos easy to eat.
Your design should...

- Keep the taco safe
- Allow the taco to still be eaten
- Be creative and have fun!

Each team will have 10 dollars to spend and can bring one item from home!
At the end, we will all compare our designs and then work with our friends to make our design even better!

Tools, Materials, and Resources:

Recycled:

Plastic Bottles	1 dollar and 25 cents per bottle
Egg cartons	4 dollars and 50 cents per carton
Plastic containers	6 dollars and 25 cents per container
Paper towel rolls	2 dollars and 10 cents per roll
Cardboard	3 dollars and 50 cents per 6”x6” square
Grocery bags	50 cents per bag
Styrofoam packaging peanuts	25 cents per peanut

Non Recycled:

Chop sticks	75 cents per stick
Cups	1 dollar and 50 cents per cup
Straws	50 cents per straw
Masking Tape	50 cents per 2in strip

Duct Tape	75 cents per 2in strip
Coffee Filters	50 cents per filter
Aluminum Foil	75 cents per sheet
Cotton Balls	25 cents per ball
Cardboard Tubes	1 dollar and 15 cents per tube

Tools:
Rulers, scissors, chomp saw, canary cutters, safety glasses/goggles, hole punch, sand paper, dremel tool, bolt cutters, small tape measure
Each team will receive one glue stick to use

Teacher Guide: Have supplies out so students are able to get an idea of what materials and tools they want to use. Should be organized by materials/resources and tools.

Content information:

Science

2-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties

- **Property**: A characteristic or trait of a material or object (such as color, size, or shape).
- **Classify**: To sort or group objects based on how they are similar or different.
- **Observable**: Anything that can be noticed using the five senses (sight, touch, hearing, smell, taste).
- **Texture**: How a surface feels (e.g., rough, smooth, soft, hard).
- **Hardness**: How firm a material is or how well it resists scratching or denting (e.g., hard rock vs. soft cotton).
- **Flexibility**: How easily a material bends or stretches without breaking (e.g., flexible rubber band vs. stiff wooden block).
- **Solid**: A state of matter that keeps its own shape and does not flow.

2-PS1-2: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose

- **Criteria:** The requirements or rules that a successful design must meet (e.g., "The material must be lightweight").
- **Constraints:** The limitations or restrictions on the design (e.g., "We can only spend $5" or "We must finish in 20 minutes").
- **Data / Evidence:** The facts, measurements, or observations gathered during testing to support a conclusion.
- **Optimize:** Making a design or choice as perfect, effective, or functional as possible based on test results.

Teacher guide: To incorporate this standard heavily into our challenge we must put a large emphasis on the process of picking the material. I would encourage the teacher to set out all the materials and have the kids walk around and look at them, drawing them out in their design journal and completing Step 3 pages in the design journal. In the journal they will describe the shape/size, color, texture, and flexibility. When they ultimately pick their material it is important to have them discuss the reason behind the materials they pick and then what their intentions are with each material. They will discuss and fill out the Step 3 pages on the design journal. In the journal they will describe the shape/size, color, texture, and flexibility.

Technology and Engineering (STEL)
Standard 2: K-2: Core Concepts of Technology and Engineering
Explain that materials are selected for use because they possess desirable properties and characteristics.

- **Everything is made of materials:** Objects are made of parts, and those parts are made from specific materials like wood, plastic, metal, fabric, glass, and rock.
- **Materials have observable properties:** Materials can be described using senses (texture, color, flexibility, strength) and behaviors (whether they absorb water or repel it).

- **Properties determine purpose:** Humans choose specific materials for engineering and building because their properties match the job that needs to be done.

Teacher guide: Have students collaborate and discuss with their tables, people around them what materials they are thinking of using and why. What materials will be best to hold tacos. Discussion is key before confirming what materials students are using. Students will fill out a design journal to decide which materials have specific properties.

Mathematics

2.GM.12: Count collections of mixed coins and solve real-world problems involving quarters, dimes, nickels, and pennies within 99 cent and whole dollar amounts.

- **Skip-Counting:** Counting forward by numbers other than 1 (e.g., counting by 5s, 10s, or 25s).
- **Collection:** A group or mix of different coins.
- **Spend:** To give money to pay for items or services.
- **Cost / Price:** The amount of money needed to buy something.
- **Amounts**: Quarter 25c, Dime 10c, Nickel 5c, Penny 1c

Teacher guide: To fulfill this standard I would encourage the teacher to go over the coins and their amounts. Make sure students understand the differences between penny, nickel, dime, quarter and how much of each it takes to get to a dollar. Also encouraging the idea of skip counting will be important. Each student will receive a random assortment of dollars and coins that add up to 10. From there they will have to count and record what amount they have and be able to physically subtract and turn in the money as they use it to purchase their materials.

Results:

At the end of this project I would expect each student to...

- Complete the prototype

- Present the prototype,
- Fill out the design journal,
- Complete the budget.

Testing:
8'x8' open cardboard box: Their taco design must fit inside this 8inch by 8inch cardboard box.
For 15 seconds each team's design will be put in the open cardboard box and then the teacher will use a leafblower or hair dryer to blow onto the team prototype. While that is happening another team will also surround the table and shake it. Between these two things the team will be able to determine how durable their design is. Also, a quick check by the teacher to ensure that the taco is still accessible is important.

Teacher Guide: Go table by table assessing students' designs. Try to make it as least chaotic as possible by explicitly explaining directions and table's roles in the testing.

Limitations:
- Student work in groups of 3-4
- Each team receives a budget of $10. Spend money wisely!
- They will receive an assortment of coins and dollar bills so they must find the right amount to buy materials
- Each team can bring one item to use in the design and will receive one glue stick to use for the design!
- The finished design must be able to fit at least one taco
- Must be able to fit inside an 8inch x 8inch cardboard box
- The taco must be available to get in and out of the taco holder!
- The design must be special and different!
- Everyone must work together!
- Students may only use materials and tools provided by the teacher.
- Students can only use the time provided
- Each team has to test their design
- Each team can make improvement after it has been tested
- Each team must test their design again after making changes

Dragon: Your team's design needs to keep the tacos safe from the dragon's fury!

Teacher Guide: Before starting the challenge, discuss options for resources from home. Along with deciding what materials are most efficient, discuss what materials from home could benefit the design. Remind students, they must work together which means sometimes we have to discuss which idea is the most efficient. Sometimes our ideas are not the ones we use.

Assessment/Evaluation:

Standards	Criteria	4 – Exceeds Expectations	3 – Meets Expectations	2 – Approaching Expectations	1 – Beginning
Science (Life, Earth/Space, or Physical Science) 2-PS1-1:	Design Journal	Journal is complete and clearly documents the problem, ideas, plan, materials, testing, results, and improvements.	Journal documents the problem, plan, materials, testing, and improvements.	The journal is partially complete and is missing some important information.	Journal is incomplete and provides little evidence of the design process.
Science (Life, Earth/Space, or Physical Science) 2-PS1-2:	Materials & Properties	Accurately identifies materials and clearly explains how their observable properties make them appropriate for the design.	Identifies materials and explains at least some properties that make them useful.	Identifies materials but gives limited explanation of their properties.	Has difficulty identifying materials or explaining their properties.
Mathematics 2.GM.12	Budget & Math	Accurately tracks material costs, uses coins/dollars appropriately, and stays within the $10 budget.	Tracks costs and stays within the $10 budget with minor errors.	Needs support calculating or tracking costs but attempts to stay within budget.	Does not accurately track costs or significantly exceeds the budget.

Technology and Engineering (STEL) Standard 2: K-2: Core Concepts of Technology and Engineering	Prototype & Intended Purpose	Prototype effectively protects the taco and allows it to be easily eaten. Design demonstrates creativity and thoughtful material selection.	Prototype protects the taco and allows it to be eaten	Prototype partially protects the taco or makes it difficult to eat.	Prototype does not adequately protect the taco or allow it to be eaten.
	Testing & Improvement	Uses test results/evidence to clearly explain what worked, what did not work, and how the design was improved.	Tests the design and makes a reasonable improvement based on results.	Tests the design but makes limited improvements or has difficulty explaining the results.	Does not adequately test or improve the design.
	Presentation & Collaboration	Clearly presents the design, explains material choices, budget, testing, and improvements. All members contribute positively.	Clearly presents the design and explains most important components. Team members participate.	Presentation includes some important information but lacks clarity or equal participation.	The presentation is incomplete or the team has difficulty working together.

Points

Science: 2-PS1-1:,2-PS1-2: _____ / 20

Math: 2.GM.12: : _____ / 20

Standard 2: K-2: Core Concepts of Technology and Engineering : _____ / 20

Build & Test: _____ / 15

Improve Our Design: _____ / 10

Engineering Journal: _____ / 5

Teamwork: _____ / 10

Total: _____ / 100

Design Journal: The design journal will be used to help physically walk each student through the engineering design loop leading to them completing their prototype. Each page will reflect each step of the design process. I will pay extra attention to the selection of materials which reflects my standards. I would spend time in the journal where the students write down/draw their material options and write out their material decision process. To represent the math standard, I would have a budget on one page and have the kids work through that. I would use this journal to physically represent what is going on in the students brain.

Teacher Notes:
Students should work in groups of 3-4, hopefully they could stay in their table groups. There will be one prototype made per team but each student needs to complete their own design journal to showcase understanding of the standards.

To set up the project...
Read through the book *Dragons Love Tacos* in its entirety. After finishing the book, talk through it as a class! Discuss what the dragons did in this story and the problems that are displayed in the story.

Preparing for them to begin..
Start by discussing different materials. What makes materials different and what can we learn about a material to determine its intended purpose. Set up the materials all around the room to allow each student to roam around and fill out step 3 on their

design journal.

Building...
Once approving their design allows the students to work together with their teams to build the project providing as little assistance as possible. Monitoring the material purchases make sure the students are correctly recording and making sure they are making correct purchases.

Student Manuel

Dragons Love Tacos

Dragons and Class party: Protect the Tacos

Scenario:
As we have seen, two things are true about dragons.
1) They LOVE tacos!
2) They do NOT like spicy salsa!
The class is going to plan a party to celebrate our school, and of course we need to invite the dragons! BUT we know what happened at our last party, the dragons encountered spicy salsa and exploded the party!

We can't predict how the dragons will act at this next party, so today we need to get prepared for them. We need to make sure the dragons can enjoy the party while also keeping the tacos safe.

Big Ideas:

- Materials can be classified by their differences and similarities
- Materials have an intended purpose based on their properties
- Coins can be used to buy things
- Budgets are useful because they help keep track of money
- Characteristics of a material determine how it is used

Essential Questions:
What differences and similarities do we classify materials by?
How do the properties of a material help determine what we use it for?
Why is it important to keep track of a budget?
How many pennies/nickels/dimes/quarters equal one dollar?
How can we make the best decision for what materials we use?

Challenge:
Working together in your teams you will design a solution that protects the tacos from the dragons while also making the tacos easy to eat.
Your design should…

- Keep the taco safe
- Allow the taco to still be eaten
- Be creative and have fun!

Each team will have 10 dollars to spend and can bring one item from home!
At the end, we will all compare our designs and then work with our friends to make our design even better!

MATERIALS:
<u>Recycled:</u>

- Plastic Bottles
- Egg cartons
- Plastic containers
- Paper towel rolls
- Cardboard
- Grocery bags
- Packaging peanuts

<u>Non Recycled:</u>

- Chop sticks
- Cups
- Straws
- Masking Tape
- Duct Tape
- Coffee Filters
- Aluminum Foil
- Cotton Balls
- Cardboard Tubes

TOOLS:

- Rulers
- Scissors
- Chomp saw
- Canary cutters
- Safety glasses/goggles
- Hole punch
- Sand paper
- Dremel tool
- Bolt cutters
- Small tape measure

+ One item of choice from home per team
+ One stick of glue per team

Limitations:
Budget: Each team is only given a $10 budget. Spend money wisely!
Item from home: Each team can bring one item to use in the design and will receive one glue stick to use for the design!
Size: The finished design must be able to fit at least one taco.

Access: The taco must be available! Can take taco in and out of the container!
Creativity: The design must be special and different!
Teamwork: Everyone must work together!
Dragon: Your team's design needs to keep the tacos safe from the dragon's fury!

Testing:
8'x8' open cardboard box: Your taco design must fit inside this 8inch by 8inch cardboard box.
Leaf blower and shaking of table: Your taco holder design must withstand the strength of a leaf blower or hair dryer at the same time your classmates will be shaking the table. This will go on for 15 seconds. If your taco is safe and your taco holder stays together, you have succeeded!
The teacher will also check to make sure the taco box is easy to open

Results:
- Finished Prototype
- Finished Design Journal

Rubric:

I Can...	I Did It!	Almost There!	I Need Some Help	I'm Just Starting
Show My Thinking!	I completed my design journal and showed all of my thinking.	I completed most of my journal.	I completed some of my journal.	I need to finish my journal.
Choose Good Materials!	I can explain the properties of my materials and why I chose them	I can explain some of my material choices.	I need help explaining my choices.	I need help choosing and explaining materials.
Be a Budget Boss!	I stayed under $10 and correctly recorded out my costs.	I stayed under $10 but did not record my costs.	I went over my budget but recorded my costs.	I went over my budget or did not keep track.
Build a Taco Protector!	My design protects the taco	My design does both, but could	My design does one part well.	My design needs more work.

	AND makes it easy to eat!	be better.		
Test & Make It Better!	I tested my design and used what I learned to make it better.	I tested my design and made a change.	I tested it but need help making it better	I did not test or improve my design.
Share My Design!	I clearly explained my design and everyone on my team helped	I explained my design and most of my team helped.	I shared some information but need more practice.	I need help explaining my design.

I can...

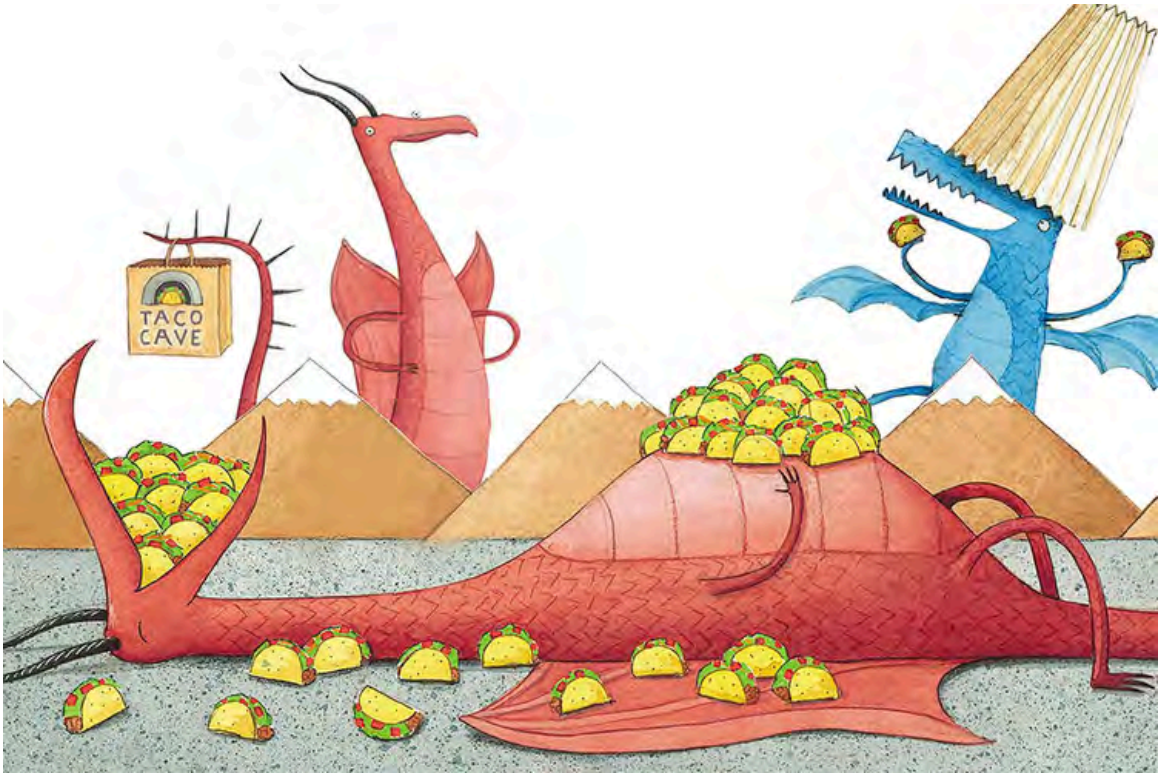
- Confidently handle a budget.
- Correctly pick out materials with a purpose in mind.
- Determine a material's intended purpose.

Design Journal: https://canva.link/u0pkngp5gk6hea8

MY ENGINEERING DESIGN JOURNAL

NAME:_____

TEAM:_____



STEP 1:

LET'S REVIEW!

IN YOUR OWN WORDS....
WHAT HAPPENS IN DRAGONS LOVE TACOS?

WHAT IS THE PROBLEM WE ARE NEEDING TO SOLVE?

WHAT ARE WE GOING TO BUILD TO SOLVE THE PROBLEM?

STEP 2:

LET'S BRAINSTORM!

SKETCH/WRITE OUT YOUR BEST IDEAS:

STEP 3:

LET'S FINALIZE!

PICK YOUR THREE BEST IDEAS:

IDEA 1:

IDEA 2:

IDEA 3:

OUR TEAM IS GOING WITH IDEA _____!

STEP 4:

LET'S EXPLORE MATERIALS!

SKETCH AND TAKE NOTES AS WE EXPLORE DIFFERENT MATERIALS:

MATERIALS	PROPERTIES			
	SHAPE/SIZE	COLOR	TEXTURE	FELXIBILITY

STEP 4:

LET'S EXPLORE MATERIALS!

CONTINUED...

MATERIALS	PROPERTIES			
	SHAPE/SIZE	COLOR	TEXTURE	FELXIBILITY

STEP 5:

LET'S CHOOSE OUR MATERIALS!

ANWSER FOR EACH MATERIAL YOUR TEAM WILL USE:
WHY DID YOU CHOOSE THIS MATERIAL?
WHAT IS ITS PURPOSE IN YOUR DESIGN?
DRAW YOUR MATERIAL:

MATERIAL #1

MATERIAL #2

MATERIAL #3

MATERIAL #4

STEP 5:

LET'S CHOOSE OUR MATERIALS!

ANWSER FOR EACH MATERIAL YOUR TEAM WILL USE:
WHY DID YOU CHOOSE THIS MATERIAL?
WHAT IS ITS PURPOSE IN YOUR DESIGN?
DRAW YOUR MATERIAL:

MATERIAL #5

MATERIAL #6

MATERIAL #7

MATERIAL #8

STEP 6:

LETS TALK BUDGET!

HOW MUCH MONEY ARE YOU STARTING WITH?

ONES:

QUARTERS:

DIMES:

NICKELS:

PENNIES:

WRITE OUT THE COST OF YOU MATERIALS:

HOW ARE YOU EXPECTING TO SPEND YOUR MONEY?

DOES THIS CHANGE WHAT MATERIALS YOU ARE GOING TO USE?

STEP 7:

LETS TALK BUDGET!

USE THIS SPACE TO RECORD HOW YOUR TEAM SPENDS THEIR MONEY:

MATERIAL	HOW MANY?	COST

TOTAL MONEY SPENT:

_____

TOTAL MONEY LEFT:_____

DID WE STAY WITHIN THE BUDGET:

YES/NO

STEP 8:

LET'S BUILD!

SHOW A DETAILED SKETCH OF WHAT YOUR TEAM PLANS TO BUILD: (INCLUDE THE SPECIFIC MATERIALS)

STEP 9:

LET'S FINISH UP!

SHOW A DETAILED SKETCH OF WHAT YOUR TEAM BUILT: (INCLUDE THE SPECIFIC MATERIALS)

STEP 10:

LET'S REFLECT!

DID WE FOLLOW OUR PLAN?

WHAT DID EACH TEAM MEMBER DO?

DID WE MAKE ANY CHANGES WHILE BUILDING?

WHAT WENT THE WAY YOU EXPECTED IT TO?

WHAT DIDN'T GO AS EXPECTED?

WHAT ABOUT YOUR DESIGN ARE YOU MOST PROUD OF?

STEP 11:

TEST IT!

WHAT IS YOUR TEAM'S EXPECTATION FOR HOW THE TEST IS GOING TO GO?

WHAT HAPPENED DURING THE TEST?

STEP 12:

IMPROVE IT!

WHATS ONE THING WE CAN CHANGE?

WHY WOULD THIS CHANGE HELP?

DRAW YOUR IMPROVED DESIGN:

STEP 13:

IMPROVE IT!

HOW DID THE SECOND TEST GO?

DID YOUR CHANGES WORK WELL THE SECOND TIME YOU TESTED?

WHAT DID YOU LEARN FROM TESTING YOUR DESIGN?

STEP 14:

LET'S CONSIDER!

WHAT WAS YOUR FAVORITE PART OF THIS CHALLENGE?

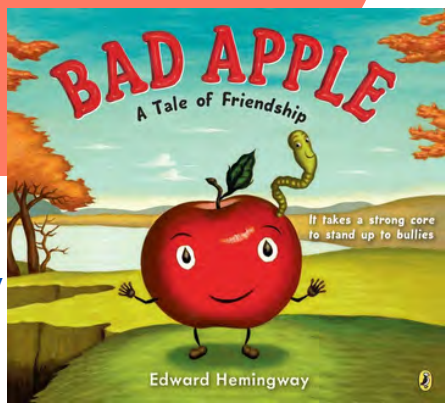
WHY ARE YOU PROUD OF YOURSELF?

WHAT DID YOU LEARN FROM THIS CHALLENGE?

HOW DID YOU TEAM WORK TOGETHER?

GREAT JOB ENGINEER!

Teacher Guide: Mac & Wills Weather-Proof Challenge



Grade Level: 3rd Grade

Literacy Content: Bad Apple: A Tale of Friendship by Edward Hemingway

STEM Standards:
Science standard:
3-ESS2-1: represent data in tables and graphical displays to describe typical weather conditions expected during a particular season.
Mathematics standard:
3.DA.1: represent a data set with multiple categories, using a scaled picture graph, scaled bar graph, and line plot.
STEL standard:
Standard 2: Core Concepts of Technology and Engineering
L: Create a new product that improves someone's life.

Big Ideas:
We can take weather data and make predictions about typical weather.
Weather doesn't stay the same, it changes throughout the seasons.
Data can be collected and organized in different ways to represent results.
We can understand that different types of data is appropriate for different types of data.
Students can successfully go through the process of the engineering design loop.

Essential Questions:
- How can we use the weather data to create an effective solution for our characters?
- How can students use testing and data to improve a design to make sure to better meet the needs of others.
- How can we use graphs to learn about seasonal weather?

Scenario:
Mac and will are outside playing when they hear a weather report warning that severe weather is coming. They realize they won't make it home in time to be safe from the storm. Mac and Will were able to find scraps of items that they could build a structure with but they need your help!

Challenge:
Design and build a shelter for Mac and Will that protects them from wind and rain. Use the materials that you have been given and show what you know about weather to create a strong shelter that keeps them safe. The shelter must be able to withhold strong winds and pouring rain.

Tools:

- Glue
- Scissors
- Rulers
- Pencils
- Markers/crayons

Materials:

- 10 Craft sticks
- 2 sheets of constructions paper
- 2 index cards
- 5 straws
- 4 pipe cleaners
- 1 foot of masking tape
- 1 piece of cardboard
- 4 puff balls
- 1 foot of string
- 2 pieces of aluminum foil

Resources:

- the children's book Bad Apple: A Story of Friendship
- design challenge directions
- some basic vocabulary words:
- local weather information
- weather data charts/graphs

Requirements:

- **Can withstand 10 seconds of low, medium, and high settings.**
- Can be pinned down to board for wind check
- Needs to protect Mac and Will from severe storms (spray bottle demonstration and leaf blower)
- Must include fun activities for Mac and Will to do during storm.
- Groups can only use materials given to them.
- MUST work together in your table group.

S**TEM Content Information Related to Identified Standards:**

- Science:
  - Weather
  - Temperature
  - Wind
  - Precipitation
  - Rain
  - Storm
  - Weather hazard
  - Season
  - Weather pattern
  - Data
  - Forecast

- Technology and Engineering:
  - Engineer
  - Design
  - Problem
  - Solution
  - Prototype
  - model
  - Materials
  - Test
  - Improve
  - Structure
  - Shelter
- Mathematics:
  - Data
  - Category
  - Picture graph
  - Bar graph
  - Line plot
  - Scale
  - Measure
  - Length
  - Height
  - Width
  - Compare

Results/Deliverables:

Students will complete an engineering journal documenting weather observations, design ideas, testing results, and improvements. Students will design and build a shelter for Mac and Will that protects them from different weather conditions. Each group will present their final design to the class, explain their design choices, and participate in a class test of their shelter.

Limitations:

You will have three days in class during our math and science period to complete project. Then on Thursday we will present to the class. You can only use the materials listed in packet. You will need to be creative and use the materials in different ways to create a unique shelter. These limits will help you practice each step of the engineering design process as you plan, build, test, and improve your design.

Assessment/Evaluation with Clear Testing Procedures:

You will work with your group to design and build a safe home for Mac and Will using the materials provided and the time you have available. You will collect weather data in your engineering journal and organize your findings in tables, scaled picture graphs, scaled bar graphs, and line plots. You will use your weather data to decide what conditions your shelter needs to protect against and create a unique design that helps keep Mac and Will safe.

After building your shelter, you will test it, record your observations, and make improvements based on your results. At the end of the project, each group will present its shelter to the class, and every student must explain one part of the design and why the group made those choices.

Finally, you will complete an individual reflection form about what you learned, the vocabulary you used, and how your group worked together. This will help show your understanding of weather patterns, data and graphs, and how engineers create and improve products to solve problems.

Teacher Directions/Necessary supporting Materials:

Teachers will use the leaf blower tool. Make sure you give students the option to pin down their project on the cork board. Include a spray bottle with water to use as a replacement for rain. Allow students to have creative freedom and don't try to lead them a certain way but instead guide them through the project.

Student Guide

Mac & Wills Weather-Proof Challenge

Name: _____

Date: _____



Big Ideas:

- We can take weather data and make predictions about typical weather.
- Weather doesn't stay the same, it changes throughout the seasons.
- Data can be collected and organized in different ways to represent results.
- We can understand that different types of data is appropriate for different types of data.
- Students can successfully go through the process of the engineering design loop.

Essential Questions:

- How can we use the weather data to create an effective solution for our characters?
- How can students use testing and data to improve a design to make sure to better meet the needs of others.
- How can we determine if a design solution effectively reduces the impact of a earthquakes, rain, or tornadoes.



Scenario:

Mac and will are outside playing when they hear a weather report warning that severe weather is coming. They realize they won't make it home in time to be safe from the storm. Mac and Will were able to find scraps of items that they could build a structure with but they need your help!

Challenge:

Design and build a shelter for Mac and Will that protects them from wind and rain. Use the materials that you have been given and show what you know about our weather data to create a strong shelter that keeps them safe, aong with fun activities for them do do while they are in the storm. The shelter must be able to withhold strong winds and pouring rain.

Tools:

- Glue
- Scissors
- Rulers
- Pencils
- Markers/crayons

Materials:

- 10 Craft sticks
- 2 sheets of constructions paper
- 2 index cards
- 5 straws
- 4 pipe cleaners
- 1 foot of masking tape
- 1 piece of cardboard
- 4 puff balls
- 1 foot of string
- 2 pieces of aluminum foil

Resources:

- the children's book Bad Apple: A Story of Friendship
- design challenge directions
- some basic vocabulary words:
- local weather information
- weather data charts/graphs

What you will be submitting:



- A completed strucutre made out of your given materials
- Your detailed sketches of your design process
  - provided in your Engineering Design Journal
- Your completed Engineering Design Journal
  - all data graphs and promtps should be completed
- Breif presentation of your completed structure and how came up with your idea, along with struggles you overcame
- Structure should still stand after 10 seconds of each setting on the leaf blower (low, medium, high)
- Structure should continue to stand while heavy rain (from spray bottle) is pouring down.

Limitations:

- You will have three days during math and science class to complete your project.
- You will present your shelter to the class on Thursday.
- You may only use the materials listed in your packet.
- Be creative and use your materials in different ways to build a unique shelter.
- Your shelter must stand for 10 seconds at each leaf blower setting: low, medium, and high.
- Your shelter must also withstand the pouring rain during the spray-bottle test.
- You may pin your shelter to the board provided to help keep it in place.
- Use the engineering design process to plan, build, test, and improve your shelter.



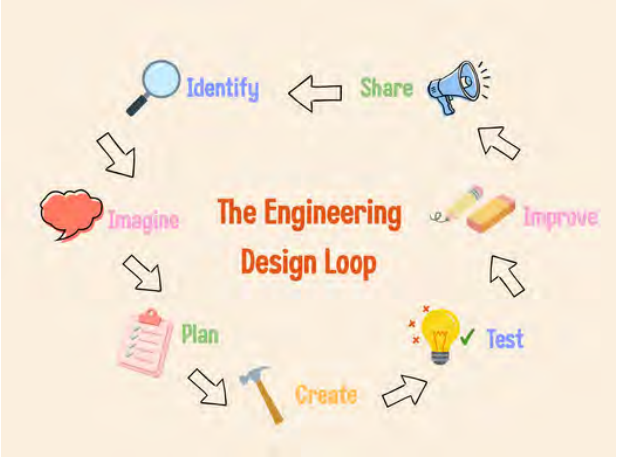
Student Rubric

Criteria	4 – Excellent	3 – Good	2 – Growing	1 – Starting
Science: Weather Data (3-ESS2-1)	I use weather data to explain seasonal weather patterns.	I collect weather data and describe the weather.	I collect some data but need help explaining it.	I need help collecting and understanding weather data.
Math: Graphs and Data (3.DA.1)	I correctly complete a table, picture graph, bar graph, and line plot using a scale.	I complete all four displays with a few mistakes.	I complete some displays but need help with others.	I need help organizing data and making graphs.
Engineering: Shelter Design (STEL 2L)	Our unique shelter protects Mac and Will from wind and rain and includes an activity for them.	Our shelter protects Mac and Will from most wind and rain and includes an activity.	Our shelter offers some protection or is missing an activity.	Our shelter needs more work to protect Mac and Will.
Engineering Process	I plan, build, test, record results, and improve my design using what I learned.	I follow the design process, test my shelter, and make an improvement.	I complete some steps but need help testing or improving.	I need help following the design process.
Presentation	I clearly explain my part and use data or test results to explain our choices.	I explain my part and why we made our choices.	I explain some of my part but need help.	I need help explaining my part.
Teamwork and Journal	I work well with my group and complete a detailed journal.	I work with my group and complete my journal.	I sometimes need reminders to participate or finish my journal.	I need help participating and completing my journal.

Engineering Design Journal

Name:

Design Challenge:



Identify-

What is the problem that needs to be solved?

Who is it that you need to help?

What does your creation need to be able to do?

Weather Chart:



Week 1

DATE	HIGH OF THE DAY	LOW OF THE DAY	WEATHER OUTSIDE

Week 2

DATE	HIGH OF THE DAY	LOW OF THE DAY	WEATHER OUTSIDE

Imagine-



What are different ways that you can protect Mac and Will?

Sketch an idea of a safe space for Mac and Will:

Plan-



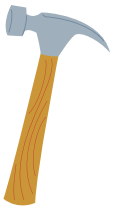
Which idea will your table group choose?

What materials will you need to build your prototype? (Make a list)

-
-
-
-
-
-
-
-
-

Draw or write out a step by step guide for how you will build your design:

Create-



Is your design turning out how you planned?

Are you following your plan step by step that you wrote out before designing?

What parts of your design has worked well since you started creating?

Test-

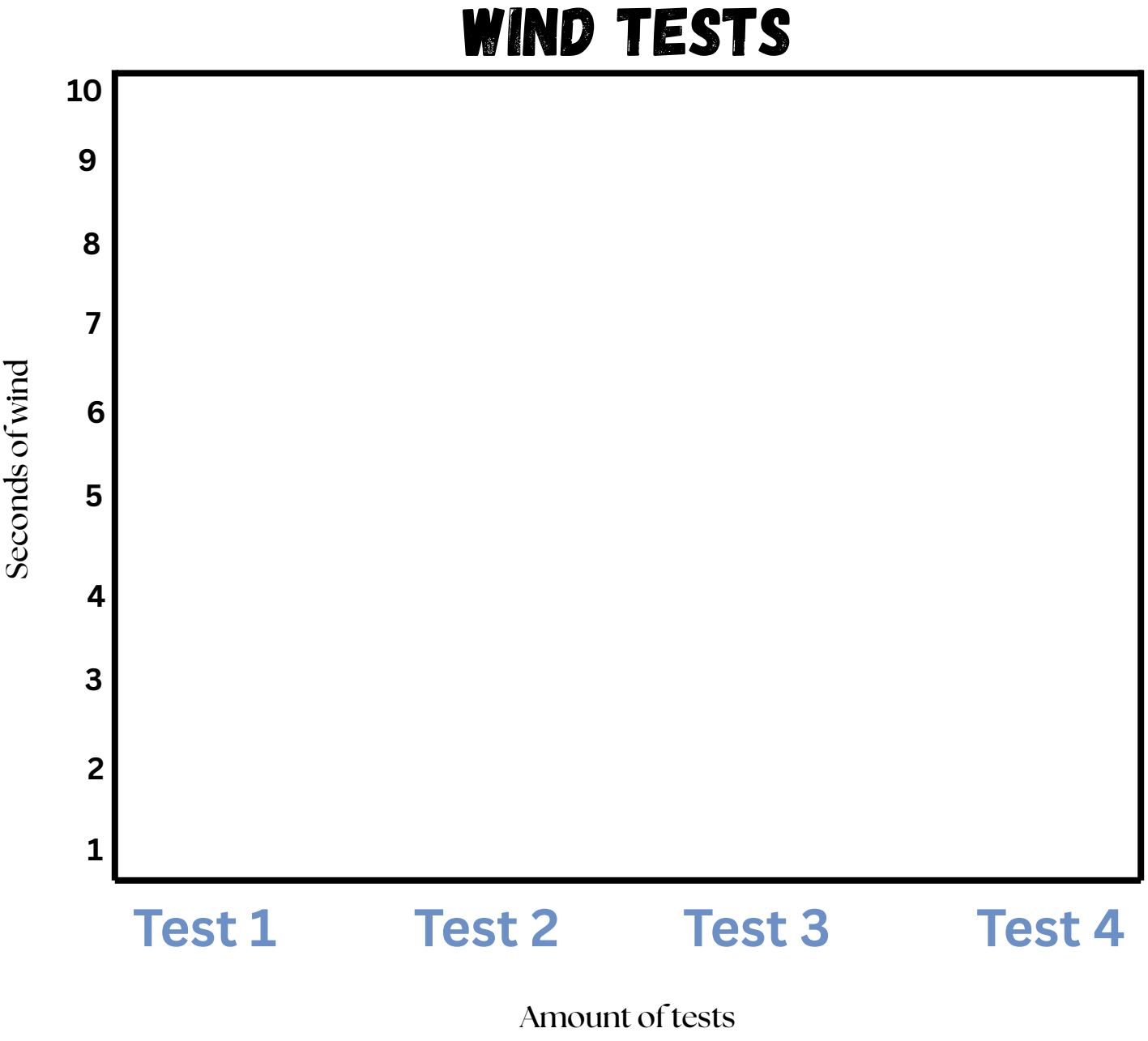


Did your design solve Mac and Wills problem?

Did your design follow all of the rules and limitations?

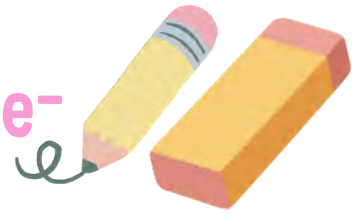
Explain what happened when you tested your safe space?

Plotting Your Test Results



Draw what happened to your design after the tests:

Improve-



What parts of your design needs improvements?

What materials could you add, remove, or change?

Draw what your new design will look like:

Share-



How did you end up fixing your initial design plan?

How did your design keep Mac and Will safe?

What materials did you choose and why?

Self Reflection

Circle the number that you feel describes you most.

Criteria	4-Excellent	3- Good	2-Okay	1-Need Improvement
Science	I can use weather data to explain weather patterns	I can collect weather data and describe weather.	I can collect some data but need help explaining it	I don't know how to collect or understand weather data.
Math	I can complete a table, picture graph, bar graph, and line plot using a scale.	I can complete all four graphs with only a few mistakes.	I can complete some of the graphs but need help with most.	I don't understand how to complete graphs.
Engineering Design	I can plan, build, test, record, and improve my design using what I learned.	I followed the design process, tested my shelter, and made an improvement .	I can complete some of the steps but need help with most.	I don't understand the design process.
Teamwork	I worked very good with my group and put in a lot of effort to the project.	I worked with my group pretty well and put in a good amount of effort.	I struggled working with my group and put in some effort.	I didn't work well with my group and I put in little to no effort.

Literature Based STEM Curriculum Project

Bigfoot on the Loose! Can you catch him?

Teachers Guide:

Grade Level: 3rd Grade

Standards:

Science: Forces and Interactions - 3-PS2-1 - Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object

Math: Data Analysis - 3.DA. 1 - Represents a data set with multiple categories, using a scaled picture graph, scaled bar graph, and line plot

STEL: Standard 1: Nature and characteristics of Technology and Engineering - H: Design solutions by safely using tools, materials, and skills

Big Ideas:

Science- Forces can affect the motion of an object.

Math- Data can be represented in multiple ways (scaled picture graph, scaled bar graph, or a line plot)

STEL- Tools, materials, and skills can help us safety find solutions when solving a design.

Essential Questions:

Science- How can we investigate using evidence to show the effects of balanced and unbalanced forces on the motion of an object.

Math- How can we use line plots, scaled pictures and bar graphs to show date based on an investigation?

STEL- How can we safely use tools, materials and skills to solve a design problem?

Scenario:

Bigfoot has been spotted, and it is time to catch him! After reading the book, *The Boy Who Cried Bigfoot,* you are now tasked with helping Ben to prove that Bigfoot is real. Bigfoot is hiding in the woods, and your group is tasked with creating a trap that will help catch him. Bigfoot is big, tall, strong, hairy, and knows how to hide in between the trees. Think carefully about where Bigfoot might be, what he likes, and what will trap him.

Challenge:

Design and build a trap that will catch Bigfoot in the woods. You will use materials such as cardboard, paper, string, wire, pipe cleaners, and other provided materials. The final trap your group makes will need to use force and be triggered by an object to trap Bigfoot. Your trap will be tested by "trapping" a wind-up toy. Use the engineering process and document all data for your group and others during testing (time it took to trap Bigfoot, observations of each group, how well it trapped Bigfoot, etc.) in a design/student activity journal.

Tools:

- Scissors
- Hot glue guns
- Sanding sponges

Materials:

Cardboard - $1.50 per square foot

Pipe Cleaners - $1.00 per four piper cleaners

Pen Springs - $0.25 per spring

Wheels and Axels - $2.00 per set

Duct Tape - $0.50 per foot

Aluminum Foil - $1.00 per sheet

Construction Paper - $1.00 per four sheets

Plastic Bins - $2.50 per bin

String - $1.75 per two feet

Bobbins - $1.00

Resources:

Physical copy of *The Boy Who Cried Bigfoot*

Design planning sheet

Data collection sheet

STEM Content Information Related to Standards:

Science:

Essential Vocabulary:

Force - a push or a pull acting on an object

Motion - the change in an objects position, speed, or direction over time

Balanced Forces-equal forces acting in opposite directions that produce no change in motion

Unbalanced Forces-unequal forces that result in a net force and cause a change in an objects motion

Net Force-the overall combined force acting on an object

Variable-a single factor that can be changed, measured, or controlled in an investigation

Essential Content:

Pushes and Pulls-forces are a push or a pull acting on a specific object from contract

Strength and Direction-every force has a relative size (strength) and a specific direction

Balanced Forces-multiple forces acting on an object that cancel each other out, resulting in no change in motion or keeping an object at rest

Unbalanced Forces-forces that do not sum to zero, they cause an object to start moving, speed up, slow down, or change direction

Gravity-addressed strictly as a downward pulling force acting on objects

Technology and Engineering (STEL)

Essential Vocabulary:

Design - a plan or drawing produced to show the look and function of an object system before it's built

Tools - devices or implements used to carry out a particular function or physical task

Materials - the matter or substances from where things are made

Skills - the ability to do something well through practice, training, and application of knowledge

Safety - the condition of being protected from potential danger, risk, or injury while working with physical equipment

Resources - a stock or supply of materials, staff, or assists, that can be drawn on to get a job done

Essential Content:

Human capability and work - people use appropriate, specific tools and techniques to accomplish tasks and extended human capabilities

Resource utilization - everyday items and solutions are created using foundational rescources such as wood, metal, stone, and cloth

Mathematics:

Essential Vocabulary:

Data-a collection of information of facts gathered through surveys, experiments, or observations

Category-a specific group or classification within a data set

Essential Content:

Data Problem Solving-answering one and two step comparison questions (such as “how many more” or “how many less”) using the information found in the graphs

Scaled Picture Graphs-graphs using a picture or a symbol where a single icon represents a specific number greater than one

Results and Deliverables:

After completeing the Bigfoot Trap Design, each student will need to deliver the following:

Bigfoot Trap

- Actual design of the trap to catch Bigfoot
- Constructed using the materials provided
- Working design that can be demonstrated in front of the class

Design Planning Sheet

- Design plan worksheet filled out
- List of materials used
- Design sketched out
- Thoughts planned out on how the design should succeed

Data Collection Sheet

- Sheet filled out with the recordings with individual data and of the rest of the class’s design data
- Data should include whether the trap works, how many attempts it took for the trap to work, how long it to the trap to work, force observed, motion observed, and a short description of what each design looked like

Limitations:

Some limitation include:

- Materials and tools (the only materials and tools students can use are the ones provided)
- Size (the trap size should be able to fit on a desk table)
- Testing (each group must test their trap three times before presenting it to the class) (students must record each test trial on their data collection worksheet or in their design journal)

Force and Motion Trap Design Challenge Rubric

Science Standard – Forces and Interactions (3-PS2-1):

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.

Mathematics Standard – Data Analysis (3.DA.1):

Represent a data set with multiple categories, using a scaled picture graph, scaled bar graph, and a line plot.

Technology & Engineering Literacy Standard 1 – Nature and Characteristics of Technology and Engineering:

Benchmark H: *Design solutions by safely using tools, materials, and skills.*

Total Points: _____ / 24

Criteria	**4 – Excellent**	**3 – Meets Expectations**	**2 – Developing**	**1 – Beginning**
1. Forces & Motion / Trap Performance	Trap successfully completes the design challenge during testing and clearly demonstrates how **balanced and/or unbalanced forces affect the motion of an object**. Student can explain the forces involved using evidence from testing.	Trap works during testing and demonstrates how **forces affect the motion** of an object. Student identifies the main force(s) involved.	Trap works inconsistently or demonstrates only a limited understanding of how forces affect motion. Explanation of forces is incomplete or partially accurate.	Trap does not work or does not demonstrate an understanding of how forces affect the motion of an object.
2. Investigation, Testing & Evidence	Student helps **plan and conduct multiple trials**, changes or controls variables appropriately, and uses observations/evidence from testing to explain how forces affected the trap's motion.	Student participates in planning and conducting trials and records observations that provide evidence about the trap's motion.	Student participates in some testing but trials, observations, or evidence are incomplete or inconsistent.	Student does not meaningfully participate in testing or provides little/no evidence from trials.
3. Data Collection & Mathematical Representation	Data for **all trials is accurate and complete**. Student records observations and appropriately represents the data using required **scaled picture graph, scaled bar graph, and line plot**, and uses the representations to	Data and observations are accurate and complete for the trials. Student represents the data using the required mathematical representation(s) with minor errors.	Some data or observations are missing/incorrect, or mathematical representations are incomplete or contain significant errors.	Data is largely missing or incorrect, and required mathematical representations are not completed.

	identify patterns or			
4. Engineering Design, Materials & Teamwork	Student actively contributes ideas, safely uses tools and materials, collaborates effectively, and helps **design, test, evaluate, and improve** the trap. Final design is creative, uses materials appropriately, and successfully solves the challenge.	Student participates, contributes ideas, safely uses materials/tools, completes assigned group work, and helps create a trap that solves the design challenge.	Student participates inconsistently or needs reminders to contribute, use materials safely, or complete assigned work. Trap needs significant improvement.	Student does not contribute appropriately to the team, uses materials/tools unsafely or inappropriately, or does not help complete the design challenge.

Score

Forces & Motion: _____ / 4

Investigation, Testing & Evidence: _____ / 4

Data Collection & Mathematical Representation: _____ / 4

Engineering Design, Materials & Teamwork: _____ / 4

Total: _____ / 16

Optional 24-Point Version

If you want to keep the original **24-point scale**, I recommend separating the engineering and teamwork components rather than having them compete for one category:

1. Forces & Motion / Trap Performance — **/4**
2. Investigation, Testing & Evidence — **/4**
3. Data Collection & Mathematical Representation — **/4**
4. Engineering Design & Improvement — **/4**
5. Safe Use of Tools & Materials — **/4**
6. Participation & Teamwork — **/4**

Total: _____ / 24

BIGFOOT ON THE LOOSE! CAN YOU CATCH HIM?



SCENARIO:

BIGFOOT HAS BEEN SPOTTED, AND IT IS TIME TO CATCH HIM! AFTER READING THE BOOK, THE BOY WHO CRIED BIGFOOT, YOU ARE NOW TASKED WITH HELPING BEN TO PROVE THAT BIGFOOT IS REAL. BIGFOOT IS HIDING IN THE WOODS, AND YOUR GROUP IS TASKED WITH CREATING A TRAP THAT WILL HELP CATCH HIM. BIGFOOT IS BIG, TALL, STRONG, HAIRY, AND KNOWS HOW TO HIDE IN BETWEEN THE TREES. THINK CAREFULLY ABOUT WHERE BIGFOOT MIGHT BE, WHAT HE LIKES, AND WHAT WILL TRAP HIM.

CHALLENGE:

DESIGN AND BUILD A TRAP THAT WILL CATCH BIGFOOT IN THE WOODS. YOU WILL USE MATERIALS SUCH AS CARDBOARD, PAPER, STRING, WIRE, PIPE CLEANERS, AND OTHER PROVIDED MATERIALS. THE FINAL TRAP YOUR GROUP MAKES WILL NEED TO USE FORCE AND BE TRIGGERED BY AN OBJECT TO TRAP BIGFOOT. YOUR TRAP WILL BE TESTED BY "TRAPPING" A WIND-UP TOY. USE THE ENGINEERING PROCESS AND DOCUMENT ALL DATA FOR YOUR GROUP AND OTHERS DURING TESTING (TIME IT TOOK TO TRAP BIGFOOT, OBSERVATIONS OF EACH GROUP, HOW WELL IT TRAPPED BIGFOOT, ETC.) IN A DESIGN/STUDENT ACTIVITY JOURNAL.

BIG IDEAS:

SCIENCE- FORCES CAN AFFECT THE MOTION OF AN OBJECT.

MATH- DATA CAN BE REPRESENTED IN MULTIPLE WAYS (SCALED PICTURE GRAPH, SCALED BAR GRAPH, OR A LINE PLOT)

STEL- TOOLS, MATERIALS, AND SKILLS CAN HELP US SAFETY FIND SOLUTIONS WHEN SOLVING A DESIGN.

ESSENTIAL QUESTIONS:

SCIENCE- HOW CAN WE INVESTIGATE USING EVIDENCE TO SHOW THE EFFECTS OF BALANCED AND UNBALANCED FORCES ON THE MOTION OF AN OBJECT.

MATH- HOW CAN WE USE LINE PLOTS, SCALED PICTURES AND BAR GRAPHS TO SHOW DATE BASED ON AN INVESTIGATION?

STEL- HOW CAN WE SAFELY USE TOOLS, MATERIALS AND SKILLS TO SOLVE A DESIGN PROBLEM?

BUDGET: **$15 LIMIT....** SPEND IT WISELY!

Materials	Unit	Price
Carboard	per square foot	$1.50
Pipe Cleaners	4	$1.00
Pen Springs	1	$0.25
Wheels & Axels	1 set	$2.00
Duct Tape	1 foot	$0.50
Alluminum Foil	12 x 12 sheet	$1.00
Construction Paper	4	$1.00
Plastic Bins	1	$2.50
String	2 feet	$1.75
Bobbins	1	$1.00

TOOLS AVAILABLE:

- SCISSORS
- HOT GLUE GUNS
- SANDING SPONGUES

RESULTS: AFTER COMPLETING THE BIGFOOT TRAP, YOUR TEAM SHOULD COMPLETE THE FOLLOWING

BIGFOOT TRAP:

- [ ] PHYSICAL BIGFOOT TRAP DESIGN (CREATED USING THE PROVIDED MATERIALS)

DESIGN PLANNING SHEET:

- [ ] DESIGN PLAN WORKSHEET (COMPLETLY FILLED OUT)

- [ ] LIST OF MATERIALS YOUR GROUP USED
- [ ] DESIGN SKETCHED OUT

DATA COLLECTION SHEET:

- [ ] DATA RECORDED OF YOUR GROUPS TRAP AND OTHER GROUP'S TRAPS
- [ ] DATA SHOULD INCLUDE WHETHER THE TRAP WORKS, HOW MANY ATTEMPTS IT TOOK FOR THE TRAP TO WORK, HOW LONG IT TOO THE TRAP TO WORK, FORCE OBSERVED (UNBALANCED OR BALANCED), MOTION OBSERVED, AND A SHORT DESCRIPTION OF WHAT EACH DESIGN LOOKED LIKE

LIMITATIONS:

- YOUR GROUP CAN ONLY USE MATERIALS FROM THE LIST (NOTHING FROM HOME!)
- THE SIZE OF YOUR TRAP SHOULD NOT BE BIGGER THAN A THIRD GRADER!
- YOU MUST TEST YOUR TRAP THREE TIMES BEFORE WE SHARE WITH THE CLASS

TRAP DESIGN CHALLENGE RUBRIC:

Name: _____ **Team:** _____ **Date:** _____

What I Am Being Graded On	4 – Excellent	3 – Meets	2 – Almost There	1 – Keep Practicing
Forces & Motion	My trap works! I can explain how forces made things move, stop, or change direction. I can tell about balanced and unbalanced forces.	My trap works, and I can explain how forces made something move.	My trap works sometimes. I can explain some of the forces, but I need more practice.	My trap does not work yet, and I cannot explain how forces affect motion.
Testing & Evidence	I helped plan and test my trap several times. I used what I saw to explain what worked and what I changed.	I helped test my trap and recorded what happened.	I helped with some tests, but I need more information about what happened.	I did not complete the tests or record what happened.
Data & Graphs	I recorded accurate data from every test. I made my picture graph, bar graph, and line plot correctly. I can tell what my data shows.	I recorded my data and made my graphs. Most of my information is correct.	Some of my data or graphs are missing or have mistakes.	My data is missing or incorrect, and I did not finish my graphs.
Build, Improve & Create	I used the right materials, built a creative trap, tested it, and improved it to make it work better.	I used the materials correctly and built a trap that works.	My trap needs more building or improving.	My trap is not finished yet.
Safe Tools & Materials	I used tools and materials safely and responsibly every time.	I used tools and materials safely most of the time.	I needed some reminders to use tools and materials safely.	I did not use tools or materials safely.
Teamwork	I shared ideas, listened to my teammates, helped everyone, and did my fair share of the work.	I shared ideas and helped my team complete the project.	I helped sometimes, but I needed reminders to participate.	I did not help my team or complete my part of the project.

MY SCORE:

FORCES & MOTION: _____ / 4 TESTING & EVIDENCE: _____ / 4 DATA & GRAPHS: _____ / 4 BUILD, IMPROVE & CREATE: _____ / 4

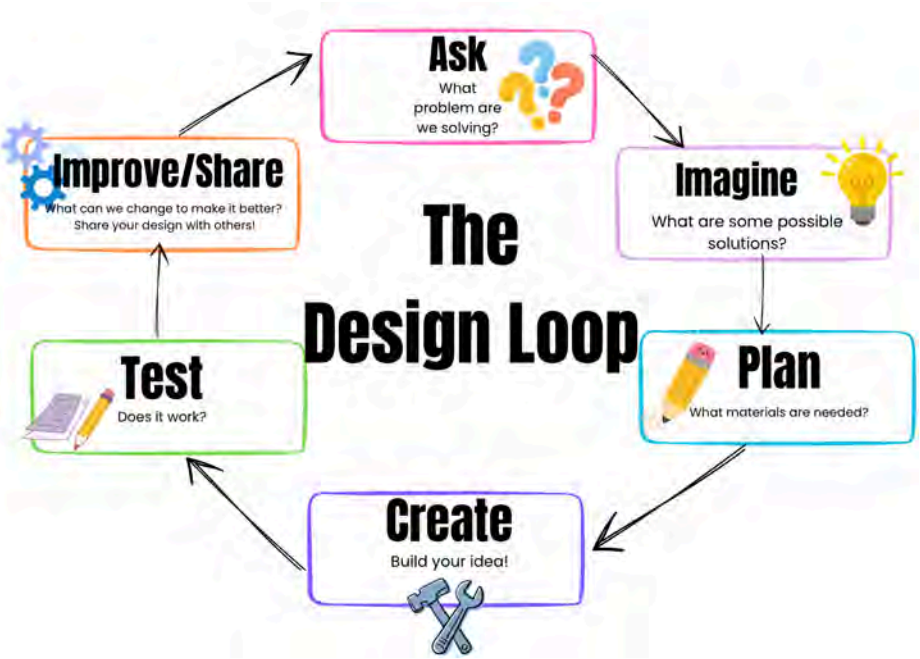
SAFE TOOLS & MATERIALS: _____ / 4 TEAMWORK: _____ / 4 TOTAL: _____ / 24

My Engineering Design Journal



Name: _____

Project Title: _____



Step 1: ASK

What is the problem you are trying to solve?

What does your trap need to do?

Step 2: IMAGINE

What are some ideas on how to solve your problem? Draw your groups possible trap ideas!

Possible Trap Idea #1	Possible Trap Idea #2	Possible Trap Idea #3

Step 3: PLAN

List out what materials your group might think they will need.

Create a labeled drawing of your "final" trap. Make sure to label materials, important parts of the trap, how your trap will use motion, and how your trap plans to catch Bigfoot.

Drawing goes here:

Step 4: CREATE

- [ ] Gather Materials & Tools
- [ ] Follow Your Plan
- [ ] Make Changes as Needed

What materials did you use to build your trap?

Did you follow your original plan/sketch:

What tools did you use to build your trap?

Materials	Unit	Price	Materials Used
Cardboard	per square foot	$1.50	
Pipe Cleaners	4	$1.00	
Pen Springs	1	$0.25	
Wheels & Axels	1 set	$2.00	
Duct Tape	1 foot	$0.50	
Alluminum Foil	12 x 12 sheet	$1.00	
Construction Paper	4	$1.00	
Plastic Bins	1	$2.50	
String	2 feet	$1.75	
Bobbins	1	$1.00	

Total Spent: _____

Step 5: Test

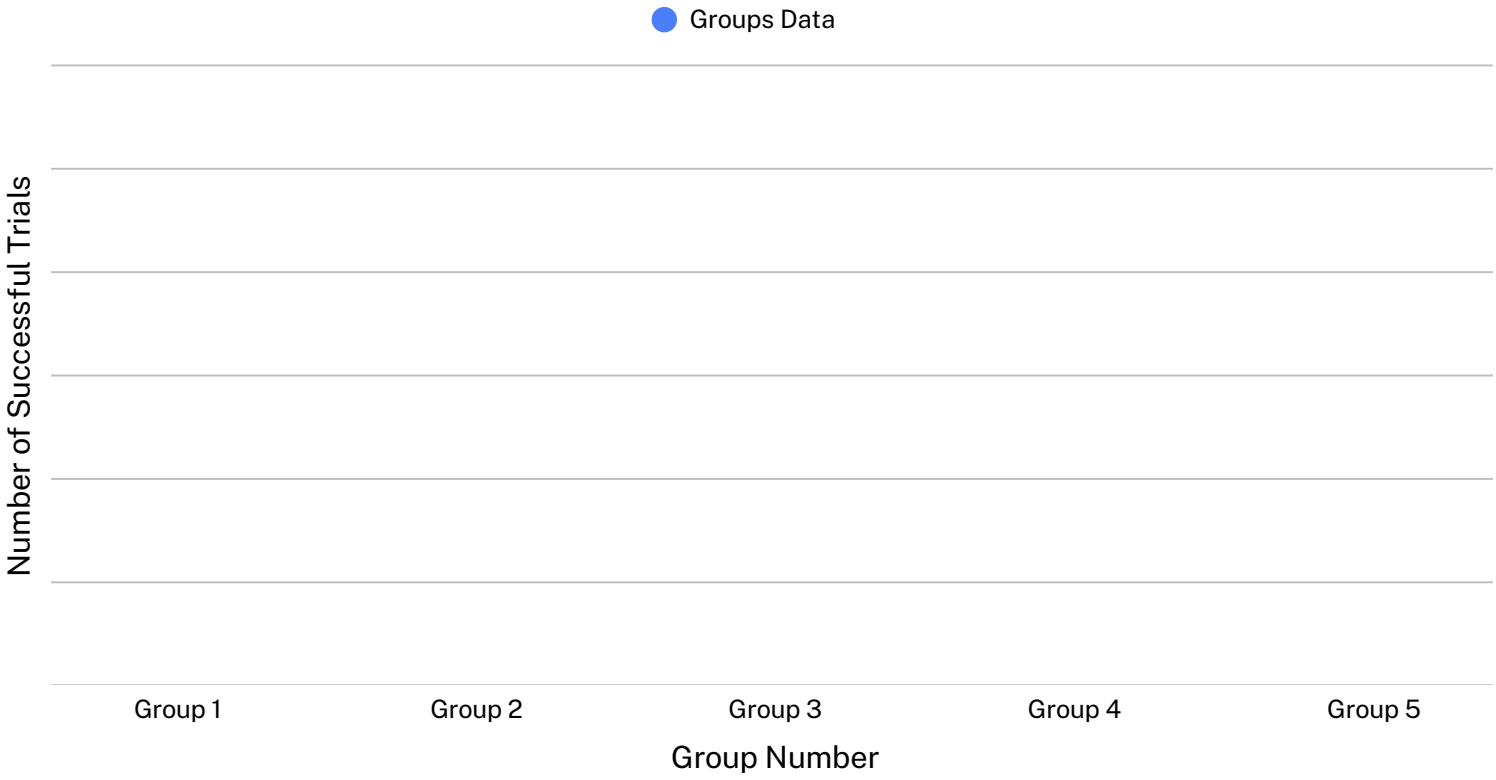
Trail #	Did the Trap Work?	What Happend?	Observations:
1			
2			
3			

Step 6: Improve/Share

Class Trap Challenge Data:

Group	Did the Trap Work? Yes or No.	How many times did the trap work? (__/3 Trials)	Force Observed (Balanced or Unbalanced) :	Observations:	Quick Drawing of the Trap Design:
1					
2					
3					
4					
5					

Using the information from the data char, fill out the graph below and shade each group's trials. :



Answer the questions below:

If your group had any problems, list them below.

What changes can be made?

Final Reflection

Our Bigfoot trap was _____ because _____.

The evidence from our data shows that _____. The most important force in our design was _____ because _____.