2014 UA

STEM Problem Solving

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Part VIII STEM Resources

<u>Title:</u> Building a Light-up Christmas card

<u>Disciplinary Unit</u>: STEM

<u>Unit:</u> Electric Currents

<u>Standards:</u>

National Science Education Content Standards (Physical Science Standards K-4): students are able to know, understand, and use the science facts, concepts, principles, theories, and models that are important in light, heat, electricity, and magnetism.

Standards for technological literacy:

- **Standard 8:** Students will develop an understanding of the attributes of design.
- **Standard 9:** Students will develop an understanding of the engineering design.
- **Standard 10:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- **Standard 11:** Students will develop abilities to apply the design process.

Common Core ELA Standards (Writing Standards): Students will conduct research to build and present knowledge.

<u>Big Ideas:</u>

- Principles of electric currents and switches
- Proper use of the design loop
- Role of brainstorming to come up with ideas

<u>Essential Question:</u> Can you design a Christmas card that includes an LED light that turns on when the card is open and turns off when the card is closed?

<u>Scenario:</u> Instead of buying your Christmas cards this year, you decide it will be cheaper to make your own. With the materials given, construct a card that will light up when you open the card.

<u>Materials:</u>

1. Battery
2. LED light
3. Aluminum Foil
4. Graphite Pencil
5. Tape
6. Cardstock
7. Markers/Crayons

Content Information:

Electricity is a way of transferring energy - rather like a bicycle chain. We talk of using electricity by which we mean making 'use of' the energy. Energy comes in as fully useable, but once transferred (or converted) it has begun its degradation into waste heat. We need to avoid using the term electricity, and instead say electrical energy or electric current.

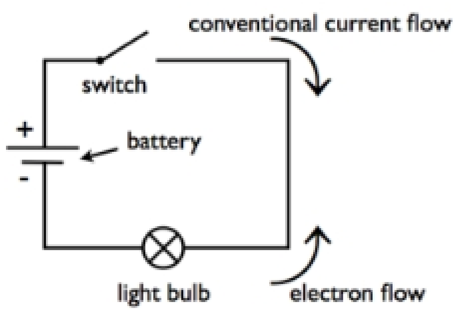
Static electricity is a type of energy that is made when something has too many electrons or protons.

- A conductor is something that lets heat and electricity go through it
- An insulator is something that does not let heat and electricity go through it easily

Most children will happily describe metals as conductors and all other substances as insulators. This is good enough for primary school but there are some non-metallic conductors:

- Ionic solutions and melts
- Graphite and other 'conjugated' organic molecules (conducting plastics were discovered in 1977)
- Gases also become conductors at high voltages (think of lightning strikes, and fluorescent lighting)

A circuit can have a switch. When the switch is turned on, the light bulb will light up. When the switch is off (or open) the light will be off.



Resources: http://schools.bcsd.com/fremont/4th_Sci_Electricity.htm#Magnets_&_Electricity

Deliverables: Students will develop a design by following the design loop. The students must first fill out the provided worksheet, where they brainstorm different ideas for the design. Students are only allowed to use the resources that are provided in the materials list. The Christmas card must include the LED light that turns on when the card is open and turns off when the card is closed.

Parameters: The light must turn on when the card opens and turn off when the card closes.

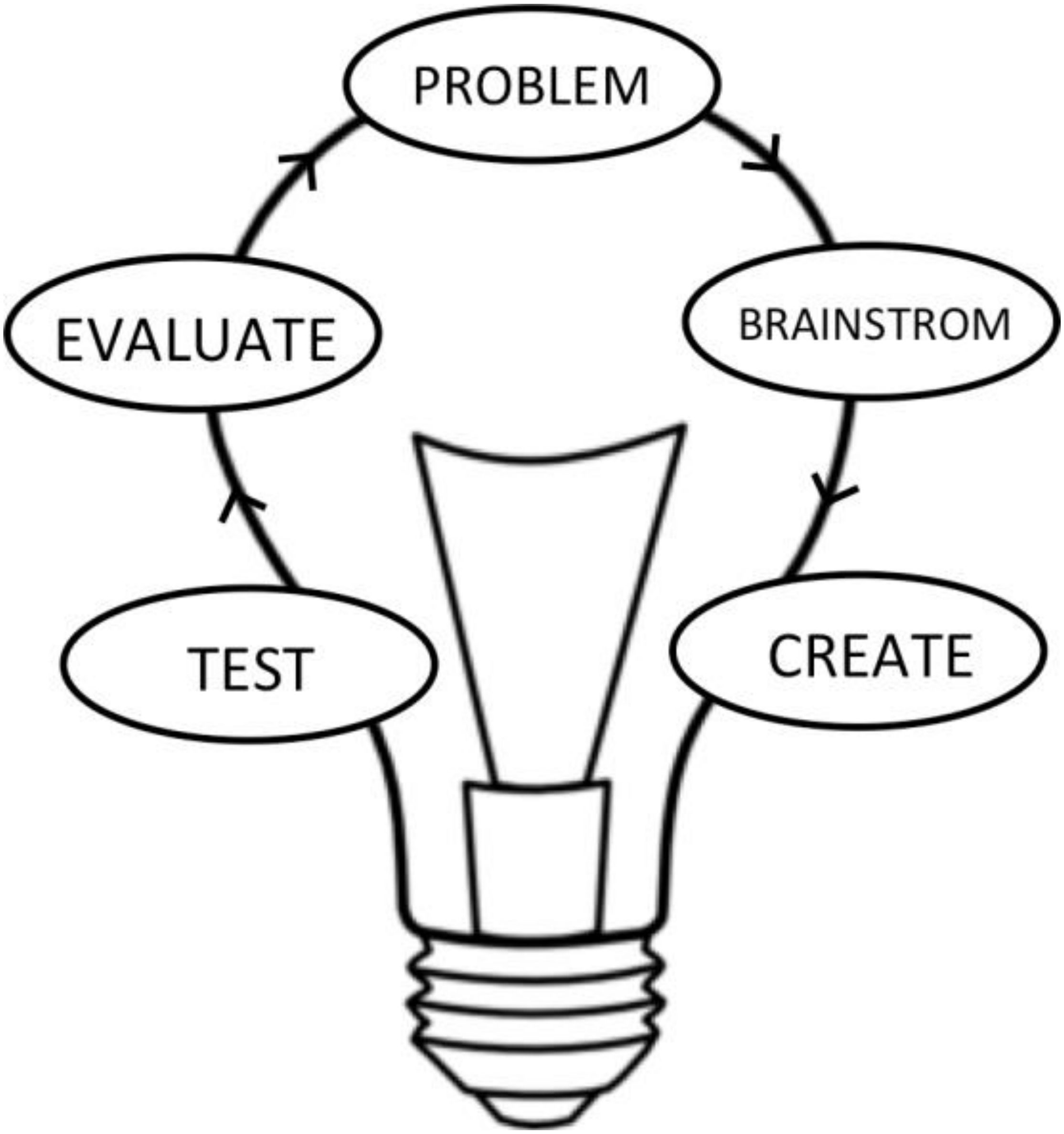
Evaluation:

Rubric for *a Light up Christmas card*

DESIGN BRIEF RUBRIC	Limited Understanding (Up to 5 pts.)	Fair Understanding (Up to 10 pts.)	Good Understanding (Up to 15 pts.)	Excellent Understanding (Up to 20 pts.)
The students restate the problem with their own words	The problem is restated in the same way, no changes	The problem is restated fair enough with their own words	The problem restate clearly with their own words	The problem restate clearly using their own words with proper language
The students brainstormed more than one idea	Zero to one idea	More than one idea that fairly acceptable	More than one idea and acceptable	More than one idea, vivid and acceptable
The students used the required materials and the light turns on when the card is open and turns off when the card is closed	Design did not work properly or follow the parameters.	Work properly with a fair card design	Work properly with a good card design	Work properly with marvelous design
The students evaluated how they could make it better next time	Zero to little evaluation	Evaluation with conclusion	Evaluation with conclusion and redesign idea	Evaluation with conclusion and redesign idea and card
Presentation of the design	Did not speak clearly Less organized	Spoke clearly Fairly organized	Spoke clearly and confidence Well organized	-Spoke clearly and confidence -Format is well designed -Well organized
The students draw a sketch for the electric circuit design of their card	Less detailed and can't be followed by another student	Fairly detailed and easier to understand	Detailed enough, and easy to understand	Detailed enough, easy to understand, and easy to reuse by other people

Total: /120

Design Loop:

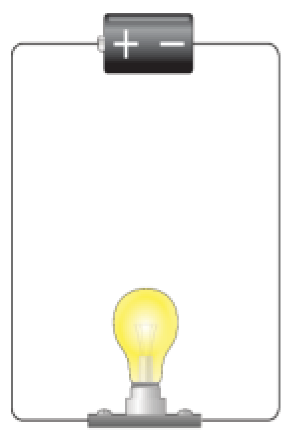


Situation: Christmas is coming soon. In your town, the stock of Christmas cards is almost gone. There are no more interesting cards left. Therefore, instead of buying your Christmas cards this year, you decide it will be cheaper and more fascinating to make your own. With the materials given, construct a card that will light up when you open the card.

Challenge: With your assigned partner, you will design a light up Christmas card. The card must include the LED light that turns on when the card is open and turns off when the card is closed. Fill out the worksheet before you begin your design.

Materials:

1. Battery
2. LED light
3. Aluminum Foil
4. Graphite Pencil
5. Tape
6. Cardstock
7. Markers/Crayons



Test:

1. Test your card design and redesign if needed.
2. Present your final design to the class.
3. The card design includes the LED light that turns on when the card is open and turns off when the card is closed.

Design Loop

Name: ____________________________

A LIGHT UP CHRISTMAST CARD

Group Members

_______________________________ ____________________________________

1. **What is the problem**? State the problem in *your own words*.

____

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____

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____

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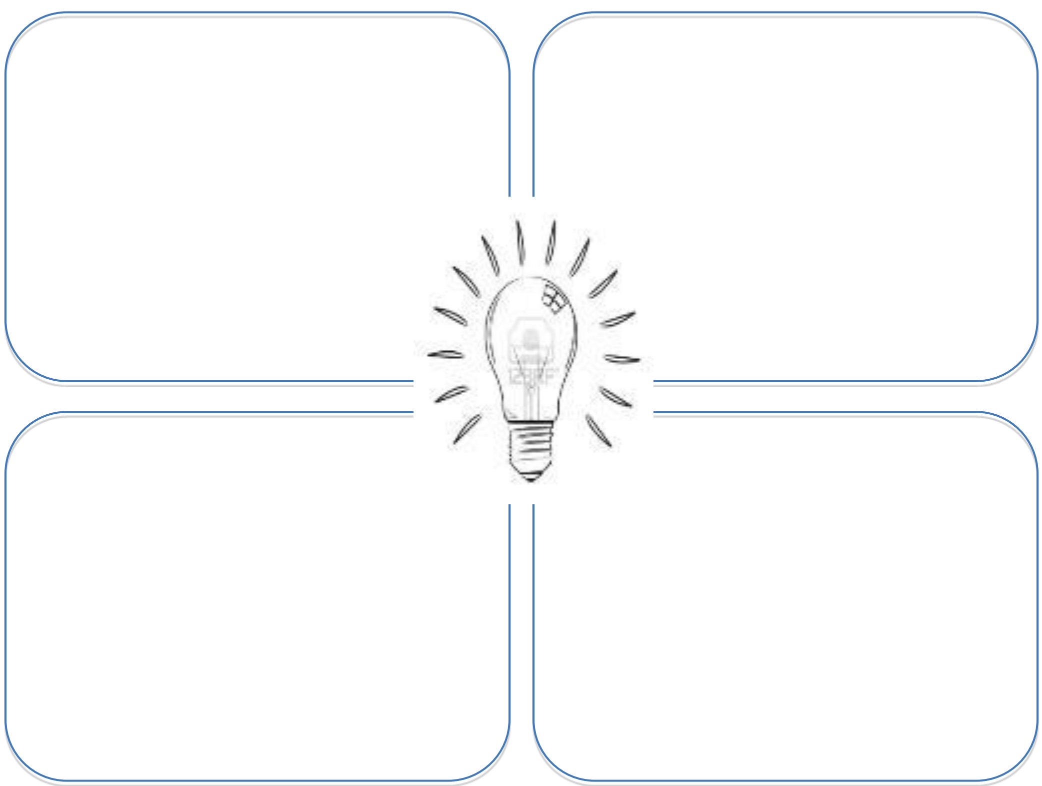
2. **Brainstorm Solutions**. Draw and describe some possible solutions.



3. **Create the solution you think is best**. *Keep notes below about the problems you have and how you solve them*.

____
____
____
____
____
____
____
____
____
____
____
____

4. **Test your solution**.

- Did you use only the material provided? YES NO
- Did the light on your card work properly? YES NO
- Does your card have an on/off switch? YES NO

5. **Evaluate your solution**.

What is the best solution? Would one of your ideas have been better? Why and why not?

____
____
____
____
____

What would you have done differently?

____

____

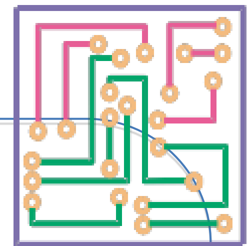
____

____

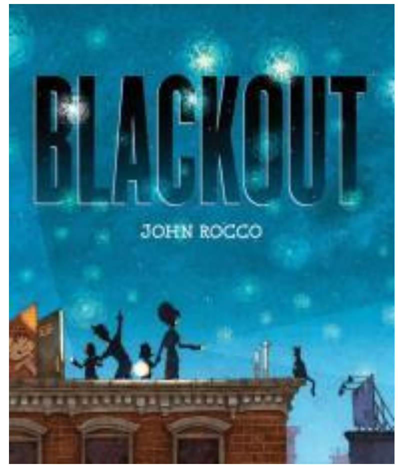
____

Attach a photograph of your final project here. If you do not have a photograph, draw a picture of your final project. How would you make your project better? Draw a picture showing how it would look after you have made changes to

Sketch: Draw a diagram of the circuit that you have been created. Other people who may follow your design should understand the sketch.



Title: Blackout



Grade Level: 2^{nd} grade

Disciplinary Area: STEM

Unit: Understanding the Use of recycled materials to create an electric current

Standards:

- PS.7.2.3 Demonstrate methods of using electricity to produce light, heat, and sound.
- N.S.E K-4 Physical properties of objects and materials.

Big Ideas:

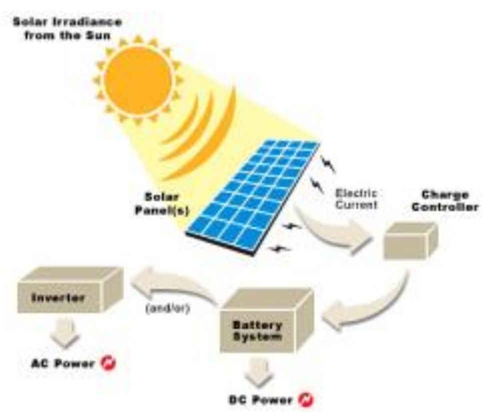
- Understand the value of solar energy.
- Use proper materials to conduct electricity.
- Understand and properly use the design loop.
- Efficiently explain and demonstrate ideas behind final product.
- Understand how to turn a circuit on and off.

Essential Question: How can you design an electrical circuit powered by solar energy using household materials in order to turn a light bulb on and off?

Scenario: After reading *Blackout* by John Rocco, design an electrical circuit that switches on and off using recycled household materials with solar power as the energy source.

Content Information:

Collecting sunlight and converting it into electricity produces solar power. This is done by using solar panels, which are large flat panels made up of many individual solar cells. This solar power creates an electrical current that produces electricity. Sometimes an electric current will have a switch, which means that you can start and stop the electric flow.



New Vocabulary:

- Solar power- energy derived from the sun
- Switch-a device for turning an electric current on or off

Directions:

1. Use the design loop to figure out the best solution before having the materials
2. Only use materials on the material list
3. Your electric current must meet the following requirements:
    a. You must create a design using the solar panels
    b. Must be able to turn on the light bulb for at least 30 seconds
    c. Maximum width and length is 12 inches
    d. Must contain a switch
4. When you have completed your design, you will be able to test it out and explain to the class the reason for your design

Materials:

- Solar panel
- Cardboard
- Aluminum foil
- Pop cans
- Pennies
- Nickels
- Straws
- Newspaper
- Milk jug
- Thumb tacks
- pencils
- LED light

Parameters:

- Maximum length and width is 12 inches
- Must have a switch
- Light must stay on for at least 30 seconds

Assessment: See attached rubric

Student Name____

The Design Loop

1. Answer the problem:

2. Collect all information that you will need:

3. Draw your ideas and choose your best solution:

4. Create your model and test it

5. Look over your model and make any changes if needed

6. Present your model to your classmates

Student Name____

Rubric for Creating a Solar Powered Current

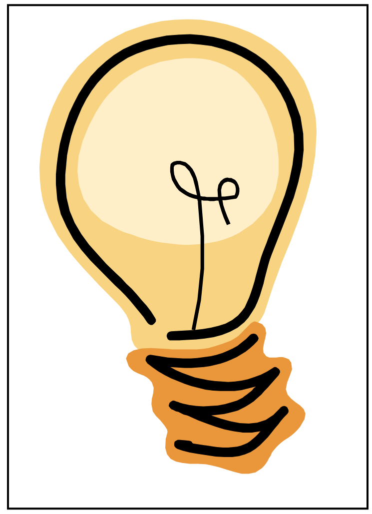
CATEGORY	4	3	2	1
Plan	Plan is neat with clear measurements and labeling for all components.	Plan is neat with clear measurements and labeling for most components.	Plan provides clear measurements and labeling for most components.	Plan does not show measurements clearly or is otherwise inadequately labeled.
Scientific Knowledge	Explanations by all group members indicate a clear and accurate understanding of scientific principles underlying the construction and modifications.	Explanations by all group members indicate a relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by most group members indicate relatively accurate understanding of scientific principles underlying the construction and modifications.	Explanations by several members of the group do not illustrate much understanding of scientific principles underlying the construction and modifications.
Construction - Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.
Design Loop	Worksheet provides a complete record of planning, construction, testing, modifications, reasons for modifications, and some reflection about the strategies used and the results.	Worksheet provides a complete record of planning, construction, testing, modifications, and reasons for modifications.	Worksheet provides quite a bit of detail about planning, construction, testing, modifications, and reasons for modifications.	Worksheet provides very little detail about several aspects of the planning, construction, and testing process.

Works Cited

Solar Power. Retrieved from http://www.alternative-energy-news.info/technology/solar-power/

Rocco, J. (2011). *Blackout*. New York, NY: Hyperion Books.

Lindsay Neely
Hollie Smith



Title: Circuit Board

Disciplinary Area: Electronics

Unit: Circuits

Standards:
Standards for Technological Literacy
- The Nature of Technology: Systems thinking involves considering how every part relates to others
- Abilities for a Technological World: Standard 11. Students will develop abilities to apply the design process.

Grade Level: 4^{th}-5^{th}

Big Ideas: Students will learn about different types of circuits.
- Simple circuit
- Series circuit
- Parallel circuit

Essential Question: Can you manipulate paperclips to make different types of circuits that will charge LED lights?

Scenario:
After learning about different types of circuits and how they work, you will now try to create your own simple, series, and parallel circuit. You will be given the needed materials and brainstorm how you want to set up your circuits. After trying out your circuits you will evaluate your designs and determine what works, what doesn't, and the reasons why.

Materials/Resources:

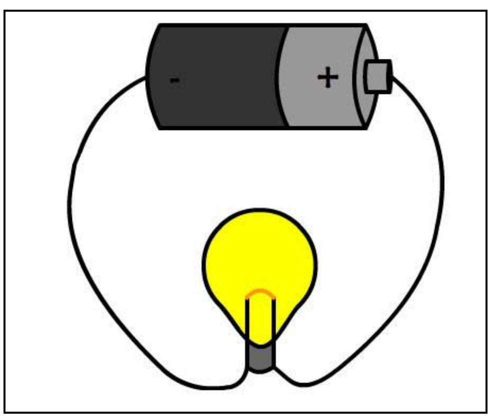
- Cork board (1ft. x 1ft.)
- Paperclips
- Brads
- 3 LED lights
- 9v battery
- Alligator clips

Content information:

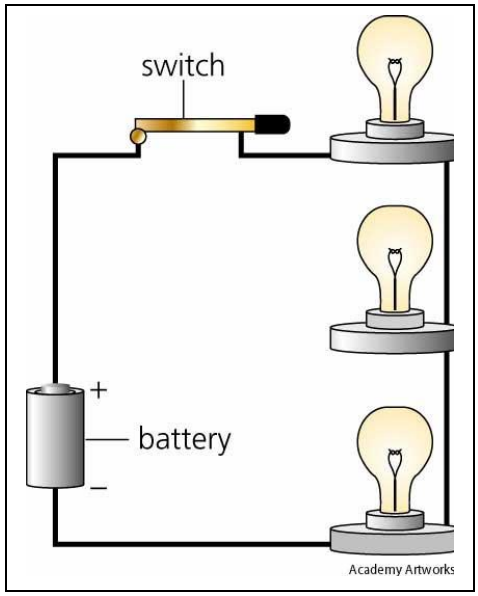
Electricity is the phenomena associated with the flow of electric charge/current. The current is the actual movement of electrically charged particles through a conducting material from one place to another. Many metals are great conductors such as silver, gold, copper, brass and graphite. Circuits move charged particles to energize equipment and in this activity we will be using different circuits to charge LED light bulbs.

A ***simple circuit*** contains the minimum things needed to have a functioning electric circuit. A simple circuit requires three (3) things:

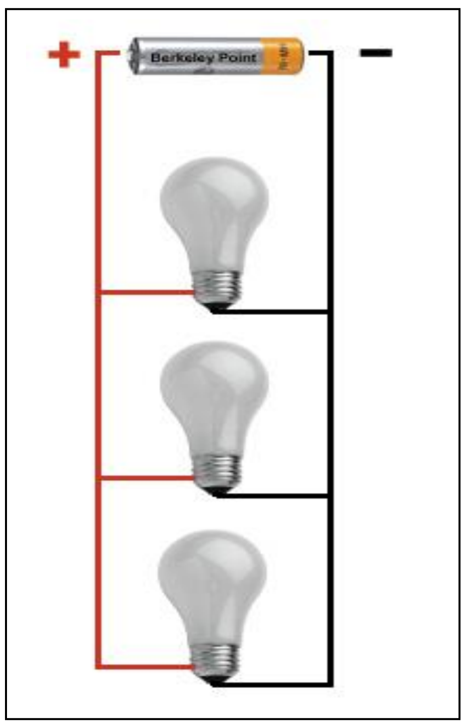
- A source of electrical potential difference or voltage. (typically a battery or electrical outlet)
- A conductive path which would allow for the movement of charges. (typically made of wire)
- An electrical resistance (resistor) which is loosely defined as any object that uses electricity to do work. (a light bulb, electric motor, heating element, speaker, etc.)



A ***series circuit*** is a closed circuit in which the current follows one path, across multiple resistors, without branching into different paths.



A ***parallel circuit*** is a closed circuit in which the current divides into two or more paths before recombining to complete the circuit.



Parameters:

After teaching the content on electric circuits, the instructor should give each student, or pair of students, a piece of cork board and all the materials needed to work with the different circuits. Each student or pair will need 3 LED lights, a 9v battery, a set of alligator clips, and at least 18 brads and paperclips. Show students an example of how to position the paperclips with the brads so that they can manipulate the connections of the circuit.

Student Worksheet

Name: ____

Explain the following:
Simple circuit:

Series circuit:

Parallel circuit:

Draw out how you will make the circuits on the board. Highlight your switch.

Simple Circuit:

Series Circuit:

Parallel Circuit:

Test out your circuits!

Did your circuits work? If not, why not? Draw out the new solution. Highlight your switch.

My simple circuit did not work because ____
____
____
____

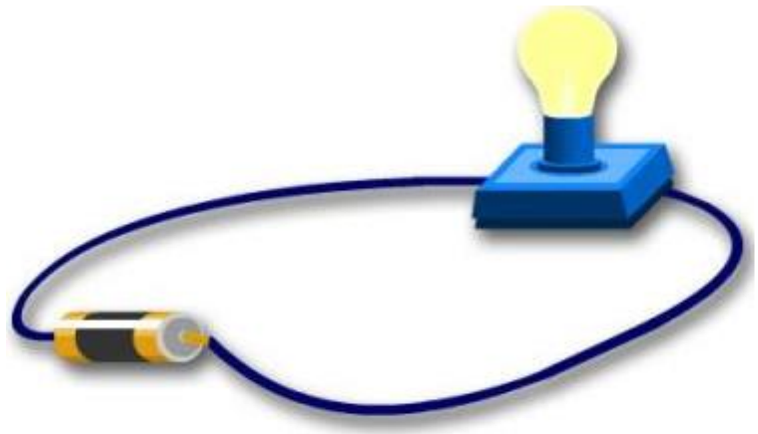
New solution:

My series circuit did not work because _____
____
____
____

New solution:

My parallel circuit did not work because ___
____
____
____

New solution:



Conducting an Experiment

Completing a technical procedure for conducting two successful circuits

Displinary Area: STEM

Unit: Electricity and Circuits

Standards:
PS.7.2.3 (Physical Science)
Demonstrate methods of using electricity to produce light, heat, and sound
10. PS.2 (Nature and Science)
Research and apply appropriate safety precautions (refer to ADE Guidelines) when designing and/or conducting scientific investigations

Big Ideas:
1) Proper use of design loop
2) Explore uses for electricity
3) Learn properties of conductors and insulators
4) Understand two types of electric circuits
5) Ability to perform experiment

Essential Question:
Can you follow a technical procedure to construct a parallel series circuit using different conductors?

Scenario:
Imagine you are going on a cave exploring trip with your family for the day. You have a flashlight and two wires. Your mom is carrying a LED light and some tape in her purse and your dad has a battery from a broken flashlight. After twenty minutes in the cave your source of light goes out and it is completely dark. What do you do? Can you use the materials your family and you have to build a simple circuit to create light to get through the cave?

Directions:
1) Introduce importance of electricity
2) Explain conductors, insulators
3) Explain parallel and series circuits
4) Only demonstrate what parallel circuits are
5) Student will complete electricity worksheets
6) Carry out experiment
7) Students will complete experiment report

Experiment/Procedure:
Students will take each take a turn at the circuit stations setup by the teacher. At each station, a shallow cardboard box will contain one D battery, one mini lamp, and three conductors: a fork, a penny and aluminum foil. The students will test the conductors by connecting each to the light bulb one at a time to understand there are different ways to conduct electricity. This demonstrates how a parallel circuit works. Series circuits should be discussed, however. After each student performs the experiment, the students will complete the lab report attached. A classroom discussion is recommended in order to ensure the student's full understanding about circuits.

Vocabulary:
circuit: a continuous path of conductor so that electricity can flow from one end of the battery, through the device (light bulb) and to the other end of the battery
electricity: attraction of particles with opposite charges and the repulsion of particles with the same charge.
parallel circuit: a closed circuit in which the current divides into two or more paths before recombining to complete the circuit
series circuit: a circuit that is attached serially
insulator: a material that electricity cannot move through easily
conductor: a material that electricity can move through easily

Materials:

1 D battery	(2) penny
1 battery box	(2) fork
flat cardboard box	aluminum foil
rubber gloves	

Content to know:
Electricity is a very important aspect of our everyday lives. Children in the current generation are seldom aware of this. It is important to begin the lesson with expressing the significance of electricity. This will entice the students and let them relate to their own lives. The video games, iPods, refrigerators, ovens, heaters, air conditioners, and light are all things that affect the students' daily lives. Electricity will only flow through a complete circuit. There are two types of circuits in this lesson. In the complete circuits, electricity begins from a source, like a battery, then travels through a path made of a conductor and goes through a device, like a light bulb, and circles through to the other conducting path and back to the battery.

Both parallel and series circuits will be taught; however, parallel circuits will be used in the experiment. Christmas tree lights are a good example of a series circuit. One bulb goes out, and like the domino effect, the rest go out as well. Students will experience parallel circuits first-hand. Another aspect of the lesson is conductors and insulators. Conductors are the paths that allow the energy to flow from the source to the device and back around. Usually made from metals, examples include copper, aluminum, graphite, silver, gold, etc. Conductors allow the flow of energy from a source to a device. Insulators are poor conductors. These materials are nonmetals. Insulators are used to cover the outside of electrical equipment and wires.

Challenge:
Can you follow a technical procedure to construct a parallel series circuit using different conductors?

Directions:
1) Put on rubber gloves.
2) Assemble battery into battery box.
3) Using tape, attach the positive wire of the battery box to one fork and the negative wire to the other fork. Make sure the forks run parallel to one another.
4) Connect the positive wire of the light bulb to the positive fork.
5) Connect the negative wire of the light bulb to the positive fork.
6) Observe results.
7) Disassemble conductors from battery and light bulb.
8) Repeat steps 3 – 7 for aluminum foil strips.
9) Repeat steps 3 – 7 for pennies.
10) Disassemble battery from battery box.
11) Remove rubber gloves.
12) Complete lab report.

Materials:

D battery
battery box
1.5V mini lamp(light bulb)
cardboard
masking tape

conductor #1 – (2) forks
conductor #2 – aluminum foil
conductor #3 – (2) pennies

Information to know:

Electricity is a very important aspect of our everyday lives. Children in the current generation are seldom aware of this. It is important to begin the lesson with expressing the significance of electricity. This will entice the students and let them relate to their own lives. The video games, iPods, refrigerators, ovens, heaters, air conditioners, and light are all things that affect the students' daily lives. Electricity will only flow through a complete circuit. There are two types of circuits in this lesson. In the complete circuits, electricity begins from a source, like a battery, then travels through a path made of a conductor and goes through a device, like a light bulb, and circles through to the other conducting path and back to the battery.

Both parallel and series circuits will be taught; however, parallel circuits will be used in the experiment. Christmas tree lights are a good example of a series circuit. One bulb goes out, and like the domino effect, the rest go out as well. Students will experience parallel circuits first-hand. Another main idea of this lesson is conductors and insulators. Conductors are the paths that allow the energy to flow from the source to the device and back around. Usually made from metals, examples include copper, aluminum, graphite, silver, gold, etc. Conductors allow the flow of energy from a source to a device. Insulators are poor conductors. These materials are nonmetals. Insulators are used to cover the outside of electrical equipment and wires.

New Vocabulary:

circuit: a continuous path of conductor so that electricity can flow from one end of the battery, through the device (light bulb) and to the other end of the battery

electricity: attraction of particles with opposite charges and the repulsion of particles with the same charge.

parallel circuit: a closed circuit in which the current divides into two or more paths before recombining to complete the circuit

series circuit: a circuit that is attached serially

insulator: a material that electricity cannot move through easily

conductor: a material that electricity can move through easily

Conductors and Insulators of Electricity

By: Ally England and Jessica Hilton

Disciplinary Area: STEM

Unit: Electricity and Circuit Structure

Standards:

- *National Science Educations Standards* (Physical Science); Electricity, characteristics of conductors and insulators.
- *Standards for technology literacy* (Engineering design): The design loop process including finding a problem, brainstorming ideas, picking a solution, testing the solution, making the structure, evaluating it, and presenting results.
- *Arkansas Department of Education Frameworks* (Oral and visual communication – speaking) Students shall use communications skills to express ideas and structures to the class.

Big Ideas:

- Definition of conductors and insulators
- Characteristics of conductors and insulators
- Process of figuring out what is a conductor of electricity
- Proper use of the design loop
- Ability to present findings to the class

Essential Questions: What household items are conductors and insulators of electricity?

Scenario: After we discuss what conductors and insulators are, we will do experiments in the classroom with items provided by the teacher to see which items conduct electricity and which do not. Based on your findings, bring to class items from home we did not test in class that you think will be a conductor of electricity. Make sure this item is okay to bring to school with parent consent.

Materials and Resources:

- Paper
- Graphite pencil
- Markers
- Pencil
- Penny
- Silver rings
- Gold earrings
- LED lights
- Batteries
- Connector cables
- Piece of plastic
- Worksheet
- Aluminum foil

Instruction for Teachers:

Begin by constructing the device that students will use to test their household items. This device consists of a 9 volt battery with two circuit cables connected to the positive and negative ends of the batter. The red cable should be connected to the positive end and the black circuit cable should be connected to the negative end. Students will use this device for testing all of the items throughout the stations. Have the various items listed above, in pairs, set up at different stations around the room. Have the students travel in groups testing these items. Be sure the students connect both one circuit cable to each item. For example, the positive cable connected to a penny and the negative cable connected to another penny. Then the students will place the long end of the bulb on the positive penny and the shorter end of the bulb on the negative penny.

Content Information:

A conductor of electricity is a material that electricity flows through easily. These items are made up of atoms whose electrons flow easily. Insulators are a material in which atoms do not easily flow freely, which prevent or blocks the flow of electricity. There are many materials we use daily to either help generate electricity and many materials we use to protect us from electricity. Electricity is used to power tools, lights, household items such as a toaster or a washing machine, and even your phone!

Deliverables:

First students will have an open discussion with the teacher about electricity. What characteristics of electricity do students already know? After discussing, students will get in groups, and travel to various stations around the room. The students will test the different circuits we have set up along the class and write down their findings on the worksheet. Some of the circuits will light up the LED lights and others will not. After the students test the materials, we will then talk about our findings as a class.

Parameters:

Based on what the students have talked about in class, the students will be asked to bring 2 identical items from home that they think will conduct and insulate electricity. It must be items we did not test in class and they must have a reason for choosing the items from home. (Do not bring items to class that are valuable, they're just simple items from home.)

Assessment:

When the students bring the items to class, they must also turn in their design loop, which justifies why they chose the items from home. The items from home will illustrate whether they understood the properties of conductors and insulators.

Worksheet:

Materials	**Conductor**	**Insulator**
Penny		
Plastic		
Gold Earing		
Paper with Marker		
Silver Ring		
Paper with Graphite		

Design Loop

Brainstorming and Ideas

Circuit and Volt: Electric Fireflies

An Introduction to Circuits, by Aleshia Hawkinson and Tara Hodge

Disciplinary Area: STEM

Unit: Basic circuits and electricity

Grade Level: 2

Standards:

- National Science Education Standards (Physical Science): Light, heat, electricity, and magnetism
- Standards for Technological Literacy (Abilities to Use and Maintain Technological Products): 1. Discover how things work. The ability to observe, analyze, and document is vital to successfully accomplish this task. 2. Use hand tools correctly and safely and name them correctly.
- Common Core ELA Standards (Reading: Foundational Skills): Read with sufficient accuracy and fluency to support comprehension
- Common Core Math (Measurement and Data): Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.

Big Ideas:

- Understand simple circuits
- Understand how a switch works to complete a circuit
- Follow detailed instructions to complete an experiment

Essential Question: Can you follow the instructions to complete a glowing firefly?

Scenario: After being introduced to basic circuits by the teacher and watching a short video, students will create a simple circuit firefly with a switch and test it to make sure it works.

Vocabulary:

Circuit- a pathway for the flow of electricity

Current- the flow of electricity through a conductor

Electrons- the negatively charged part of an atom

Filament- the part of a light bulb that gets hot and makes light

Conductor- a substance through which electricity will flow

Insulator- a material that prevents flow of electricity; common insulators are plastic, rubber, glass, and air

Electrode- the negative or positive part of an electric cell

Polarity- the direction of an electric field; it will be either negative or positive

Switch- a device used to interrupt the flow of electrons in a circuit

Tools:

Drill Press	Scissors
Thumb Tacks	Erasers
Wood Cutter	Needle Nose Pliers
Single Hole Punch	

Materials (per student):

Plastic Eggs (1)	Wooden Dowel Rod (1)
Pipe Cleaners (3- 2 for legs and 1 for antennas)	Coin Cell Batteries (3V- CR 2025)(1)
LED Light Bulbs (1)	

Materials (Consumables):

Shiny Silver Duck Tape	Masking Tape
Goggly Eyes	Sharpies or Markers
Cardboard box pieces	Tacky Glue

Situation:

Circuit and Volt, best firefly friends, have lost their light. They are very sad, because the thing fireflies like to do most, as you can imagine, is light up. Today you will help restore Circuit and Volt's lights. Follow the instructions to create a simple circuit to put the "fire" back in the firefly.

Circuit and Volt: Electric Fireflies

An Introduction to Circuits

Teacher Instructions

Leg holes

- **Preparation:** Prepare materials for class. Depending on your students, you may want to drill holes in the eggs ahead of time, as this requires quite a bit of dexterity and patience. An electric drill press will yield the best results, but it is possible to drill the eggs using a hand-operated drill press. Each egg will need:
  - 6 "leg" holes (3 on each side of the egg)
  - 1 "switch" hole for the dowel rod to stick out of (on the top, slightly behind where the egg snaps together)
  - 2 "antenna holes" (on the top, front of the egg).
    - It is easier to drill the eggs when they are stuffed with a piece of scrap paper and taped closed.
    - NOTE: We used a 1/16" drill bit for the pipe cleaner holes (legs and antennas), and a 1/4" drill bit for the dowel rod hole.
- **Content Information:** Introduce simple circuits to your class. The video at http://youtu.be/VnnpLaKsqGU is a great starting point! After watching with your class, define and explain the terms included in the *Vocabulary* section of this lesson.
- Using a battery and an LED light bulb, demonstrate to your students how touching the electrodes (the wires sticking out of the bulb) to the sides of the battery lights the bulb.
- Explain that each bulb will have a positive electrode and a negative electrode. Usually, the longer wire will be the positive, but this is not always the case. Because of polarity, the electrodes must be pressed to the correct sides of the battery or the bulb will not light.

- Introduce the situation to your students and explain that everyone will be building their own firefly to experience electrical circuits for themselves and cement their learning.
- Pass out supplies and facilitate bug making!

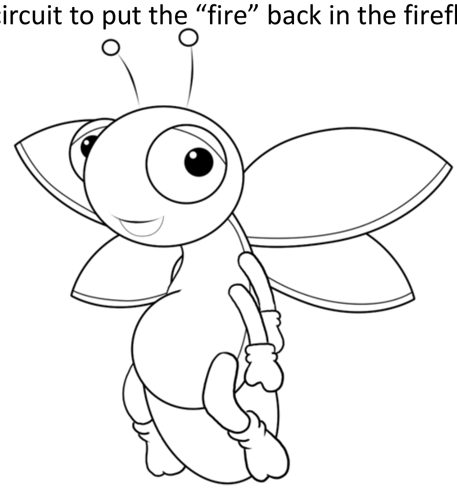
Circuit and Volt: Electric Fireflies

An Introduction to Circuits

Student Handout

Situation:

Circuit and Volt, best firefly friends, have lost their light. They are very sad because the thing fireflies like to do most, as you can imagine, is light up. Today you will help restore Circuit and Volt's lights. Follow the instructions to create a simple circuit to put the "fire" back in the firefly.



Instructions:

1. Gather your supplies from your teacher. You will need:

Plastic Eggs (1)	Wooden Dowel Rod (1)
Pipe Cleaners (3- 2 for legs and 1 for antennas)	Coin Cell Batteries (3V- CR 2025)(1)
LED Light Bulbs (1)	Cardboard box pieces
Shiny Silver Duck Tape	Masking Tape
Goggly Eyes	Sharpies or Markers
Tacky Glue	Scissors
Wood Cutters	Pliers
Single Hole Punch	

2. Cut your pipe cleaners to length (2-3 inches) and put them through the leg holes to give your bug legs. Cut a longer piece for the antenna. You will thread this through the 2 antenna holes and curl the ends.

TIP:

Secure the legs inside the egg with a small piece of tape. This will make your legs more stable.

Fold the "foot" piece under with pliers to keep the sharp edge of the pipe cleaner from hurting someone!

3. Test your LED light bulb to see which way it needs to go on the battery to light up.
4. It's time to start building your circuit! In the back half of the egg (the one with the big hole in top for your switch), carefully tape the sides of your battery to the egg. You will then slide the LED in with one wire under the battery, and one on top. You can push down on the top wire to make sure your bulb lights.

TIP:

Make sure you don’t tape over too much of the top surface of the battery. You want plenty of surface area for your top wire to make contact and your bug to light up!

5. Cut a small circle out of your cardboard scraps. It should be about the size of your battery. This is part of your switch!
6. Cut your dowel rod (be careful!) to 2.5- 3 inches long. Make sure you can insert it in the egg from the inside. If not, it is too long.
7. Cut 4 strips of tape and use them to tape the dowel rod to your cardboard circle.

Your switch should look something like this!

8. Insert the top of the switch through the hole in the top of your egg. It should line up so that it can be easily pressed down and make the light bulb light up. If pressing down on the switch does not easily light the bulb, you might need a small cardboard shim under your battery.
9. Tape the sides of the switch to the sides of the egg. This will keep your switch from becoming misaligned and not working.

TIP:

Just a little tape will do!

10. Snap the two pieces of your egg together, making sure your bug legs are lined up.
11. Attach googly eyes to your bug and draw on a happy face with your markers. You are almost there!
12. Cut wings out of your shiny tape. First fold the tape over on itself so that the sticky sides stick together. Then cut out your wing shapes.

TIP:

After your wings are cut out, use a single hole punch to make a hole through them- this is where the switch will stick out of your egg. You can attach the wings to your egg with a tiny dab of tacky glue.

13. Hold the egg in the palm of your hand and carefully press down on the switch. You should be holding your very own firefly! Now, go home and tell your parents that you built an electric circuit with a working switch today!

Circuit and Volt: Electric Fireflies

An Introduction to Circuits

Student Worksheet

1. Why does pressing down on the switch cause the bulb to light up?

____

____

____

2. How can you tell the difference from the positive (+) electrode and the negative (-) electrode on the LED light bulb?

____

____

____

3. Did you find any errors in your work as you made your bug? If yes, how did you fix them?

____

____

____

Circuit and Volt's Amazing Word Search

WORD BANK:

CIRCUIT

CONDUCTOR

CURRENT

ELECTRODE

ELECTRONS

FILAMENT

INSULATOR

POLARITY

SWITCH

F	I	L	A	M	E	N	T	S	N	Y	U
U	A	A	D	E	V	W	C	N	Y	N	I
M	X	H	M	M	G	T	T	O	T	I	Q
V	C	Y	C	N	T	B	J	R	I	V	D
C	K	U	T	T	H	H	O	T	R	Y	C
T	Q	Y	X	S	I	T	C	C	A	B	A
N	H	H	J	H	C	W	S	E	L	B	C
E	O	A	T	U	Z	V	S	L	O	L	F
R	U	X	D	P	D	Z	A	E	P	R	W
R	Y	N	I	N	S	U	L	A	T	O	R
U	O	P	T	I	U	C	R	I	C	V	X
C	J	K	E	D	O	R	T	C	E	L	E

Fun Firefly Facts

1. Fireflies, also called lightning bugs, are neither flies nor bugs.
    - They are actually beetles!

2. Fireflies are the world's most efficient light producers.
    - Have you ever touched a light bulb that's been on for a while? If you did, you probably burned your finger! An average electric light bulb gives off 90% of its energy as heat, and only 10% as light. All 100% of the firefly's energy goes into making light.

3. Fireflies "talk" to each other using light signals.
4. Firefly eggs glow.
5. Not all adult fireflies flash.
6. Firefly larvae feed on snails.
7. Some fireflies are cannibals.
8. Female fireflies sometimes mimic the flashes of other species.
9. Firefly luciferase (the enzyme that releases their light) is used in all kinds of medical research.
10. Some fireflies synchronize their flash signals.

Adapted from: http://insects.about.com/od/beetles/a/10-Cool-Facts-About-Fireflies.htm

Circuit and Volt: Electric Fireflies

An Introduction to Circuits

Evaluation and Assessment

Grading Rubric

Demonstrates knowledge of simple circuits (0-25pts): _____________

Student is able to describe how a simple circuit works and implement a switch into a circuit's design.

Followed procedural instructions to complete experiment (0-25pts): _____________

Student is able to follow multi-step instructions to create a simple circuit bug.

Effective use of tools (0-25pts): _____________

Student is able to use tools recommended in procedural instructions to complete given task.

Completion of provided handouts for evaluation (0-25pts): _____________

Student completed all questions and demonstrated knowledge and comprehension of simple circuits.

Total Points: ________/100

Circuit and Volt's Amazing Word Search (KEY)

Word Bank:

CIRCUIT

CONDUCTOR

CURRENT

ELECTRODE

ELECTRONS

FILAMENT

INSULATOR

POLARITY

SWITCH

F	I	L	A	M	E	N	T	S	N	Y	U
U	A	A	D	E	V	W	C	N	Y	N	I
M	X	H	M	M	G	T	T	O	T	I	Q
V	C	Y	C	N	T	B	J	R	I	V	D
C	K	U	T	T	H	H	O	T	R	Y	C
T	Q	Y	X	S	I	T	C	C	A	B	A
N	H	H	J	H	C	W	S	E	L	B	C
E	O	A	T	U	Z	V	S	L	O	L	F
R	U	X	D	P	D	Z	A	E	P	R	W
R	Y	N	I	N	S	U	L	A	T	O	R
U	O	P	T	I	U	C	R	I	C	V	X
C	J	K	E	D	O	R	T	C	E	L	E

Magnificent Matching Madness

Curriculum Development Assignment #2

Disciplinary Area: STEM

Unit: Electricity, Energy, Life Science

Standards:

- *National Science Education Content Standards* (Physical Science): Properties of objects and materials including light, heat, electricity, and magnetism
- *National Science Education Content Standards* (Life Science): Characteristics of organisms and their environments
- *Standards of Technological Literacy* (The Nature of Technology): Students will develop an understanding of the core concepts of technology.
- *Standards of Technological Literacy* (Core Concepts of Technology): Systems have parts or components that work together to accomplish a goal.

Big Ideas:

- Properties of materials and tools as well as their ability to contribute to an electric circuit
- Recognizing that everyday objects can be utilized to create an electric circuit
- Understanding why the light shines when it does
- Attributes to conductors and insulators and their ability to create electricity

Essential Question:

- Why does the light bulb become bright when you choose two matching options?
- When you pick two options that do not match, why does the light remain unlit?

Scenario: After learning the basics of electricity, the students will use the Magnificent Matching Madness board to match two similar items and test their knowledge regarding many different subjects. By doing this, the students will learn what causes the light bulb to light up when certain answers are chosen. This will help further their understanding of electric circuits and will teach them how household items (foil, paperclips) can make electric circuits.

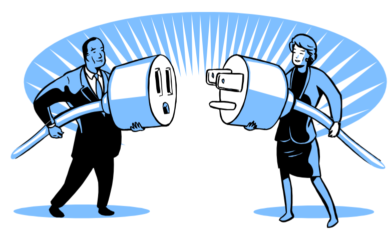
Materials/Resources:

- Cardboard/Foam board (any size)
- Aluminum foil
- Electric Tape
- Velcro
- Matching printouts
- Battery
- Lightbulb

Directions for Teacher: The teacher will create the board prior to the lesson using the materials listed above. To start, the teacher will cut the foam board to size and attach the matching materials (in random order) using Velcro in two columns. Next, the teacher will need to poke a small hole next to each picture/vocabulary word close to the boarder of the board. Then, the teacher will flip the board over and create aluminum foil lines between the matching pictures/vocabulary words. Between each piece of foil, the teacher will need to cover it with electric tape in order to keep each circuit separate. The teacher will tape the battery with electric tape to the front of the board and connect one strand of foil to each side of the battery. Next, the teacher will take one end of the foil and tape it to one wire from the light bulb. The teacher should then explain to the students how the matching board operates using the content information listed below.

Content Information: In this lesson, everyday materials are used to complete an electric circuit. In order to make an electric circuit, the light bulb must be connected to a series of conductors that create a complete unit.

Circuit	An electrical device that provides a path for electrical current to flow
Conductor	A substance that conducts heat, light, sound, or especially an electric charge
Insulator	A material of such low conductivity that the flow of electric current through it is negligible
Electricity	The collection of physical effects related to the force and motion of electronically charged particles, typically electrons, through or across matter and space



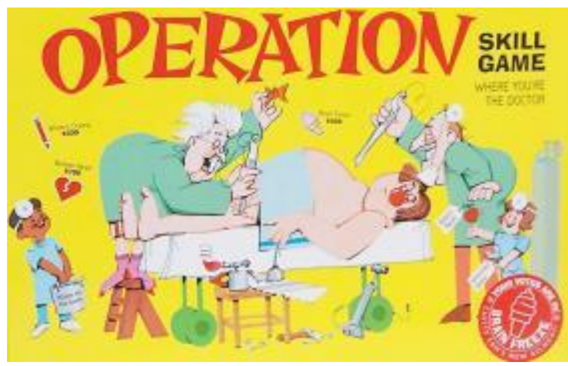
Deliverables/Student Instructions: Use the Magnificent Matching Madness board to explore electricity and electric circuits while testing your knowledge regarding different subjects, such as life science, numbers, and shapes.

Assessment: Teacher will have a discussion with the students about electric currents and circuits and ask them why certain materials are able to conduct electricity and others are not. The teacher will also ask the students how they think the Magnificent Matching Madness board works.

“Operation Simple Circuit”

Disciplinary Area: Elementary Education

Unit: Simple Electronics



Standards:

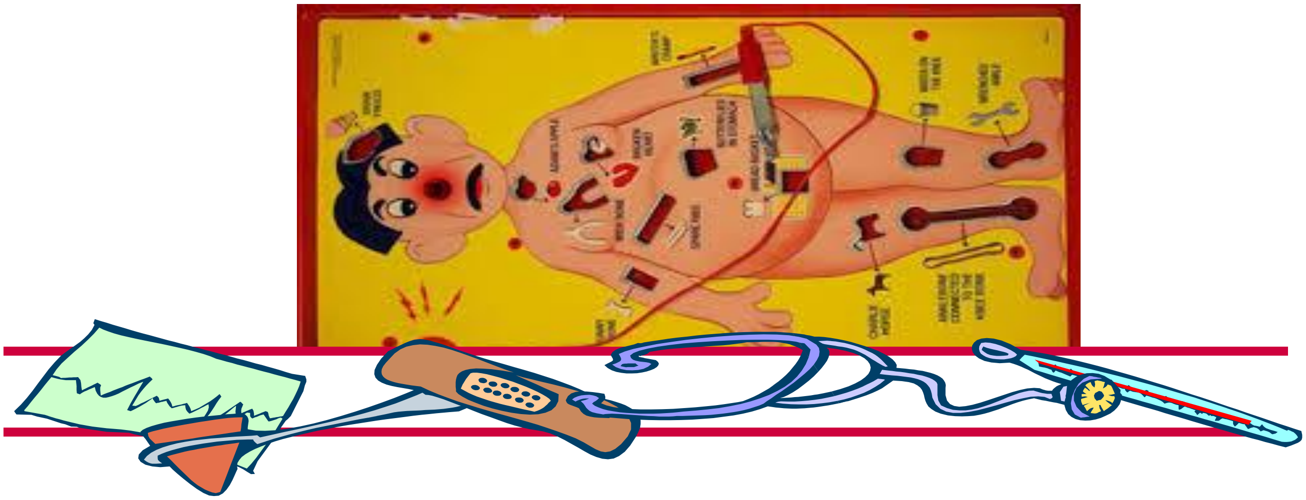
- CCSS.ELA-Literacy.RST.6-8.3 (Craft and Structure): Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.
- National Science Education Standards (The Designed World): Students will develop an understanding of and be able to select and use energy and power technologies.

Big Ideas:

- Power is the rate at which energy is converted from one form to another.
- Understand how power systems work

Essential Questions: Can you design and create your own Operation game using circuits?

Scenario: We have learned some basic knowledge about electrons and their role in circuits. How we are going to apply that knowledge by creating our own version of the game Operation. Make sure you use the content information as well as the resources provided.



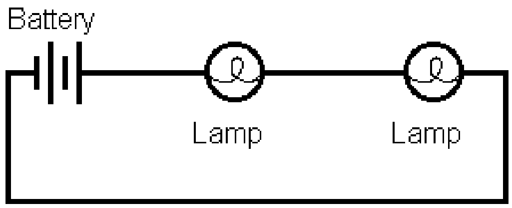
Deliverables/ Directions: Students will create and design their own Operation game by using their knowledge about circuits. Students will use the design loop to create their game. You're game must buzz or light up or both when you touch the side of the cans. We will test everyone's games on the due date. Be ready to explain how you built it and why.

Materials: cardboard, wood, steel cans, screws or nails, paint, aluminum foil, chop sticks, battery, buzzer and/or light, objects (to pull out), steel wool, knitting needles

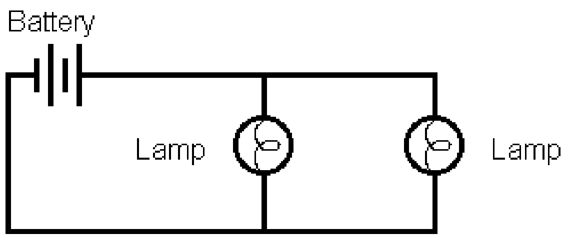
Parameters: Your game board must be 12''X16''

Content Information: A circuit is the circular pathway that electrons take from the power source and through the wire. The power source is what moves the electrons through the wires and to the device to give it power. There are two kinds of circuits we talked about:

SERIES



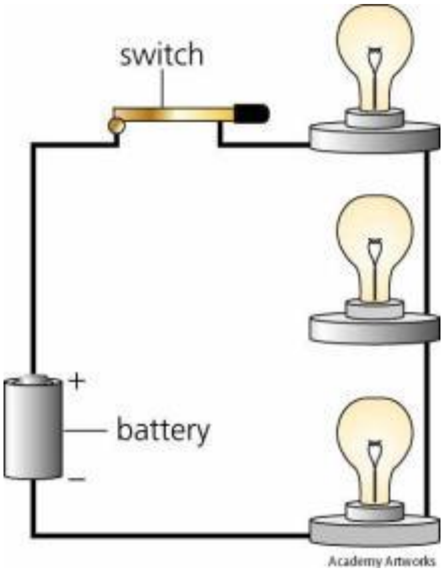
PARALLEL



Series Circuit – the wires that connect to the battery and your device will create a circle.

Parallel Circuit – the devices are connected to the battery through their own branches of wire.

Some circuits are broken, which means there is a gap in the wire. This breaks the flow of electrons. In order to start the flow back up you need to complete the gap so the wire is not broken. You can do this by adding a switch. When you turn the switch on it closes the circuit and starts the electrons flow. When you turn the switch off it breaks the circuit and stops the flow.



Resources: http://kids.discovery.com/tell-me/curiosity-corner/science/how-do-electric-circuits-work

http://www.fplsafetyworld.com/?ver=kkblue&utilid=fplforkids&id=16185

http://www.bbc.co.uk/bitesize/ks3/science/energy_electricity_forces/electric_current_voltage/revision/4/

Using the Design Loop to Create a Game

1. Identify the problem (Define the task at hand).

   ____

2. Write notes about research here:

   ____
   ____
   ____
   ____

3. Brainstorm ways to solve the problem/Develop solutions for the problem and choose the best one. Draw it out below.

4. Make improvements to your solution on the drawings you just made.
5. Build your own solution. List the materials you used below and why you chose those materials.
____
____
____
____

6. Share your game with the class. Don’t forget to explain how it works and tell us the rules!

Assessment:

Game board must meet parameters. ______________/20

Game board lights up and/or buzzes when played. ____________/20

Creativity ____________/10

Presentation ________________/20

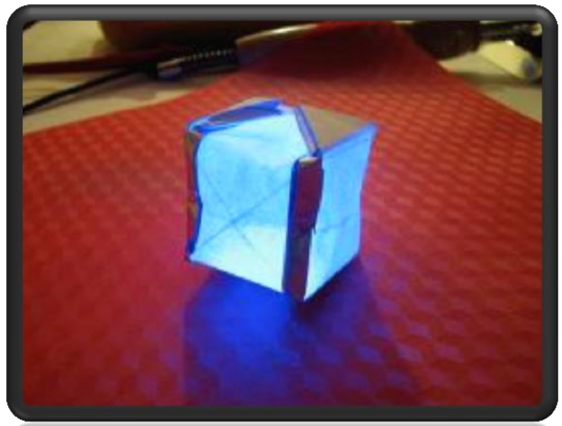
Students used design loop _____________/15

Students complete work on time ________________/15

Total Score __________________/100

Comments:

Origami Night-Light



Creating a night-light using Electrical Circuits
Hillary Walker and Hailey Alayon

Grade Level: 6th grade
Discipline area: STEM
Unit: Geometry/ Electricity /Simple Circuits

Standards:

1. CCSS. Math. Content 6.G.A.1 Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.
2. National Science Education Standards (physical science) Electricity in circuits can produce light, heat, sound, and magnetic effects. Electrical circuits require a complete loop through which an electrical current can pass.
3. Arkansas Department Education Frameworks Strand 3: Physical Science
Standard 7: Energy PS.7.4.2 Classify electrical *conductors* and electrical *insulators*

Learning Goals/ Objectives:

Know (Big Ideas):

- Determine how to construct a cube/ and understand properties of a cube.
- Understand what makes a good insulator and conductor of electricity.
- Understanding the basic properties of how to make a circuit.
- Determine the best way to solve a problem (Design Loop)
- Students will understand how electricity circulates through the circuit to make light through the cube.

Understand:

- Electricity flows through using different conductors and insulators
- Positive and negative charges leave the battery and are connected to the foil to make a complete circuit.

Do:

- Create their very own night light by creating a simple circuit
- **Essential Question:** Can you follow the steps to create a complete circuit to light your own night-light?

Scenario:

After learning about simple circuits, students will be given instructions to create a cube out of paper, unfold it, construct a circuit, reassemble, and then test the circuit by connecting the positive and negative ends to a 9-Volt battery.

Procedures: (Part 1)

Students will start this assignment by learning about the basics of a circuit. The lesson should be taught first, and then students will begin to create their own circuit using the materials listed below. They will start by creating a cube out of an 8X8 in paper square. These instructions should be given explicitly as the construction might be difficult for students.

Cube Building:

1) Fold square diagonally on both corners.

2) Now fold the sides in as shown in the photo. This is called a mountain fold. Then fold it down as shown.

3) Fold the two sides in so that the tips touch the center.

4) Fold the two sides in so that the tips touch the center.

5) Fold down the two flaps at the top. Also notice that there are two slots that you can open near the center. Tuck the flaps into the slots.

6) Repeat steps 3-5 on the other side of the shape.

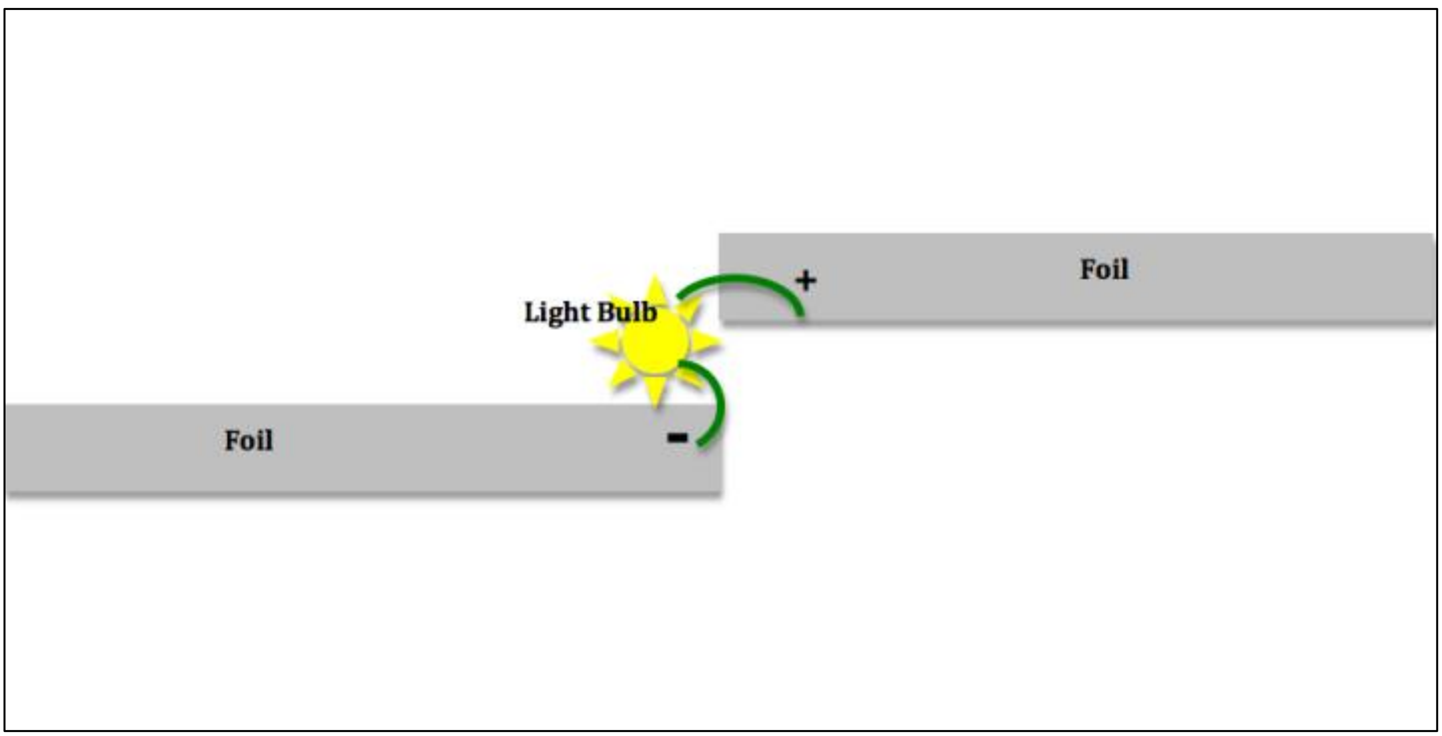
7) Blow into the end of the shape with the hole.

8) Crease edges to finish the cube.

Procedures: (Part 2)

Circuit Construction:

1) Have students unfold their paper cubes to construct their circuit on the inside of the cube.
2) Students will measure 2 8-inch strips of foil, one positive and one negative.
3) Have students attach the wires from the bulb to each strip of foil using electrical tape, and attach the foil to the paper cube as well using tape. There will be a few inches of foil that will reach longer than the edge of the paper, which should not be cut off.
4) Have students reassemble their cubes being careful that the circuit remains intact. The foil strips should come out of the cube through the hole used for air intake.
5) Students will then use the 9-Volt battery and connector to touch the positive end of the battery connector to the positive foil piece, and the same for the negative end. This should cause the bulb to light.



New Vocabulary Terms:

- Three Dimensional: To have dimension of depth, width and height
- Circuit: The act or instance of moving around.
- Insulators: A material of such low conductivity that the flow of current through it is negligible.
- Conductors: A substance, body, or device that readily conducts electricity.

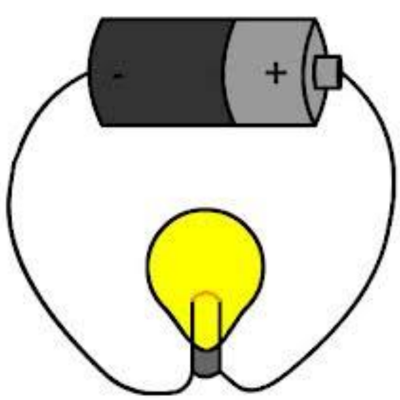
Materials: Students will be provided with all the materials needed to create an Origami night-light.

- 9 Volt Battery
- Christmas Light
- Foil
- Electrical tape/ Duct tape
- White 8X8 inches paper
- Battery Connecters

Content Information:

A cube is a three-dimensional shape, where all six sides are squares. Every square will be the same dimensions, and all sides will be the same. A cube has six faces, eight vertices, and twelve edges.

We use electricity every day to make our lives easier. Electricity powers the lights we use in our room, electronic devices like computers and telephones, and many other devices. Electricity travels through circuits, a loop of conductors connecting a power source to an object that uses electric currents to work. Electricity cannot flow without a power source. A complete circuit means that a full loop is creates, and there are no holes in the circle. Positive and negative charges are given off and when connected correctly in the circuit, electricity will flow. A circuit can be created through using good conductors like electrical wires, foil, or even graphite from a pencil. See the example of a complete circuit below.



Additional Planning:

This lesson can also be used in a unit to learn about surface area. After the circuit is created, and the cube is complete, a lesson taught about determining surface area can be done. Students can measure the dimensions of each square, find the area of one square, and multiply by six to find the total surface area. The lesson can be expanded even further to find the volume of cube. Students could be given the volume of the light bulb and will need to subtract that measurement from the total volume, etc.

Assessment:

Students will be assessed based upon if their night-light glows and if their circuit is complete. The design loop worksheet attached can also be used to assess if the students are following the appropriate steps of the design loop.

Citations:

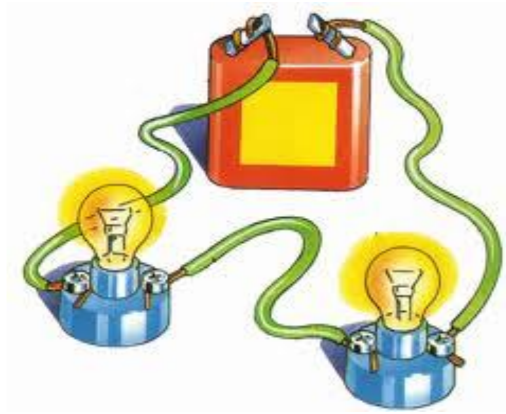
"How to Make a Paper Cube." *Instructables*. AutoDesk, 2013. Web. 08 Oct. 2013. <http://www.instructables.com/id/How-to-make-a-paper-cube/step6/Two-more-folds/>.

Lenore. "Evil Mad Scientist Laboratories." *Evil Mad Scientist Laboratories*. N.p., 19 Mar. 2008. Web. 08 Oct. 2013. <http://www.evilmadscientist.com/2008/paper-circuitry-at-home-electric-origami/>.

Simpson, Janice. "Electricity - Simple Circuits." *Electricity - Simple Circuits*. UCI Summer Science Institute, 8 Aug. 2000. Web. 08 Oct. 2013. <http://www.can-do.com/uci/lessons99/electricity.html>.

Which Materials Conduit?

Lyndsey Strange and Alexis Hennessey



Disciplinary Area:

- ✓ STEM grades K-2

Unit:

- ✓ Electricity
- ✓ Problem Solving
- ✓ Troubleshooting

Standards:

- ✓ The core concepts of technology
- ✓ The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- ✓ The engineering design process, involves defining a problem, generating ideas, selecting a solution, testing the solution, making the item, evaluating it, and presenting the results.

Big Ideas:

- ✓ Proper use of the design loop.
- ✓ Introduction to properties of electricity
- ✓ Identifying the proper use of a conductor

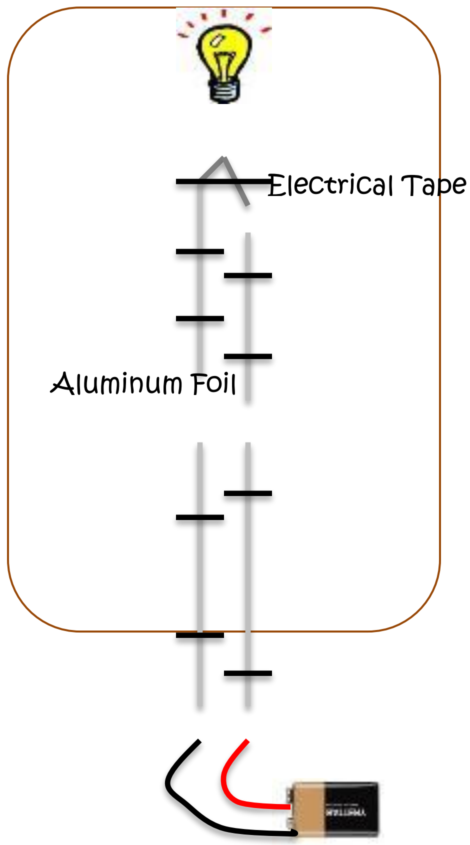
Essential Question:

- ✓ How can you complete the circuit to make the light bulb light up?

Scenario:

- ✓ Teach the students a brief lesson on electrical circuits and how to complete them. Then, students will be given a circuit maze. They need to complete the circuit to make the light bulb light up at the end of the maze. They will be given choices of materials that they can use to complete the circuits.

Circuit Diagram



Materials/Resources:

Materials for students to test:

- ✓ Paper clips
- ✓ Crayon
- ✓ Eraser
- ✓ Wood
- ✓ Aluminum
- ✓ Paper

Materials for building the circuit:

- ✓ Aluminum foil
- ✓ Electrical tape
- ✓ 9 volt battery
- ✓ Red and black battery wires
- ✓ Light bulb
- ✓ Cork board (17X11")

Steps for building the circuit:

- ✓ Cut 4 Pieces of aluminum foil, and fold each one into a long rectangle about 1 inch wide
    - o 2 pieces will be about 10 inches
- ✓ the other 2 pieces will be about 6 inches.
- ✓ Tape the 2 long pieces about 2 and a half inches apart vertically with one end touching the bottom. (Make sure and leave room for the battery to connect)
- ✓ Leave a space (about one inch) from the top of the long aluminum strips, and tape the other two shorter strips above going inward.
    - o Make sure the 2 shorter strips are not touching at the top, but are leaning inwards
- ✓ Tape the light bulb to the top of the shorter strips with each prong on one of the aluminum pieces.
    - o Make sure the metal wire on the light bulb is touching the aluminum underneath the tape.
- ✓ Connect your battery to the red and black cord by clipping one of them to the positive end and one to the negative end
- ✓ Connect each unattached end of the cords to the 2 long pieces of aluminum creating a circular flow of energy from the battery to the light bulb

Content:

- ✓ Teacher should give a short lesson covering the following definitions:
- ✓ Definitions:
    - o **Electricity:** energy made available by the flow of electric charge through a conductor
    - o **Circuit:** a complete or partial path over which electrical current may flow
    - o **Conductor:** a substance or medium that conducts heat, light, sound, or especially an electric charge
    - o **Insulator:** A material that insulates, especially a nonconductor of sound, heat, or electricity.
- ✓ Teacher will then show the students the circuit she has made along with the different materials that may or may not be used to complete it.
- ✓ Class can work together to hypothesize which materials will make the light bulb light up and which will not.
- ✓ Then the materials can be tested.
- ✓ Afterwards the teacher can ask the students to bring items from home that they think will make good conductors of electricity.
- ✓ The students will then test those items.
- ✓ The class can then each complete the attached worksheet.

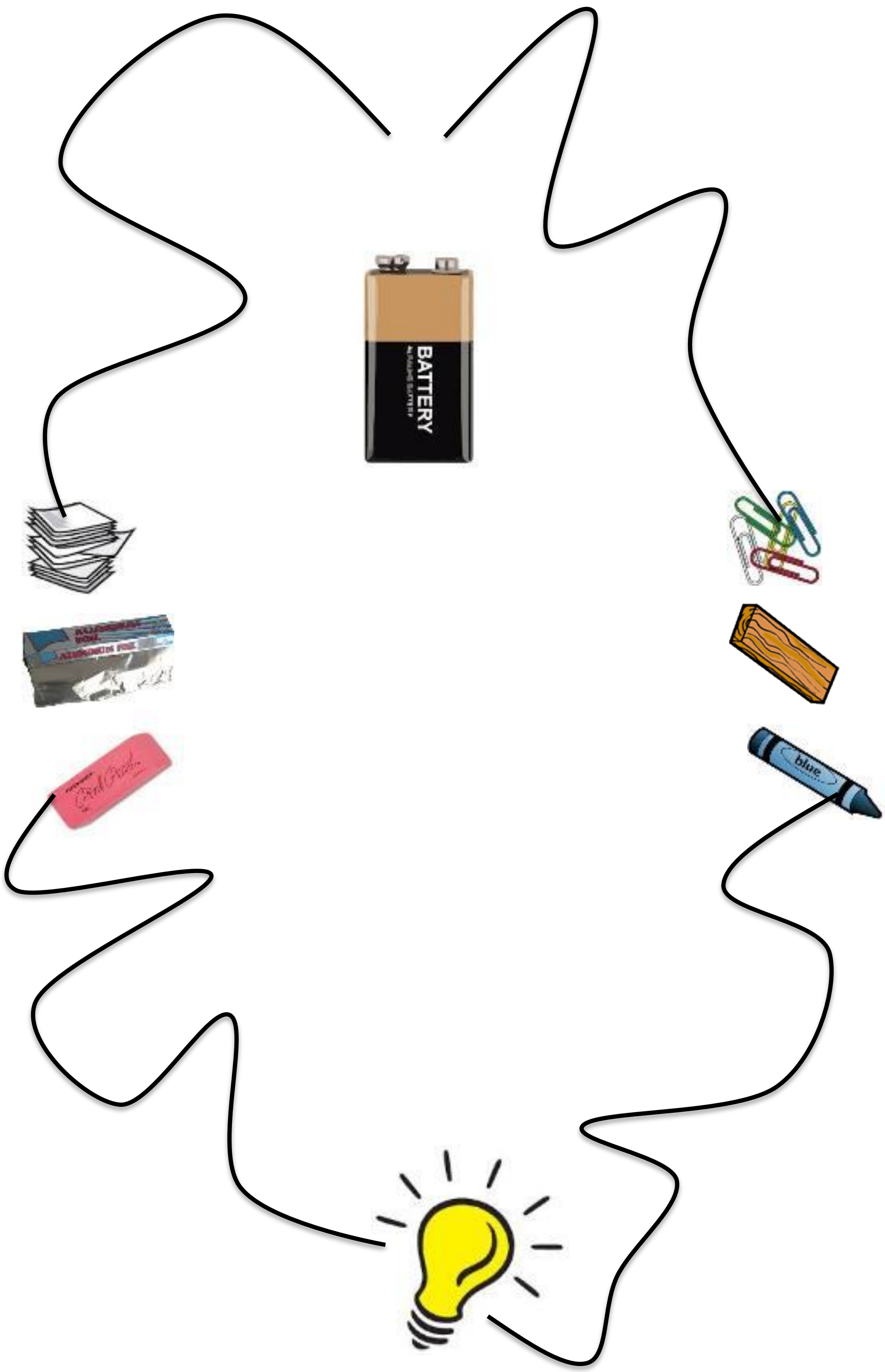
Parameters:

- ✓ Students can only use the materials given to bridge the gaps in the circuit.
- ✓ Students can use each material only once.

Assessment:

- ✓ Students can be assessed on weather the item they brought from home did make a good conductor.
- ✓ Students can be assessed on the successful completion of the worksheet.

Directions: Choose the material that would make the best conductor to complete the circuit.



STEM
ZOMBIE CHALLENGE
UNIT: ELECTRICITY

TEACHER GUIDE

BIG IDEAS:

- General understanding of Electric Circuit with Switch
- Understanding of where power can come from (depletable/renewable)
- Utilization of the design loop!

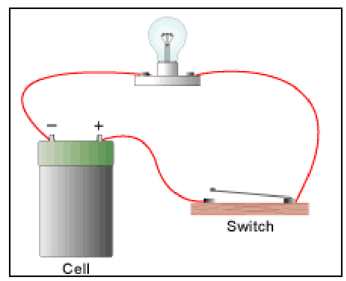
STANDARDS:

- Core Curriculum Physical Science Standards: Physics Standard 8. Students shall demonstrate an understanding of the role of electricity and magnetism in the physical world.
- Core Curriculum Physical Science Standards: (Strand: Physics) Standard 6. Students shall demonstrate an understanding of the role of forces in physics. P.6.PS.13 Design an experiment to show conversion of energy.
- National Science Education Standards: 6.2 Motions and Forces, Electricity: **SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES,** Science and technology in local, national, and global challenges.
- Core Curriculum Math Standards: Content Standard 5: Students will interpret linear models, calculate expected values to solve problems, and use probability to evaluate outcomes of decisions. Students will learn Mathematical Modeling Cycle

ESSENTIAL QUESTION: Can you design a wind-powered device to power the lights in a house to stave off a Zombie attack?

SCENARIO: There has been an unusual and incurable virus affecting millions of people. They have become light sensitive Zombies and only come out at night. There are small groups of people that make their way around in the daylight and hide at night. If there was a way to power the lights in the old abandoned cabin your group has sought refuge in, you could stay there comfortably for a lengthy amount of time and survive.

CONTENT INFORMATION: An electric circuit only works if there is a power source. A simple circuit consists of conductors connecting the power source to the element being powered and a switch to stop or start the flow. A power source can be a battery or gasoline or another source that is depletable or nonrenewable. A generator is a way to create an electric flow by electrons interacting with coils and magnets spinning in wires. As a battery has a set lifespan, a generator is only limited to the force that drives it. Electricity is not mandatory for sustaining life; however, can you think of how it has changed our lives?



DIRECTIONS: Have this be a fun challenge. After going over the basics of a simple circuit, expand with this challenge. Divide the students into groups of your choice. We recommend 4 to 5. Read the challenge aloud and present the students with a box of the essential items to build their wind-powered generator. (The challenge box explained below.) Emphasize the utilization of the design loop. Provide the design work sheet with their packet for brainstorming ideas. Let the students see inside the box but do not let them start building until you see a clear thought process forming on their papers.

CHALLENGE BOX: Let the challenge box consist of:

Safety goggles	Small motor	Small hammer	Glue	Fabric
Dowels	A small fan blade	Scissors	Gears	Possibly include Legos or K'nex
Aluminum foil	Wires	File	Scotch tape	String
Foam pieces	Cardstock	Small PVC Pipe	Masking tape	Light bulbs
Craft Sticks				

The challenge box allows for creativity and versatility of the unit.

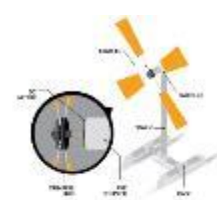
VOCABULARY:

ENERGY – The ability to do work or to cause a change.

ENERGY CARRIER – A secondary energy source that is an efficient and safe way to move energy from one place to another. Energy carriers do not exist in nature but must be refined or generated from a primary source of energy. Gasoline and electricity are examples of energy carriers.

NONRENEWABLE ENERGY – Energy sources that have a fixed amount of supply on the earth, because they take a long time to form. Petroleum and natural gas are examples.

RENEWABLE ENERGY – Energy that can be replenished within our lifetime such as such as energy from the Sun and wind.



BLAD PITCH – The angle of the blades with respect to the plane of rotation. (Blades perpendicular to the oncoming wind would be 0 degrees. Blades parallel to the wind would be 90 degrees.)

FORCE – A push or pull.

DIRECT CURRENT (DC) – Current that flows in one direction. A battery, capacitor, or spinning DC motor all provide DC current.

ELECTRICAL GENERATOR – A device that converts mechanical energy to electrical energy.

GRADING and ASSESMENT:

Students are graded on their applied knowledge of the design loop and simple circuit concepts. A walk around assessment will be part of the grading process.

Demonstrates knowledge of a simple circuit and the way they can be powered (0-25)_______

Uses the design loop and shows steps with alternate designs and brainstorming (0-25)______

Creativity and Team work (0-15)______

Finished product has all components required (switch, lit light bulb, generator, device to harness the force to drive the generator and power the light bulb i.e... Windmill)(0-25)_____

STEM
ZOMBIE CHALLENGE
UNIT: ELECTRICITY

STUDENT HANDOUT

SITUATION: There has been an unusual and incurable virus affecting millions of people. They have become light sensitive Zombies and only come out at night. There are small groups of people that make their way around in the daylight and hide at night. If there was a way to power the lights in the old abandoned cabin your group has sought refuge in, you could stay there comfortably for a lengthy amount of time and survive.

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DIRECT CURRENT (DC) – Current that flows in one direction. A battery, capacitor, or spinning DC motor all provide DC current.

ELECTRICAL GENERATOR – A device that converts mechanical energy to electrical energy.

The materials will be provided in you **Challenge Box**!

DIRECTIONS:

1. Use the design loop table to brainstorm ideas. You must have written thoughts and drawings to illustrate your ideas. Be sure to utilize all resources including the computer, teacher, friend or parent.
2. Open your Challenge Box and see what can be used that best suits your initial designs and then modify if necessary.
3. Be sure to evaluate the design and the possible flaws. Be sure to make changes or start over if needed.
4. Test time! Once you have a viable option test it. Make more changes to get ready for the final test with the class!

BRAINSTORM

What is the challenge and what is your initial thought on how you want the project to go?

____

____

____

____

____

What have you learned from your research?

____

____

____

____

REFLECTION

Which design was your best? Why? How did it differ from other designs?

____

____

____

____

Is there anything that you would change if you could?

____

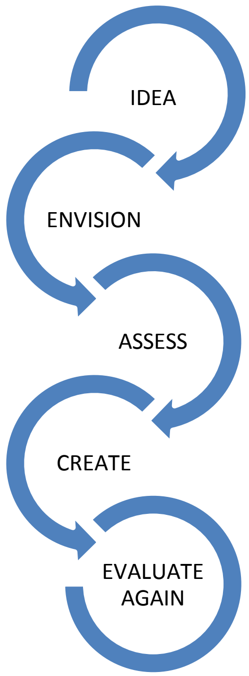
____

____

____

DESIGN LOOP

Be Creative with utilizing the Design Loop! Remember to research and have at least three ideas for the worksheet.

Keva Coaster Design Challenge

Introductory Lesson

Tara Hodge

Disciplinary Area: STEM

Unit: Energy, Forces, and Motion

Grade Level: 3

Standards:

- National Science Education Standards (Physical Science): Position and motion of objects
- Standards for Technological Literacy (Understanding of Design): The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Common Core Mathematics (Measurement and Data): Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.
- Common Core ELA (Writing): Write opinion pieces on topics or texts, supporting a point of view with reasons.

Big Ideas:

- Demonstrate a basic understanding of Newton's first two Laws of Motion and how they apply when designing objects that incorporate movement
- Follow the design loop to build a Keva Coaster

Essential Question: Can you apply your knowledge of Newton's Laws of Motion to design and a build a roller coaster out of Keva blocks that will keep a ball in motion for the longest amount of time possible?

Scenario: You are a roller coaster designer, and your boss wants you to design the biggest, best roller coaster ever- only in a twist, he wants it to be SLOW! Follow the design loop to create a series of contraptions that will keep your cart (a ball) in motion for as long as possible.

Materials: Keva Blocks

Content Information: Introduce the laws of motion to your students. A great way to do this would be to watch *The Magic School Bus* episode titled *The Magic School Plays Ball*, which is available on Vimeo: *http://vimeo.com/50104053*.

The episode will explain that

1. Forces are pushes or pulls that change how things move.
2. Once moving, things keep moving until forces change or stop their motion.
3. How friction, or a lack of it, changes movement.

Sir Isaac Newton lived in the 17th century. He published his ideas on motion and forces, which became knows as Newton's Laws of Motion.

> *1st Law: If no forces (or a combination of forces that is balanced) act on an object then, if it is at rest, it will remain at rest, and if it is in motion, it will continue to move in a straight line path at a constant speed.*

What does this mean? **Objects keep on doing what they are doing**. This is the law of inertia.

> *2nd Law: If a single force (or a combination of forces that is unbalanced) acts on an object, its speed and/or its direction will change. How quickly the speed (and/or direction) changes is directly related to the strength of the net force and inversely related to the object's mass.*

Simplified, this means that a force pushing or pulling on an object will change its direction and/or its speed. When you kick a soccer ball, your kick is the force. Your kick will increase the soccer ball's speed. If the ball was rolling towards you before the kick, it will most likely change direction. The harder you kick, the more drastic and noticeable the change will be. A quick demonstration with a ball and a couple of students would be a great way to introduce this concept! What does it mean when says that changes are inversely related to an object's mass? The easy answer is that the heavier something is, the harder it is to get it moving, keep it moving, and the slower it will go.

What about friction? Friction is what happens when two things rub together. You might have your students rub their hands together for a minute and feel the heat produced. This is a side effect of friction! Think about the molecules on the surfaces of two materials (even ones we think are smooth) like sandpaper, and then imagine rubbing them together. Just as the individual grains of sand rub against one another, so do the molecules in our smooth surfaces. While we could go in to a lot of detail about friction, it is really just important that you get one thing across to your students at this point. That is: Friction is an opposing force, and it is always at work here on earth, and it slows things down!

To sum up, here are the key points:

- Objects keep doing what they are doing.
- A force acting on an object will change its speed or direction, or both.
- The heavier something is, the slower it will go. Alternately, the lighter something is, the faster it will go.
- Friction slows things down.

Keva Coaster: Evaluation and Assessment Grading Rubric

Demonstrates knowledge of Laws of Motion (0-25pts): ____________

Student is able to describe how the first two laws of motion apply in making a cart go faster or slower.

Followed Design Loop (0-25pts): ____________

Student used Design Loop to design and build a roller coaster.

Effective Collaboration (0-25pts): ____________

Student is able to work in a group to design and build, treating others' ideas with respect.

Completion of provided handouts for evaluation (0-25pts): ____________

Student completed all questions and demonstrated knowledge and comprehension of Laws of Motion, line plots, and creative writing.

Total Points: ________/100

Keva Coaster Design Challenge: Student Handout

Situation: You are a roller coaster designer at the biggest amusement park in the world, and your boss wants you to design the biggest, best roller coaster ever- only in a twist, he wants it to be SLOW! Follow the design loop to create a series of contraptions that will keep your cart (a ball) in motion for as long as possible.

Materials: Keva Blocks

Vocabulary:

Acceleration- the rate at which an object changes its velocity
Balanced- equal
Constant- occurring continuously over a period of time
Force- a push or a pull
Friction- the resistance that one surface encounters when moving over another
Inertia- a tendency to remain unchanged
Inertia- a tendency to remain unchanged
Mass- the quantity of matter that a body or objet contains
Pull- a force drawing something in a particular direction
Rest- not moving
Speed- the rate at which something is able to move
Velocity- the speed of something in a given direction

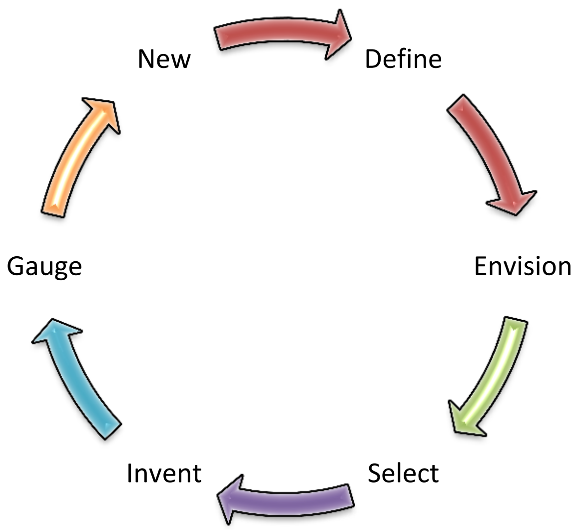
Instructions:

1. Within your group, follow the design loop to come up with your roller coaster plan. You will need to fill out the design loop worksheet before getting your blocks!
2. Build your roller coaster. Make adjustments as you go!
3. Complete the Student Worksheet
4. Complete timed runs with the entire class, and record data on line plots
5. Write an opinion piece- be creative!

Design Loop Worksheet

Instructions: Follow the design loop to come up with 3 possible solutions to make your car faster. Be creative!

The Design Loop



Keva Coaster Design Challenge

Student Worksheet

1. Draw a line plot to show how long it took your cart to complete the coaster (time and mark 3 test runs).

____

2. Draw a line plot to show how long it took all carts to complete their coasters (time and mark 3 test runs)(you will want to make a different mark for each coaster, such as X,Y,Z, as well as a key).

____

3. If you could do this challenge again, what would you change? What you keep the same? Why?

____

____

____

____

____

____

____

____

4. Imagine you are a newspaper reporter going to the amusement park on the day the new, improved, and super slow roller coaster opens. Write a short article about your opinion of the coaster. Your article can be supportive or not, but you have to justify your opinion. Be creative!

Ciabocchi

Keva Craze

Standards:

- Next Generation Science Standards: K-PS2-2: (Motion and stability: Forces and Interactions) Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull.
- Common Core ELA standards: CCSS.ELA-Literacy.SL.2.1. (Comprehension and collaboration) Participate in Collaborative conversations with partners about grade 2 topics with peers and adults in small and larger groups.

Big Ideas:

- Creating and utilizing contraptions such as turns, chutes, slopes, troughs, and funnels.
- Experimenting with balance and placement.
- Communicating ideas with others, and bringing them together to create a product.
- Utilizing and understanding gravity.

Name______________________

Keva Craze

Directions: Find the vocabulary words found below in this word search. They can be placed horizontally, vertically, or diagonally. Circle or highlight each word you find.

T	G	M	S	Y	C	Y	E	L	L	M	Y	R	E	H
O	R	Y	H	H	A	T	P	X	P	L	F	C	N	M
D	Z	O	U	L	N	I	O	F	U	N	N	E	L	T
P	E	T	U	U	K	V	L	O	B	A	U	M	M	D
I	E	E	S	G	D	A	S	F	L	F	U	D	S	L
G	L	D	P	J	H	R	B	A	Q	B	M	K	S	T
Y	R	A	L	S	B	G	B	V	M	U	D	Q	H	P
V	G	J	E	V	M	M	R	A	W	L	R	N	X	C
T	Q	C	F	M	B	X	S	M	C	B	V	V	E	U
A	J	P	T	Q	Y	O	X	H	B	L	R	Y	P	Q
J	J	V	C	T	B	G	S	N	R	I	P	E	L	U
K	C	A	R	T	Q	Z	R	M	B	R	P	V	A	M
A	V	G	B	I	J	U	V	B	F	K	W	O	N	X
O	T	I	A	O	T	G	O	F	L	I	K	S	K	Z
S	J	P	B	A	L	L	H	E	B	N	T	R	I	Q

BALANCE
BALL
CHUTE
FUNNEL
GRAVITY
PLANK
SLOPE
SPEED
TRACK
TROUGH
TURN

Name___________________

Keva Craze Evaluation

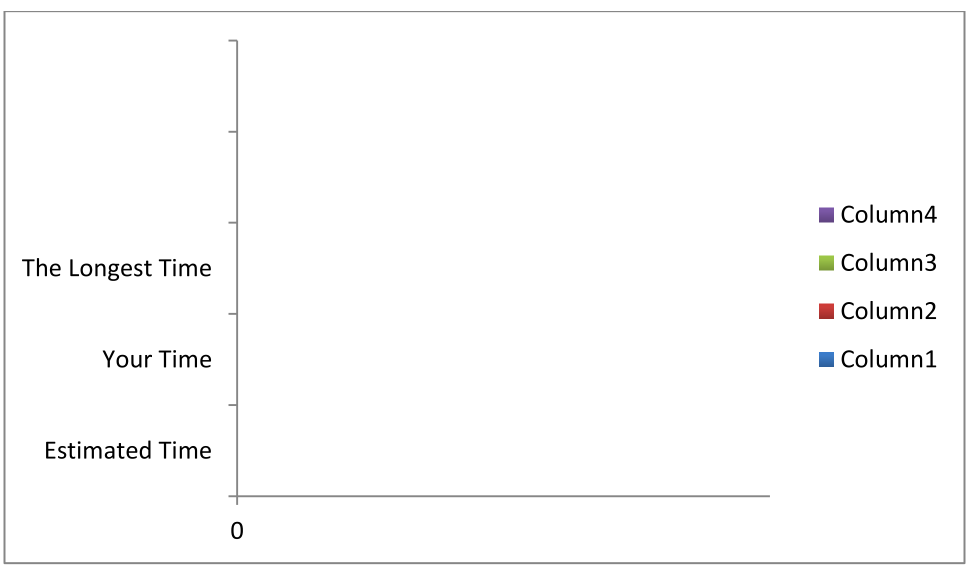
Directions: Fill in the answers to the questions below. Use the information you learned by building your keva maze!

1. **Prior to building your maze**, write down your estimation for how high you think your maze will be, how many blocks you will use, and how long your ball will stay in motion.

2. Why did the maze stay up without glue? Do you think it would make a difference if the planks were glued?

3. Would the ball move faster if it were heavier or lighter? Do you think change in direction of the track has an effect on the time?

4. Chart your estimated time, your maze's time, and the longest time of the class



Where do you use gravity?

Think about how we use gravity every day. How does gravity help us sleep in bed at night? How does gravity help our food stay on our plates? How does gravity help our water stay in our glass? How do we use gravity when we play sport, jump on our trampolines or skip rope? Draw a picture of how you use gravity and label it.

STEM Curriculum Assignment—Artika

TEACHER'S LESSON PLAN

Title: Keva Maze

Disciplinary Unit: STEM

Unit: Momentum (Motions and Forces)

Standards:

Next Generation Science Standard (NGSS): Science Models, Laws, Mechanisms, and Theories Explain Natural Phenomena: Science theories are based on a body of evidence and many tests. Science explanations describe the mechanisms for natural events.

National Science Education Content Standards (physical Science Standards K5-8): students are able to know, understand, and use the science facts, concepts, principles, and theories that are important in motion and forces (momentum).

Standard for technological literacy:

- **Standard 8:** Students will develop an understanding of the attributes of design.
- **Standard 9:** Students will develop an understanding of engineering design.
- **Standard 10:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Common Core ELA Standards (CCSS.ELA-Literacy.SL.5.4): Report on a topic or text or present an opinion, sequence ideas logically and use appropriate facts and relevant, give descriptive details to support main ideas or themes; speak clearly at an understandable pace.

Essential Questions: Can you design a Keva in 75-inute class period that allows a Keva ball to be set in motion and remain in motion for the greatest amount of time?

Scenario: Using the Keva materials given, construct a structural device that allows a Keva ball to be set in motion and remain in motion for the greatest amount of time (changes in direction are allowed) and then finally stop after dropping into a ball holding area.

Materials:

1. Keva planks
2. Keva ball

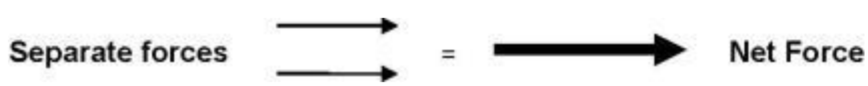
Content Information:

Objects store energy as a result of their position. Stored energy is referred to as potential energy. If you think about a bow, in its usual position without an arrow, the bow has no stored energy, thus it has no potential energy. When the bow is drawn, there is stored energy, as a result of its position. This is potential energy; it is stored in the drawn bow. Gravitational potential energy is the energy stored in an object as a result of its vertical position or height. The energy is stored as the result of the gravitational attraction between the Earth and the object. Kinetic energy is the energy of motion. When an object has motion, it has kinetic energy. Mechanical energy is the energy possessed by an object due to its motion or its stored energy of position. It can be either kinetic or potential energy.

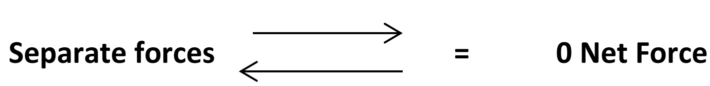
Forces

A force is defined as a push or pull. When you write, for example, you are exerting a force on your pencil because you push or pull it across the paper.

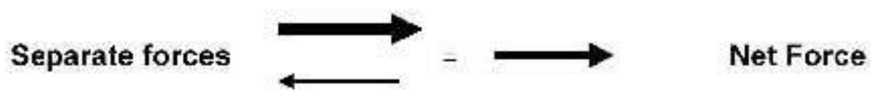
Sometimes there are two forces acting together. If two people are pushing a table across the floor in the same direction, the two forces are added together. Adding these two forces together is called the net force. In the case of the two people pushing the table, the net force is unbalanced. When there is an unbalanced force there is a force that changes an object's motion or causes it to accelerate. This can be shown with arrows; the wider arrow is the stronger of the forces.



Two forces can also act in opposite directions. When the forces are equal and act in opposite directions, they balance each other out. There is no net force in this case. Using the example of two people pushing on a table, if there is a person on each of the opposite ends of the table and they are both pushing on the table with an equal amount of force, they balance each other out to a zero net force. This means the table will not accelerate.



When there are separate forces that are not equal and one force is more powerful than the other, they will not balance out to zero net force. Because there is one force stronger than the other, the weaker force is not strong enough to balance the other end. They are pushing in opposite directions but one of them is pushing with a greater force. The motion will occur in the direction that the stronger force is moving. If two people are pushing on opposite ends of the table and one is pushing with more force, the table will accelerate in the direction that the person with the stronger force is moving.



Newton's Laws of Motion

Newton's First Law

If there is a ball in front of you that is just sitting there, it will stay there until you kick it or until another force acts on it. Why is that? It is inertia. Inertia is the tendency of an object to resist any change in its motion, that means the object does not want to move or if it is moving, it wants to keep moving. Newton's First Law of Motion is also called the Law of Inertia. This law states that an object at rest will remain at rest unless there is unbalanced force acting on it. An object in motion will keep moving until there is an unbalanced forced acting on it.

Newton's Second Law

Newton's Second Law of Motion explains how force, mass, and acceleration are related. The law states acceleration equals force divided by mass. When something accelerates it gains speed. When someone is driving and putting their foot on the gas pedal to gain speed, they are accelerating. If two people are pushing two tables, one a very heavy table and the other a very light table, the person pushing the light table will move it across the room faster than the one with the heavier table. That is because the lighter table has less mass. Students in fifth grade do not need to work with the formula, but they need to understand the concept of the relationship between force, mass, and acceleration.

Other Forces

Some surfaces, like ice, are so slick it is easy to slip and fall. Others are so rough that it is difficult to slide things across them. All surfaces have irregularities that make up textures on the surface. Some textures you can see and others cannot be seen. Friction is caused by the irregularities getting caught on one another as two surfaces rub against each other.

Friction acts as force acting in the opposite direction of an object's motion. Friction slows things down and can cause them to come to a stop. Friction helps us to move around as well. Without friction it would be difficult to move around on some surfaces. Friction can change its force based on the surfaces of the objects sliding together and how hard the surfaces are being pushed together. Besides slowing things down, friction also creates heat. If you rub your hands together they get warm because of friction.

When you hold something up and let go, it falls because of gravity. Gravity is the force that pulls things towards Earth. The force of gravity acts between all objects. Gravity is an unbalanced force on a falling object, so when objects are dropping in a free fall, (with no other forces acting on the object), they will accelerate at a rate of 9.8 meters per second per second. So, in theory all objects would fall at the same rate. On Earth however, when something is dropped another force, air resistance is a force that acts upon the object as well. Air resistance is an opposite force acting on the falling object. Air resistance causes an object to fall slower. Air resistance is not the same on all objects because they have different surface areas. Objects with larger surface areas have more air resistance but that doesn't necessarily mean they fall slower, the object's weight also plays a factor. Weight is a measure of the force of gravity on an object. When a falling object's air resistance equals the force of gravity upon that object, the object will still fall, but will stop accelerating. This is called terminal velocity.

Momentum:
Some objects are easier to stop than other. Baseball catchers often catch a baseball that can be moving at very fast speed, or velocity, such as 80 or 90 miles per hour. Can they stop cars moving at the same speed? It is probably not something they want to try. The ball and the car have different masses. Even though moving at the same speed, it is not the same amount of momentum. The reason that these objects do not have the same momentum is because of their masses. The car has a much larger mass than the ball and has more momentum, making it more difficult to stop. Momentum is found by looking at the mass and velocity on a given object.

Objects that have a small mass can also have a lot of momentum. Think of a bullet being fired from a gun. Because of its velocity being fired from that gun, it has a very large amount of momentum.

Resources:
http://edhelper.com/Forces_and_Motion.htm
http://library.thinkquest.org/CR0215468/momentum.htm

Deliverables: Students will develop a design by following the design loop. The students must first fill out the provided worksheet, where they brainstorm different ideas for the design. Students are only allowed to use the resources that are provided in the materials list. The Keva maze structural device is built in 75-minute class and it will allow the Keva ball to be set in motion and remain in motion for the greatest amount of time before it finally stops. Students record the motion time using a stop watch.

Parameters: The Keva ball sets in motion for the greatest amount of time before it finally stops.

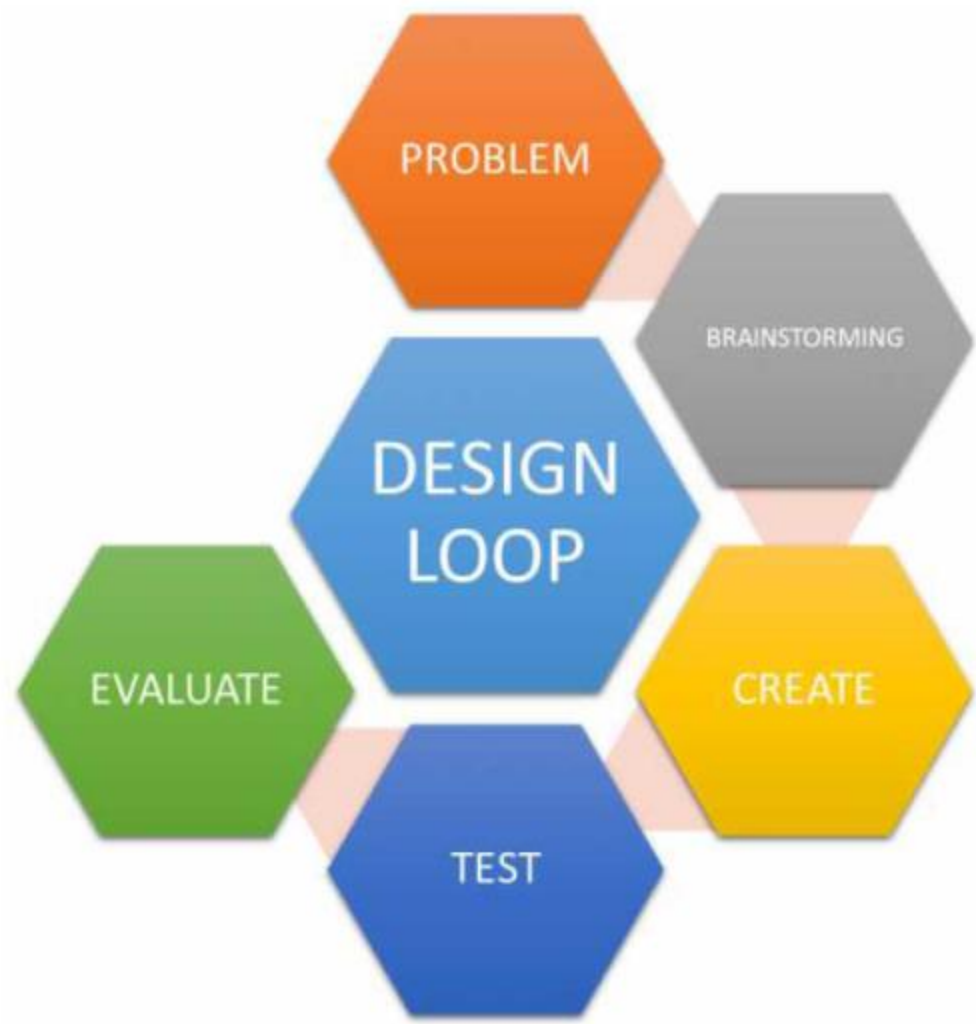
Evaluation:

Rubric for *Keva Planks Maze*

DESIGN BRIEF RUBRIC	Limited Understanding (Up to 5 pts.)	Fair Understanding (Up to 10 pts.)	Good Understanding (Up to 15 pts.)	Excellent Understanding (Up to 20 pts.)
The students restate the problem with their own words	The problem is restated in the same way, no changes	The problem is restated fair enough with their own words	The problem restate clearly with their own words	The problem restate clearly using their own words with proper language
The students brainstormed more than one idea	Zero to one idea	More than one idea that fairly acceptable	More than one idea and acceptable	More than one idea, vivid and acceptable
The students used the required materials and the ball sets in motion	Design did not follow the parameters. No ball motion	Work properly with a fair design Low times record of ball motion	Work properly with a good design Medium times record of ball motion	Work properly with marvelous design Medium times record of ball motion
The students evaluated how they could make it better next time	Zero to little evaluation	Evaluation with conclusion	Evaluation with conclusion and redesign idea	Evaluation with conclusion and redesign idea and keva maze
Recording the Keva ball motion time and presenting the design	Did not speak clearly Less organized	Spoke clearly Fairly organized	Spoke clearly and confidence Well organized	-Spoke clearly and confidence -Format is well designed -Well organized
The students draw a sketch of their keva maze design or picture design attachment	Less detailed and can't be followed by another student	Fairly detailed and easier to understand	Detailed enough, and easy to understand	Detailed enough, easy to understand, and easy to reuse by other people
Team Work	Zero discussion and team work	Fair discussion and team work	Good discussion and team work	Great discussion and solid team work

Total: /140

Design Loop:



Student Worksheet

Challenge:

With a team (3-4 people) and using the Keva materials given, construct a structural device that allows a Keva ball to be set in motion and remain in motion for the greatest amount of time (changes in direction are allowed) and then finally stop after dropping into a ball holding area. Each team has 75 minutes to finish the device/design. Fill out the worksheet before you begin your design.

Materials:

1. Keva planks
2. Keva ball

Test:

1. Test your ball to your Keva maze design and redesign if needed.
2. Three times attempt (ball runs) and record the times.
3. No human interaction will be allowed once the Keva ball is in motion during testing.
4. Teams will be allowed to troubleshoot the maze between tests.

Design Loop

Name: ____________________________

KEVA MAZE

Group Members

_______________________________ _________________________________

_______________________________ _________________________________

1. **What is the problem**? State the problem in *your own words*.

____

____

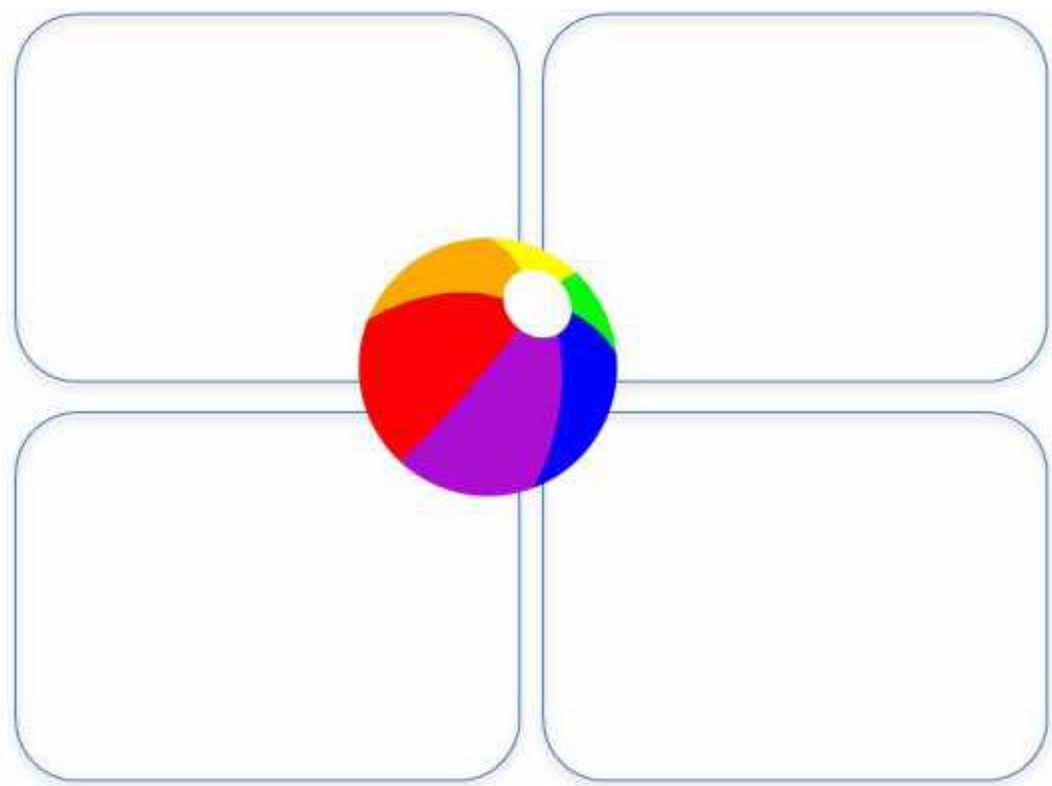
____

____

____

____

2. **Brainstorm Solutions**. Draw and describe some possible solutions.



3. **Create the solution you think is best**. *Keep notes below about the problems you have and how you solve them*.

____
____
____
____
____
____
____
____
____
____
____
____

4. **Test your solution**.

• Did you use only the material provided?	YES	NO
• Did you build your Keva maze design in 75 minutes?	YES	NO
• Did you record the times?	YES	NO

5. **Evaluate your solution**.

What is the best solution? Would one of your ideas have been better? Why and why not?

____
____
____
____
____

What would you have done differently?

____
____
____
____
____

Attach a photograph of your final project here. If you do not have a photograph, draw a picture of your final project. How would you make your project better? Draw a picture showing how it would look after you have made changes to.

Keva Maze Assignment

- Disciplinary Area: STEM; second/third grade

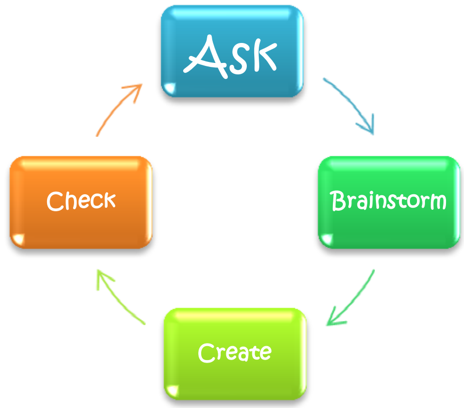
- Big Ideas:
  1. Basic use of the design loop
  2. Understanding of the vocabulary words
  3. Communicate and demonstrate the solution with others (for activity/design loop)
  4. Understanding the engineering design process (for activity)
  5. Proper use of materials to create and environment for the ball to travel the longest distance (for activity/design loop)

- Vocabulary Words:
  1. Gravity- the force of attraction by which terrestrial bodies tend to fall toward the center of earth
  2. Distance-the extent or amount of space between two things, points, lines, etc.
  3. Elevation-the height to which something is elevated or to which it rises
  4. Force- strength or power exerted upon an object
  5. Density- the state or quality of being dense; closely set or crowded condition

- STEM Standards:
  1. National Science Education Standards: (Science and Inquiry) Students will learn how to conduct observations by asking questions, as well as following through with a well-planned and conducted experiment using proper tools for the given age level.
  2. Standards for Technology Literacy: (Engineering Design) The engineering design process entails identifying the problem, researching and brainstorming, the creation of a solution through sketches and models presented to others.
  3. Standards for Technology Literacy: Students will develop an understanding of the attributes of design. The design process is a purposeful method of planning practical solutions to problems. Requirements for a design include such factors as the desired elements and features of a product or system or the limits that are placed on the design
  4. Arkansas Department Education Frameworks: (Scientific Equipment and Technology) Students will use simple equipment, age appropriate tools, technology, and mathematics in scientific investigations.

Worksheet #1: Use of the design loop to build the keva maze

The Design Loop



1. Ask yourself what the problem is:

____

2. Brainstorm ideas that will solve the problem:

____

3. Create your ideas:

4. Check your work by testing it out:

____

5. Evaluate your model and make changes if needed:

____

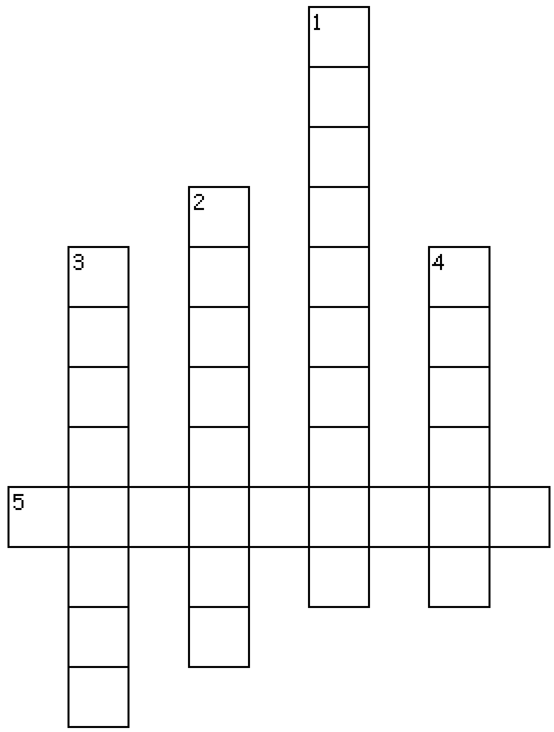
6. Present your ideas to others:

Worksheet #2: Word search to become more familiar with terms

A	P	W	W	U	R	X	M	B	Q	N	B	Z	D	O
P	P	N	O	I	T	A	V	E	L	E	Y	Y	S	X
R	I	E	W	P	N	O	I	Y	K	K	T	Q	A	K
T	T	L	C	E	S	F	C	D	D	I	I	J	Q	V
K	V	S	P	N	O	H	S	L	V	P	S	P	V	G
B	X	D	A	W	A	F	C	A	R	L	N	F	I	V
Y	E	I	Z	V	K	T	R	B	Z	X	E	O	Z	L
B	F	O	R	C	E	G	S	M	A	X	D	Y	H	N
U	G	O	I	X	T	W	G	I	Y	H	M	X	O	C
P	N	I	I	I	D	H	C	J	D	G	M	H	U	G
W	B	Y	Q	M	I	V	X	W	S	P	K	O	L	E
Q	E	V	M	M	L	U	P	I	O	R	H	L	Z	J
S	V	C	P	O	Z	P	L	G	I	R	J	L	K	U
A	T	W	M	V	W	F	P	J	U	A	P	I	I	N
F	M	V	C	K	F	F	O	J	T	J	X	C	J	L

DENSITY
DISTANCE
ELEVATION
FORCE
GRAVITY

<u>Worksheet #3</u>: Crossword Puzzle to become for familiar with terms and their meanings



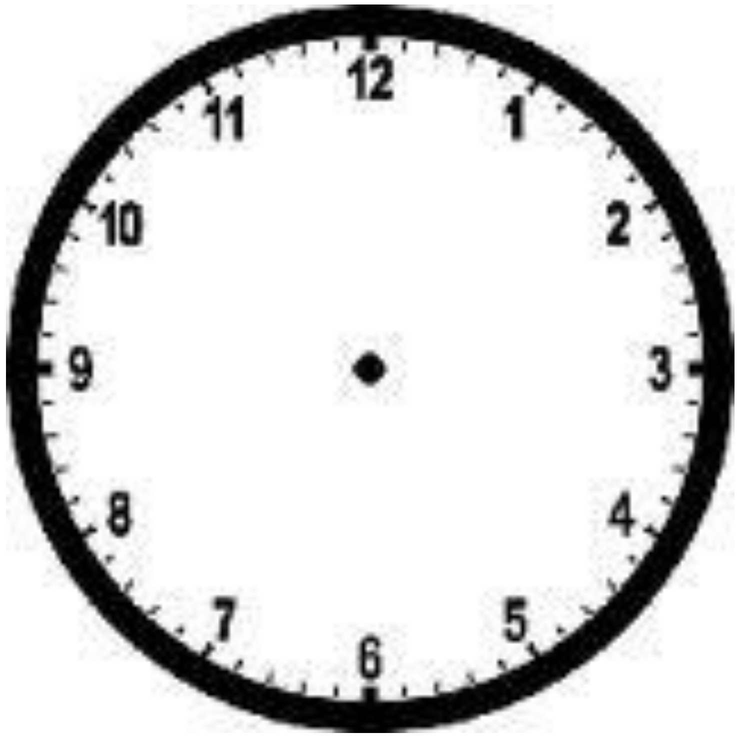
Across

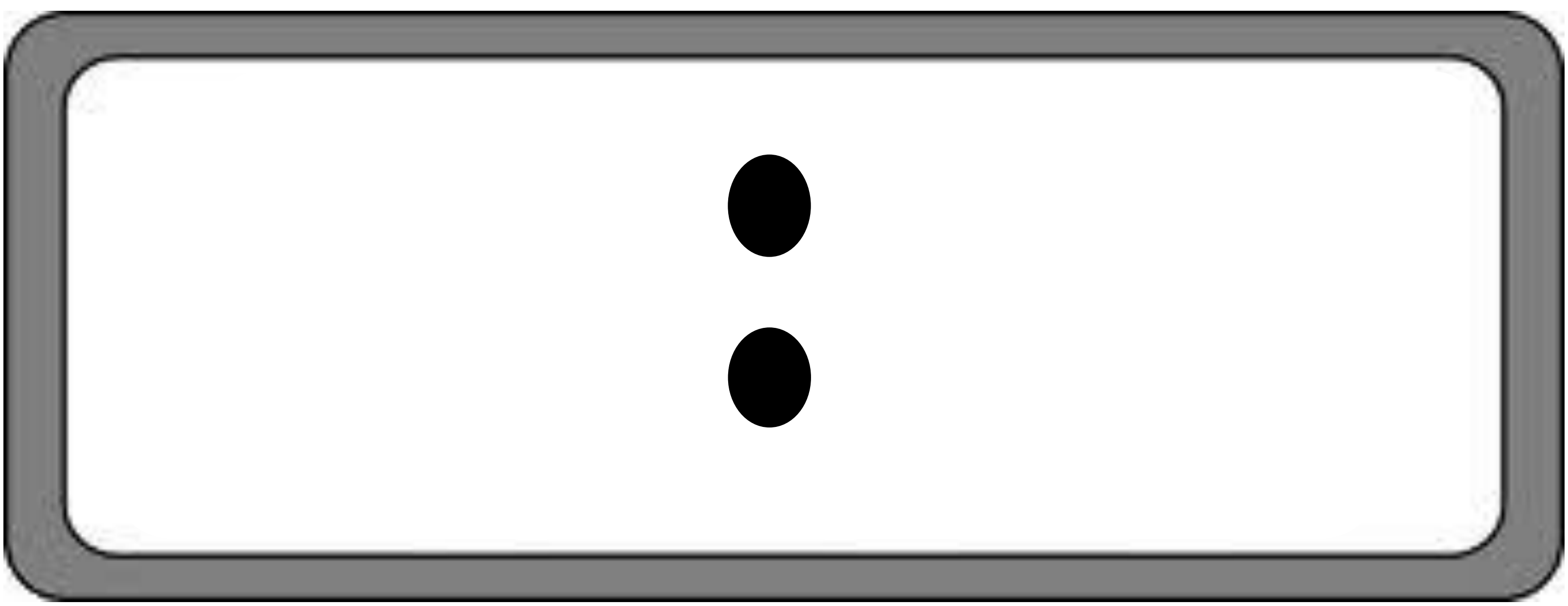
5. The extent or amount of space between two things, points, lines, etc.

Down

1. The height to which something is elevated or to which it rises
2. The state or quality of being dense; closely set or crowded condition
3. The force of attraction by which terrestrial bodies tend to fall toward the center of earth
4. Strength or power exerted upon an object

Worksheet #4: Use of the analog and digital clock to record the distance traveled by the ball





Workout 5: Word Search with a hidden phrase for a fun and creative way for students to discover out what the activity is

C	A	N	Y	O	U	C	B	U	I	L	D	A	A	K
E	V	Y	A	M	A	A	Z	E	T	H	V	A	T	W
I	L	O	L	A	L	N	L	O	W	E	T	H	E	B
A	L	U	L	T	O	E	T	R	K	A	V	E	L	T
H	E	L	O	N	G	H	E	S	T	T	I	M	E	M
L	E	V	A	R	T	T	B	O	M	T	I	M	E	L
P	S	Q	I	L	E	S	C	J	L	L	A	B	Z	T
T	F	G	U	J	N	V	P	M	S	L	E	D	D	M
E	Q	P	S	V	X	I	I	A	L	R	L	N	T	S
I	O	L	B	Z	N	W	E	O	F	I	K	H	Z	R
L	L	I	W	R	V	T	W	Z	U	R	A	Z	I	Z
U	I	H	H	O	H	S	E	B	A	T	P	B	A	X
R	M	E	G	P	B	U	W	W	J	M	T	O	E	J
Z	E	J	L	O	N	G	E	S	T	S	L	N	M	H
J	K	G	Y	T	H	Q	U	G	X	W	J	B	D	K

ALLOW
BALL
BUILD
CAN
KEVA
LONGEST
MAZE
THAT
THE
TIME
TRAVEL
WILL
YOU

___ ___ _____ _ ____ ____ ____

____ _____ ___ ____ __ ______

___ _______ ____

Geyser Riser

- Educators
- Students

Materials

- A Geyser Riser activity sheet for each student
- Water
- Liquid soap
- Small bottle with a narrow neck, two-liter bottle recommended
- Alka-Seltzer® broken into pieces
- Large tub or sink
- Sponge/towels for clean up

In this experiment, your group will create pressure in a bottle to reenact one of the special conditions under which a geyser erupts. A geyser is a hot spring that shoots a column of hot water into the air. Your group will make a model geyser using liquid soap, a bottle, and Alka-Seltzer® tablets.

Background

Although geysers are rare, 60% of the geysers in the world are found in Yellowstone National Park, where one of the most famous is called Old Faithful. A geyser is a hot spring that erupts, shooting a column of water into the air. Geysers are rare because they require certain conditions—water, volcanic heat, and pressure. Water seeps underground and flows through channels of underground rock and then some of it collects in underground reservoirs. When the water inside a pocket of a closed-off reservoir becomes extremely hot, pressure begins to build. If there is enough pressure, the water will stay in liquid form until it is very hot (as opposed to changing to steam like boiling water). When the high pressure causes some of the water to finally change to steam, the steam will launch water out of the reservoir causing the geyser to erupt. When the geyser stops erupting, the pressure starts to build again in the reservoir pocket, and the whole process starts over.

Activity Instructions

Set-Up

Ask your group: “Do you know what a geyser is?” They likely know, but they may not know why one erupts and it also may be (depending on geography) that they have never seen one.

Regardless of the answers, go to Old Faithful Photos or Old Faithful Geyser Photos to pull up a photo of Old Faithful.

Tell your group that Old Faithful is a famous geyser located in Yellowstone National Park. Then ask: “How do you suppose the water can be spewed that high out of the ground?” Whether kids know the answer or not, this is a great set-up question before they do their own explosive experiment.

Activity

Now, break your group up into small groups, point them toward the student web page, and give each group a set of supplies—a copy of the Geyser Riser activity sheet, liquid soap, a bottle, Alka-Seltzer®, and a tub. They will need to fill their bottles with water and the bottles will overflow once they’ve followed the directions. You may need to arrange for each group to have a turn at the sink if you don’t have individual tubs.

After kids have done the experiment, ask: “What makes a bottle erupt?” The main point is simply that pressure needs to build up to create an eruption. Relate the bottle activity to geysers if that helps them understand.

Other ideas for follow-up activity questions include asking kids to predict what would happen if they didn’t cover the top of the bottle, or what would happen if more Alka-Seltzer® were added, or more soap. Kids should make predictions and then try it.

Related Activities

For more about geysers, send kids to the National Park Service’s Windows into Wonderland: Geyser Quest. The program runs a full 55 minutes, so, if time is a concern, encourage kids to read along and click ahead. There are interactive activities at Slides 15, 19, 26, and 40, and a movie of Old Faithful erupting runs at Slide 38.

Afterschool Resource Details

Grades

- 3-7

Themes

- Earth Science
- Physics

Type

1. Hands-On

WAKE UP, DAD!

The Sleepwalk Alarm System Design Challenge

Situation:

Jason's father is sleepwalking once again and every time Jason wakes his father up and gets back in bed his father is already out his door sleepwalking some more! Jason has tried everything to keep his father from sleepwalking, he finally ties his father's toe with rope to the bed, and this stops him from sleepwalking. In the end, Jason's mom finds Jason asleep on top of the refrigerator; so after all this time Jason is sleepwalking just like his father.

Challenge:

In your assigned groups, you will help Jason design the best sleepwalk alarm possible. Using the design loop and the materials below, create a device that is easy to control and will make noise loud enough to wake up a person who is sleepwalking.

Tools:

String	masking tape	can of beans
Empty water bottle	thumbtack	(10) coins
Yarn	empty soda can	uncooked rice

Test:

1. Test your solution and make any needed adjustments.
2. Once your design is at the best it can be, your group will present to the class.
3. After everyone has presented, we will put all of the designs to the test and see which groups sleepwalk alarm system was the loudest.

Idea 1)

Idea 2)

Idea 3)

Are your ideas original? Are they accommodating? Do they achieve the goal?

Sleepwalk Alarm System Literacy Challenge

Constructing a Sleepwalk Alarm System

Disciplinary Area: STEM

Unit: Communication, technology

Standards:

Standards for Technological Literacy: Students will develop an understanding of and be able to select and use information and communication technologies.

"Big Ideas":

- the use of a design loop to solve a problem
- effective use of recycled resources as communication technology
- engineering design

Essential Question: Can you design an alarm system from recycled materials that will wake Jason's father up whenever he sleepwalks?

Scenario:

Jason's father is sleepwalking once again! Every time Jason wakes up his father is already out his door sleepwalking. Jason has tried everything to keep his father from sleepwalking. He even finds his father asleep on top of the refrigerator. The entire situation is getting out of hand. Using recycled materials found around the house, help Jason build an alarm system that is loud enough to awaken his father. In a small group of two or three, find a solution to the problem. Use a design loop to make sure you build the best alarm system possible.

Materials & Resources:

String	masking tape	can of beans
Empty water bottle	thumbtack	(10) coins
Yarn	empty soda can	uncooked rice

Content Information:

Communication is the exchange of thoughts, messages, or information. It more than just a verbal conversation between people. Communication can be in the form of talking, writing, body language, or even through technology. Simple technology such as a homemade alarm can communicate the message of “Wake up!” to a sleepwalker.

Sleepwalking is a disorder that causes people to do certain activities while still asleep. It happens unconsciously with no communication to their surroundings. Most people think that you are not to awaken a person while they are sleepwalking. Actually, by waking the person up you may prevent them from hurting themselves or someone else. Proper communication is one way of helping person with this disorder. By placing an alarm or bell on the bedroom door and if necessary on any windows is an effective at home self-care to prevent sleepwalking.

Using simple technology like a homemade alarm system is a good form of communication instead of watching the person to assure that they do not sleepwalk. When a sleepwalker hears the sound from the alarm, he/she may be a little confused when they are awakened. This confusion can last from a few seconds to a few minutes.

Source: http://www.communicationstudies.com/knowledge-base

http://www.medicinenet.com/sleepwalking/article.htm#what_is_sleepwalking

Deliverables:

In your group, design and create an alarm system that can awaken someone who is sleepwalking using the recycled materials. Each design will be tested to see which one is the most efficient, effective, and the loudest.

Parameters:

- be made from recycled materials
- be easy to assemble
- be able to put away when not in use or needed
- be placed on or around the door area

Evaluation:

Constructing a Sleepwalk Alarm System Rubric

Machine Name: ________________________________

Group Members: ____

Assessment Criteria:

1) Machine was submitted along with brainstorm activity ideas

_________/10

2) Machine demonstrated creative, helpful and planned use of materials to carry out design

_________/25

4) Students in group clearly and effectively presented their project to the class

_________/15

5) Machine made a loud alarming sound when the door opened

_________/20

6) Machine was easy to operate and removable

_________/10

7) Evidence that team followed the design loop to create their machine

_________/20

Total ___________/100

Title: Equations: Introductory to Keva Planks

Grade Level: 2nd

Subject: Equations

Written By: Aleshia Hawkinson

Standards:

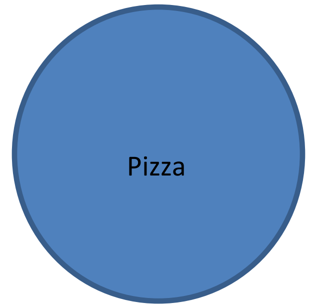
- Common Core Standards (*Operations and Algeb*raic Thinking): Use addition and subtraction within 100 to solve one- and two-step word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem.
- Next Generation Science Standards (*Engineering Design*): 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.
- Standards of Technological Literacy and Benchmarks (*Core Concepts of Technology*): Systems have parts or components that work together to accomplish a goal.

Big Ideas:

- Know how to solve word problems within a 100 with addition and subtraction.
- Word problems serve a purpose of solving the unknown.
- Parts work together to solve a goal.

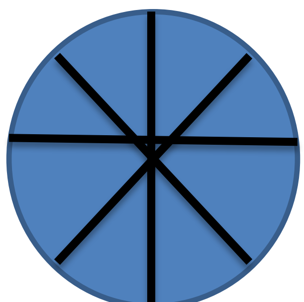
Schema Activation: Have you ever had to share something? Like a candy bar, pizza, or a bag of cookies? How do you divide the food up? Is it equal? Do you get more or less? Imagine you have a full uncut pizza. You and your three other friends want two slices of pizza each. Think about how you would solve the problem by cutting the pizza into correct slices.

Procedure: Describe to the students by drawing the pizza out and drawing the people. Represent the data in equation format as well.



4 people   2 slices each   How many slices should the pizza be cut in?

2+2+2+2=____   **8**   **The pizza should be cut into 8 slices.**



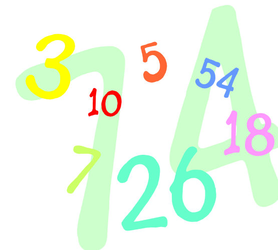
Pass out worksheet for students to answer.

Closure: Have students explain why solving for missing components help solve real world problems. Be prepared to introduce Keva Planks and cover the bridge problem on the worksheet. Discuss how parts combined help make a whole and solve a problem.

Evaluation: Students will turn in worksheet. Points will be given out of 25. 5 points for each completed problem.

Name________________________________

______
25



Word Problems Using Equations

Directions: Solve the problems below using **at least** one picture and one equation per question. Show all your work.

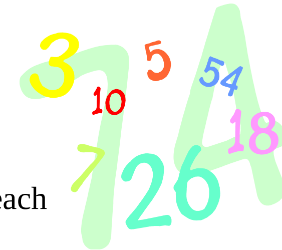
5 points 1. Danny has a box of 20 cookies. He plans to give Sally 4, Jane 6, and 3 to John. How many cookies will be left for Danny?

5 points 2. Beverly is going to walk to the library. She knows there are a total of 27 houses on the way there. 14 of the houses are on the right side? How many houses are on the right?

5 points 3. The local pet shelter has 31 adult cats, 7 kittens, 35 dogs, and 7 puppies. If each animal gets 1 food bowl, then how many food bowls does the local pet shelter need?

5 points 4. The Perkins family reunion plans to go river rafting. 20 family members can all fit in the 4 different rafts. How many seats are there in each raft?

5 points 5. Bailey needs to cross from one hill to another. He needs to build 4 columns. Each column will need 4 logs. The road to cross on the columns will take 10 large planks which will be combined together as one solid piece. How many logs and how many planks will Bailey need to build the bridge across?



Word Problems Using Equations

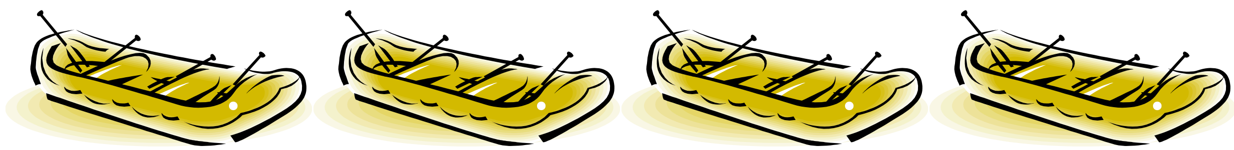
Answer Key: Note: Accept correct variations of pictures or equations for each

1.4+6+3+____=20 **7**

2.14+___=27 or 27-14=_____ **13**

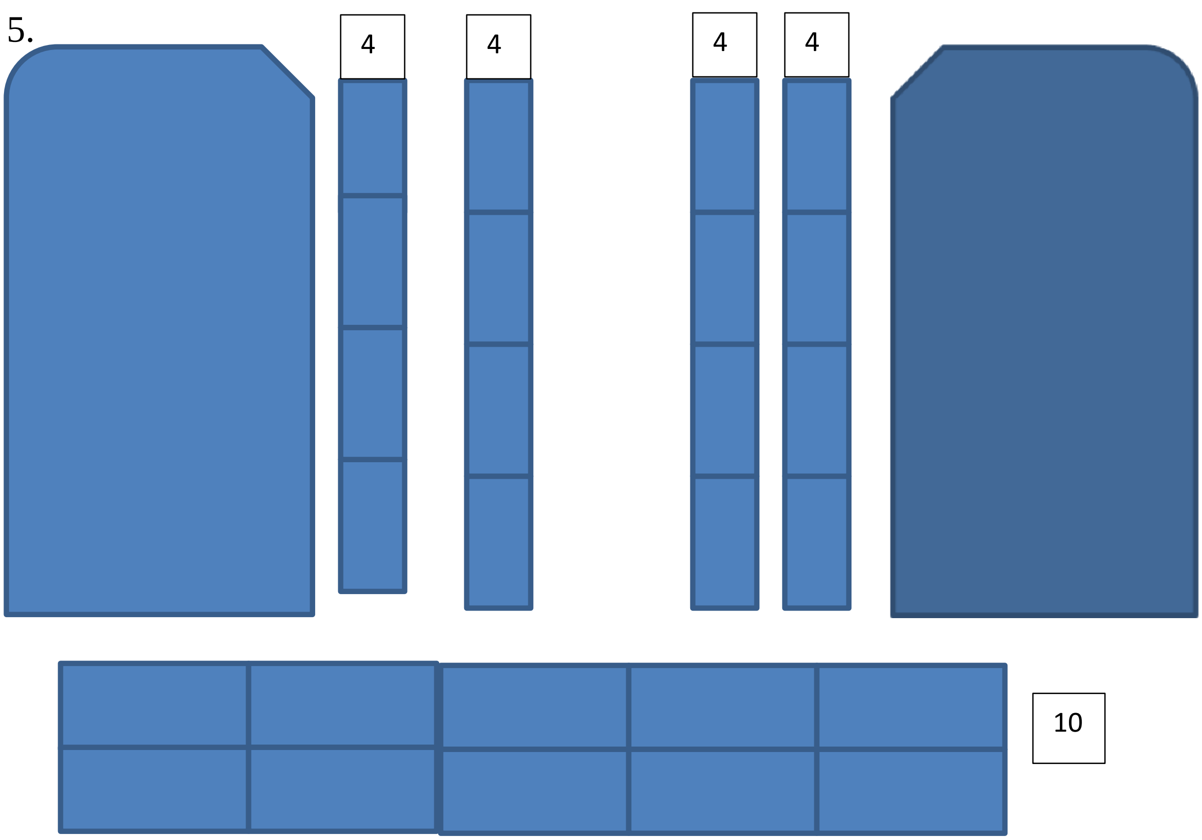
3.31+7+35+7=_____ **80**

4.



5+5+5+5=20 **5 people in each**

5.



4+4+4+4+10=______ **26**

Fun with Area & Perimeter

Discipline: 3rd to 6th

STEM/MATH

Content: Area and perimeter can be a hard concept to grasp when going back and for the between the two on a quiz or a test. Instead of the standard worksheets where students count the sides of the shaded area, have the students use Keva Planks for a fun and engaging supplemental activity to the lesson. Explain to the students that they will be measuring in one unit. This unit happens to be a Keva Plank instead of an inch or centimeter. At this time in the lesson, they should be familiar with the measuring aspect of things. Be sure to discuss the difference of area and perimeter. Doing the activity side-by-side should help them visualize the difference of the two.

INSTRUCTIONS

1. Divide students into groups of two or three with 50 Keva Planks per group.
2. Start with small shapes like a square or triangle and have the students write down the perimeter for each.
3. Gradually name parameters for the students to construct. Maybe a square with a perimeter of eight and a rectangle with the perimeter of eight. Increase the size and shape as they grasp the concept.
4. Ask the students how they have been figuring out how to get a perimeter and have them write down the formula. P=2L+2W or P=S+S+S+S. Have them build any shape they want and write down the formula and perimeter.
5. Have the students keep a few of their smaller perimeter shapes on the tables and Introduce AREA. Ask the students what might be different as they move forward with the next part of the lesson.
6. Have the students build a square using one Keva Plank on each side. Ask them what they think the area is and why.
7. Gradually increase the size and area you want them to build.
8. Ask the students how they calculate the area. Give them the formula if they are struggling. A=S*S
9. Have the students stay in their groups and build for each other while they record their findings.
10. At this time, pass out the worksheet with different parameters for the students to build for each other.

KEVA PLANKS WORKSHEET

PERIMETER

1. Construct different shapes with a perimeter of: **18, 24, 32, and 44**

   How many shapes could you make for each perimeter total?
   18

   24

   32

   44

2. What is the formula for Perimeter?

3. Can you construct a rectangle with a perimeter of 20 and have it look different from another person's rectangle in your group? Why?

AREA

4. What is the difference between Area and Perimeter?

5. What is the formula for AREA?

6. In your groups, construct rectangles with an AREA of: **8, 36, 12, 18, 56**

7. How many different rectangles (including squares) could you make for each AREA?

8

36

12

18

56

A-MAZING TOOLS

Creating a tool to assist with completing a maze with parameters

Disciplinary Area: STEM

Unit: Design, Obstacles, Magnetic Force, Wind

Literacy: *Oh, the Places You'll Go!* By Dr. Suess

Standards:

National Science Education Standards (Physical Science): Properties of objects and materials.

Compendium of Major Topics for Standards for Technological Literacy #11

- Apply the design process
- Solve problems through designs
- Build something
- Investigate how things are made
  #12
    - Follow step by step instructions

Big Ideas:

1) Proper use of design loop

2) Explore materials used in reality

3) Create a functional tool

4) Relate fundamental idea to reality

5) Demonstrate solution to others

Essential Question:

Can you design a tool that will be used to successfully complete the maze?

Scenario: In *Oh, the Places You'll Go!,* Dr. Suess addresses the Great Balancing Act of life in which characters overcome obstacles put in their paths. In order to be successful, one will have to conquer life's trials and tribulations. Students will create a tool, using the design loop, to make their way through the maze. The tool is tested by whether or not the student can follow the parameters and successfully complete the maze.

Directions: Students will follow the design loop to complete the task at hand. Students will create an efficient tool that will allow them to successfully complete the maze, given the parameters. The maze measures 24" x 24" and the paths are 4" wide throughout the maze. The parameters are as followed: Students are not allowed to place hands within a boundary box above the maze, which measures 18" from the top of the maze structure. Also, at least two materials from the list must be used purposefully. All materials that began the maze must exit the maze to complete the maze. Each student will explain his or her tool and demonstrate how it works. Classmates will observe each trial.

New Vocabulary:

<u>Obstacle-</u> a thing that blocks ones way or prevents progress

<u>Magnet-</u> material able to attract its own

<u>Parameter-</u> factor that sets the conditions of its operation; rules

<u>Efficient-</u> achieving maximum productivity with minimum wasted effort

Materials:

-Ruler

-String

-Magnets

-Source of wind

-Marbles

-Whiffle ball

-Tape

- Pipe cleaners

-Styrofoam

Content: A maze is a network of paths and hedges designed as a puzzled which one has to find a way out. The maze in this curriculum represents the path taken and the struggles endured to obtain success. The tool created by the student represents the measures one would take to help complete a task. Mazes range in size from two-dimensional to life size.

A-MAZING TOOLS

Creating a tool to assist with completing a maze with parameters

Situation:

After exploring the idea and what the story is about in Dr. Seuss' *Oh the Places You'll Go,* you will be assigned to create an effective tool that will be guided successfully through the maze that has been created with limited materials.

Challenge:

Can you build an effective tool with the following guidelines, to move through the entire maze start to finish?

Directions:

1. Follow design loop for task

2. Skim over guidelines/parameters

3. Choose up to three materials from the list

4. Demonstrate efficient tool

5. As a class we will observe each other's solution

Materials:

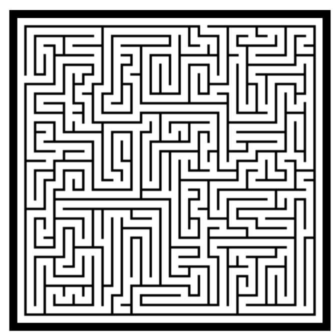
(Choose up to three, no less than two.)

ruler	source of wind	tape
string	marbles	pipe cleaners

magnets	whiffle ball	styrofoam cup
water		

Background Knowledge:

A maze, also known as a puzzle, is a network of paths where one must find a way out. The maze will represent the obstacles in easy and difficult situations as we read in the book, *Oh the Places You'll Go.*



Vocabulary:

Obstacle- a thing that blocks ones way or prevents progress

Magnet- material able to attract its own

Parameter- factor that sets the conditions of its operation; rules

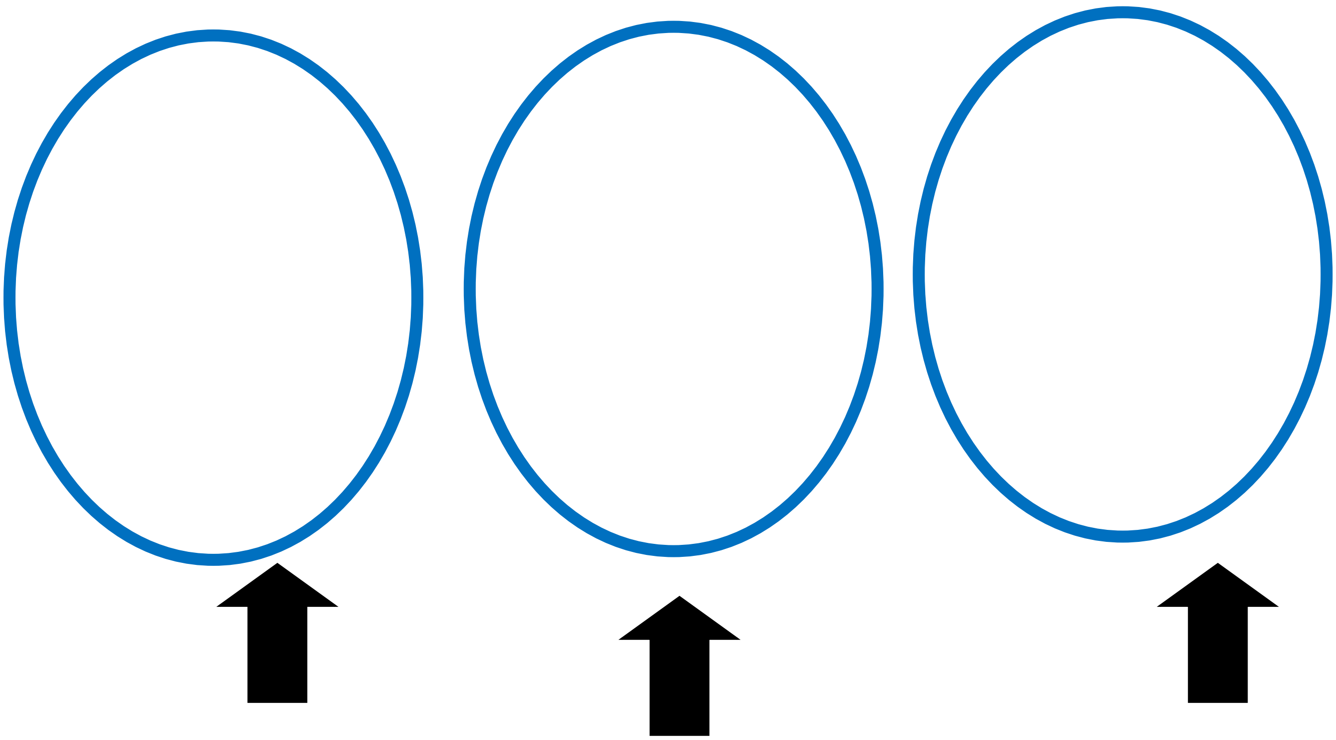
Efficient- achieving maximum productivity with minimum wasted effort

THE DESIGN LOOP!

1. Problem ?? ______________________________

   ____

2. Brainstorm Ideas



3. Choose One Solution

4. **Plan/Test Solution**

5. **Presentation to class**

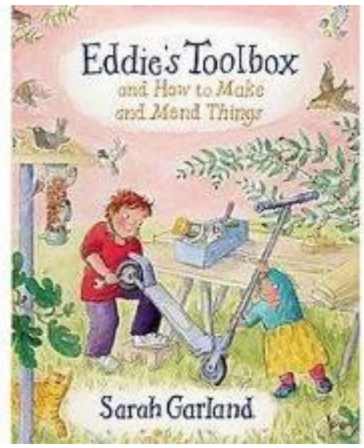
“Birdhouse Build”

Building a birdhouse with multiple features from recyclables

Disciplinary Area: Elementary Environmental Science

Unit: Animal Habitats, Recyclable Materials

Literacy: *Eddie’s Toolbox* by Sarah Garland



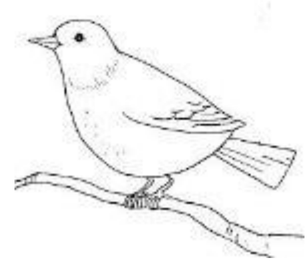
Standards:

- *National Science Education Standards* (Life Science): Organisms and environments.
- *Common Core Math Standards* (Measuring, Geometry): Measure lengths of objects with correct tools. Understand area as is relates to planes and volume as it relates to three-dimensional objects.
- *Design Standards* (Engineering Design): Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Big Ideas:

- Recognize that animals are living things that grow, eat, breathe, and reproduce.
- Identify the ways in which an organism’s habitat provides for its basic needs.
- Design and build a birdhouse with multiple features out of recyclable materials.

Essential Question: Can you design a birdhouse out of recyclable materials that has multiple features?



Scenario: After reading *Eddie's Toolbox*, a story about a boy who finds ways to make and mend things, research birds' habitats in order to design and build a birdhouse with multiple features using recyclable materials.

Directions/"Deliverables": Students will create a birdhouse out of recyclable materials. The birdhouse must have multiple features such as: a bird bath, living space, feeding space, etc. Students should develop a plan using the Engineering Design Loop.

Optional: Combine students' designs to build a real-life, full-size birdhouse to be placed outside the classroom window for observation of wildlife.

Parameters: The birdhouse must have multiple features, it must be made out of recycled or recyclable materials, and the dimensions should be *no greater than* one cubic foot (12" x 12" x 12").

Materials: *Bring these items from home*: Recyclables: empty aluminum cans, empty plastic bottles, small cardboard boxes, newspapers, etc. *These items will be available at school*: scissors, glue, tape, rubber bands, staples, etc.

Content Information: Birds' needs are very similar to our own. The basic necessities are food, water, and shelter. The table below shows which birds eat what type of food and where it can be found:

Food Type	Natural Source	Some of the birds attracted
Nuts		
	Oak, hickory, buckeye, chestnut, walnut	Woodpeckers, nuthatches, jays, turkeys
Seeds		
	Pine, spruce, fir, maple, alder, sunflowers, coneflowers, asters, goldenrod, grasses	Woodpeckers, finches, bobwhites, cardinals, chickadees, jays, nuthatches, junco, sparrows, wild turkey, doves, blackbirds
Fruit		
	Holly, cherry, elderberry, mulberry, raspberry, blueberry, cranberry, pokeberry, grape, cactus	Thrushes, robin, mockingbird, bluebirds, sparrows, woodpeckers, junco, thrashers, wren, flickers, roadrunner, bobwhite, warbler
Nectar		
	Various flowers, especially red tubular flowers, such as azalea, fuchsia, trumpet vine, and native honeysuckle; also yucca	Hummingbirds, orioles

Shelter is also an important aspect of a bird's habitat. Some birds like to nest in the open, like on the branch of a tree or under the roof of a porch. Other birds enjoy a more private nest in the cavity of a tree trunk or deep in the bushes. Some birds even build their nests on the ground! In nature, birds usually use mud, twigs, and mosses to build their nests. However, we can help them out by leaving yarn, pet hair, cotton, and other objects around to use when they are ready to build their home.

Now, think of ways to attract the most birds to your birdhouse. Draw out a plan for your birdhouse by using the Engineering Design Loop:

Design Loop Steps:

1. Identify a Problem
2. Research About the Issue
3. Brainstorm Ways to Solve the Problem
4. Develop Solutions for the Problem and Choose the Best One
5. Make Improvements to your Solution
6. Build the Solution, Make the Solution Come to Life

*Remember the task: Build a birdhouse with multiple features that is made out of recyclable materials.

Using the Design Loop to Build a Birdhouse

1. Identify the problem (Define the task at hand).

____

2. Write notes about research here:

____
____
____
____

3. Brainstorm ways to solve the problem/Develop solutions for the problem and choose the best one. Draw it out below.

4. Make improvements to your solution on the drawings you just made.

5. Build your solution. List the materials you used below and why you chose those materials.

____
____
____
____

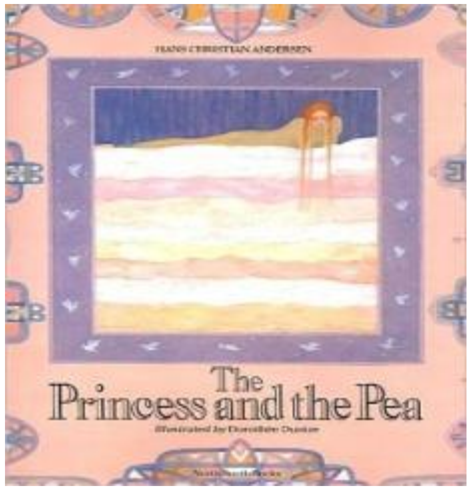
6. Share your birdhouse with the class. Don't forget to tell us about all of the extra features it has!



Assessment/Grading Rubric (for Teacher Use):

The birdhouse is made of recyclable materials. _____________/15
The birdhouse has multiple features. ______________/15
The birdhouse is less than one cubic foot. _____________/10
Creativity of project _____________/10
Is the birdhouse functional?/Could it really be used? __________/10
Understanding and completion of Design Loop ___________/15
Student explains birdhouse to class clearly ____________/15
Student completes work on time ______________/10

Total Score _____________/100
Comments:



Decoys and Fractions: Building an Effective Decoy to Trick Your Classmates

By Jessica Hilton and Ally England

Disciplinary Area: STEM

Unit: Fractions and Illusions

Literacy: The Princess and the Pea by Hans Christian Anderson

Standards:

- *Standards for Mathematical Practice:* Explain equivalence of fractions in special cases, and compare fractions by reasoning about their size. CCSS.Math.Content.3.NF.A.3
- *National Science Educational Standards:* PLAN AND CONDUCT A SIMPLE INVESTIGATION. In the earliest years, investigations are largely based on systematic observations. As students develop, they may design and conduct simple experiments to answer questions. The idea of a fair test is possible for many students to consider by fourth grade.
- *Arkansas Department Education Frameworks* (Oral and Visual Communications – Speaking): Students shall demonstrate effective oral communication skills to express ideas and to present information.

Big Ideas:

- Attributes and characteristics of fractions and how one can change data into fractions
- Ability to work with limited resources
- Ability to build multiple sustainable structures
- Proper use of the design loop
- Ability to demonstrate and present final project

The Essential Question: Can you design a structure that will hide a pea from your classmates?

Scenario: After reading The Princess and the Pea, a story of a prince seeking to find a true princess, you will create two structures that entail one decoy structure. Can you trick your classmates into picking the decoy structure, making them believe it is actually the structure with a pea inside?

Directions: First students will brainstorm and create a plan for their structures using the design loop. Students are only allowed to use the listed materials given and only the designated amounts and choices. One structure must hold the pea inside while the other is for the decoy. After students create their structures, it will be tested by other students, and they must determine which structure houses the pea.

New Vocabulary Terms:

Decoy- A person, device, or event meant as a distraction, to conceal what an individual or group might be looking for.

Illusion- A distortion of the senses, revealing how the brain normally organizes and interprets sensory stimulation.

Fraction- One or more equal parts of something.

Materials/Resources:

- Everyone receives two milk cartons
- Everyone receives one black eyed pea

May choose one from each category

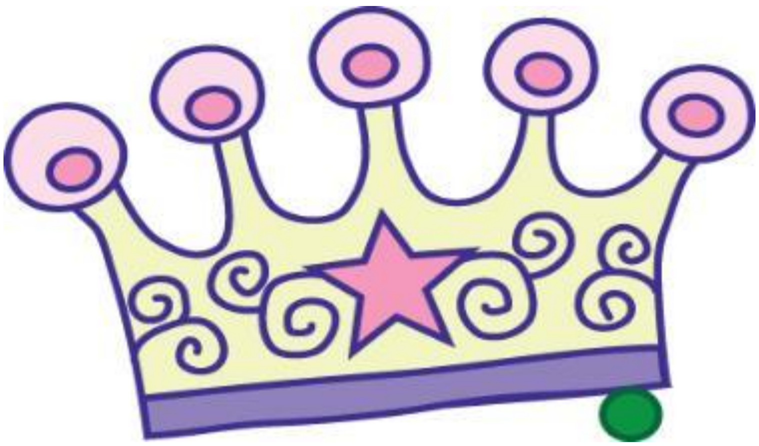
- Four cotton balls OR 1 sheet of tissue paper
- Tacky glue OR masking tape

Content Information:

- Decoys and illusions are used to distract people from seeing the obvious. If you have ever witnessed a magician performing a magic trick, you have witnessed an illusion. A decoy is specifically used to distract you or to make you believe something other than the truth. Examples of decoys can commonly be found in hunting supplies and military jargon. Decoys have been used for thousands of years and in many great historical events such as World War 1 & 2.
- Fractions and ratios are common and fun ways to represent data in math. In this activity, students are able to collect data in several different ways. Students are able to keep track of how many of their classmates pick their decoy structure and how many pick the real pea

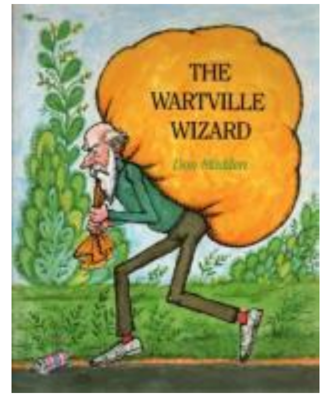
structure. They are then able to take this data and make them in to fractions and ratios to determine who tricked the most classmates.

- Students may also create fractions based on their design loop process and how many different ways there are to build their structures with the limited resources given.



Don't Be a Litterbug!

Building environmentally friendly trash-holding mechanisms



Disciplinary Area: STEM

Unit: Ecology, Structures

Literacy:

- *The Wartville Wizard* written by: Don Madden

Standards:

- *National Science Education Standards* (Physical Science) Properties of objects and materials. Objects have many observable properties including size, weight, shape, color, temperature, and ability to react with other substances.
- *Standards for Technological Literacy* (Effects on the Environment) Some materials can be reused or recycled. Materials such as plastic or glass containers and cardboard tubes or boxes, may be reused to make useful items.
- *Common Core Math Standards* (Mathematical Practice) Make sense of problems and persevere in solving them. Students can make sense of a problem by looking for entry points to a solution
- *Common Core Math Standards* (Mathematical Practice) Use appropriate tools strategically. Students should consider the available tools in order to solve a mathematical problem. They should make sound decisions about when each of these tools might be helpful in recognizing the insight to be gained and their limitations

Big Ideas:

- The role of creativity and problem solving
- The proper use of the design loop
- Properties of materials and the effectiveness in picking up the trash

Essential Question:

- Can you create a system using limited recyclable materials that can effectively pick up trash and keep your area clean?

Scenario: After reading the Wartville Wizard, a tale about a man who strives to keep his town litter-free, you will now create your own structure that help him keep Wartville tidy and neat!

Materials and Resources: Students are limited to using these resources, but they do not have to use all of these resources in the completion of their structure.

- Jumbo popsicle sticks
- Straws
- String
- Scissors
- Tape
- Empty 2-liter soda bottle
- Rubber bands

Content Information: Americans generate over 250 million tons of trash each year. Trash or garbage can consist of everyday items such as bottles, appliances, newspapers, grass clippings, product packaging, food scraps, bottles, etc.

Ecology	The scientific study of interactions among organisms and their environment.
Recycling	The recovery of useful materials, such as paper, glass, plastic, and medals, from the trash to use to make new products, reducing the amount of new raw materials needed.
Composting	Involves collecting organic waste, such as food scraps and yard trimmings, and storing it under conditions designed to help it break down naturally. This results in compost that can be used as a natural fertilizer.
Landfills	Engineered areas where waste is placed into the land. Landfills usually have liner systems and other safeguards to prevent polluting the groundwater.
Municipal Solid Waste	(MSW) More commonly known as trash or garbage

Deliverables: Using only the materials supplied by your instructor, the student and a partner will create a system that will efficiently pick up trash to keep the environment litter-free.

Parameters: The completed trash system must:

- Be designed using each design loop step effectively
- Consist of only the materials provided
- Effectively pick up trash
- Not exceed 2'x 2' x 2' in size

Assessment:

- Completed trash structure submitted with brainstorming sheet showing proper use of the design loop
- Partners worked collaboratively as a team to complete the project
- Completed trash structure showed evidence of creative use of materials
- Team utilized the design loop to solve the problem
- Team was able to demonstrate that their model worked using the parameters outlined

The Design Loop

1. What is the problem that you are looking to solve?

____

2. Brainstorm possible solutions to this problem:

3. Create your model and test its effectiveness

4. Evaluate your model and make changes

5. Compare your model with your classmates. What could you have done differently?

____

A Home for a Caterpillar

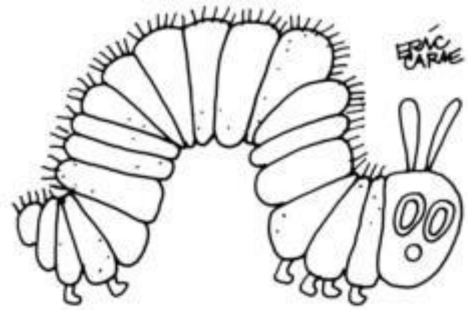
Build a home for a very hungry caterpillar.

Created by: Lyndsey Strange and Mary Catherine Martinka

Disciplinary Area: STEM

Unit: lifecycles and habitats of an insect

Literacy: *A Very Hungry Caterpillar* by Eric Carle



Standards:

- *National Science Education Standards* (Life Science): Life cycles of an organism
- *Standards for Technology Literacy* (Engineering Design):The students will understand the Design loop and how to find a problem

Big Ideas:

- What are the stages of the life of a butterfly?
- What structures can make a good habitat?
- What kind of environment does a caterpillar live in?

Essential Question:

- Can the students build a habitat that a caterpillar can live in comfortably as well as observe the metamorphosis of the caterpillar?

Scenario:

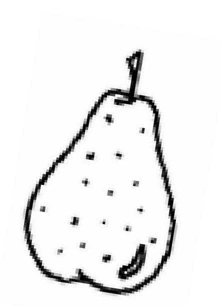
- There is a caterpillar that needs a new home that he/ she can live in comfortably; can you help make this caterpillar a new home?
- This caterpillar will need a comfy living environment as well as food to eat.

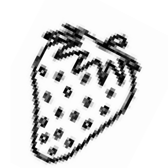
Materials:

- Container to sevre as habitat
    - Shoe box
    - Bottle
    - Tupperware
    - Other
- Inside the habitat
    - Dirt
    - Sand
    - Rocks
    - Flowers
    - Grass
    - Leaves
    - Twigs
    - Students will go on a nature walk to find these
- Other materials
    - Saran wrap
    - Glue sticks/ tape
    - 7-8 small squares blank white paper for each student
    - Safety scissors
    - Construction paper
    - Markers
    - Crayons
- Any other materials the teacher or student believe would be useful

Parameters:

- Habitat needs to be able to support the life of a caterpillar.
- Caterpillar needs to be observable inside its habitat.
- Habitat needs to illustrate student's knowledge of the four stages of the lifecycle of a butterfly.
- Needs to demonstrate student's individual creativity.

Directions:

- **Day 1:**
  - Read *The Very Hungry Caterpillar*.
  - Give them an overview of the project
  - Show an example of a container for their caterpillar habitat and discuss other options for containers.
  - Tell the students they will need to bring a container to class for Day 2.
- **Day 2**
  - Reread *The Very Hungry Caterpillar*
  - Teacher should show examples of changes she made on her container.
  - Look at containers and think about any ideas of what they need to do to make them a good habitat for caterpillars (i.e. air holes, windows to observe, …)
- **Day 3**
  - Reread *A Very Hungry Caterpillar*
  - Talk about the stages of a lifecycle of a butterfly
  - Color and complete worksheet 1 (lifecycle)

Content:

- **Day 1**
  - What is a **habitat**?
    - **Habitat:** the natural environment of someone or something.
- **Day 2**
  - Students need to know what a caterpillar needs to be able to survive (breath, eat, live)
  - How can students see the caterpillar in their habitat
- **Day 3**
  - Learn the **lifecycle** of a caterpillar
    - **Lifecycle:** changes that happen to a living thing during its lifetime

Directions:

- **Day 3 cont.**
  - As a class number the stages in correct order
  - Give each student 4 small squares of paper and have the students draw each stage of the life cycle on their own.
  - Give the students 3 or 4 pieces of paper to draw their favorite things (i.e. color, toy, food) these decorations will go on the habitat
- **Day 4**
  - Reread *A Very Hungry Caterpillar*
  - As a class complete worksheet 2
  - Go on a nature walk and collect items for the insides of their habitats.
  - Arrange collected items inside their habitat
- **Day 5**
  - Reread *A Very Hungry Caterpillar*
  - Share their completed habitat with the class.
  - Have them talk about how they decorated them and why, also the lifecycle of a butterfly.

Content:

- **Day 3 cont.**
  - Egg
  - Caterpillar
  - Cocoon – caterpillar makes the hard shell to protect them while they turn into a butterfly.
  - Butterfly
- **Day 4**
  - What does a caterpillar eat?
  - Where does a caterpillar live?
  - What will make the caterpillar feel at home?
  - Teacher could present the habitat so that the students know how they will present their own habitats on Day 5.

Assessment:

- Assessment worksheet to show the students know the stages of a butterfly lifecycle in order
- Students will be graded on the presentation of their project
  - Is the habitat something a caterpillar could live in?
  - Did the students accurately show the life cycle of a butterfly to the best of their ability?

How Do You Lift a Razorback?

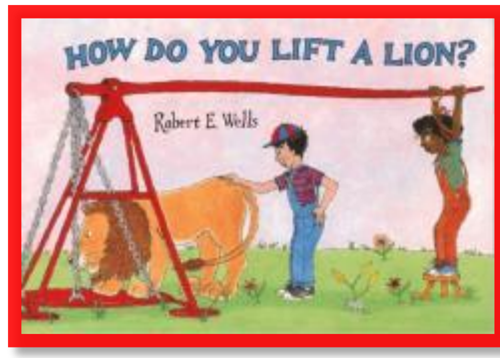
Moving Things Using Simple Machines, by Dawn Cook and Tara Hodge

Teacher Instructions

Disciplinary Area: STEM

Unit: Simple Machines

Literacy: *How Do You Lift a Lion*, written by Robert E. Wells



Standards:

- National Science Education Standards (Physical Science): Motions and forces.
- Standards for Technological Literacy: Tools and machines extend human capabilities, such as holding, lifting, carrying, fastening, separating, and computing.
- Common Core Math Standards (Measurement and Data): Students will solve problems using measurement and data. Students will express measurements in a single system to larger units in terms of a smaller unit. (Geometry) Students will draw and identify lines and angles, and classify two- dimensional figures based on the properties of their lines and angles.
- Common Core ELA Standards (Speaking and Listening): Students will engage effectively in a range of collaborative discussions with diverse partners.

Big Ideas:

- Attributes of simple machines and their uses
- Forces and motion, and how machines harness these to create mechanical advantage
- Proper use of the design loop

Essential Question: Can you design a simple machine that will allow Tusk to be safely released from his pen?

Scenario: Tusk has returned to his farm after the big game. He can't wait to get back to his favorite mud hole and cool down. Upon arriving, his caretakers discover that the gate of his pen is jammed and he cannot be released. They decide to remove the top to get him out. His pen can still be rolled. How will you help Tusk?

Content Information: A machine is a device that allows people to do work with less effort. Simple machines have few or no moving parts to them. These machines help us to move objects together, apart, up, or down by increasing the force or changing the direction of the force. Simple machines offer a mechanical advantage, lessoning the needed effort but still using the same amount of work to do a job.

Directions: Assign students to groups of 2- 4. After reading *How Do You Lift a Lion,* lead a discussion with your class about simple machines and their uses. You might want to see what kinds of simple machines they can spot around the room or name from their homes. Hand out the student worksheets and read the problem aloud to your students. Have your students brainstorm several possible solutions on paper using the design loop before handing out the materials to build their machine. After each group has completed their machine, test them to see who can save Tusk!

Materials/ Resources:

Tusk (Water bottle on its side, stuffed animal, etc.)	Holding Pen (A shoebox works well for this)
Pipe Cleaners	Twine
Craft Sticks	Glue
Masking Tape	Dowel Rods
Fulcrums (Binder clips with the clips removed work well)	Bobbins
Something from which to suspend a pulley	Construction Paper
Index Cards	

Vocabulary:

Simple Machine: A tool that makes work easier. These are levers, screws, pulleys, wheels and axles, inclined planes, and wedges.

Machine: A device for doing some kind of work

Compound Machine: More than one simple machine working together

Lever: A stiff bar that moves on a fixed point called a fulcrum, used to lift or move heavy objects

Wheel and Axle: A wheel that turns on a center post or rod, used to move objects or change power, speed, or direction of movement

Pulley: A wheel with a groove that a rope fits into, used to lift or move objects

Inclined Plane: A sloping surface connecting a lower surface with a higher surface, used to move heavy loads up or down

Screw: An inclined plane wrapped around a shaft, used to hold objects together or lift objects

Wedge: Two inclined planes put together to form a v-shape, used to split, separate, or raise an object

Energy: Ability to do work

Force: A push or pull on an object that causes it to change direction, move or stop

Work: The result of a force moving an object

- work = effort force x distance

Effort: The amount of energy exerted

Distance: The amount of area an object will move

Load: The amount of weight that needs to be moved

Fulcrum: Part of a lever that supports length of bar

Evaluation and Assessment

Grading Rubric

Demonstrates knowledge of simple machines and their use (0-25pts): _____________

Team shows understanding of the different simple machines talked about in class.

Used design loop showing steps and alternate designs (0-25pts): _______________

Team used included brainstorming sheet and showed use of design loop.

Creativity and teamwork (0-25pts): _______________

Team showed creativity with materials used and demonstrated teamwork.

Structure was able to successfully complete challenge (0-25pts): _____________

Team was able to successfully move Tusk.

How Do You Lift a Razorback?

Moving Things Using Simple Machines

Student Handout

Situation: Tusk has returned to his farm after the big game. He can't wait to get back to his favorite mud hole and cool down. Upon arriving, his caretakers discover that the gate of his pen is jammed and he cannot be released. They decide to remove the top to get him out. His pen can still be rolled. How will you help Tusk?

Content Information: A machine is a device that allows people to do work with less effort. Simple machines have few or no moving parts to them. These machines help us to move objects together, apart, up, or down by increasing the force or changing the direction of the force. Simple machines offer a mechanical advantage, lessoning the needed effort but still using the same amount of work to do a job.

Challenge: Can you design and build a simple machine that will help get Tusk out of the pen?

Vocabulary:

Simple Machine: A tool that makes work easier. These are levers, screws, pulleys, wheels and axles, inclined planes, and wedges.

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- work = effort force x distance

Effort: The amount of energy exerted

Distance: The amount of area an object will move

Load: The amount of weight that needs to be moved

Fulcrum: Part of a lever that supports length of bar

Materials/ Resources:

Pipe Cleaners	Twine
Craft Sticks	Glue
Masking Tape	Dowel Rods
Fulcrums	Bobbins
Construction Paper	Index Cards

Directions:

1. Brainstorm possible solutions to the problem. Draw three ideas on the Design Loop Worksheet, then decide which solution is the best to solve the problem.
2. Collect the needed materials to build your design.
3. Evaluate! Do you need to make any changes? If so, this is the time.
4. Test your design. Were you able to save Tusk? Is he safe and happy?

BRAINSTORMING

What is the challenge?

____
____
____
____

What has your research shown you?

____
____
____
____

AFTER THE PROJECT

Was your design a good one? Explain.

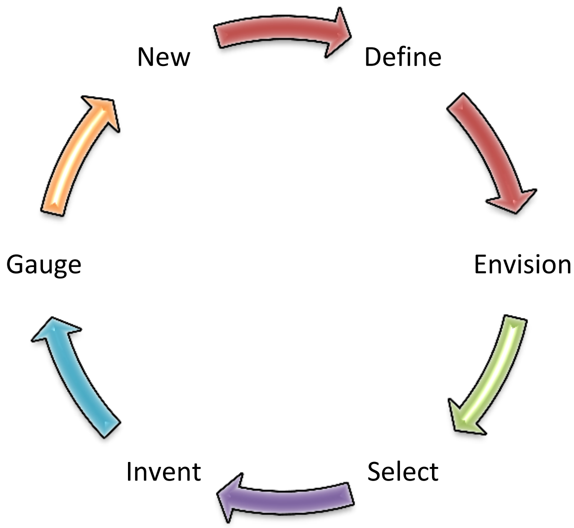
____
____
____
____

If you could do the project over, what would you do differently? Why?

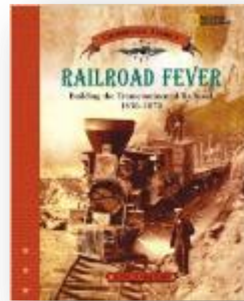
____
____
____
____

Design Loop Worksheet

Instructions: Follow the design loop to come up with 3 possible solutions to the problem. Be creative!

The Design Loop 	

I've Been Workin' on the Railroad



Disciplinary Area: STEM

Unit: Structures and U.S. Westward Settlement

Literacy: *Railroad Fever* by Monica Halpern

Standards:

- *CCSS.ELA-Literacy.RI.4.3* : Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information in the text.
- *CCSS.ELA-Literacy.RI.4.9* : Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.
- *NS.1.4.12:* Evaluate the quality and feasibility of an idea or project
- *National Science Education Standards (Physical Science K-4)* : Properties of objects and materials

Big Ideas:

- Efficiency of Design
- Proper use of research design loop
- Teamwork and Presentation

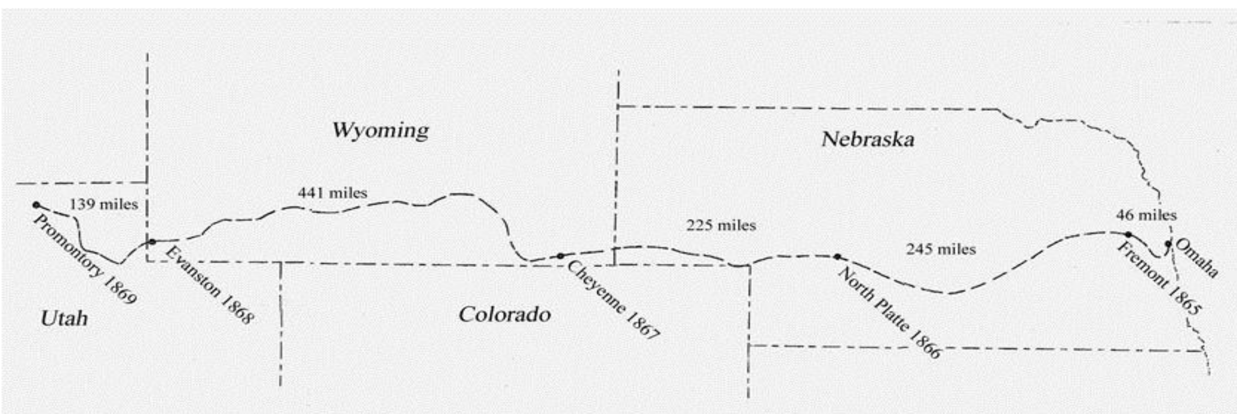
Essential Question: How can railroad workers be housed and fed while building the transcontinental railroad?

Scenario: After reading *Railroad Fever*, a history of the building of the transcontinental railroad, you will research and build a model of the Casement brother's solution to housing, feeding and supplying workers as they lay track for the transcontinental railroad.

Materials/Resources:

- Shoebox
- Scissors
- Craft Sticks
- Tape
- Glue
- Construction Paper
- Small wooden wheels and axels

Content Information: As the transcontinental railroad was being built problems naturally occurred. There was a shortage of workers, which the Casement brothers remedied by raising the pay when workers met deadlines. Another problem was how to house, feed and supply workers who were covering an average distance of two miles per day. The Casement brothers found a solution in designing a "work train". There were multiple train cars on this work train with some for building supplies such as rails, spikes, ties and other wood. While other cars were for blacksmiths to make repairs and kitchens for the food and even sleeping cars with built in bunk beds. They even had herds of cattle follow the train to supply the workers with fresh meat.



Deliverables: Students will present their research findings in the form of an oral presentation and will present their model of an improved work train car.

Parameters: Students will break into groups of 3-4 and research the problem of how to house, feed and transport supplies to workers building the transcontinental railroad, by using credible sources. The students will then recreate a work train car model and attempt to improve it by utilizing the Design loop and using the materials stated above and the information gained by research.

Assessment: See attached Rubric

Research Design Loop

1. Clarify the Question
____

2. Research (at least 3 sources including the book)
You will type your research findings on a separate sheet of paper to turn in with your model. Be sure to give credit to the sources you use!

3. Brainstorm Ideas for Model

4. Plan Model
Draw a picture of the steps you will take. Make a list of materials you will need.

5. Build Model
6. Refine Model
   Explain the changes you made.

7. Present Model to classmates
   Be prepared to answer questions about why you built your model the way you did.

Group Planning -- Research Project : Model Railroad Car

CATEGORY	**4**	**3**	**2**	**1**	**Score**

Plan for Organizing Information	Students have developed a clear plan for organizing the information as it is gathered and in the final research product. All students can independently explain the planned organization of the research findings.	Students have developed a clear plan for organizing the information in the final research product. All students can independently explain this plan.	Students have developed a clear plan for organizing the information as it is gathered. All students can independently explain most of this plan.	Students have no clear plan for organizing the information AND/OR students in the group cannot explain their organizational plan.	
Delegation of Responsibility	Each student in the group can clearly explain what information is needed by the group, what information s/he is responsible for locating, and when the information is needed.	Each student in the group can clearly explain what information s/he is responsible for locating.	Each student in the group can, with minimal prompting from peers, clearly explain what information s/he is responsible for locating.	One or more students in the group cannot clearly explain what information they are responsible for locating.	
Quality of Sources	Researchers independently locate at least 2 reliable, interesting information sources.	Researchers independently locate at least 2 reliable information sources.	Researchers, with some adult help, locate at least 2 reliable information.	Researchers, with extensive adult help, locate at least 2 reliable information sources.	
Plan for Organizing Information	Students have developed a clear plan for organizing the information as it is gathered and in the final research product. All students can independently explain the planned organization of	Students have developed a clear plan for organizing the information in the final research product. All students can independently explain this plan.	Students have developed a clear plan for organizing the information as it is gathered. All students can independently explain most of this plan.	Students have no clear plan for organizing the information AND/OR students in the group cannot explain their organizational plan.	

	the research findings.				
Research Design Loop	Each student accurately completes each step in the research design loop in a way that can be easily explained.	Each student completed all but one portion of the research design loop in a way that can be easily explained.	Each student completed most of the research design loop in a way that can be easily explained.	Each student only completed a few steps in the research design loop in a way that can be easily explained.	

Building A Structure : Model Railroad Car

CATEGORY	**4**	**3**	**2**	**1**	**Score**
Modification/ Testing	Clear evidence of testing and refinements based on data or scientific principles.	Clear evidence of testing and refinements.	Some evidence of testing and refinements.	Little evidence of testing or refinement.	
Construction - Care Taken	Great care taken in construction process so that the structure is neat, attractive and follows plans accurately.	Construction was careful and accurate for the most part, but 1-2 details could have been refined for a more attractive product.	Construction accurately followed the plans, but 3-4 details could have been refined for a more attractive product.	Construction appears careless or haphazard. Many details need refinement for a strong or attractive product.	
Construction - Materials	Appropriate materials were selected and creatively modified in ways that made them even better.	Appropriate materials were selected and there was an attempt at creative modification to make them even better.	Appropriate materials were selected.	Inappropriate materials were selected and contributed to a product that performed poorly.	

Research Design Loop Content	Worksheet provides a complete record of planning, construction, testing, modifications, reasons for modifications, and some reflection about the strategies used and the results.	Worksheet provides a complete record of planning, construction, testing, modifications, and reasons for modifications.	Worksheet provides quite a bit of detail about planning, construction, testing, modifications, and reasons for modifications.	Worksheet provides very little detail about several aspects of the planning, construction, and testing process.	
Creativity	Ideas are based on research, and are original in nature so students own ideas are easily seen and explained.	Ideas are based on research, but not very original in nature.	Ideas are somewhat based on research, and somewhat original in nature.	Ideas are kind of based on research, but not original in nature at all.	
Parameters	Structure is proportional, stable, and is kept within the limits of the shoe box.	Structure is mostly proportional, stable, and within the limits of the shoe box.	Structure is somewhat proportional, stable, and within the limits of the shoe box.	Structure is not very proportional, stable, and is mostly outside the limits of the shoe box.	

Keep Your Feet Dry on *The Snowy Day*

Designing Water Repellant Footwear

Disciplinary Area: STEM

Unit: Weather, Climate

Grade Level: First- Second Grade

Literacy: *The Snowy Day* by Ezra Jack Keats

Standards: Standards for Technological Literacy-

Standard 5: Students will develop an understanding of the effects of technology on the environment.

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

BIG Ideas:

- Properties of materials and how they can repel water.
- Proper use of the design loop
- Ability to demonstrate and present final project to group

Essential Question: Can you design water proof footwear to repel melting snow from making your feet wet?

Scenario: After reading The Snowy Day by Ezra Jack Keats about a little boy who spends the day out playing in the snow and returns home with wet and cold feet, you will design and create some sort of footwear that would keep your feet dry when you are out playing in the snow.

Directions: Students will develop a plan by following the design loop. Students are only allowed to use materials from the materials list and must only choose one item from each list. This footwear must be able to fit your foot and keep your foot or sock dry when placed in a bucket of ice for 1 minute.

New Vocabulary Terms:

- **Blizzard**: (noun) a storm with lots of snow and wind

- **Frostbite**: (noun) a skin condition caused by overexposure to the cold
- **Flurries**: (noun) very light snowfall
- **Snow storm**: (noun) large amounts of wind and snow
- **Forecast**: (noun/verb) the expected weather for the future
- **Meteorologist** : (noun) a person who studies weather patterns

Content Information:

During the season of winter, when it gets really cold outside, sometimes there is a precipitation that falls from the sky in the form of water-ice flakes. These flakes are also known as snow, or snowflakes. Snow is composed of ice, and it has an open and soft structure. Snowflakes are each unique, and come in a wide variety of sizes and shapes. In order for the snowflakes to remain frozen, they must be at a temperature of 32 degrees Fahrenheit. When the weather warms up, the snow melts and does not stick to the ground. However, if the temperature remains low, the snow will continue to fall and accumulate on the ground. The world record for the most snowfall to accumulate in one area occurred in the United States, just outside of a town in Washington. In the 1998-1999 winter season, this town accumulated a total of 1,140 inches of snow. That's a lot of snowflakes! When this much snow accumulates, it can be dangerous for people to drive on the roads, until a snowplow comes and can move all of the snow.

Keep Your Feet Dry on *The Snowy Day*

Designing Water Repellant Footwear

Scenario: After reading *The Snowy Day* by Ezra Jack Keats about a little boy who spends the day out playing in the snow and returns home with wet and cold feet, you will design and create some sort of footwear that would keep your feet dry when you are out playing in the snow.

Challenge: Develop a plan by following the design loop. Students are only allowed to use materials from the materials list given and may choose up to 3 of those materials. This footwear must be able to fit your foot and keep your foot and sock dry for 1 minute when placed in a bucket of ice. Only make for a model for one foot.

Criteria:

1) Follow the design loop

2) Only use the given materials

3)Choose only 3 of the given materials to use

4) Must be able to fit your foot

Materials and Resources: Everyone will be given access to a ruler and tools such as scissors for this challenge.

-Sponges

-Saran Wrap

-wax paper

-Rubber bands

-Tape

-sandwich size zip lock baggies (limit 2)

-Styrofoam take-out containers

-Paper Towels

- old t-shirts (limit 1 per person)

New Vocabulary Terms:

- Blizzard: (noun) a storm with lots of snow and wind
- Frostbite: (noun) a skin condition caused by overexposure to the cold
- Flurries: (noun) very light snowfall
- Snow storm: (noun) large amounts of wind and snow
- Forecast: (noun/verb) the expected weather for the future
- Meteorologist : (noun) a person who studies weather patterns

Information to Know about Snow:

During the season of winter, when it gets really cold outside, sometimes there is a precipitation that falls from the sky in the form of water-ice flakes. These flakes are also known as snow, or snowflakes. Snow is composed of ice, and it has an open and soft structure. Snowflakes are each unique, and come in a wide variety of sizes and shapes. In order for the snowflakes to remain frozen, they must be at a temperature of 32 degrees Fahrenheit. When the weather warms up, the snow melts and does not stick to the ground. However, if the temperature remains low, the snow will continue to fall and accumulate on the ground. The world record for the most snowfall to accumulate in one area occurred in the United States, just outside of a town in Washington. In the 1998-1999 winter season, this town accumulated a total of 1,140 inches of snow. That's a lot of snowflakes! When this much snow accumulates, it can be dangerous for people to drive on the roads, until a snowplow comes and can move all of the snow.

The Design Loop

1) What is the problem?

____

2) What is a possible solution?

____

3) Draw at least 4 possible solutions

4) Choose you best solution and build it!

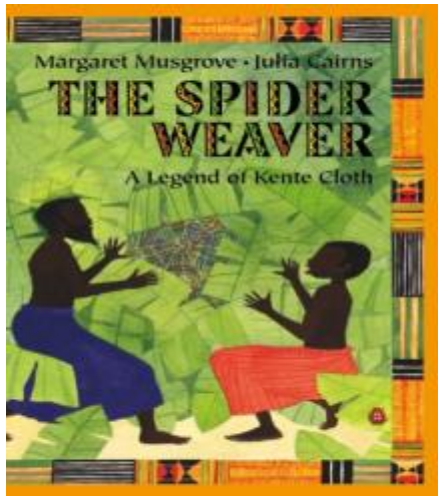
5) Test your solution

6) Evaluate your model and make changes
____

____

7) Present your idea to others!

The Master Web Weaver Design



Situation: The Ashanti Village has noticed that the black and yellow spider has been catching a lot of food in her web. The problem is her web can't withstand the weight of the all of the insects. The people in the village want to create a web that can hold the weight of all of the food to help the spider. But, they need a little help! The Ashanti Village will use the web that can withstand the most weight.

Challenge: With your assigned partner, you will design an intricate web. Using the design loop and the provided materials, design and create a web that will be able to withstand at least five pounds. **You must measure out 2 pounds on your own to test the design with your partner**

Materials:

- Circular Frame
- Tacks
- 3 yards of string
- Scale
- 2 pound barbell

Test:

1. Test your design and redesign if needed.

2. Present your final design to the teacher and class.

3. The design that can hold the most weight will win the design challenge!

What are my ideas?

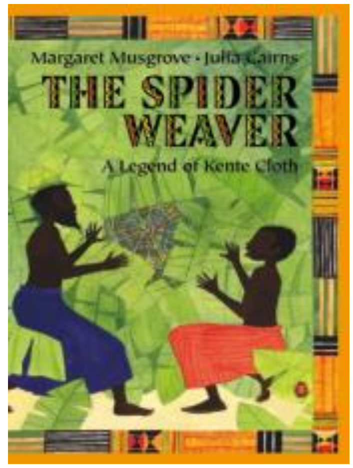
#1.

#2.

#3.

Narrative Curriculum

The Master Web Weaver Design



Disciplinary Unit: STEM

Grade: 1-2

Unit: Geometry (Structure)

Literacy: *The Spider Weaver* by: Margaret Musgrove

Standards:

- **Common Core State Standards**
  - **Kindergarten: Geometry:** Analyze, compare, create, and compose shapes.
  - **1st Grade: Geometry:** Reason with shapes and their attributes.
  - **1st Grade: Measurement & Data**: Represent and interpret data.
  - **1st Grade: Writing, Standard 7** Participate in shared research and writing projects.

- **National Science Education Standards**
  - **Content Standard A**: Science as Inquiry
    - As a result of activities in grades K-4, all students should develop
      - Abilities necessary to do scientific inquiry
  - **Content Standard E**: Science and Technology
    - As a result of activities in grades K-4, all students should develop
      - Abilities of technological design
      - Understanding about science and technology

- **Standards of Technological Literacy**
  - **Standard 8:** Students will develop an understanding of the attributes of design.
  - **Standard 9:** Students will develop an understanding of the engineering design.
  - **Standard 10:** Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
  - **Standard 11:** Students will develop abilities to apply the design process.

Big Ideas:

- Role of brainstorming to come up with ideas

- Attributes of shapes and how “strong” they are
- Ability to measure the weight of an object
- Proper use of the design loop
- Ability to present final design to a group/teacher

Essential Question: Can you design a web will withstand the weight of 2 pounds?

Scenario: The Ashanti Village has noticed that the black and yellow spider has been catching a lot of food in her web. The problem is her web can’t withstand the weight of the all of the insects. The people in the village want to create a web that can hold the weight of all of the food to help the spider. But, they need a little help! The Ashanti Village will use the web that can withstand the most weight. Students should work with a partner to create their web with the provided materials. It is the students’ job to measure out the two pounds (and any additional weight) to test their web. Students must first fill out the worksheet to brainstorm their ideas before actually building their web.

Materials:

- Circular Frame
- Tacks
- 3 yards of string
- Scale
- 2 Pounds Barbell

Content Information: (http://www.mathsisfun.com)

Geometry is about the shape and size of things. Like algebra, geometry has its own special vocabulary. You can see geometry everywhere around you, in manmade structures, in nature, in sports, in manufacturing, and in art. In geometry there are only four imaginary items—simple ideas—upon which everything else is built: point, line, plane, and space.

A Point has no dimensions, only position
A Line is one-dimensional
A Plane is two dimensional (2D)
A Solid is three-dimensional (3D)

Geometry can be divided into:

- Plane Geometry is about flat shape like lines, circles, and triangles…. shapes that can be drawn on a piece of paper. (Triangles, squares, circles are the shapes you want the students to focus on).

- Solid geometry is about three-dimensional objects like cubes, prisms, cylinders and spheres.

Deliverables: Students will develop a design by following the design loop. The students must first fill out the provided worksheet first, where they brainstorm different ideas for the design. Students are only allowed to use the resources that are provided in the materials list. The web must be able to hold at least two pounds, but the students should be trying to create a web that can hold the most weight possible.

Parameters: The final design must be created by use of the design loop, be able to hold at least 2 pounds, and be turned into the teacher by the end of class.

Evaluation

Name: **Date:**

DESIGN BRIEF RUBRIC	**No evidence (0)**	**Limited understanding (10)**	**Fair understanding (15)**	**Good understanding (20)**	**Excellent understanding (25)**
The students brainstormed more than one idea					
The students evaluated how they could make it better next time					
The students spoke clearly and with confidence when presenting design					
The students used the required materials and the web was able to hold 2 pounds.					

Total: /100

“Oh, No! Save the Animals”

Build a catapult to rescue the animals from the tiger’s grasp

Disciplinary Area: STEM

Unit: Gravity, Tension, Structures, Force

Literacy: “Oh, No!” Written by Candace Fleming and illustrated by Eric Rohmann.

Standards:

- National Science Education Standards: (Science as Inquiry) Students will learn how to conduct observations by asking questions, as well as following through with a well-planned and conducted experiment using proper tools for the given age level.
- Standards for Technology Literacy: (Engineering Design) The engineering design process entails identifying the problem, researching and brainstorming, the creation of a solution through sketches and models presented to others.
- Common Core Math Standards: (Measurement and Data) Students will learn to measure an object twice, using two different length units, and describe how they both relate to the object chosen. (Geometry) Reason with shapes and attributes.
- Arkansas Department Education Frameworks: (Inquiring/Researching) The student will begin to use inquiry and research to answer questions related to the problem, make good judgments, and communicate their ideas with others.

Big Ideas:

- Proper use of steps in design loop
- Proper use of materials to aid the animals and capture the tiger
- Understanding the engineering design process
- Communicate and demonstrate the solution with others

Essential Question:

Can you build a secret, hidden catapult that will send the tiger flying away far enough from the hole so that the villagers have enough time to help free the animals to safety?

Scenario:

Once you have read “Oh, No!” in class, it is the student’s job to build a catapult that will hold the tiger’s weight, and send it as far away from the hole as possible, leaving the villagers (students) to rescue the rest of the animals.

Directions:

1. Use the design loop to devise a plan that applies to the essential question.

2. Once the students get past the first two steps of the design loop, those being asking and brainstorming, they will pick out a maximum of four materials of their choice provided by the teacher.

3. Carry out the solution

4. After students are complete with their catapult, they will place the catapult in the mystical rainforest, and test their project.

5. If any issues came about, students would go back to their design and make any appropriate tweaks.

6. Students will test out their catapults in front of the class in the mystical rainforest.

The group that is able to send the tiger flying the farthest, while keeping it as hidden or appealing as possible, will have their catapult used in the following years as an example for the incoming students in the year following.

Limitations:

The catapult constructed must have a maximum base of 10X5 inches and at least 5 inches tall, while remaining hidden and/or appealing to the tiger, be made ONLY using the materials provided and affectively get rid of the tiger.

Content Knowledge:

Catapults were effective weapons used by knights and crusaders during the medieval times in warfare. They are comparable to seesaw’s on the playground because of their they use gravity and force to throw materials a far distance. Catapults actually evolved from crossbows that became too large to be handheld. The modern elementary school catapult is often used to pass notes or pick on a classmate!

New Vocabulary Terms:

Catapult- A machine that stores energy then quickly releases this energy to fire a projectile

Gravity- Is a force which tries to pull two objects toward each other

Habitat- The natural environment of an organism

Descend: To go or pass from a higher to a lower place

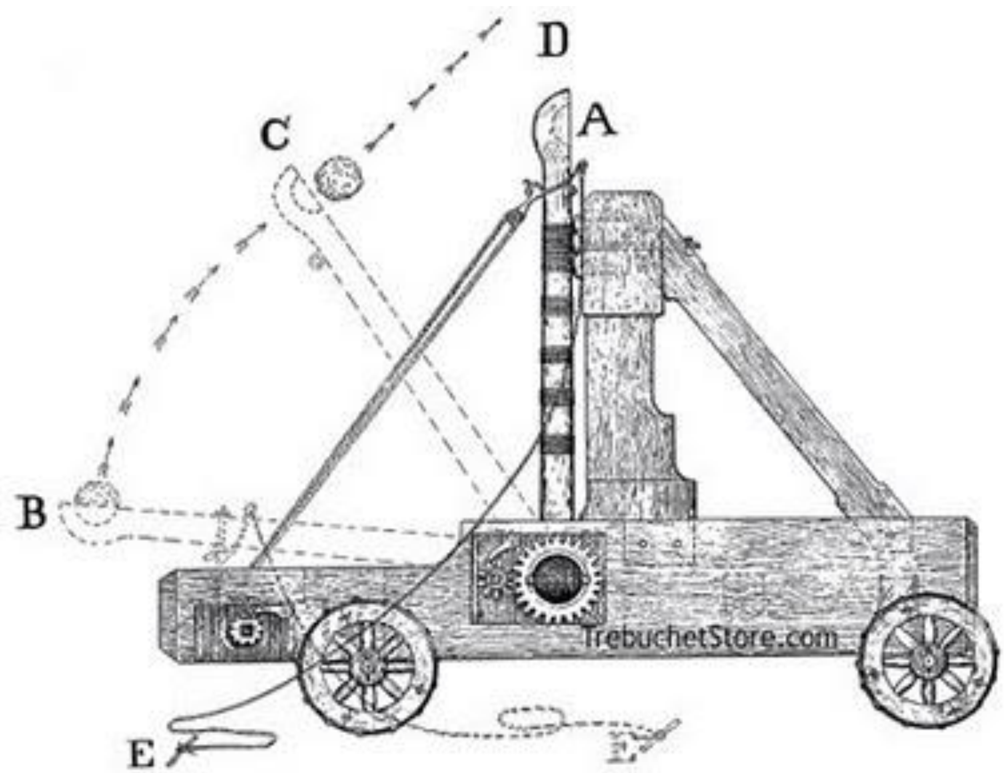


FIG. 194—SIDE VIEW OF THE CATAPULT. Scale ½ in. = 1 ft.

Oh, No! Save the Animals!

By building a catapult that will shoot the tiger away from the other animals

Scenario:

We just finished reading “Oh, No!” in class, the story about how the animals fell in a hole and managed to get to safety before the tiger could get them. Now it is the your job to build a catapult that will hold the tiger’s weight, and send it as far away from the hole as possible, leaving the villagers (students) to rescue the rest of the animals.

Challenge:

Can you build a secret, hidden catapult that will send the tiger flying away far enough from the hole, so that the villagers have enough time to come help the animals to safety in in time before the tiger comes back?

Materials: You must use the mandatory items, but only a maximum of three of the other materials.

- Tissue box/soda can/popsicle sticks/ (pick one)
- Rubber bands (applicable to all designs)
- 1 bottle cap (optional)
- 2 Pencils (optional)
- Tacky glue (applicable to all designs)
- 1 spoon (Mandatory)
- Ruler (Mandatory)

Limitations:

The catapult constructed must have a maximum base of 10X5 inches and at least 5 inches tall, while remaining hidden and/or appealing to the tiger, be made ONLY using the materials provided and affectively get rid of the tiger.

Directions:

1. Use the design loop to devise a plan that applies to the essential question.

2. Once you get past the first two steps of the design loop, which is to ask and brainstorm, you will pick out a maximum of four materials of your choice provided by the teacher.

3. Carry out the solution

4. After you complete building catapult, you will place the catapult in the mystical rainforest, and test your catapult.

5. If any issues came about, you should go back to your design and make any appropriate tweaks.

6. You will test your catapults in front of the class in the mystical rainforest.

The group that is able to send the tiger flying the farthest, while keep it as hidden or appealing as possible, that catapult will be displaced in the classroom and used in the following years to teacher the incoming students.

New Vocabulary Terms:

Catapult- A machine that stores energy then quickly releases this energy to fire a projectile

Gravity- Is a force which tries to pull two objects toward each other

Habitat- The natural environment of an organism

Descend: To go or pass from a higher to a lower place

The Design Loop

1 Ask yourself what the problem is:

____

2 Brainstorm ideas that will solve the problem:

____

3 Create your ideas:

4 Check your work by testing it out:

---

5 Evaluate your model and make changes if needed:

____

6 Present your ideas to others:

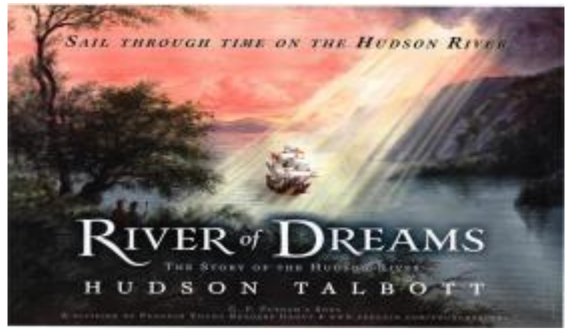
Work Cited

1. All Things Medieval. "*All About Catapults.*" http://medieval.stormthecastle.com/armorypages/catapults.htm. Web Access (Sept. 24, 2013).
2. Cool Cosmos. *"What is Gravity."* http://coolcosmos.ipac.caltech.edu/ask/300-What-is-gravity-. Web Access (Sept. 24, 2013).
3. http://dictionary.reference.com/. Web Access (Sept. 24, 2013).

Lesson Plan

<u>Paddle Boat Race; Designing a paddle boat to move the fastest in the water</u>

Created By: Aleshia Hawkinson and Tiffany Cromwell
Disciplinary Area: STEM
Unit: Structures, Motion, Engineering, Water
Literacy: *River of Dreams* written by: Hudson Talbott



Grade Level 4

Standards:

- *Standards for Technological Literacy and Benchmark* (Energy and Power technologies): Tools, machines, products, and systems use energy in order to do work.
- *Standards for Technological Literacy and Benchmark* (Transportation Technologies): The use of transportation allows people and goods to be moved from place to place.
- *Common Core Math Standard* (Measurement and Data): Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit.
- *Common Core Science Standard* (Energy): Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

Big Ideas:
- Proper use of the design loop
- Recycled materials and their ability to move across the water
- Understand kinetic energy and the improvement of water transportation
- Ability to validate and present final model to the class

Essential Question: Can your group design a paddle boat that can travel the fastest in water?

Scenario: After reading *River of Dreams*, a non-fiction children's book about the history of the Hudson River, you will now create a model that can move the fastest through water like the early forms of the transportation of goods across the river.

Directions: Students will design and create a form of transportation, no more 7 inches long and five inches wide, which can travel the fastest in a water race by using the design loop. Each design will be created out of the allowed materials and tools, and tested in the race to see which design can travel to the finish line the quickest. Each group must designate a recorder to measure the distance in inches per second.

Parameters: Each design must:
- Have used the design loop in creating the model
- Be able to move as fast as possible in water
- Be no more than 7 inches long and 5 inches wide
- Propel itself through kinetic energy built within the model
- Be turned in to the instructor along with worksheet

After your students create a model, it will be tested to determine its ability to move across water created from a simulation of a river.

New Vocabulary Terms:
<u>Propel</u>- To drive, or cause to move, forward or onward.

Kinetic Energy- The energy of a body or a system with respect to the motion of the body or of the particles in the system.
Force- Strength or power exerted upon an object.
Knots- A unit of speed used by nautical vessels, being one nautical mile.
Velocity- Rapidity of motion or operation

Tools:
- Ruler
- Scissors
- Stopwatch

Suggested Materials/Resources*:
- Hot glue
- Masking Tape
- Paper
- Pencil
- Plastic
- Rubber bands

*Note: Other materials used can be found in the classroom, outside the classroom, or at home and must not be bought.

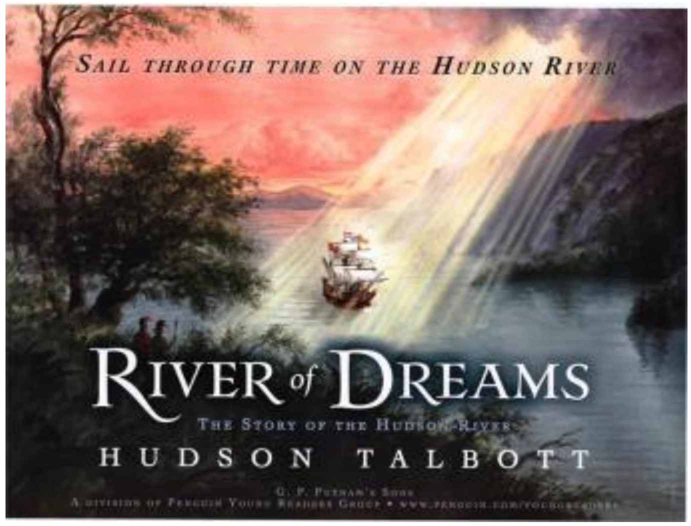
Content Information:
Long before cars, airplanes, and right before trains, people used boats as the primary mode of transportation across rivers and oceans. Trade was a big commodity in the early times and boats were the best way to transport these goods. The big improvement in the early 1800's was when the boats went from relying on the wind to relying on kinetic energy to propel the boat down the river. Kinetic energy is the necessary force for an object with a specific mass to move from resting position. This creates a velocity in the movement of the boat creating speed. Boat speed is measured in knots per hour across the water, as opposed to a car that is measured in miles per hour on solid ground.

Teacher Assessment	
Problem is stated	__/15
Research	__/15
Creativity	__/20
Model Test	__/15
Calculations	__/15
Participation	__/20
Total	__/100

Student Handout

PADDLE BOAT RACE

DESIGNING A BOAT THAT CAN MOVE THE FASTEST IN WATER



Situation:
We have just finished reading *River of Dreams* by Henry Talbott. We learned that Henry Hudson set sail, in 1609, on his third voyage in search of a new route to China. He came across “the river that flows both ways”-Hudson River. The Hudson River became a source of transportation of goods for over two centuries. Now your group will create a vessel that travels the fastest in water.

Design Challenge: Can your group design a paddle boat that can travel the fastest in water?

Directions:

1. You must follow the design loop process until your group is ready to start the building process. Then, your group can take materials.
2. Your resources and materials must be found in the classroom, outside the classroom, or at home. The object is to use recycled materials.
3. Your model must NOT be more than 7 inches tall and 5 inches wide.
4. Your model must be able to move across water.

5. After you create your model, the design will be tested by its ability to move across water created from a simulation of a river.
6. Record the time it takes your boat to travel to the finish line, and then measure the distance.

Tools:

- Ruler
- Scissors
- Stopwatch

Suggested Materials/Resources*:

- Hot glue
- Masking Tape
- Paper
- Pencil
- Plastic
- Rubber bands

*Note: Other materials used can be found in the classroom, outside the classroom, or at home. Items found must not be bought.

New Vocabulary Terms:

Propel- To drive, or cause to move, forward or onward.
Kinetic Energy- The energy of a body or a system with respect to the motion of the body or of the particles in the system.
Force- Strength or power exerted upon an object.
Knots- A unit of speed used by nautical vessels, being one nautical mile.
Velocity- Rapidity of motion or operation

Information to Know:

Long before cars, airplanes, and right before trains, people used boats as the primary mode of transportation across rivers and oceans. Trade was a big commodity in the early times and boats were the best way to transport these goods. The big improvement in the early 1800's was when the boats went from relying on the wind to relying on kinetic energy to propel the boat down the river. Kinetic energy is the necessary force for an object with a specific mass to move from resting position. This creates a velocity in the movement of the boat creating speed. Boat speed is measured in knots per hour across the water, as opposed to a car that is measured in miles per hour on solid ground.

The Design Loop

1. What is the problem? ____
____

2. Research and collect information to develop a solution. ____________________________
____

3. Put your ideas on paper!

4. Build your model and Test.

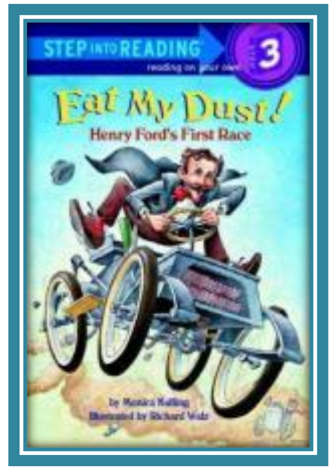
5. Calculate your speed (in/s) and make changes. ____
____

6. Now Race your ideas against others!

Racing For The Future

An Introduction to Newton's Laws of Motion

Tara Hodge and Kelly Anderson



Disciplinary Area: STEM

Unit: Newton's Laws of Motion

Grade Level: 3

Literacy: *Eat My Dust! Henry Ford's First Race* by

Standards:

- National Science Education Standards (Physical Science): Position and motion of objects.
- Standards for Technological Literacy (Understanding of Technology and Society): The influence of technology on history.
- Common Core ELA Standards (Presentation of Knowledge and Ideas): Report on a story, or recount an experience with appropriate facts and relevant descriptive details, speaking clearly at an understandable pace.
- Common Core Math Standards (Measurement and Data): Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.
- National Standards in Economics: Standard 14: Entrepreneurship- Entrepreneurs are individuals who are willing to take risks, to develop new products, and start new businesses. They recognize opportunities, like working for themselves, and accept challenges.

Big Ideas:

- Follow detailed instructions to complete an experiment
- Demonstrate a basic understanding of Newton's first two Laws of Motion
- Proper use of the design loop

Essential Question: After building a racecar following detailed instructions, can you apply your knowledge of Newton's Laws of Motion to modify it to go faster and farther?

Scenario: Henry Ford wants to build a car that is affordable for everyone, but he needs money to start his factory. He sees that a race is being held with a prize of $8,000, and he just knows he can win. Unfortunately, his car is just a regular car- not a racecar! Using the design loop and what you have learned about Newton's Laws of Motion, can you modify his original car design so that he can beat The Daredevil?

Vocabulary:

Acceleration- the rate at which an object changes its velocity

Balanced- equal

Constant- occurring continuously over a period of time

Entrepreneur- a person who starts a business and is willing to risk loss in order to make money

Force- a push or a pull

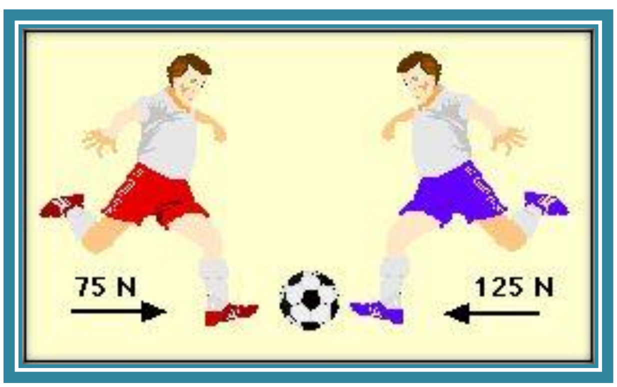
Friction- the resistance that one surface encounters when moving over another

Inertia- a tendency to remain unchanged

Inertia- a tendency to remain unchanged

Mass- the quantity of matter that a body or objet contains

Net Force- the overall force acting on an object. In the diagram of the soccer players, the player in red is kicking with a force of 75 N, while the blue player is kicking with a force of 125 N. 125 - 75=50, so there is a net force of 50 N moving the ball from right to left.



Newton (N)- the standard metric unit for measuring force

Pull- a force drawing something in a particular direction

Rest- not moving

Speed- the rate at which something is able to move

Velocity- the speed of something in a given direction

Tools:

Reamer	Wood Cutter
Wax, Soap or Crayon	Mallet or Hammer
Pliers	Screwdriver
Scissors	Rulers
Measuring Tape	Board to roll cars down
Stop Watch	

Materials/Resources (Teacher Provided):

String	Rubber Bands
Dowel Rods	Screws and Bolts (optional- #10)

Materials/Resources (TeacherGeek, per group)(1st number for basic racer, 2nd optional for advanced):

Connector Strip- 4,6	Hole Plate- 2
Wheel Hub- 4	Stop Clip- 2,4
50 Tooth Gear- 0,1	40 Tooth Gear- 0,1
20 Tooth Gear- 0,1	10 Tooth Gear- 0.1

Content: Introduce the unit by showing the following YouTube videos, which explain the first two laws of motion, to your students:

- http://www.youtube.com/watch?v=pxWHWOYVov4#t=111
- http://www.youtube.com/watch?v=iwP4heWDhvw#t=24

This site has many resources on Newton's Laws of Motion that may be helpful to you as a teacher:

- http://www.neok12.com/Laws-of-Motion.htm

TIP: There is a Magic School Bus episode titled The Magic School Bus Plays Ball that would be perfect to show a day or so before this project, if time allows! It is available to watch on Vimeo.

In the late 17^{th} century, Sir Isaac Newton published his ideas on motion and forces, which became known as Newton's Laws of Motion.

1^{st} Law: If no forces (or a combination of forces that is balanced) act on an object then it is at rest, and it will remain at rest. If an object is manipulated with force, it is in motion; it will continue to move in a straight line path at a constant speed.

What does this mean? **Objects in motion stay in motion**. This is the law of inertia.

> *2^{nd} Law: If a single force (or a combination of forces that is unbalanced) acts on an object, its speed and/or its direction will change. How quickly the speed (and/or direction) changes is directly related to the strength of the net force and inversely related to the object's mass.*

Simplified, this means that a force pushing or pulling on an object will change its direction and/or its speed. When you kick a soccer ball, your kick is the force which will increase the soccer ball's speed. If the ball was rolling towards you before you kick it, it will most likely change direction once you do. The harder you kick the more drastic and noticeable the change will be. A quick demonstration with a ball and a couple of students would be a great way to introduce this concept! What does it mean when Newton says that changes are inversely related to an object's mass? The answer is easy! The heavier something is, the harder it is to get it moving, keep it moving, and the slower it will go.

Before we get started building, let's take a moment to talk about friction. Friction is what happens when two things rub together. You might have your students rub their hands together for a minute and feel the heat produced. This is a side effect of friction! Think about the molecules on the surfaces of two materials (even ones we think are smooth) like sandpaper, and then imagine rubbing them together. Just as the individual grains of sand rub against one another, so do the molecules in our smooth surfaces. While we could go in to a lot of detail about friction, it is really just important that you get one thing across to your students at this point. That is that this opposing force, friction, is always at work here on earth, and it slows things down!

So, how do we use this information to build a better racecar? Here are the key points:

- Objects in motion will stay in motion.
- Force acting on an object will change its speed or direction, or both.
- The heavier something is, the slower it will go. Alternately, the lighter something is, the faster it will go.
- Friction is bad. It will slow you down. While we cannot entirely escape it here on Earth, we do want to mitigate its effects as much as we can.

Teacher Instructions:

- After introducing the concepts to your students, have them build their basic racers. They will most likely be working in groups for this, so now is the time to assign them to their respective teams!
- After each group has built their basic racer following the instruction sheet, they will need to test the speed on the "test track" you have set up. For our experiment, we used a 6' long board angled on a 27" stool, lined the back wheels up with the back (top) of the board, and let the racer go. Students will need to time exactly how long it takes the racer to roll down the board and come to a stop, as well as measure the distance travelled. They will then record this information on their handouts.
- After each group has conducted their initial experiment, read the book *Eat My Dust! Henry Ford's First Race* by Monica Kulling to your students. This is based a true story and details how Henry Ford obtained the money to start building cars that everyone could afford to own!
- After reading, introduce the design problem to your students. They will then return to their groups to work through the design loop in the student packet to come up with a way to modify their cars and win the race you will be having later!
    - TIP: To be sure your students are using the design loop; have them draw out three ideas before allowing them to collect more materials for their cars!
- Once everyone has completed their new, improved racer, the students will need to return to the "race track" to complete their worksheets with the data found by averaging their three tries.

- After everyone has filled out their worksheets, hold a race and time each car to see whose car will travel the farthest distance in the shortest amount of time.
    - Optional: Have a prize for the team that wins first place!
    - Optional: As a class, figure out how fast the winning car was going.
        - average speed = $\frac{\text{total distance traveled}}{\text{travel time}}$

Racing For The Future

Evaluation and Assessment

Grading Rubric

Demonstrates knowledge of Laws of Motion (0-25pts): _____________

Student is able to describe how the first two laws of motion apply in making their car go faster and farther.

Followed procedural instructions to complete experiment (0-25pts): _____________

Student is able to follow multi-step instructions to create a basic racecar.

Effective use of tools (0-25pts): _____________

Student is able to use tools recommended in procedural instructions to complete the given task.

Completion of provided handouts for evaluation (0-25pts): _____________

Student completed all questions and demonstrated knowledge and comprehension of Laws of Motion and line plots.

Total Points: _________/100

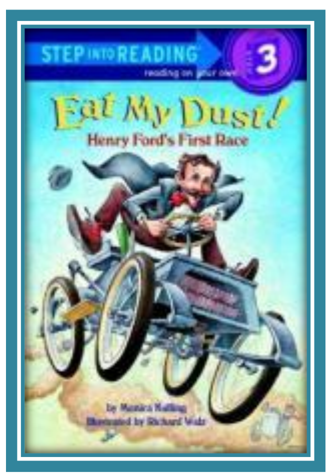
Racing For The Future

An Introduction to Newton's Laws of Motion

Student Handout

Instructions:

- Build a basic rubber band racer following the instructions included with this handout.
- After your car is built, test it on the "test track" your instructor has set up. Start with the back wheels lined up with the back (top) of the board, and let the racer go. Using a stopwatch, time exactly how long it takes the racer to roll down the board and come to a stop. Then measure the distance your car travelled. Record this information on the line plots on your student worksheet. You will need to conduct this experiment three times, recording the data each time.
- STOP! After you have completed your line plots, wait for your instructor to share a book with the class.



Situation: Henry Ford wants to build a car that is affordable for everyone, but he needs money to start his factory. He sees that a race is being held with a prize of $8,000, and he just knows he can win. Unfortunately, his car is just a regular car- not a racecar! Using the design loop and what you have learned about Newton's Laws of Motion, can you modify his original car design so that he can beat The Daredevil?

- Now that you have heard the story, are you ready to help Henry win the race? Use the design loop to decide to how to make your car fast enough to win the race! After you have drawn three designs on your design loop worksheet, you may collect materials from your teacher to implement your best idea!
- You may use ideas for your modifications given in the handout, but be creative! After you modify your racecar, test it on the test track again. Start with the back wheels lined up with the back (top) of the board, and let the racer go. Using a stopwatch, time exactly how long it takes the racer to roll down the board and come to a stop. Then measure the distance your car travelled. Record this information on the line plots on your student worksheet. You will need to conduct this experiment three times, recording the data each time.
- Complete the student handouts.
- Compare your results with the rest of the class. Was yours the fastest car?

Vocabulary:

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Constant- occurring continuously over a period of time

Entrepreneur- a person who starts a business and is willing to risk loss in order to make money

Force- a push or a pull

Friction- the resistance that one surface encounters when moving over another

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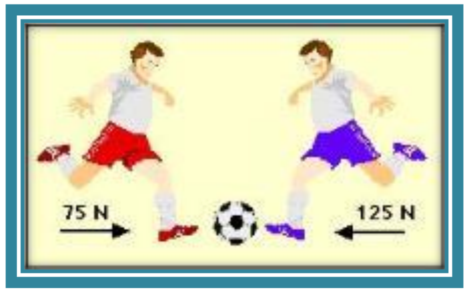

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Tools:

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Wax, Soap or Crayon	Mallet or Hammer
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Scissors	Rulers
Measuring Tape	Stop Watch

Materials/Resources (TeacherGeek, per student or group)(1st number for basic racer, 2nd for advanced):

Connector Strip- 4,6	Hole Plate- 2
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20 Tooth Gear- 0,1	10 Tooth Gear- 0.1
String	Rubber Bands
Dowel Rods	Screws and Bolts

Racing For The Future

An Introduction to Newton's Laws of Motion

Student Worksheet

5. Draw a line plot to show how long it took your basic racer to complete the test track.

____

6. Draw a line plot to show the distance your basic racer traveled on the test track.

____

7. Draw a line plot to show how long it took your advanced racer to complete the test track.

____

8. Draw a line plot to show the distance your advanced racer traveled on the test track.

____

9. After you modified your car, did it perform as you expected? If not, why do you think this was?

____

____

____

____

10. In your own words, explain the 1st and 2nd Laws of Motion.

____

____

____

____

____

Fun With Physics Word Search

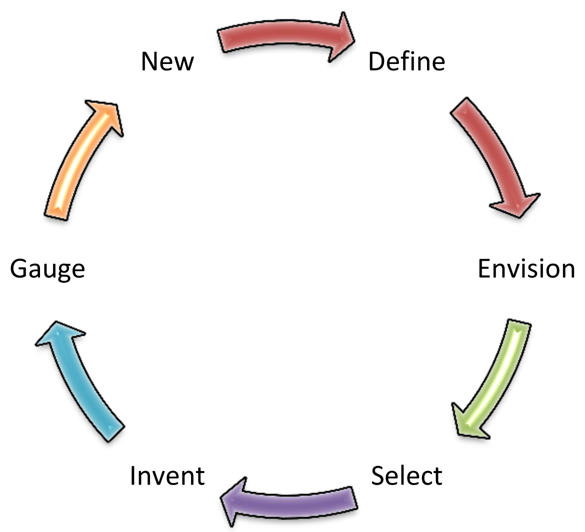
T	D	J	I	N	E	R	T	I	A	F	Z	E	F	A
N	C	E	D	N	L	L	U	P	M	Y	N	E	O	C
A	S	G	C	I	V	C	B	W	X	T	D	Y	R	C
T	Q	S	A	N	S	E	T	X	R	N	T	X	C	E
S	W	U	A	P	A	R	R	E	J	I	S	C	E	L
N	I	O	E	M	T	L	P	S	C	C	E	A	N	E
O	W	E	B	R	I	R	A	O	E	F	R	X	R	R
C	D	Z	O	X	E	O	L	B	W	T	H	Z	Y	A
N	E	Y	M	N	A	E	V	A	S	D	Z	B	D	T
K	U	D	E	R	V	W	O	P	G	M	A	O	R	I
O	U	U	N	O	I	T	C	I	R	F	K	U	N	O
D	R	U	Q	A	T	V	E	B	E	G	Z	P	C	N
I	L	G	D	P	B	K	R	Z	A	L	G	I	X	F

ACCELERATION, BALANCED, CONSTANT, ENTREPRENEUR, FORCE, FRICTION, INERTIA, INVERSE, MASS, PULL, REST, SPEED, VELOCITY

Sir Isaac Newton

Design Loop Worksheet

The Design Loop



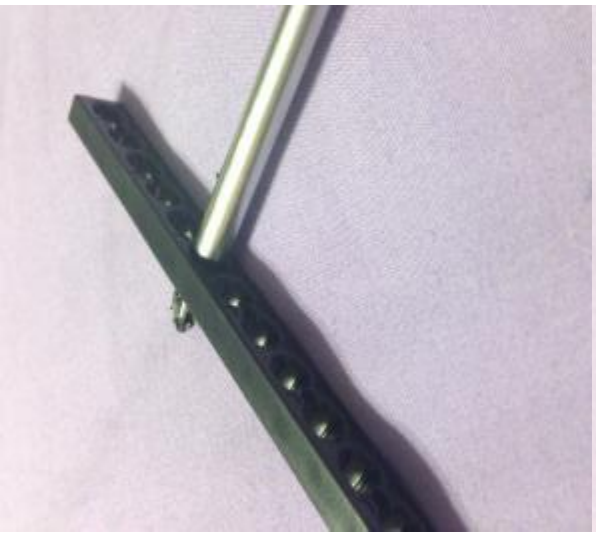
Racing For The Future

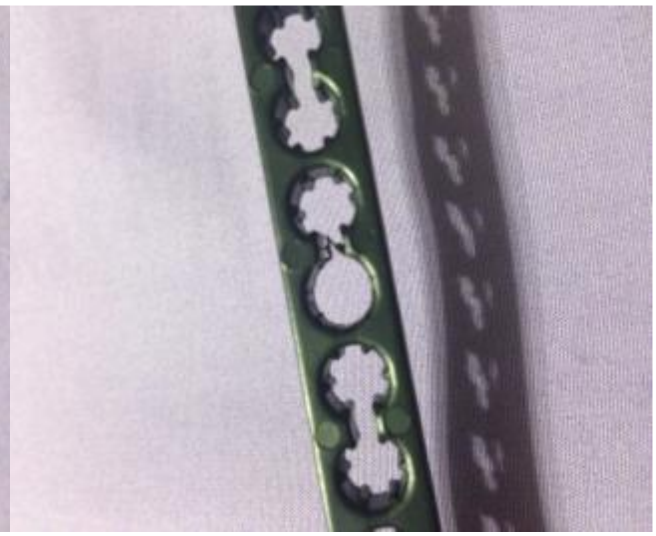
An Introduction to Newton's Laws of Motion

Basic Racer Instructions

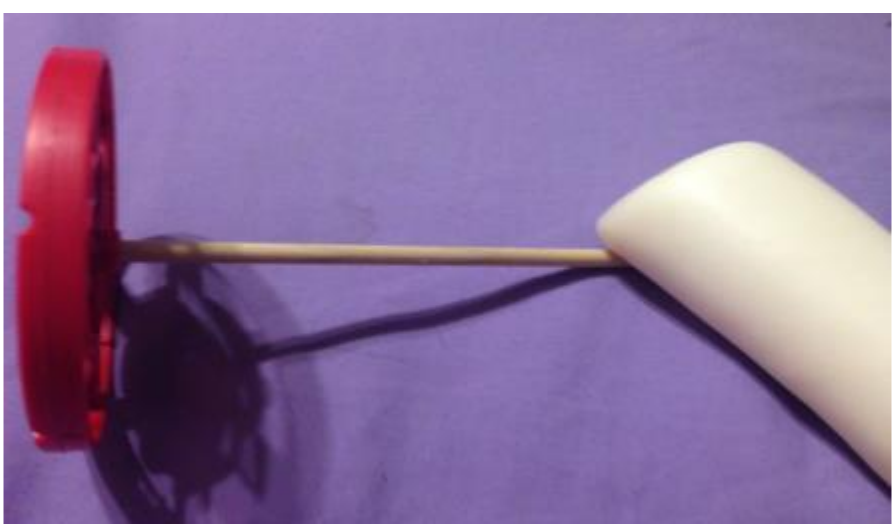
Holes and Reaming: Use a Reamer or a screwdriver to create holes that will allow the dowel rods to move freely. The holes that have not been reamed will securely hold onto the dowel rods!

Be careful not to ream too many holes! Most holes are needed to keep dowels in place!





Push dowels into place by wiggling and pressing them with your hands or tapping them with a hammer.Here's a tip! You can use soap, crayon or wax on a dowel to allow it to slide in and out of holes easier!



Let's Start Building!

1. **Build the frame**

Cut four 4 inch dowels.

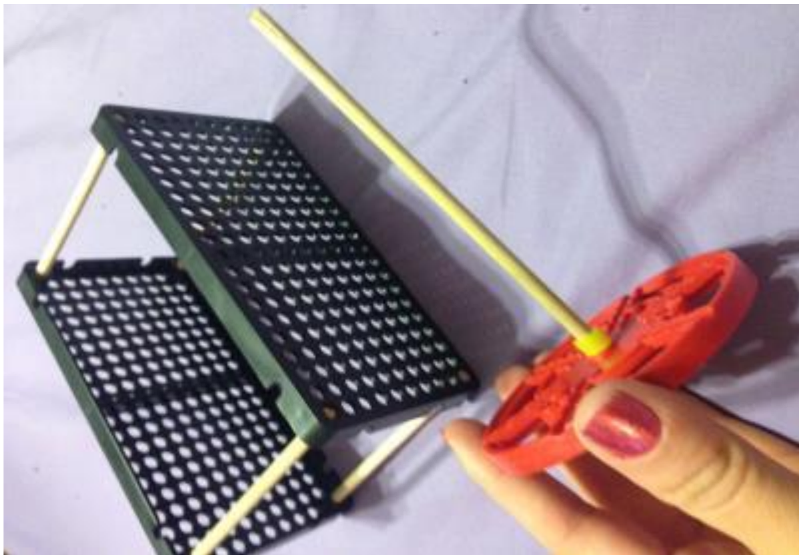
Insert them into the four corners.

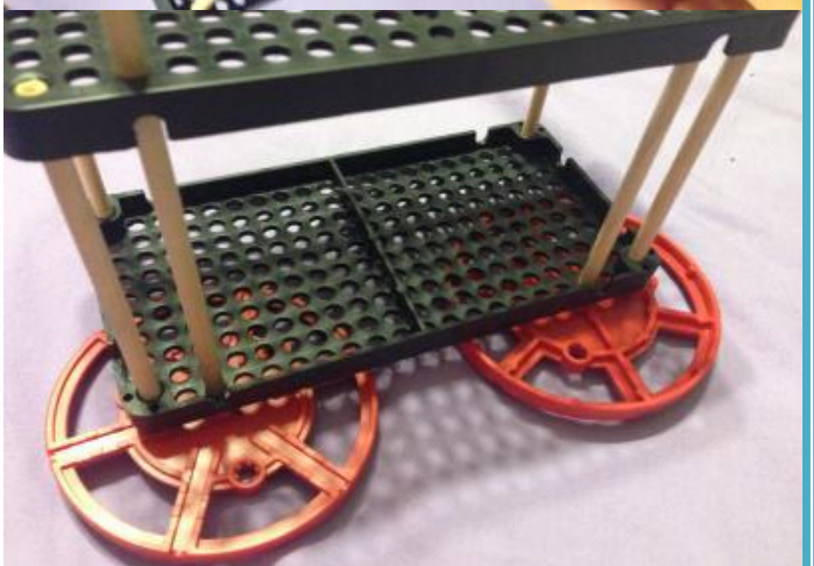
Don't ream these holes! They need to be secure.

These are the only dowels that you will not change during your modifications.

They are your constant

2. Wheels





Cut two 5 inch dowels.

Press wheels onto dowels.

These will become axles!

Do not ream holes.

Insert the wheels through the frame where you think they will work the best.

You can modify them later!

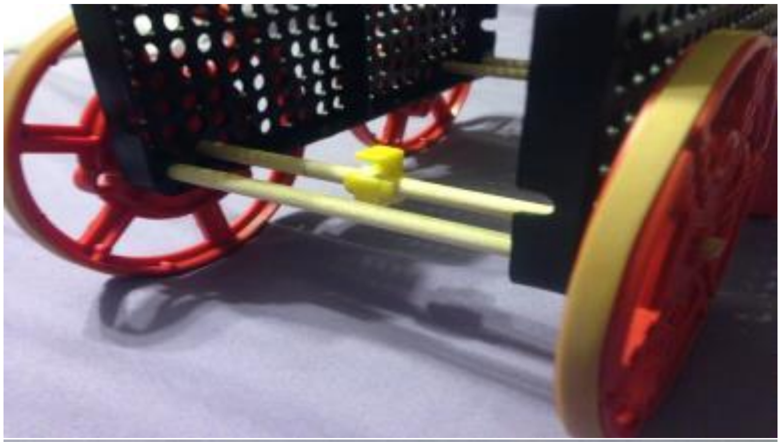
Tip! The wheels should not be tight against the frame.

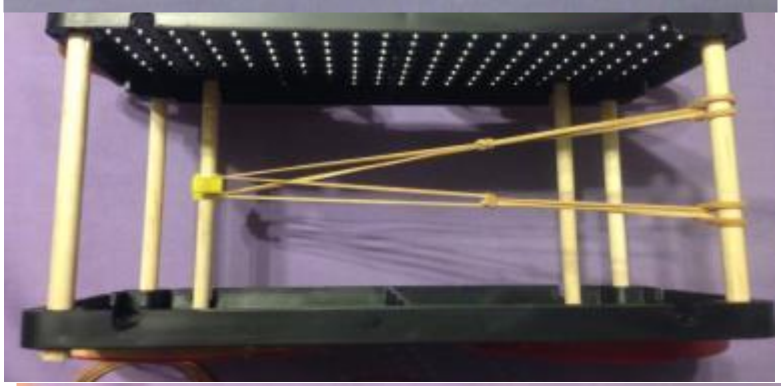
You can provide traction to the wheels by stretching a rubber band around them.

Secure with glue if needed!

Now it's time to test your racer!

3. **Clip and Bands**





Attach the stop clip on the front wheel axle.

The hook should be facing forwards so the rubber band will slip over it.

You may need to use a drop of glue to hold it in place!

Rubber bands may be linked in a series-

They store and release less force over a greater distance

Or be linked in a parallel form- these release greater force over a less distance!

Find out which option will make your racer go faster and/or farther!

Attach two sets of rubber band links, (either linked in a series or parallel) to the back top dowel rod and around the stop clip.

Hold in place and wind backwards.

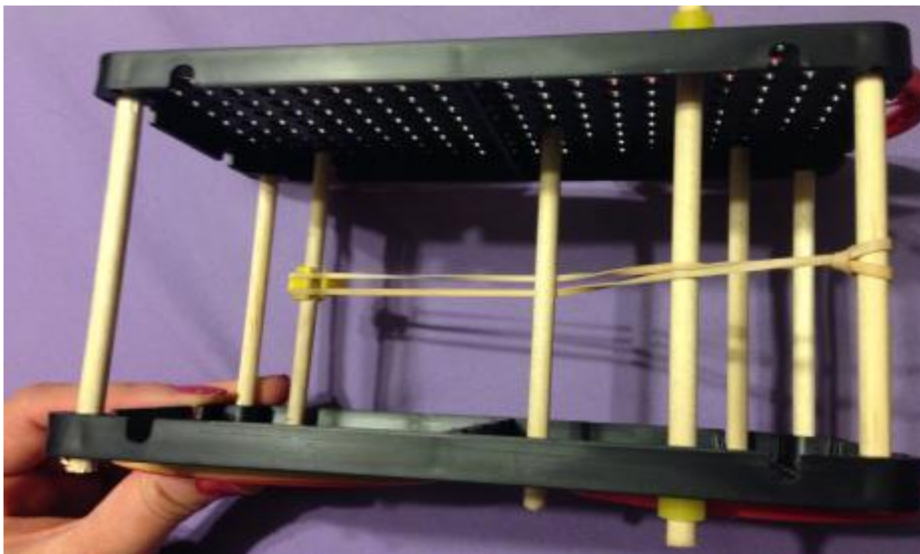
The rubber bands will wrap around the axle.

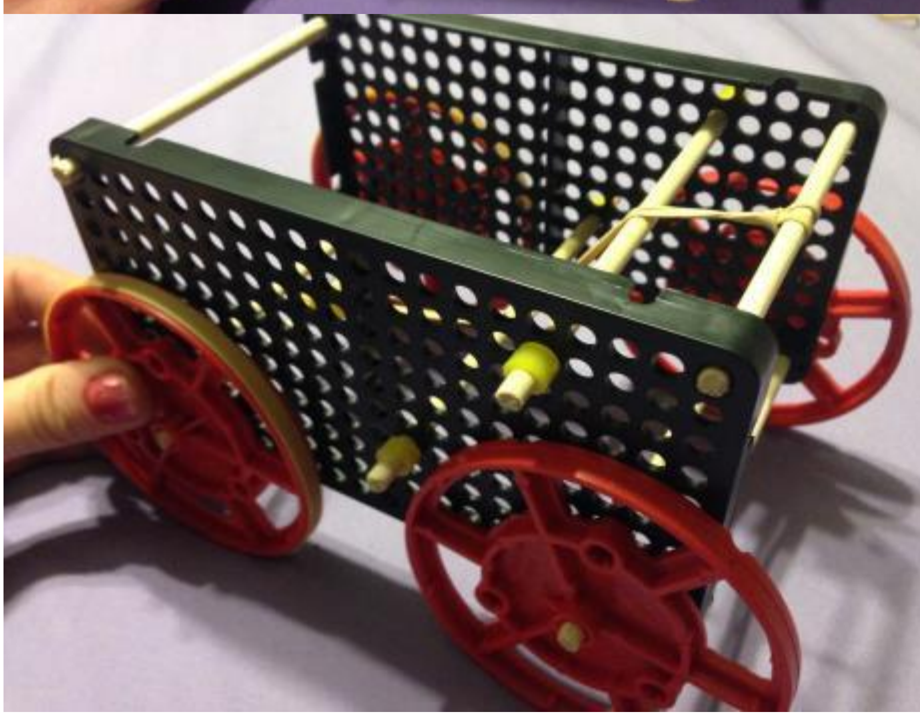
Let it go!

4. **Mechanical Advantages!**

Here are some examples of how you can modify your racer!

Routing: Pulleys can be used to change the direction of a rubber band, or string, and the force it applies. Dowels allowed to spin in lose fit holes (reamed holes), can be used as pulleys!



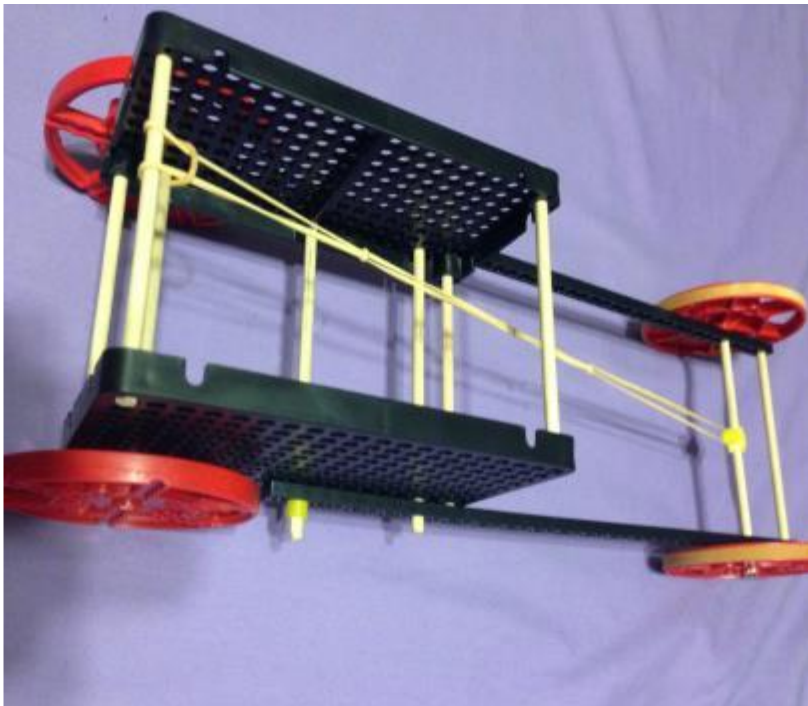


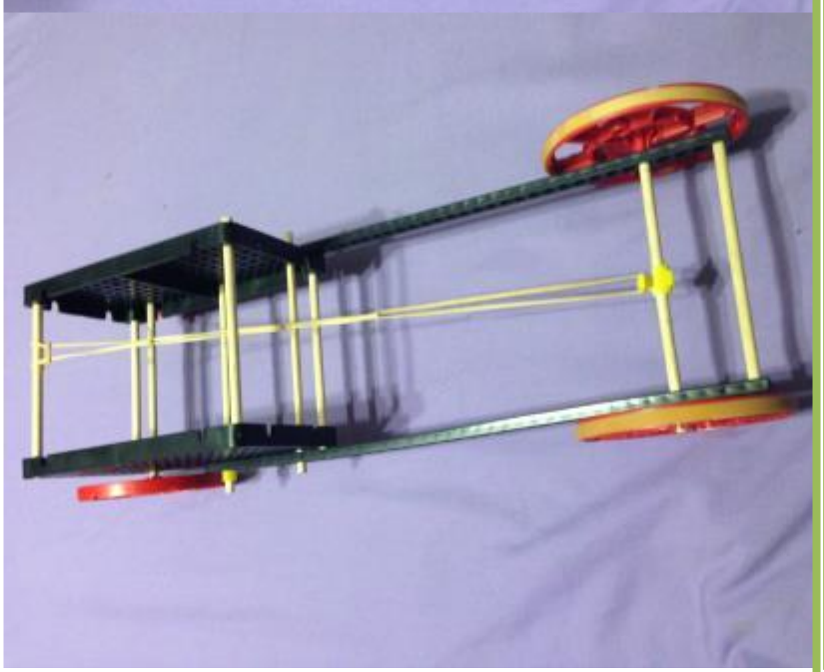
Add extra dowels to have the rubber band stretch over to change the force!

Use these slide stops to keep the dowels from slipping out of the holes!

Be creative and try different patterns to see what works best!

Frame Extension

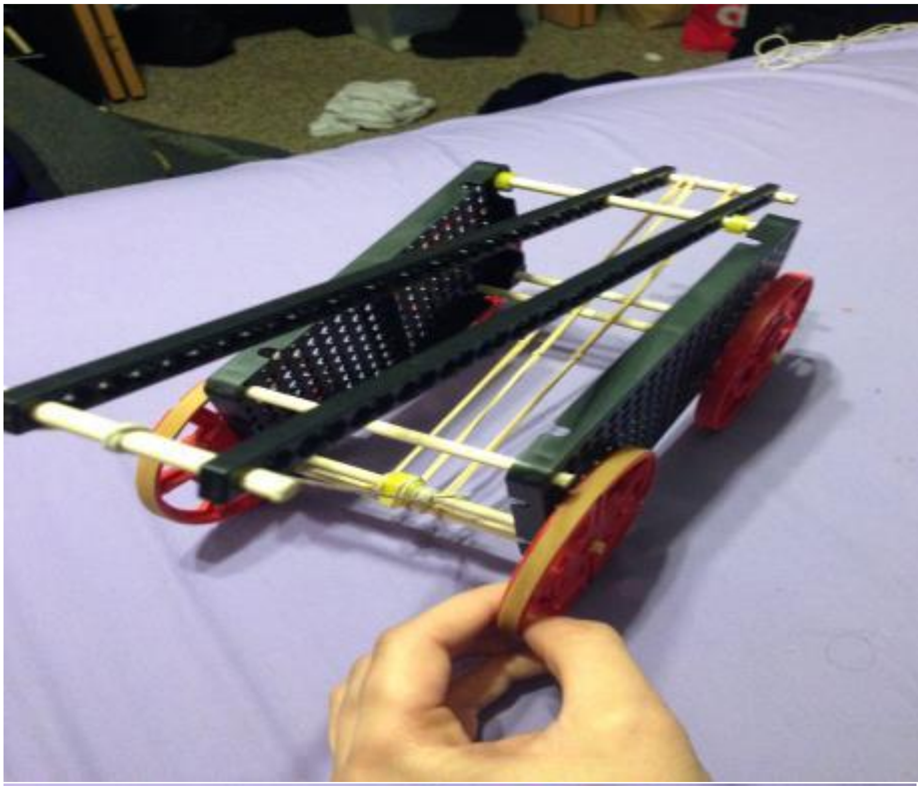


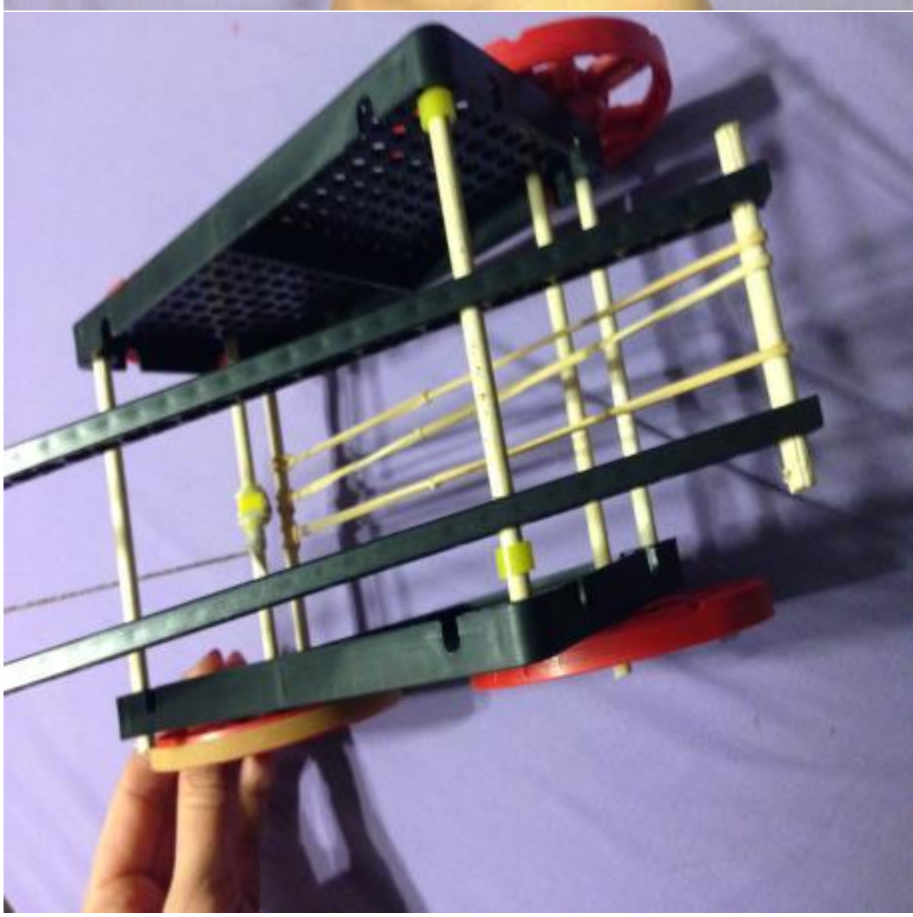


These connector strips can be added to make your racer taller or longer!

Connect with dowel rods and slide stops.

Only ream the holes that the wheel axles go through





Join 2 connector strips by 2 or more dowels to make a lever arm.

Only ream the holes in the lever arm where it will pivot.

(About 9 holes down)

Slide the lever onto the back top dowel, use slide stops to stop it from moving.

Rubber bands will be connected from the back dowel rod on the lever to the front bottom dowel on the frame.

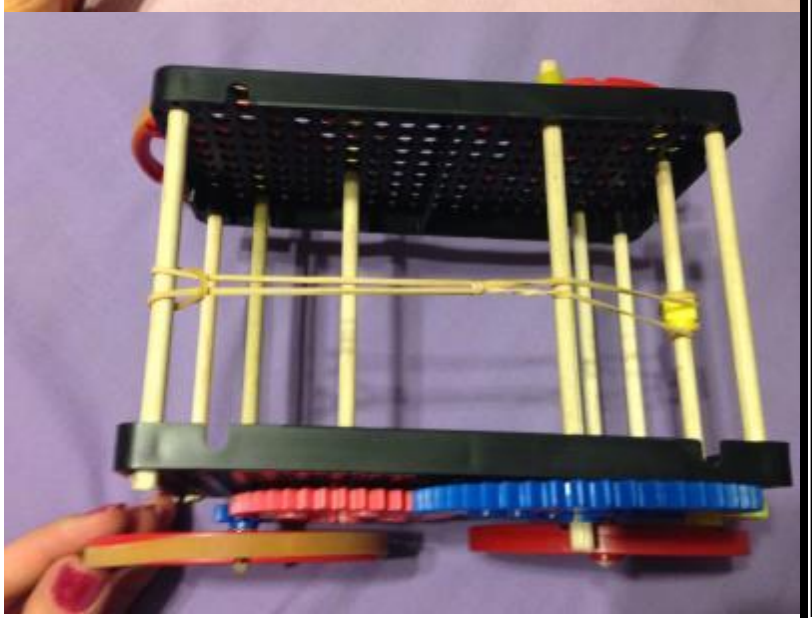
A 16 inch string is connected from the front of the lever and will hook onto the stop clip by creating a loop.

Wind back and let her fly!

The lever will swing forward and release the string.

Gears

A gear is a wheel with evenly spaced teeth around its perimeter. The teeth on multiple gears can mesh to form a gear train. Gear trains can transmit force, create a mechanical advantage and change the direction of force!



Connect gears by dowel rods.

Do not ream holes.

This gear train uses multiple gears to create a mechanical advantage greater than a 2 gear train.

It is called a compound gear train.

Be creative!

Experiment with combinations of pulleys, extensions, gears, lever arms, different rubber band techniques, and placements of dowel rods to create the ultimate racer that will help Henry Ford win the race!

Rubber Band Racer: Chitty Chitty Bang Bang Traveling Home

Created By Lisa Ciabocchi and Aleshia Hawkinson

Disciplinary Area: STEM

Unit: Speed and Transportation

Grade Level: 2

Literacy: *Chitty Chitty Bang Bang and the Race Against Time* by Frank Cottrell Boyce.

Standards:

- Common Core Math (Measurement and Data): Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph.
- Common Core Math (Measurement and Data): Measure the length of an object by selecting and using appropriate tools such as rulers, yardsticks, meter sticks, and measuring tapes.
- Standards for Technological Literacy (Transportation Technologies):A transportation system has many parts that work together to help people travel.
- National Science Standards (Engineering Design): 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.

Literacy: *Chitty Chitty Bang Bang and the Race Against Time* by Frank Cottrell Boyce.

Big Ideas:

- Understand a system powered by four wheels.
- Understand concepts of energy, simple machines, and friction.
- Be able to follow a set procedure to complete the experiment.

Essential Question: Can your group follow the steps to create a four-wheel drive Chitty Chitty Bang Bang, and measure the distance that the car can travel over the rocks?

Situation: Read *Chitty Chitty Bang Bang and the Race Against Time* by Frank Cottrell to your students. Divide the students into pairs and provide them with the procedures to creating a racecar. Supply the students with a rocky landscape for the students to test their car on. The students will then follow the steps to create a four-wheel drive Chitty Chitty Bang Bang, and measure the distance that their car can travel over the rocky landscape.

Materials: For this activity, you will need:

2 12 inch dowels	3 stop clips
2 stretch tires	4 wheel hubs
2 hole plates	Thin rubber bands

Tools: For this activity, you will need:

Cutting Shears	Pencil
Glue	Rubber Mallet
Measuring Tape	Ruler

Vocabulary:

Debris: Scattered fragments, typically of something wrecked or destroyed.

Energy: The strength and vitality required for sustained physical or mental activity.

Four-Wheel Drive: A transmission system that provides power directly to all four wheels of a vehicle.

Friction: The resistance that one surface or object encounters when moving over another.

Gear: One of a set of toothed wheels that work together to alter the relation between the speed of a driving mechanism and the speed of the driven parts.

Landscape: All the visible features of an area of countryside or land, often considered in terms of their aesthetic appeal.

Simple Machine: Any of the basic mechanical devices for applying a force, such as an inclined plane, wedge, or lever.

Terrain: A stretch of land, with regard to its physical features.

Vehicle: A thing used for transporting people or goods, especially on land such as a car, truck, or cart.

Scenario: Mr. Tooting has yanked Chitty's "chronojuster" lever again, which has put the family back into normal time. Unfortunately, Chitty has lost several pieces, and her wings have been damaged, not allowing her to fly over the rocky debris to get home. Due to the rocky terrain, two-wheel drive is not enough. Add four-wheel drive to Chitty Chitty Bang Bang to help her get over the rocky path without her wings. Can you and your partner reassemble Chitty Chitty Bang Bang to make the last stretch home over the rocky road?

Rubber Band Racer: Chitty Chitty Bang Bang Traveling Home
Teacher Instructions

Scenario: Read *Chitty Chitty Bang Bang and the Race Against Time* by Frank Cottrell to your students. Divide the students into pairs and provide them with the procedures to creating a racecar. Supply the students with a rocky landscape for the students to test their car on. The students will then follow the steps to create a four-wheel drive Chitty Chitty Bang Bang, and measure the distance that their car can travel over the rocky landscape.

Preparation: Prepare materials for class, including the rocky terrain that you will supply for the students to test their vehicle on. In order to create your rocky terrain for Chitty to overcome, you will need several materials:

Teacher Materials:

- 1 piece of cardboard 2 feet long
- Several rocks/pebbles
- Tacky glue
- Student Handouts
- Book

Directions:

- Cut cardboard 2 feet x 2 feet
- Gather a handful or two of small rocks or pebbles
- Hot glue rocks onto the piece of cardboard.

Student Materials:

- Cutting Shears
- Dowels
- Glue
- Hole plates

- Pencils
- Rulers
- Stop clips
- Stretch tires
- Thin rubber bands
- Wheel hubs

Content Information: Read the book *Chitty Chitty Bang Bang and the Race Against Time* written by Frank Cottrell Boyce. Discuss and define vocabulary terms with students provided in this handout. Explain the following:

- Humans have created vehicles to transport people or goods, and the types of landscapes vary throughout different areas. To modify this, humans have created four-wheel drive to help us get across more difficult terrains and climates, and to help us get out of rough places. The friction of the wheels in two-wheel drive causes the wheels to spin, while the four-wheel drive option can transfer the energy to the other two wheels to make rougher terrain such as rocks, snow, mud, and rain more escapable. After reading *Chitty Chitty Bang Bang and the Race Against Time*, introduce these key ideas, deliver the instructions to the students, and allow them to gather materials to assemble their own Chitty Chitty Bang Bang!

Prepare the students:

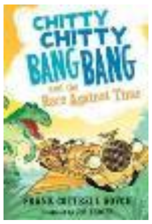
- Explain the situation to the class to introduce the procedural lesson.
- Separate the students into pairs. The students may choose their partners freely
- Have the tools and materials available for class, and student handouts to each student.
    - Each pair will need the following materials to create their vehicle:
        - 2 hole plates
        - 2 stretch tires
        - 4 wheel hubs
        - 3 stop clips
        - 2 12 foot dowels
        - Thin rubber bands
        - Ruler
- Facilitate the students learning.

Resources

Teacher Geek Inc. "Rubber Band Racer." 2012. http://teachergeek.org/rubber_band_racer.pdf.

Rubber Band Racer: Chitty Chitty Bang Bang

Traveling Home



Student Handout

Situation: Mr. Tooting has yanked Chitty's "chronojuster" lever again, which has put the family back into normal time. Unfortunately, Chitty has lost several pieces, and her wings have been damaged, not allowing her to fly over the rocky debris to get home. Due to the rocky terrain, two-wheel drive is not enough. Add four-wheel drive to Chitty Chitty Bang Bang to help her get over the rocky path without her wings. Can you and your partner reassemble Chitty Chitty Bang Bang to make the last stretch home over the rocky road?

Vocabulary:
Debris: Scattered fragments, typically of something wrecked or destroyed.
Energy: The strength and vitality required for sustained physical or mental activity.
Four-Wheel Drive: A transmission system that provides power directly to all four wheels of a vehicle.
Friction: The resistance that one surface or object encounters when moving over another.
Gear: One of a set of toothed wheels that work together to alter the relation between the speed of a driving mechanism and the speed of the driven parts.
Landscape: All the visible features of an area of countryside or land, often considered in terms of their aesthetic appeal.
Simple Machine: Any of the basic mechanical devices for applying a force, such as an inclined plane, wedge, or lever.
Terrain: A stretch of land, with regard to its physical features.
Vehicle: A thing used for transporting people or goods, especially on land such as a car, truck, or cart.

Content information: Humans have created vehicles to transport people or goods, and the types of landscapes vary throughout different areas. To modify this, humans have created four-wheel drive to help us get across more difficult terrains and climates, and to help us get out of rough places. The friction of the wheels in two-wheel drive causes the wheels to spin, while the four-wheel drive option can transfer the energy to the other two wheels to make rougher terrain such as rocks, snow, mud, and rain more escapable. After reading *Chitty Chitty Bang Bang and the Race Against Time*, introduce these key ideas, deliver the instructions to the students, and allow them to gather materials to assemble their own Chitty Chitty Bang Bang

Instructions:

1. Gather supplies from your teacher. Each pair will need:

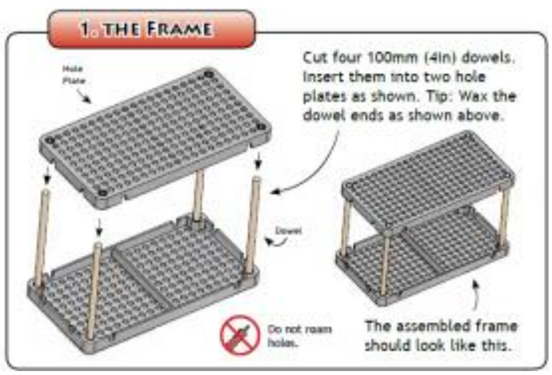
2 12 inch dowels	3 stop clips
2 stretch tires	4 wheel hubs
2 hole plates	Thin rubber bands

Cutting Shears	Pencil
Glue	Rubber Mallet
Measuring Tape	Ruler

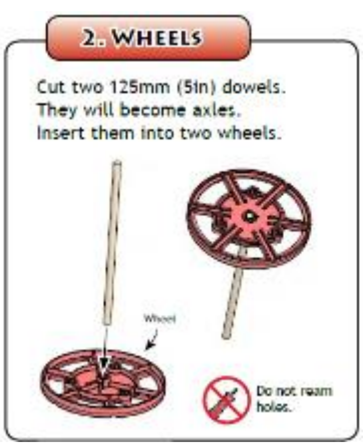
2. Begin building!

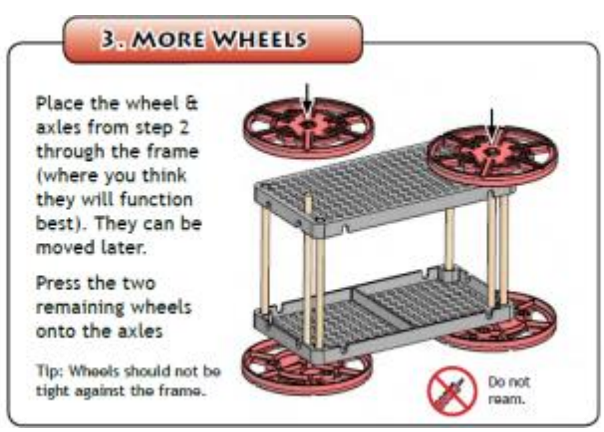
   1. Measure 4 (4inch) dowels by using your ruler. Mark each four inches with a pencil. Once you have measured each dowel, cut them one by one using your cutting shears.

   2. Take one hole plate, and push 1 (4 inch) dowel in each corner circle. Once you have done this, take the other hole plate and attach it to the other end of the dowels.

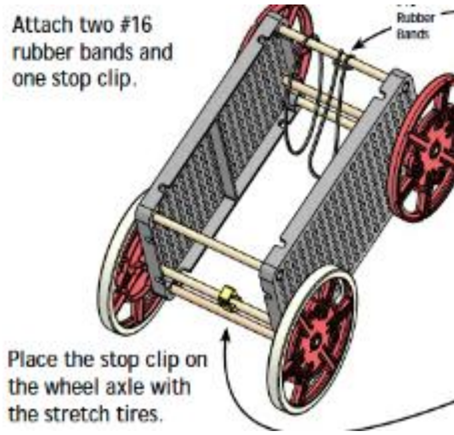


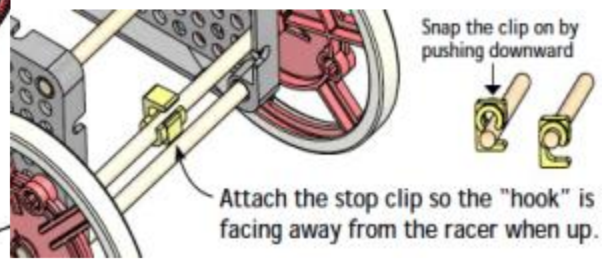
   3. In order to add wheels, you must cut 2 (5 inch) dowels, and insert one side of each into the wheels. Push the wheel and axle through the frame, about two holes higher than the frame dowels that you added first. Then, press the two wheels you have left onto the other end of the axle.





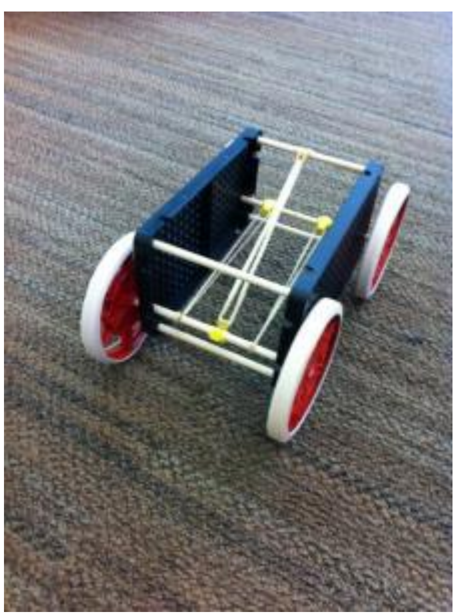
4. Next, take two stretch tires, and place them around your two back wheels.
5. Loop 2-3 thin rubber bands around the top front dowel (parallel store), and place the stop clip on the back axle so that the hook faces away from Chitty Chitty Bang Bang as shown below.
6. Now, pull the thin rubber bands, and attach them to the stop clip on the opposite axle.





7. Now that you have assembled Chitty, she needs a bit more help from her other two wheels to get over the rough surface. To do this, you'll need to create four-wheel drive!
8. In order to create four-wheel drive, first start by adding two stop clips to the opposite axle, one closer to the right, and the other closer to the left. Make sure these two clips face inward.
9. Next, loop two rubber bands on the side with one stop clip, and connect them to the two stop clips.
10. Last, pull back Chitty, and let her race across the debris!

Congratulations on assembling Chitty Chitty Bang Bang!



Rubber Band Racer: Chitty Chitty Bang Bang Traveling Home

Student Worksheet

1. What types of terrain would four-wheel drive be necessary?

____

____

____

2. Does winding the rubber bands more or less cause the car to travel faster or slower? Is the distance affected by the winding of the rubber bands? Explain.

____

____

____

____

3. Use the bar graph and color how far you **estimate** your rubber band racer car will travel over the rocks, how far the race care **actually** travels, and which car traveled the **longest** on the rocky terrain below. Test the first two using a measuring tape. As a class we will record the longest car together.

Rubber Band Race Car Travel Distance

Rubber Band Race Car

Estimated												
Actual												
Longest												
	2	4	6	8	10	12	14	16	18	20	22	24

Distance Traveled (in inches)

Rubber Band Racer: Chitty Chitty Bang Bang Traveling Home

Evaluation and Assessment

Grading Rubric

Demonstrates knowledge of transportation technologies (0-25pts): ____________

Student is able to describe how transportation technology works and understand friction.

Followed procedural instructions to complete experiment (0-25pts): ____________

Student is able to follow multi-step instructions to create a rubber band racer.

Effective use of tools and materials (0-25pts): ____________

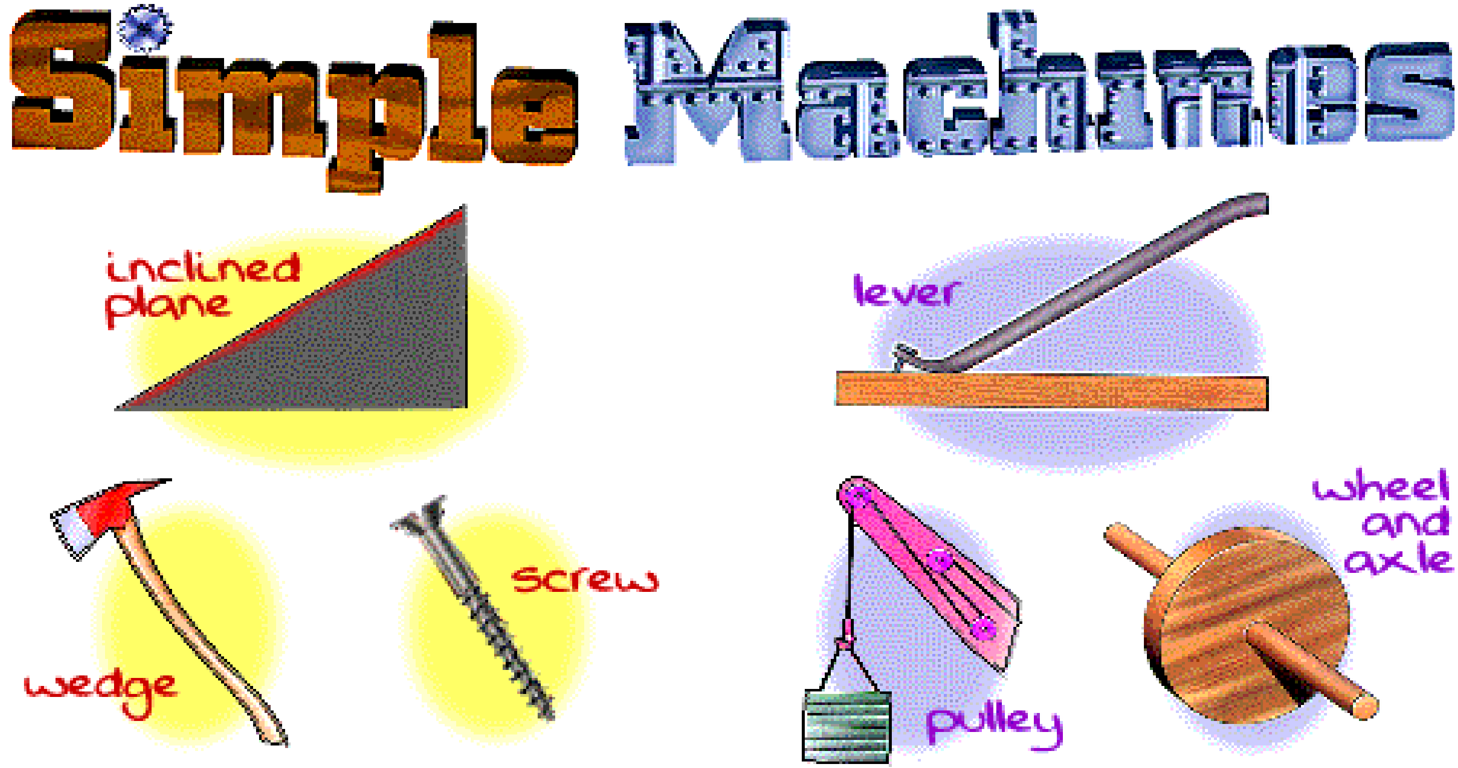
Student is able to use tools recommended in procedural instructions to complete given task.

Completion of provided handouts for evaluation (0-25pts): ____________

Student completed all questions as well as bar graph. Demonstrated knowledge and comprehension of transportation technology.

Total Points: ________/100

Comments:



Are You Afraid of the Dark?

A lesson plan on the use of Simple Machines to power a Night Light.

By: Ashley Woodward, Breanna Jewell, and Lisa Ciabocchi

Disciplinary Area: **STEM**
Literacy: ***The Dark*** **by Lemony Snicket**
Grade Level: **4th-8th grade**
Time: **Three days for approximately one hour each day to acquire background information, to research and design, and to present their design.**

Common Core ELA Standards:

- Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- Determine a theme of a story, drama, or poem from details in the text; summarize the text.

National Science Education Standards:

- Form and Function. (Unifying Concepts and Principles)
- Understandings about Scientific Inquiry. (Science as Inquiry)
- Transfer of energy. (Physical Science)
- Understandings about Science and Technology. (Science and Technology)

Standards for Technological Literacy:

- The relationships among technologies and the connections between technology and other fields.
- The role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Apply the design process.

Big Ideas:

- Proper use of steps in the design loop
- Connect knowledge of simple machines to create a simple electronic
- Understand an electrical circuit
- Communicate and demonstrate the solution with others

Scenario:

Once your class has been given a background lesson plan about circuits and the flow of electrons, the teacher will need to read "The Dark" by Lemony Snicket, and you all will begin your journey to cure an issue for children all over the world; fear of the dark! First, the students will pick a partner to research, share ideas, and brainstorm different ways to create a night-light. The students must use one of the six simple machines, taught in the last lesson, in order to create their night light. The students should not use any switch type design, since this is already how a light is turned on and off. Next, they will need to follow the process of the design loop in order to design and carry out their idea to create a functioning switch to turn on and off a night-light that will solve anyone's fear of the dark. Finally students will test and present their designs.

Essential Question:

Can you use your knowledge on the six simple machines, as well as the materials provided to create a functioning night-light using a simple machine to cure fear of the dark?

Directions:

1. Give students a short background lesson on circuits.
2. Read "The Dark" by Lemony Snicket as a class. Have the kids throw out their ideas about how they could help the character feel more comfortable in the dark.
3. Introduce the idea of creating a night light by using a simple machine. The class will split up into groups of two to begin their project.
4. Use the design loop to devise a plan that applies to the essential question.
5. After the students create their design, they must attach their machine to the night light in order to complete the electrical circuit.
6. If the night-light does not light up, then the pairs need to re-group and assess what went wrong and how they can fix it.
7. Finally, students will test out their lights in front of the class, and communicate their ideas, process, and models.

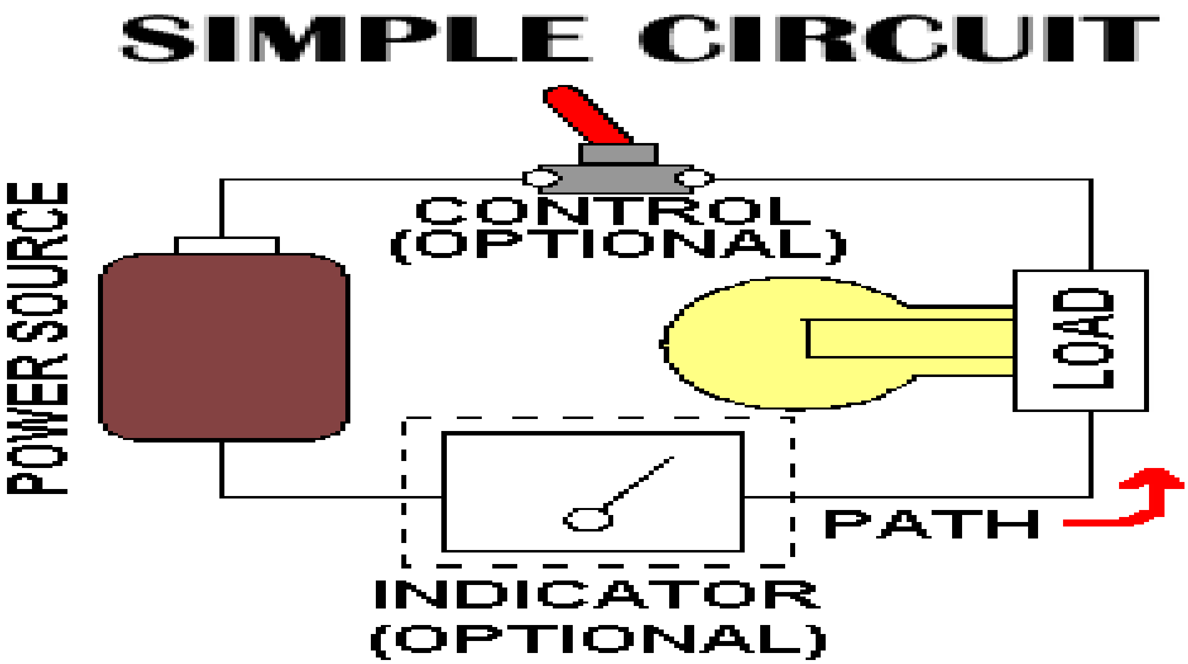
New Vocab:

Simple Circuit: A source of electrical potential difference or voltage like a battery, a conductive path which would allow for the movement of charges like wire or aluminum foil, and an electrical resistance (resistor) which is loosely defined as any object that uses electricity to do work.
Parallel Circuit: has more than one resistor and multiple paths for the electricity to move along.
Open Circuit: An incomplete circuit in which electricity does not flow.
Closed Circuit: A complete circuit in which electricity flows.
Conductor: A material or materials that will allow free movement of electrons.
Insulator: A material or materials that will not conduct electricity.
Voltage: Measured units of electric potential.

Content Information:

First students will need a lesson on circuits and how electrons flow through wires in a circuit. Students should have prior knowledge of electrons and simple machines before doing this activity:

Explain to students that a circuit is a source for electricity (battery) and a load (light bulb) which are connected in a continuous cycle of wires and/or other conductors which electricity can flow through. Make the circuit (using battery, wire, and light bulb). Show students how to light up the light bulb using a simple circuit. Explain to students that when electricity is flowing, the circuit is complete (or "closed"), which means electrons can flow through. When there is a break somewhere in the circuit (a light is burned out, a wire is not properly connected), the circuit is called "open" and electricity cannot flow through.



Materials required for content information lesson:

2 wires

Aluminum foil

Battery

Light bulb

The Design Loop

Use this worksheet to keep track of your design loop process to present in class. Remember the design must:

- Must be able to turn the light on and off
- Must use simple machine(s) to turn on and off.
- Cannot use a switch mechanism like light switches already use.

Step 1. Ask- What is the question we are trying to answer?

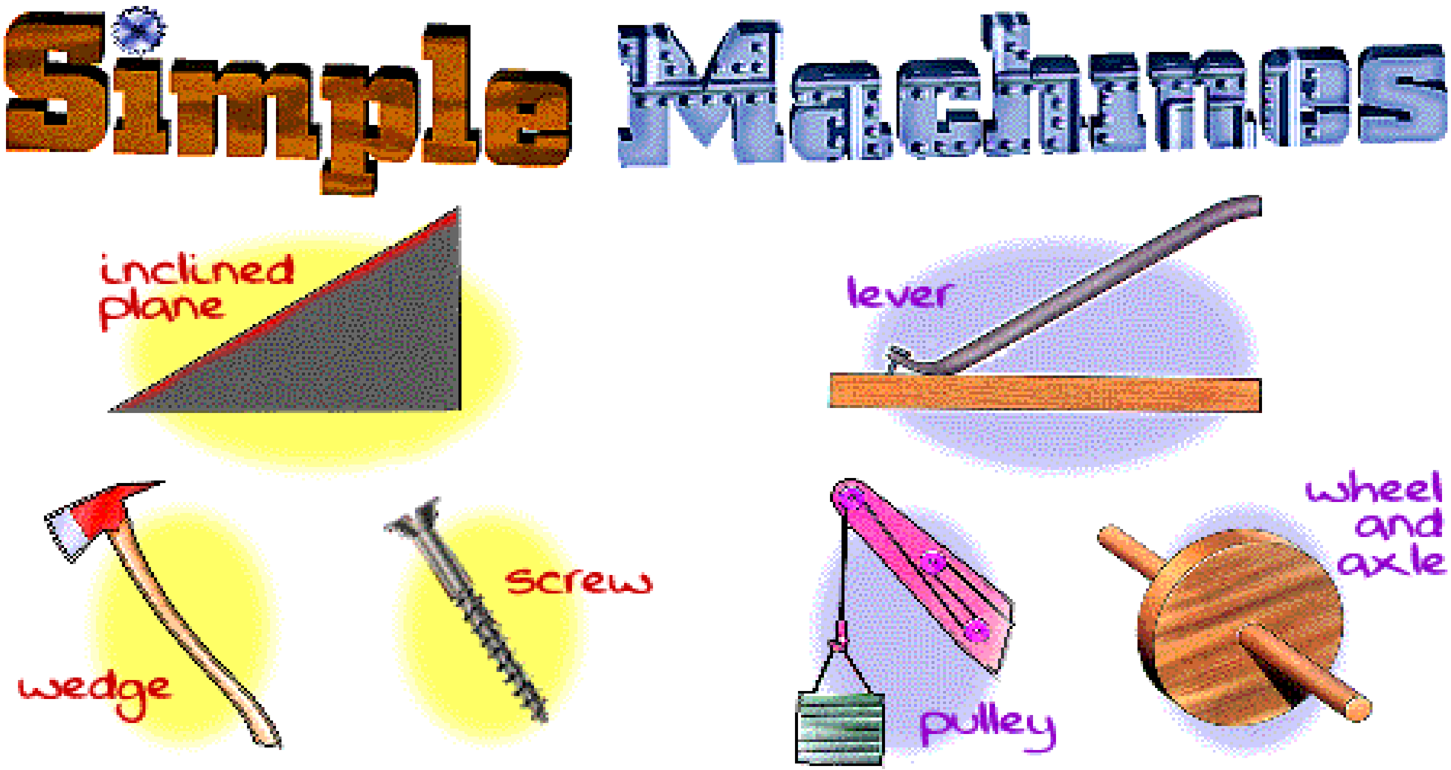
Step 2. Brainstorm- Research the question and come up with a plan. Use the back of the paper to record notes and write 2-3 sentences about your design here:

Step 3. Create- Draw your design here:

Step 4. Demonstrate: Prepare to test your design, explain your design, and your process to creating your design to the class.

Step 5. Evaluate: Ask at least two other classmates what you could have done to make your design better. Write a 1 page paper to turn in with this paper, evaluating your design and your classmate's reactions.

Simple Machines and their Function



Inclined Plane: Reduce the amount of force used to lift an object by increasing the distance that the force is applied.

Lever: Applies force to one point of an object and causes a magnification of force at another point of the object.

Wedge: Pushes two objects apart from each other.

Screw: Used to fasten objects together securely.

Pulley: Uses the principle of applying force over a longer distance and the tension in the rope or cable, to reduce the magnitude of the necessary force.

Wheel and Axle: Helps objects move by rotating.

Disciplinary Area: STEM

Unit: Life Sciences

Literacy: *Zoo* written by: Anthony Browne

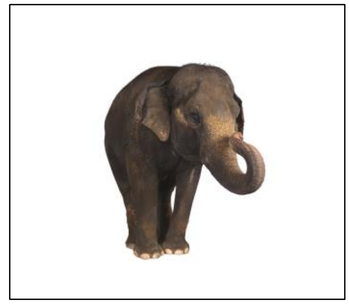
Grade Level: 1-3

Standards:

- *National Science Education Standards:*
  - Life science:
    - environmental quality
- *Standards for Technology Literacy:*
  - Design:
    - develop an understanding of the role of troubleshooting, research, and development
- *Common Core ELA standards:*
  - Presentation and knowledge of ideas:
    - Report on a topic or text using appropriate facts and relevant, descriptive details to support main ideas or themes

Big Ideas:

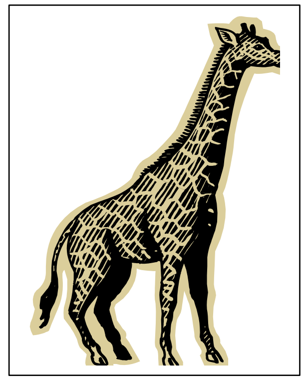
- Attributes of structure and climate
- Properties of materials and their ability to live actively in their environment
- Proper use of the design loop
- Ability to demonstrate and present final project to class



Scenario: The local zoo is adding 5 new animals at their location: an elephant, giraffe, baboon, penguin, and a polar bear. After reading *Zoo*, a story about a family exploring the different habitats of all animals, you will now choose an animal from the 5 listed and design then build your very own enclosure for your zoo animal. Along with meeting your animals' needs it is important that its environment is stimulating for the animal to keep it happy and active.

Challenge: Can you design a model of a zoo enclosure that is suitable for your animal to thrive in and enjoy?

- Things to think about:
  - What does your animal like to eat?
  - Does it live in hot or cold climates?
  - Can it climb?
  - Can it swim?
  - Does the enclosure need trees?
  - When reading *Zoo*, what do you think made the animals unhappy about their environment?
  - What would make your animal happy and active?

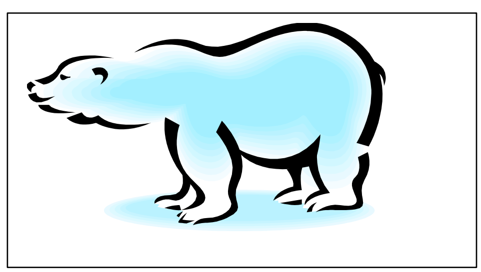


Directions: Design an enclosure for the animal of your choice (elephant, giraffe, baboon, penguin, or polar bear) by using only the materials listed below. After doing some research on your animal, you should know what type of environment is proper for he/she to live in. Brainstorm what type of environment your animal should live in. Your enclosure must be no bigger than 2x2 and no smaller than a shoebox. Have fun!

*You may use credible sources from the internet and library to research your animal**. Be ready to explain why you picked your animal and the different aspects of its environment that you included in your model.**

Materials/Resources: Use at least 4 of the materials listed below to construct your enclosure model. The size of your model must be at least the size of a shoebox and no bigger than 2ft. x 2ft.

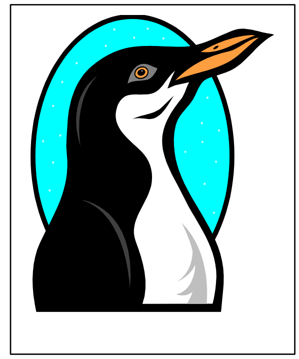
- Items from your yard (grass, leaves, pebbles, sticks, etc.)
- Cardboard
- Popsicle sticks
- Cotton balls
- String
- Glue/tape
- Clay
- Pipe cleaners
- Markers
- Construction paper
- Cellophane



Content Information:

Having a vast area to live in is important for animals. They need the proper dimensions in order to function. Whether it's a small or large animal, they still need to be taken care of in order to fulfill their liveliness while living at the local zoo. The zoo is their home and they need to feel welcomed while living in their enclosure. After reading *Zoo*, do you think the animals were happy? What is missing in their home? Each animal has special requirements that take care of their needs. The problem with zoo's today is that the animals are locked into confined spaces and cannot enjoy their environment. Can you solve this problem and use the knowledge that you know and build your own enclose for an animal?

Information to Know:



Giraffes need tall trees for food and nourishment.

Polar Bears and Penguins need to swim in a large pool or cold water.

Baboons need lots of trees and shade to swing around on.

Elephants need water and dirt to bathe themselves in.

The Design Loop:

1. Identify the problem:

2. Consider the Facts and develop a solution:

3. Choose your solution and draw your idea:

4. Build your model and Test

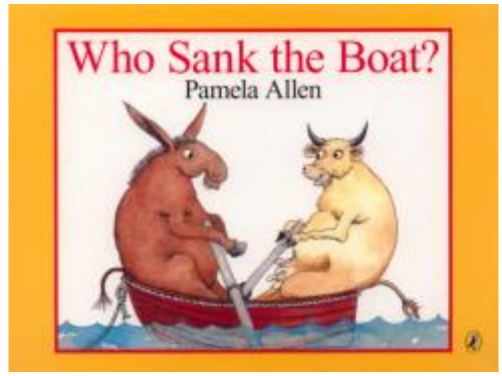
5. Evaluate your model and make changes

6. Present your ideas to others

Rubric

	No (zero points)	Somewhat (half points)	Yes (full points)	Total Points
Picks an animal from the selection				
Model is within the given dimensions				
Uses at least 4 materials from given list				
Aspects of model fit the animal selected				
Explains why they picked their animal				
Explains the different parts of the model and why they would benefit the animal				
It is obvious that time and effort was spent on the project				
*Grade Total				

Making a Boat Float with the Most Weight



Disciplinary Area: STEM

Unit: Structure, Force, Buoyancy, and Motion

Literacy: *Who Sank the Boat* written by Pamela Allen

Standards:

- *Common Core Math Standards* (Geometry): Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape
- *National Science Education Standards* (Physical Science): Properties of objects and materials
- *Standards for Technology Literacy* (Engineering Design): The engineering design process, involves defining a problem, generating ideas, selecting a solution, testing the solution, making the item, evaluating it, and presenting the results
- *Arkansas Department Education Frameworks* (Oral and Visual Communications- Speaking): Students will demonstrate their ideas orally by presenting their project to their classmates

Big Ideas:

- Characteristics of shapes and their effect on buoyancy
- Proper use of the design loop
- Ability to demonstrate and present project to classmates

Essential Question: Can you design a boat that will float and hold the most weight?

Scenario: *Who Sank the Boat?* is a story about five animal friends wanting to get into the boat. Each animal went into the boat one by one seeing which animal sank the boat. With the inspiration of this story, you will now create your own boat that will carry the most weight before it sinks.

Directions: Students will use the design loop to create a plan for the activity. Students will be given time to identify the question, brainstorm ideas, and choose the best solution. The boats measurements will need for the maximum 8 inches in length, width, and height. When the students have chosen their solution, we will hand out the materials that will be available. Students will then construct their prototype within the requirements given. Once the students have completed their design, they will get to test it out and demonstrate to the rest of the classroom.

Materials/Resources: You will build your boat with only once material, but will have certain time requirements for the added weight to the boat.

- Duct tape 

Materials to use for weight:

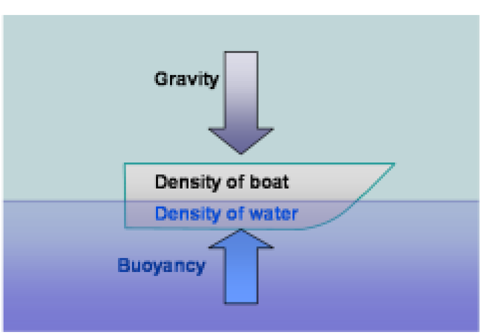
- Marbles 

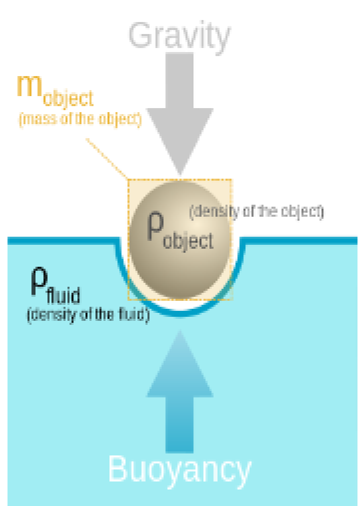
Content Information:

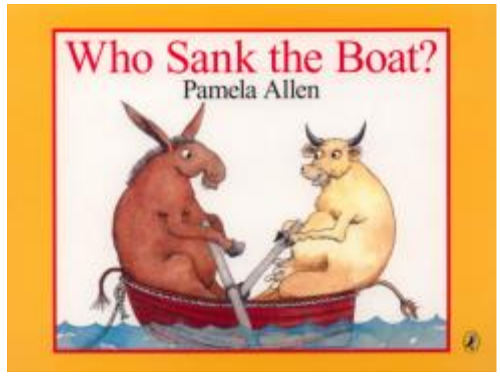
The students will need to go through the design loop, first answering the question. Next allow the students to do some research on boats seeing which shape and design can hold a great amount of weight. They will need to know that a boat is an object that has a use is for transportation in the water. It is constructed to provide buoyancy (the ability to float). A boat excludes the water and with a certain shape allows stability. The boat also needs to it propel through the water. For a boat to be able to float and hold weight it depends on the density of the material the boat is made of, it can float regardless of shape. However, by using shape we can displace more air, thus making the boat more buoyant. With the boat having more buoyancy, it means that more weight can be added to the boat. Then the students will come up with their best design and create it with the given materials. Once they have completed their prototype they will evaluate it seeing if they need to make any corrections. Once the students have completed their prototype they will demonstrate it to their classmates.

Vocabulary Terms

Boat- a vessel for transport by water constructed to provide
buoyancy by excluding water and shaped to give stability and resist the water.
Buoyancy- the ability to float
Stability- firmness in position
Weight – the amount of heaviness or mass
Propel-cause to move
Density- the state closely compact







Making a Boat Float with the Most Weight

Situation:

We just completed the book *Who Sank the Boat?* It is about five animal friends wanting to row the boat. All the animals tried to fit into the boat, but when the last friend joined it tipped over. With that story, you will create a boat that will be able to float and be able to hold the most weight.

Challenge: Can you build a boat that can hold 5 marbles?

Directions:

1. You must find research and find the best solution for your design before having the materials

2. Only materials and weights that can be used will be given on the material list

3. You boat must meet the following requirements:

- Must be able to float (entire boat under water is considered sunk)
- Maximum width, height, and length is 8 inches
- Each added marble must hold for at least 20 seconds before another marble is added

4. When you have completed your design, you will be able to test it out and explain to the class the reason for your design

5. When testing, weight will then be added to your boat and will calculate how much weight it held

Materials/Resources: You will design your boat out of duck tape, and to measure how much weight can be added to your boat, we will add marbles into your design.

- Duct tape

Materials to use for weight:

- Marbles

Information to Know:

A boat is an object that has a use is for transportation in the water. It is constructed to provide buoyancy (the ability to float). A boat excludes the water and with a certain shape allows stability. The boat also needs to it propel through the water. For a boat to be able to float and hold weight, it depends on the density of the material that you are using. The shape of the boat does not matter for the boat to be able to float. However, using a particular shape can make the boat more buoyant. For the boat to have more buoyancy, it means that more weight can be added to the boat. You will need to research to see what is the best shape with the specific measurement can hold great amount of weight.

Vocabulary Terms

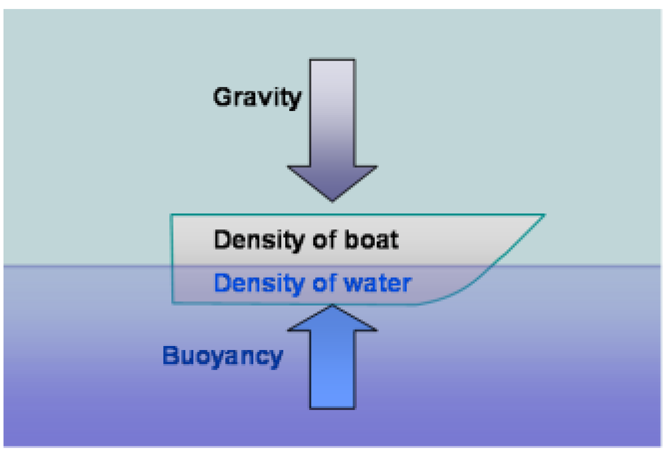
<u>Boat</u>- a vessel for transport by water constructed to provide
buoyancy by excluding water and shaped to give stability and resist the water.

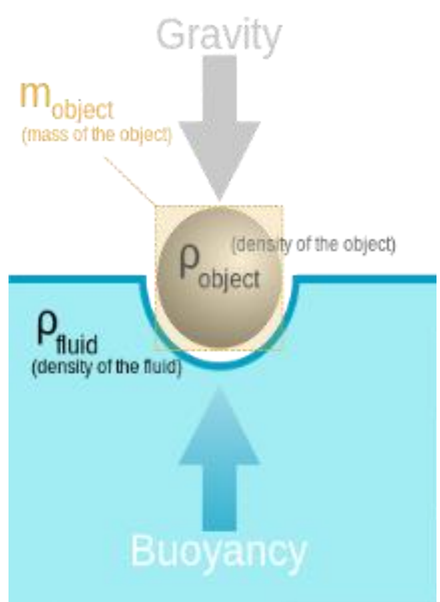
<u>Buoyancy</u>- the ability to float

<u>Stability</u>- firmness in position

<u>Weight</u> – the amount of heaviness or mass

<u>Density</u>- the state closely compact





The Design Loop

1. Answer the problem:

2. Collect all information that you will need:

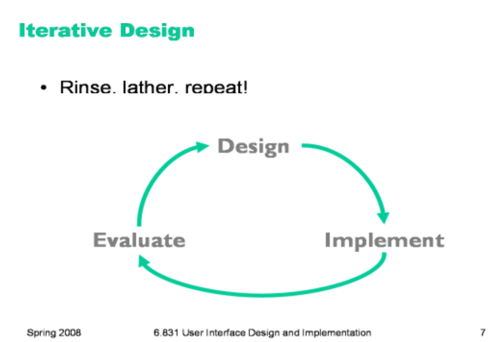
3. Choose and draw your best idea:

4. Create your model and test it

5. Look over your prototype and make any changes if needed

6. Present your prototype to your classmates

Work Cited



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SKYSCRAPER DOWN, 911!

Disciplinary Area: STEM

Unit:

Standards:

K-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.

K-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.

Big Idea:

- Design loop
- Skyscrapers
- Building materials
- Planning of a structure

Delivery of Knowledge:

The Teacher will discuss materials and their properties. Also, the students will be taught the things that affect skyscrapers such as wind, heat, and compression. The Students can come up with alternative or new materials as well.

Content:

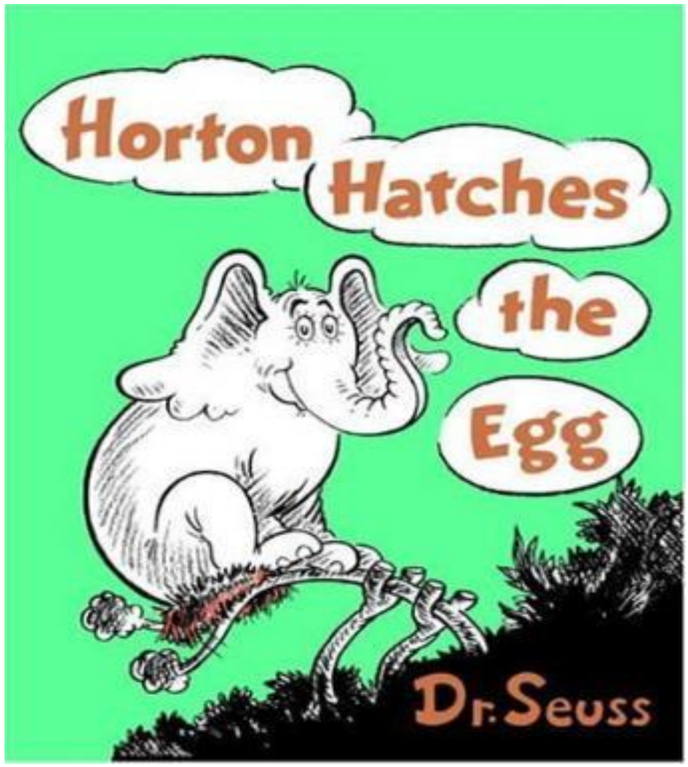
In The book, Building Big, The topic of skyscrapers is focused on in one section. This Design challenge is based on skyscrapers and the materials that can be used to build them. Wood is certainly strong in compression, it's cheap, and it won't burn in a fire, but it is really heavy. Stone isn't the best material for a really tall building because it's too heavy. Steel is a dense material that can be stretched and squeezed to great extremes without breaking or snapping. But while steel is very strong at normal temperatures, it loses its strength and melts when the temperature rises above 700 Degrees Fahrenheit. Steel Is very strong in tension, and concrete is strong in compression, so together, they can be pushed and pulled without breaking or collapsing---ideal qualities for a tall apartment building in a windy city. But most importantly, concrete is a good insulating material. It protects the steel for a long time from melting in a fire.

Assess:

Students will be assessed by a rubric made for the detailed plan and sketch of the new skyscraping apartments. Because each material has different properties, some seem better suited for skyscrapers than other. However, the students can justify any of them.

Structurally Built Platform

Building a platform that can hold the weight of an elephant



Standards:

- Standards for Technology Literacy (Design: Standard 10) Students will develop an understanding of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
- Common Core Math Standard (Measurement and Data): Solving problems with measurement and estimation
- National Science Education Standards (Physical Science): Properties of objects and materials
- Arkansas Department Education Frameworks (Oral and Visual Communications-Speaking): Students shall demonstrate effective oral communication skills to express ideas and to present information.

Big Idea:

- Properties of materials that can withstand weight and pressure
- Modeling the characteristics of sustainability
- Using the design Loop
- Exhibiting the final project to the group

Challenge: Can you design a model that will sustain a 2lb weight when placed on the platform that resembles a tree?

Situation: After reading *Horton Hatches the Egg*, the story pertains to an elephant sitting on top of a small tree while trying to keep it upright. It's your assignment to build a model that will keep the tree stable long enough to hold the 2lb weight (Horton) that is applied.

Directions:

1. You must complete the first 3 steps of the design loop before beginning to build the model.
2. You are only allowed to use materials that are supplied to you.
3. Your model must be the height of the top of the tree.
4. The model can be more than 5 inches wide and 5 inches long.
5. The structure provided must be attached to a cardboard base.
6. After the model is built it will be tested to withstand the 2lb weight.

Materials/Resources: Choose from the following

- Masking tape or Elmer's glue
- Tongue depressors or small craft sticks

Vocabulary words:

Instability: The sense of being uncertain
Pressure: The act of force upon a surface by an object
Weight: The amount of mass of an object
Model: The act of representing something
Sustain: To support or hold from below

Information to know:

Elephants are the largest land animals that roam the earth. They can weight anywhere from 5,000 to 14,000 lbs. A tree of any size will have a very hard time being able to sustain the weight of an elephant. For the tree to be strong enough to hold the pressure of an elephant, students must build a durable structure that is sturdy enough for the elephant. Because the weight of an elephant is so hefty, the tree might collapse. The purpose of the structure is to aid in the support for Horton to sit on the egg in the tree without the tree breaking or falling over.

The Design Loop

1. Identify the problem:

____

2. Develop a solution:

____

3. Draw your ideas:

4. Build and Test your model
5. Evaluate and make changes
6. Present your idea to others

We're "Stuck" on Simple Machines:
A lesson plan on the use of Simple Machines in today's technology
By: Ashley Woodward and Breanna Jewell

***Disciplinary Area**:* STEM

***Literacy:** Stuck* by Oliver Jeffers

Grade Level: 4th- 8th grade

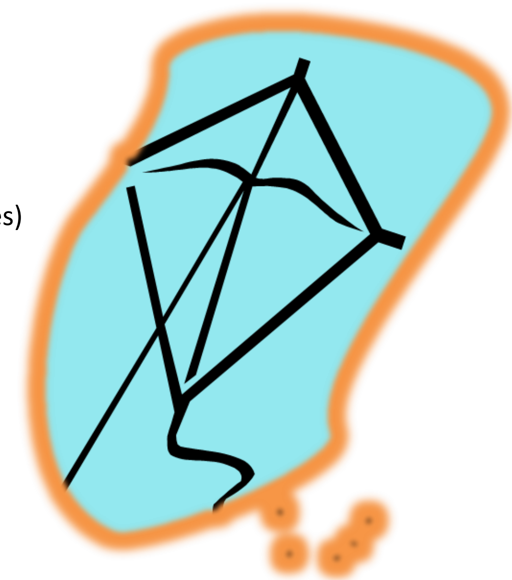
Time: Approximately 1-1/2 hours over two to three days- to acquire background information, to research and design, and to present their design.

Common Core ELA Standards:

- Key Ideas and details.
- Describe how character(s) in story respond to major events and challenges.
- Describe how character's actions contribute to sequence of events.

National Science Education Standards:

- Form and function. (Unifying Concepts and Principles)
- Understanding about scientific inquiry. (Science as Inquiry)
- Evidence, models, and explanations. (Unifying Concepts and Principles)



Common Core Mathematic Standards:

- Measuring length of object(s).

Standards for Technological Literacy:

- Abilities of technological design.
- Understanding about science and technology.
- Developing understanding of design.
- Applying the design process.
- Role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Big Ideas:

- Learning the importance of simple machines by having students design and construct a machine that correlates to the story.
- Proper use of the design loop.
- Ability to utilize the library for research.
- Ability to demonstrate and present final project to group.

The Essential Question:
What can you create to reach and grasp things out of reach when you don't have access to a ladder?

Scenario:

The lesson plan will correspond with teachings on building simple machines. Start the lesson by reading "Stuck" by Oliver Jeffers- a tale about a boy who gets his kite stuck in a tree and tries a variety of things to get it out- to frame the project. After the reading, the students will need a brief background lesson on simple machines and their everyday uses. Students will research what types of simple machinery have been used by people who have lost their hand(s) or arm(s) to grasp or reach for or pick up things. This will require students having access to the school library for a short time (approximately 30 minutes). Students will then use the design loop to design a simple machine of their own that can reach and pick up a loop on a hook hanging approximately 2 feet above their heads.

Directions:

Use the Design Loop to research what other people have created to reach and grasp things. Students will need access to the library in order to conduct appropriate research. Have the students come up with several ideas; this can be done separately, in pairs, or even in small groups. Make sure students have design loop planning page to take notes and form ideas and designs. Once students pick the most plausible idea, they will continue to follow the steps of the design loop to create, then test their designs. Students will introduce their design and their idea process to the class; explaining why they decided on their design, how they constructed their plan, if it worked, and explain why it did or did not. After presentations students will have a chance to ask others what they could have done differently, or what could they do to improve their designs.

Materials/Resources:

Students will need a weekend (or any other couple of nights) to construct the project at home. Students must use recycled materials found in their homes or select some of the materials the teacher provides in class. The design must be able to reach a hook hanging from the ceiling/wall approximately two feet above the student and pick up a hoop and bring it down. The design must be able to pick up or grasp the hoop, not knock it down.

Content Information:

Simple machines are devices that have been created to make work easier. These machines are non-motorized and are often used with other simple machines to create more complex machines. Simple machines have specific movement or "mechanism". There are hundreds of simple machines, but we classify six types of the most basic simple machines as simple machine elements: the lever, the pulley, the wedge, the wheel and axel, the screw, and the inclined planes.

Information for the teacher to know:

Teachers will need to give a short lesson about simple machines, their use in everyday technology, and what people have built in the past and currently use to reach things in high places. The lesson on simple machines does not need to go in depth- we are covering simple machines as tools to make life easier, not as the complex machine systems they can build. This lesson is created as more of a tool to introduce simple machines and their use, then a later lesson could incorporate energy, work load, and force aspects, as well as more complex machines. A handout of the simple machines and the design loop should be given to each student to generate ideas. Teachers will also need to set up a short 30 minute library session for research. To test the student's designs, teachers will need to design a simple machine of their own, like so:

We used the same guidelines as we gave the students: we created our design using materials we found at home. The last picture, the hammer on twine with a para-cord bracelet, is the design we created to test student's designs. Here's what YOUR design's needs are in order to effectively test the students:

- ✓ It needs to have some sort of adjustable rope to adjust height to approximately 2 feet above the student.
- ✓ It needs to have a hook of some sort that an object can fairly easily be pulled on and off.
- ✓ It needs an object that can be placed on it that can't fall or slide off.

Information for students to know:

Students need a background lesson on simple machines and their use in technology today. Students will require a short research session in the school library. Students will need to be given freedom to use any repurposed materials recycled from home to create their design (and if students aren't familiar with repurposed materials, they may need this idea defined as well!). Students will need to be aware of the rules of this design project:

- ✓ The design must be able to reach and grasp or pick up an object approximately 2 feet above the students head.
- ✓ The design must be made from recycled materials from home.
- ✓ The design must show knowledge of using simple machines effectively.
- ✓ Students must use the design loop to design their project.
- ✓ The design must pick up or grasp the intended object- not knock it down.

New Vocabulary:

Simple machine: a machine created in order to make work easier.
Inclined Plane: a flat, slanted surface such as a ramp that can help move objects across distances.
Wedge: A pointed edge that can be used to push things apart.
Screw: An inclined plane wrapped around a pole which holds things together or lifts materials.
Lever: An arm that pivots or turns against an object referred to as a fulcrum that is used to pry something loose.
Wheel and Axle: A wheel with a cylindrical post called a rod passing through the middle that can move or turn loads.
Pulley: a simple machine that uses grooved wheels and a rope to raise, lower, or move a load.
Recycled Materials: materials that can be used for a different purpose than originally intended.

The Design Loop

Use this worksheet to keep track of your design loop process to present in class. Remember the design must:

- ✓ Be able to reach and grasp or pick up an object approximately 2 feet above the students head.
- ✓ The design must be made from recycled materials from home.
- ✓ The design must show knowledge of using simple machines effectively.
- ✓ Students must use the design loop to design their project.
- ✓ The design must pick up or grasp the intended object- not knock it down.

Step 1. Ask- What is the question we are trying to answer?

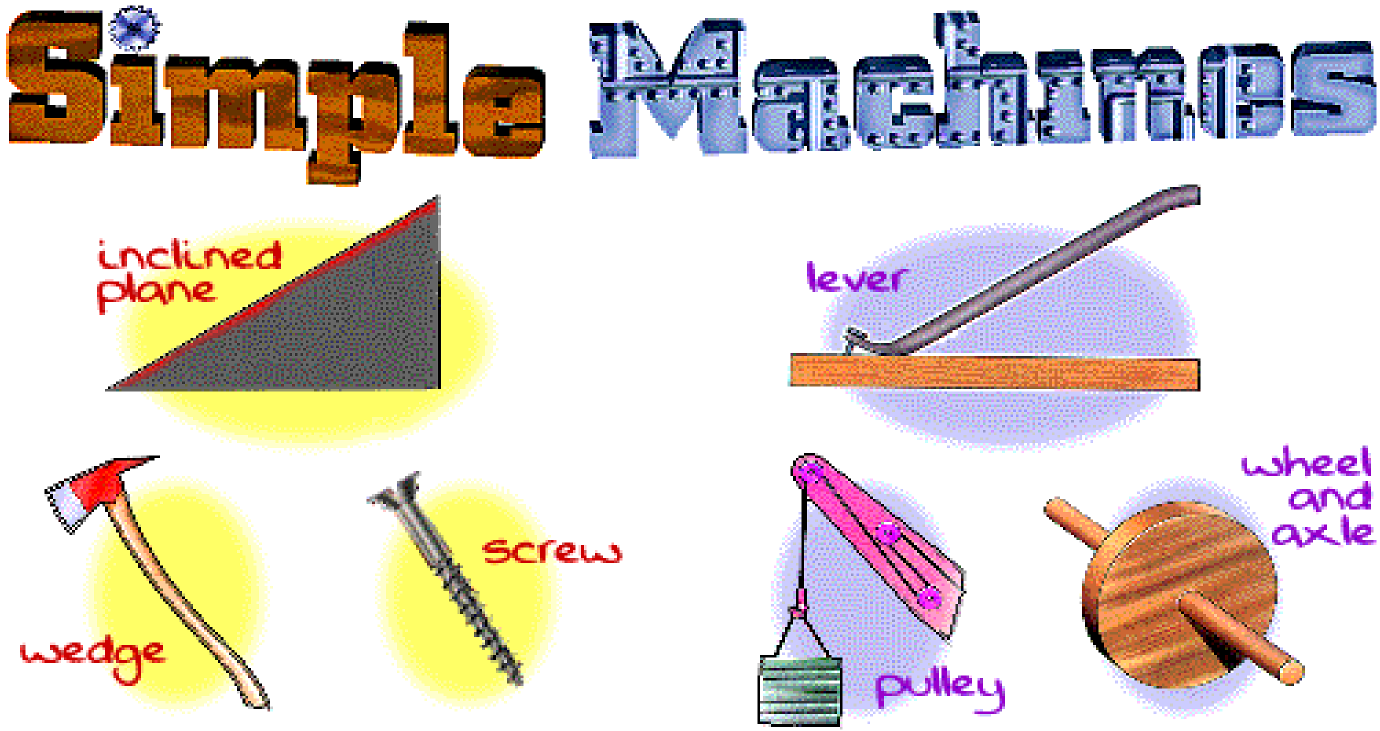
Step 2. Brainstorm- Research the question and come up with a plan. Use the back of the paper to record notes and write 2-3 sentences about your design here:

Step 3. Create- Draw your design here:

Step 4. Demonstrate: Prepare to test your design, explain your design, and your process to creating your design to the class.

Step 5. Evaluate: Ask at least two other classmates what you could have done to make your design better. Write a 1 page paper to turn in with this paper, evaluating your design and your classmate’s reactions.

Simple Machines and their Function



Inclined Plane: Reduce the amount of force used to lift an object by increasing the distance that the force is applied.

Lever: Applies force to one point of an object and causes a magnification of force at another point of the object.

Wedge: Pushes two objects apart from each other.

Screw: Used to fasten objects together securely.

Pulley: Uses the principle of applying force over a longer distance and the tension in the rope or cable, to reduce the magnitude of the necessary force.

Wheel and Axle: Helps objects move by rotating.

Factor of Increasing Velocity

Discussing ideas that will increase velocity in a rubber band car

Grade Level: 5th grade

Discipline area: STEM

Unit: Solving Real-World Multiplication and Division-Math/Velocity- Science

Standards:

1. Common Core Math Standards (Numbers and Operations-Base 10): N.NBT.B.6-Perform operations with multi-digit whole numbers and with decimals to hundredths.

2. National Science Education Standards (engineering design) ETS1.B: Developing Possible Solutions- Research on a problem should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

3. Arkansas Department Education Frameworks (Science)- NS.1.5.6 Develop and implement strategies for long-term, accurate data collection

Learning Goals/ Objectives:

Know (Big Ideas):

- Determine how to calculate velocity given a formula.
- Understand the components that need to be determined to calculate velocity.
- Calculating measurements of distance.
- Determine the best way to solve a problem (Design Loop)
- Students will discover how to increase velocity by changing constants.

Understand:

-Velocity can be determined by calculating the set distance divided by the amount of time it take for the rubber band car to cross that the distance.

-Elements of the experiment can be manipulated to increase the velocity over a certain distance.

Do:

-Experiment with different factors to increase velocity.

Essential Question: Can you use the materials given to increase the velocity of a rubber band car given a marked distance?

Procedures:

Scenario: After creating a rubber band car given the instructions provided, students will use the materials given to change one factor at a time to attempt to increase the car's velocity. Students must use the design loop to brainstorm ideas of how to have the highest velocity.

Directions: Through using the design loop students will manipulate the factors of the experiment to attempt to increase the velocity of a rubber band car. The students should work through the steps of brainstorming on the design loop first before being given the materials. Students should only use the materials provided. The students should only change one variable at a time, and go through the steps of the design loop after the experiment. After students finish all five attempts, they will record their data and share with the rest of the class.

New Vocabulary Terms:

Velocity: the displacement an object travels with respect to the time traveled.

Independent variable: the variable that can be controlled or changed in an experiment.

Dependent variable: the variable that does not change and remains constant.

Displacement: the shortest distance recorded from the initial to the ending spot.

Materials: Students will be provided with materials that can be used to change the experiment to increase velocity.

- Materials to build rubber band car
- Stopwatch
- Yard stick
- Tape
- Weight
- Variety of sizes of rubber bands (thick, thin, short, long)
- Aluminum foil
- 2X4 boards

Content Information:

“Velocity is a vector quantity that refers to "the rate at which an object changes its position." Imagine a person moving rapidly - one step forward and one step back - always returning to the original starting position. While this might result in a frenzy of activity, it would result in a zero velocity. Because the person always returns to the original position, the motion would never result in a change in position” (2013). The less time that the car takes to reach the set distance, the greater the velocity will be.

$$\text{Average Velocity} = \frac{\text{change in position}}{\text{Time}} = \frac{\text{distance}}{\text{time}}$$

Assessment:

Students will be assessed on how well the students utilize the design loop on the data sheet provided. Students will also be assessed on their ability to answer the essential question and can increase the velocity of their rubber band car by using the materials provided. The teacher will also see if students thought of five separate ideas to test.

Citation:

"Speed and Velocity." *Speed and Velocity*. ComPADRE, 2013. Web. 30 Oct. 2013. <http://www.physicsclassroom.com/class/1dkin/u1l1d.cfm>.

Ready, Set, STOP!
Testing how braking mechanisms work

Disciplinary Area: Physics

Unit: Kinetic Energy, Mass, and Speed

Standards:

- Next Generation Science Standards
  - **MS.PS3.1**—Construct and interpret displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
  - **MS.PS2.4**—Construct and present arguments using evidence to support the claim that gravitational interactions depend on the masses of interacting objects.

Big Ideas:

- Students will follow steps to construct a race car from TeacherGeek® materials.
- Students will observe how different masses affect the speed of an object.
- Students will observe how different masses affect the braking time and distance of an object.

Essential Question: How far does your race car go before it stops? What happens when you add weight to your car?

Terms to know:

Mass—refers to how much an object weighs
Speed—refers to distance traveled over a period of time
Kinetic Energy—refers to movement of an object (objects moving fast have a high KE, objects moving slow have a low KE)
Friction—something causing an object in motion to slow down or lose kinetic energy
Elastic Potential Energy—how much "give" is being used in an elastic object such as a rubber band (a stretched rubber band would have a high elastic potential energy)

Directions:

Students will build rubber band race cars with TeacherGeek® materials. Steps to build the cars are attached along with diagrams. The teacher may need to assist some students in certain areas of construction.

Students should modify the mass of their race cars to test if mass affects the braking distance of the car. Answer the questions on the next page.

Ready, Set, STOP!
Worksheet

1. Build a rubber band race car from the steps given. Do not add extra weight to your car yet. Ask the teacher if help is needed.

2. Weigh your car on a classroom scale. What is the **mass** in **grams**? ___________________

3. Test your race car with a ramp three times. Do not push the car. Simply place it on the ramp and allow it to move on its own. Be ready with a stopwatch to time your car.

   What is the car's **distance** in **centimeters** the first time? _____________________
   What is the car's distance in centimeters the second time? ___________________
   What is the car's distance in centimeters the third time? ____________________

   How many **seconds** was your car in motion the first time? ___________________
   How many seconds was your car in motion the second time? _________________
   How many seconds was your car in motion the third time? ___________________

4. Calculate the **speed** of your car for each trial run by **dividing distance by time**.

   What is the speed in **cm/sec** for the first trial? __________________________
   What is the speed in cm/sec for the second trial? ________________________
   What is the speed in cm/sec for the second trial? ________________________

5. Now add weight to your car. Weight your car on a classroom scale. What is the **mass** in **grams**? ________________ How many grams did the mass increase by? ______________

6. Do you think it will take shorter or longer for the car to stop with the added mass? Why?
   ____
   ____
   ____
   ____

7. Test your race car with a ramp three times. Do not push the car. Simply place it on the ramp and allow it to move on its own. Be ready with a stopwatch to time your car.

   What is the car's **distance** in **centimeters** the first time? _____________________
   What is the car's distance in centimeters the second time? ___________________
   What is the car's distance in centimeters the third time? ____________________

   How many **seconds** was your car in motion the first time? ___________________
   How many seconds was your car in motion the second time? _________________
   How many seconds was your car in motion the third time? ___________________

8. Calculate the **speed** of your car for each trial run by **dividing distance by time**.

   What is the speed in **cm/sec** for the first trial? _______________________
   What is the speed in cm/sec for the second trial? _____________________
   What is the speed in cm/sec for the second trial? _____________________

9. Did your hypothesis math your results? How or how not?
   ____
   ____

10. Create a table with all your information in one place. Think of how you would explain what you just learned to a friend or family member.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6
Distance (cm)						
Time (sec)						
Speed (cm/sec)						

Below is how students will be graded:

(For Teacher Use Only)

Students followed directions to construct a race car ______________/15

Students tested their original cars and recorded data ______________/20

Students computed the speed of their original cars ________________/15

Students tested their weighted cars and recorded data _____________/20

Students computed the speed of their weighted cars _______________/15

Students completed the table with all consolidated data ____________/15

Total Score:

HOW TO CONSTRUCT A RUBBER BAND RACER:

1. By using the materials provided by TeacherGeek®, begin building the frame of your rubber band racer.

2. Collect the materials needed to build one rubber band racer:
    - 2 connector strips
    - 2 300mm dowel rods
    - 3 hole plates
    - 4 wheel hubs
    - 4 stretch tire rubber bands
    - 1 100mm (3in) slide stop cut 6mm (1/4in) sections
    - 1 stop clip
    - 4 #16 rubber bands

3. Collect any additional tools needed to build a rubber band racer:
    - Cutter
    - Reamer
    - Wax, soap, or crayon

4. In order to create the frame for your car, you will need to cut four 100mm (4in) dowels. After cutting the dowel rods, insert them into each of the four corners connecting two of the hole plates together. Tip: Wax the dowel ends to make it easier to slip into the holes of the hole plate.

5. To construct an axel for the wheels, cut two 125mm (5in) dowels. After cutting, insert the dowel rod into each of the wheels. You can place the dowel rods with the wheels in any hole of the hole plate, just be sure they are even on both sides of the hole plate.

6. Now for the tricky part, using the stretch tire rubber bands, wrap them around each of the wheels of the cart. This will provide traction to your cart. Your teacher will come around to help you if needed. Tip: Applying glue to the outside of the wheel will help stretch tire stay on properly.

7. After adding each of the wheels to the hole plates, roll your racer across the floor or down a ramp to test it out!

8. Attach two #16 rubber bands to a dowel rod on the inside of the cart. You will need to tie a not to connect the two rubber bands from the dowel rod.

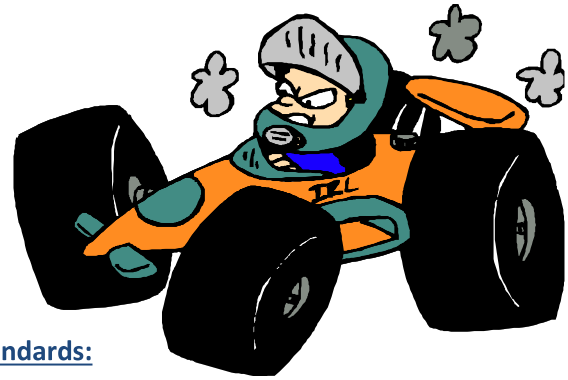
9. Place the stop clip on the wheel axel with the stretch tires.
10. Snap the stop clip on the dowel rod across from the dowel rod with the rubber band by pushing downward. Make sure the stop clip is facing away from the racer when up. Tie a not with the rubber bands and the stop clip.

11. Wind up your rubber band racer:

    - Hook the rubber band around the clip
    - Wind the rubber band around the axle by pulling the racer backwards with the wheels on the ground, or by holding the racer and turning the wheels backward with your hands.
    - Let it go!

12. If you want to add more weight to your rubber band racer, here's how:
    - Add another hole plate to the top of the cart.
    - Form a frame around the hole plate with connector strips. (You will need to cut these strips)
    - Cut a 3-inch dowel rod into 8 little pieces to connect the hole plate and connecting strips to the cart.
    - Slide each of the dowel rods into the connecting strips along the four corners of the hole plate.
    - Place the slide stop cut sections onto the top and bottom of the dowel rods to keep them in place.
    - Add weight to the center of the hole plate frame
    - Attach two rubber bands to the slide stop cut sections creating an X on the weight. This will keep the weight from moving side to side on the rubber band cart.
    - Test the final product and make improvements if needed.

Rubber Band Racer
Grade Level: 4^{th}-6^{th} grade
Time: Approximately 2-3 hours



National Science Standards:

- Unifying Concepts and Principles: Form and Function
- Science as Inquiry: Understanding about scientific inquiry
- Physical Science: Motions and forces; Position and motion of objects.

Standards for Math:

- CCSS MATH: 3.MD.B.3 Representing and Interpreting data

Big Ideas:

- Demonstrate understanding of force, gravity, friction, speed, velocity, and .
- Experimenting effects of distance travelled by redesigning the racer using traction, lever, and a series.
- Following directions to design and redesign the racer while also properly taking measurements, gathering, recording and graphing data.

Essential Question:

How can a rubber band racer be redesigned to travel the furthest distance possible?

Scenario:

Students will be given background knowledge of kinetic and potential energy, elastic potential energy. Students should already know basic ideas about simple machines such as levers, as well as having basic knowledge of fulcrums, friction. Students will then break up into small groups (best in groups of 2-3) and will follow directions to build a basic model rubber band racer. Students will then follow directions to redesign the racer in several ways, while collecting data on the distance the racer travels. The students will graph the data and find the velocity, acceleration, mass and elastic potential energy. They will then apply the knowledge they have learned into redesigning the racer a fifth time (using the design loop) in a way of their own choosing in order to make the racer travel the furthest distance possible. The students will present their final designs to the class and race to see who wins!

Content Information:

Energy is the ability to do work. Energy is most often transferred between two or more working objects. If objects have the ability to do work, then they contain potential energy. Energy comes in several forms, including kinetic and potential energy, as well as elastic potential energy. Potential energy is the stored energy, whereas kinetic energy is what physically moves objects. Potential and kinetic energy are generally measured in joules. Elastic potential energy is the energy that is stored by forces within a distorted elastic object. While there are several other types of potential energy, elastic is the one we will be working with while building the rubber band racers. The elastic limit of an object is important to know as well, because once the object exceeds the elastic limit, it will become permanently deformed. It's important not to over-stretch the rubber bands! To determine Elastic energy the formula is E= ½ the spring constant "k" multiplied by distance "x" squared. We will first need to determine the values of mass, acceleration, and height to determine the Elastic Potential Energy. The spring constant "k" will be a small number if the elastic is easily stretched, and get progressively larger the harder it is to stretch. There are several formulas we will be using. To determine the speed or velocity: speed/velocity= distance divided by time. Acceleration equals the final velocity minus the initial velocity divided by the time it takes to cover the distance. Mass equals the weight of the object divided by the acceleration. We need these calculations in order to find the Elastic Potential Energy. Elastic Potential Energy equals mass multiplied by acceleration multiplied by height.

What the Teacher Needs to Know:

Several Testing Apparatuses should be set up around the room: this involves creating a ramp; ramps should all be same height and length for accurate testing- for example: using classroom desks or tables and some type of flat surface that can form a ramp. This should be a relatively easy task. A scale or scales to weigh the race car is/are required for the calculations.

What Students Need to Know:

Students need to be given the lesson on energy as well as the following formulas:

Speed/Velocity= distance/ time (V=d/t)
Acceleration = Final velocity – Initial velocity/ time (a= vf-vi/t)
Mass= weight/ acceleration (m=w/a)
Elastic Potential Energy= mass x acceleration x height (P.E= mah)

Materials/Resources: (Per group)

- ✓ Safety Glasses
- ✓ 2 Dowels
- ✓ 4 Wheel Hubs
- ✓ 2 Hole Plates
- ✓ 1 -2 Stop Clip
- ✓ 10 #16 Rubber Bands
- ✓ 2 Stretch Tires
- ✓ 16 inches of string
- ✓ 2 Connector Strips
- ✓ Cutter
- ✓ Hammer
- ✓ Wax, Soap, or Crayon
- ✓ Reamer
- ✓ Graphing paper

New Vocabulary:

Elastic Potential Energy: Energy stored within an elastic object, such as a rubber band.
Friction: A force that resists motion between two bodies in contact.
Kinetic Energy: The energy that can be seen; the energy of an object in motion.
Potential Energy: Stored energy; derived from condition or position rather than motion.
Speed: The rate of motion. Distance travelled divided by time of travel.
Spring Constant: The stiffness or ability to stretch.
Velocity: The speed of an object moving in a specific direction.
Work: Total applied force multiplied by the total distance travelled.

Rubber Band Racer Distance Challenge

Directions:

1. Make a basic rubber band racer using the "How To" worksheet.
2. Set up racer at the starting line of the racetrack. Pull racer back to send down the track.
3. On the Data Chart (below) record the distance and time of the racer.
4. Add 2 large rubber bands to the front wheels of your racer to create friction like tires.
5. Repeat steps 2 and 3.
6. Remove the "friction" rubber bands and add the series to your racer. (Use "How To" worksheet)
7. Repeat steps 2 and 3.
8. Remove the series and add a lever to the racer. (Use "How To" worksheet)
9. Repeat steps 2 and 3.
10. Leave the lever attached. Place a rubber band around the front two wheels to create friction and replace the rubber band series.
11. Repeat steps 2 and 3.
12. Remove the lever, rubber band series, and rubber band around the wheels. This is your chance to add what you want to make your racer go as far as you possibly can.
13. Repeat steps 2 and 3.
14. On the data sheet, finish the other calculations to determine the velocity, acceleration, mass, and elastic potential energy.
15. Use graph paper to graph the data you have collected in your Data Chart.

Rubber Band Racer Data Chart

Rubber Band Racer	Basic	With friction	With series	With lever	With all three	Design of your choice
Distance:						
Time:						
Velocity:						
Acceleration:						
Mass:						
Elastic Potential:						

How to Build a Rubber Band Racer:

Make sure to follow directions exactly! Do not skip parts or skim directions! While re-designing, think of what each addition did for the racer and how you could apply that knowledge in other ways to make the racer faster when you create your own re-design.

The Frame:

Cut four dowels to 4 inches each. Insert the dowels into the four corners of the hole plates, then match up the other hole plates four corners to insert the opposite end. It should create a box shape that will be the frame.

Add the wheels:

Cut two more 5 inch dowels. Place a wheel on one end of one of the dowels, then choose which open end you want to use as the "bottom" of the car and thread them through the hole plates two holes above the dowels holding the frame together. On the other side where the dowel pokes through, place the other wheel.

Add the wind up:

Attach one of the stop clips to the middle of one of the wheel dowels. Make sure to attach the stop clip so that the "hook" is facing away from the racer when up. On the opposite end, find the upper dowel holding the frame together. Take a rubber band and fold over the top of the dowel, pulling one side of the rubber band through the hole the other side makes. This creates a knot that will hold the rubber band in place. Pull the free end of the rubber band down to the stop clip and hook onto the stop clip. Now you can wind the wheels back and let it go!

Adding Friction:

To add friction simply take two of the larger rubber bands and place them on the front two wheels to create "tires".

Adding a series:

To add a series- a long thin band- knot the rubber bands as you knotted the first rubber band around the dowel. Knot three rubber bands together to create a series.

Adding a lever:

Cut two inch dowels. Connect two connector strips at one end with a short 2 inch dowel. On the other side place five rubber bands that will later attach to the wheel of the opposite side. Attach this short 2 inch dowel to the side that hasn't been connected yet. On the opposite side count down 9 holes from where you plan to attach the lever and ream the holes on both sides so the lever can pivot freely, creating a fulcrum. Take of one wheel below the stop clip and pull it out half way. Thread the five rubber bands onto the dowel, put back through the hole, and replace the wheel. Pull the lever through the middle of the two dowels on the other side. Remove the top dowel and thread it through the holes we reamed. Tie one end of the string to the opposite short dowel on the lever. Make a loop on the other end of the string in order to attach it to the stop clip. You can now pull it back to wind it up and let it go! (Just a side note- the five rubber bands together create a parallel, which does the opposite of a series and releases greater force over a shorter distance.)

You Choice:

In your final design, remember all the ways the friction, series, parallel, and lever worked. What could you do to optimize the racer to cover the most distance? Think out of the box and use your design loops! Remember- we will be presenting final ideas and designs to the class and racing them against each other to see who creates a racer that can travel the furthest distance!

The Design Loop

Step 1. Ask:

What is the question we are trying to answer?

Step 2. Brainstorm:

Research the question and come up with a plan. Record notes and turn in 1-2 paragraphs about your brainstorming.

Step 3. Create:

Draw a picture of your design to turn in with your notes. Then build it!

Step 4. Demonstrate:

Test your design and explain your design process to the class.

Step 5. Evaluate:

Ask at least two other classmates what you could have done to make your design better. Write 1-2 paragraphs about their thoughts and your final thoughts on your design.

The Wonder Gears

Disciplinary Area: STEM, 6^{th}-8^{th} grade

Unit: Science (Physics) and Mathematics

TEACHER GUIDE

Standards:

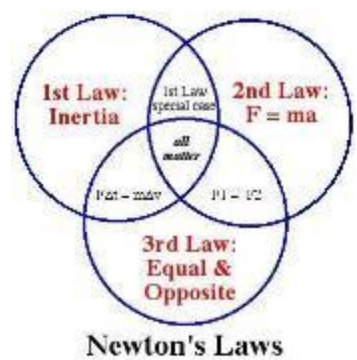
CCMS. 7.EE.B.3 (Expressions & Equations): Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

CCMS. HSA-CED.A.4 (Creating Equations): Create equations that describe numbers or relationships.

CCMS. HSA-REI.A.1 (Reasoning with Equations & Inequalities): Understand solving equations as a process of reasoning and explain the reasoning.

NSES. Science as Inquiry CS.A (grades 5-8): Abilities necessary to do scientific inquiry; Understandings about scientific inquiry.

NSES. Physical Science CS.B (grades 5-8): Properties and changes of properties in matter; Motions and forces; Transfer of energy.



Big Ideas:

- Test and refine the design
- Utilizing the Design Loop to modify
- Communicate design process and data results
- Understand the use of equations to find data
- Understand the laws of Newton and the mathematics applied to these concepts

Essential Question: Does adding gears make a difference in the distance or speed of your car? If so, what kind of a difference and what does this mean for other machines using gears?

Scenario: Build a car in which you are able to measure the distance that it travels and compare it to the distance travelled of a modified version. Also, compare your modified model to other student's version of the car using the same resources.

Materials/Resources:

- Connector strip
- Dowels
- Hole plates
- Wheel hubs
- Rubber bands- large and small
- Machine screws and nuts
- Stop clips
- Slide stop
- 50, 40, 20, and 10 Tooth gears
- String

Content Information: Energy is the ability to do work. All forms of energy fall into two basic categories: potential energy and kinetic energy. Potential energy is mechanical energy, which is due to a body's position. It is also known as stored energy. A car at rest has potential energy. Kinetic energy is mechanical energy that is due to a body's motion. For a car to move, potential energy must be transformed into kinetic energy. Newton's First Law states that an object at rest will remain at rest and an object in motion will remain in motion at a constant speed, unless acted on by an unbalanced force (such as friction or gravity). This is also known as the Law of Inertia. Newton's second law states that an object's acceleration is directly proportional to the net force acting on it and inversely proportional to its mass. The direction of the acceleration is in the direction of the applied net force. This law can be expressed as F=ma. Finally, Newton's third law states that for every action there is an equal and opposite reaction. In this lesson, you will be able to experiment with these laws using the rubber band powered car. You will use the different equations to calculate the force, speed, and acceleration of the car, which will determine the quality of the car that is built.

Equations you will need:

a= (Vf-Vi) / T k.e.=1/2mv^2

F=ma S=d/t (speed = distance/time)

E=FD

Deliverables: Students will pair up and build a rubber band powered car using the materials supplied by the teacher. The students will then race the cars against one another, measuring distance and speed using Newton's laws and equations. The example given is for one car that can be transformed into a more efficient car. The student s will only need the materials for the one car that they may modify for the next testing run.

Vocabulary:

- Energy
- Kinetic energy
- Resistance
- Drag
- Force
- Newton's Laws

Parameters:

- Utilize the design loop for designing a second car to reach the desired distance faster.
- The teacher will provide the materials needed to build the cars.
- Students must design their cars to travel a distance of at least 2 meters.
- Students will be analyzed on the understanding of physics and mathematics related to technology.

Assessment: Rubric

Car Model	__/20
Creativity	__/10
Model Test	__/10
Calculations	__/20
Applied Math	__/10
Participation	__/10
Worksheet	__/20
Total	___/100

STUDENT HANDOUT

Essential Question: Does adding gears make a difference in the distance or speed of your car? If so, what kind of a difference and what does this mean for other machines using gears?

Scenario: Build a car in which you are able to measure the distance that it travels and compare it to the distance travelled of a modified version. Also, compare your modified model to other student's version of the car using the same resources.

Vocabulary:

- Energy
- Kinetic energy
- Resistance
- Drag
- Force

Parameters:

- Utilize the design loop for designing a second car to reach the desired distance faster.
- The teacher will provide the materials needed to build the cars.
- Students must design their cars to travel a distance of at least 2 meters within a 1 meter wide track.
- Students will be analyzed on the understanding of physics and mathematics related to technology.

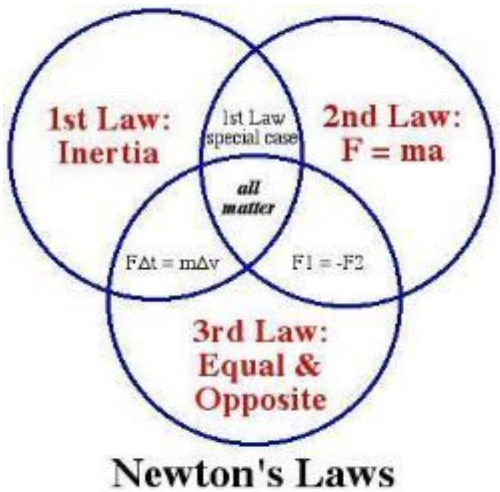
Content Information: Energy is the ability to do work. All forms of energy fall into two basic categories: potential energy and kinetic energy. Potential energy is mechanical energy, which is due to a body's position. It is also known as stored energy. A car at rest has potential energy. Kinetic energy is mechanical energy that is due to a body's motion. For a car to move, potential energy must be transformed into kinetic energy. Newton's First Law states that an object at rest will remain at rest and an object in motion will remain in motion at a constant speed, unless acted on by an unbalanced force (such as friction or gravity). This is also known as the Law of Inertia. Newton's second law states that an object's acceleration is directly proportional to the net force acting on it and inversely proportional to its mass. The direction of the acceleration is in the direction of the applied net force. This law can be expressed as $F=ma$. Finally, Newton's third law states that for every action there is an equal and opposite reaction. In this lesson, you will be able to experiment with these laws using the rubber band powered car. You will use the different equations to calculate the force, speed, and acceleration of the car, which will determine the quality of the car that is built.

Equations you will need:

a= (Vf-Vi) / T k.e.=1/2mv^2

F=ma S=d/t (speed = distance/time)

E=FD



Design Loop for Modified Model of Rubber Band Racer

1. How do you make it go faster with gears?
   ____
   ____
2. Research:
   ____
   ____
3. Ideas:

4. Build and test.

	Distance	Speed	Distance
Model 1			
Model 2			

	Distance	Speed	Distance
Model 1			
Model 2			

	Distance	Speed	Distance
Model 1			
Model 2			

Assembly Instructions:

★ Step 1 ~ Assemble the body of the car. (Use picture as a guide)

★ Step 2 ~ Attach wheels to the back of the car and one wheel to the very front of the body.

★ Step 3 ~ Attach clip to back axle.

★ Step 4 ~ Attach rubber band guide. (Blue circle.) Top front of the main body of the car.

★ Step 5 ~ Embellish if you choose! Have fun!

SAMPLE CALCULATIONS

Distance: 10.41 ft (125 inches) W/O Gears

Mass: 16 ounces

Time traveled: 5.7 Second

Acceleration: 1.8 feet per second

F=16*1.8 … F=29.12N

Kinetic Energy=1/2mv^2

.5*16*1.8^2 = 25.92 J

Once the measurements, times, and weights are obtained just plug in the numbers.

Lisa Ciabocchi

Exploratorium: Dream Up the Future

10/8/13

Research Procurement Assignment 1

The teacher resource that I chose related to STEM education is "Engineering Go For It Magazine," also known as eGFI. This magazine is more than just a quick read in the waiting room at the doctor's office. eGFL opens with what exactly engineering is, what gadgets designed offer us, and asks some questions that are left unanswered as to what we could expect of a product of engineering in the future. This magazine would most likel be used best by students who are in the fourth grade and up, and is applicable to them by including truly engaging topics. One that stuck out to me was the creation of new materials like Under Armour's E39 shirt that includes sensors that monitor breathing, heart rate, and measure the swiftness of a runners strides on each side. Another topic includes ideas on transportation in the future for example, warming effects on the road that melt snow, have glass that lets sunlight in that converts into electricity for the car, and LED's that light up road markings for nighttime driving. Several pages in, the author focuses on different majors such as aerospace, architecture, biomedical, civil, engineering management, and so many more, and offer so many ideas you could bring to the table in a certain profession. For example, in a nuclear setting, students could create different uses for materials, and find safe ways to dispose of harsh materials. They can develop ideas even further off; all it takes is a little push and a lot of imagination. All of these ideas and fantastic articles have truly gotten my mind rolling, and I think there are so many activities that teachers could base off of this magazine.

Reference Citation:

Gibbons, Michael, Thomas K. Grose, Pierre Home-Douglas, Margaret Loftus, Cathy Tran, and Chris Woolston. *Engineering Go For It* 2011: n. pag. Norman L. Fortenberry. Web. 8 Oct. 2013.

Travis Spencer
Resource Assignment #1
10/10/2013
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Geyser Riser Resource

The Geyser Riser resource is an excellent resource that presents a true hands on learning experience. The resources is fit for grades three through seven and illuminates the educational areas of earth science and physics. A geyser is a small reservoir of water that is heated by geothermal activity and erupts due to the pressure that is created. This experiment illustrates how the physics of pressure works in conjunction with water and heat. The experiment also assists in the understanding of earth science by explaining how and why a geyser is formed. Over all, the sciencenetlinks site and the afterschool resources are great sources for project based learning.

Stefan Palmer

TEED 3203: Technology & Communication

Topic #1: Strategies for teaching STEM

9/10/13

LEGO MINDSTORMS Education EV3

Robotics in the Middle School Classroom

Advancing Your Program

I attended the ISEA 2013 conference in Branson Missouri October 6, 7, & 8. While I was there I went to the LEGO MINDSTORMS Education EV3 Robotics in the Middle School Classroom Advancing Your Program seminar. This seminar showed how to use the LEGO robot and how to program it. I think this system is and will be a very helpful and engaging tool for the present and the future. The system used everything from coding to units of measurements. The robots can be used with a wide variety of sensors. This means that they can be used with many other classes such as science, physics, etc. I feel that this teaching instrument will be a great tool for any age. I would gladly recommend to the class room.

Dawn Cook

Resource Procurement Topic 1

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October 10, 2013

Minnesota One Stop Search

The University of Minnesota has a great website available to all who care to use it. The website (reference section) is http://www.cehd.umn.edu/stem/Resources/Default.html and the site has compiled links to many key STEM websites all in one location. There site also had all the projects the department has, or is working on. As a new teacher is searching for that one crucial idea that can throw their lesson up to a completely new level, this website has everything they need. The resources are conveniently categorized from general STEM to each of the disciplines separately as well. For instance, as a soon to be new science teacher I will need to be able to link all of my lesson plans back to common core standards. Since this is a national website, I can click on the link from the Universities website and make my way to my state. Many useful websites can be a helpful teaching tool when getting key concepts across. For instance, a good link to understanding the water cycle is found by clicking on the Seametrics link. This takes you into a kid's overview of the water cycle. From a basic understanding of STEM to a plethora of information to focus a lesson, the University of Minnesota's website is a fantastic resource for New and seasoned educators alike.

REFERENCE CITATION

http://www.cehd.umn.edu/STEM/ October 6, 2013

Tiffany Cromwell

October 10, 2013

STEM 4033

Resource Procurement Assignment Topic #1

The website Engineering is Elementary was developed by the Museum of Science in Boston. "Engineering is Elementary increases students' interest in and confidence about engineering. EiE's 20 units present fun, engaging engineering challenges that allow students to apply science knowledge." This website has a great section of videos from classrooms across the country that show lessons in engineering and the projects that go along with it. The section on Innovative Problem Solving includes the 21st century skills of hands-on learning that we are currently studying in the classroom today. So therefore I find this website very useful in the integration of STEM in the K-4 classrooms. EiE also integrates with other subject areas such as literacy, social studies, and mathematics. Although most of the hands-on projects are science based, these other subjects are integrated as much as possible. One of the videos I watched was a lesson on engineering and what the engineers have to think about when they are going to build something. The example used is a bridge and after the lesson, the students get hands on with building bridges. It was fun to watch them experiment with paper and blocks and weighing it down to see how strong of a bridge they built. I love seeing kids getting excited about learning and this is a website that I will definitely be using in my future classroom.

Reference Citation: http://eie.org/ October 10, 2013

Brittany Richert
STEM 4033-001
10 October 2013

STEM Resource Procurement Assignment 1

The resource I found was a website from the Exploratorium in San Francisco, California. The Exploratorium is a museum which exhibits all aspects of STEM. With programs for students, such as homeschool programs and hands-on activities, and programs for teachers, such as professional development opportunities and online resources, this website has been the most useful I have found when looking for strategies for teaching STEM.

The Exploratorium website offers free photos, video, and audio from the museum and from experts on topics central to the museum's purpose. There are also online activities and printables available for teachers to use in the classroom.

Below is the link of the Exploratorium Education Website:
http://www.exploratorium.edu/education/digital-library

Below is the link of explo.tv, an online resource for webcasts and podcasts:
http://www.exploratorium.edu/tv/

Below is the link to SMILE. This is probably the most useable feature of the Exploratorium site:
http://howtosmile.org/resourcesearch?ddssearch_q=&%2FsmileItem%2FauthorshipRights%2FsourceInstitutions%2FsourceInstitution[]=The+Exploratorium&ddssearch_materials_q=&verb=Search

Overall, this website is easy to use with extra links to external sites. Everything you would need is in one place! Enjoy!

Lindsay Neely
10/10/13
Resource Procurement Assignment: Topic #1

STEM Education Resource Center

I found a large variety of STEM teacher resources at www.pbs.org/teachers/stem . This website is very organized and easy to navigate. All of the lessons and resources are categorized by topics as well as grade levels. The resources include various informational videos, lesson plans, and activities that relate to various subjects of the STEM curriculum. I think you could find an informational video for pretty much any STEM concept you are teaching in your classroom. This site covers so many subject areas from life sciences, the nature of science, engineering technology, to earth sciences, and mathematics. Each category if further broken down into more specific subjects so it is very easy to find exactly what you are looking for. A few resources that I looked at were an animated video depicting the cycle from seed to fruit of a cherry tomato plant, a lesson plan in which students explore gravity and the rate of falling objects, and an interactive online activity that explores the Antarctic ecosystem. To access some of the resources you do need to make an account on pbs.org but it is completely free to sign up. I think this website is a great resource for STEM educators and I love how organized it is. It is easy to find exactly what you need and I will definitely use it in the future.

http://www.pbs.org/teachers/stem/
date of download: 10/10/13

Resource Procurement Assignment Topic #1

The article I found about strategies for teaching STEM talks about how some schools don't know how to effectively teach STEM. The article mentions how some schools add an extra intensive Math course or Science course because that is what they think makes them a STEM school. There were four parts the article mentioned that would make teaching STEM successful. The first one was "Teach knowing and doing," this part focuses on having the student's create items, not just take tests all the time, receiving help by doing research and talking to experts, and paying a lot of attention to the design process. The second one was "Allow for creativity," this part focuses on incorporating a lot of creativity into lessons and pushing for the students to become creative when doing projects. The third one was "Make teamwork central," this part focuses on putting students into groups to work on projects; this helps them learn great teamwork which will help them in their future careers. The fourth one was "Start with questions," this part focuses on asking the students questions that will push their minds to come up with the greatest products they can. All four of these parts mentioned work together to make a great strategy for teachers to use while teaching STEM.

Reference Citation: http://www.edutopia.org/blog/strategies-pbl-stem-thom-markham-buck-institute

Resource Procurement Assignment: Topic #1
Strategy for Teaching STEM

My resource is a video of a 5^{th} grade STEM class taught by Donna Migdol at Oceanside School District in New York. In the video, the class is constructing a model roller coaster that has to be fun and safe. One of Migdol's strategies is called "chiming." Chiming is when the teacher gives the students certain questions to answer in their journal. Once students answer them independently, they discuss these questions as a class in a circle so each student feels involved. The teacher doesn't sit in the circle so the class can actively participate in discussions. Migdol uses a great strategy to help students understand real-life engineering by giving them a certain amount of money. Each material costs money which causes students to critically think about the materials they can use based on the amount of money they are given. Migdol believes the budget part of STEM is essential because it creates better problem solvers. In the roller coaster project, students are broken into groups of four. Each group member has a specific job. One student is the recorder, and they write down all the ideas and modifications. Another student is the organizer, and they make sure everything gets done on time. One more student is the accountant, and they keep track of how much money has been spent. The last job is the measurer, and they record the rise, run, height, and width of the coaster. After roles have been assigned and chiming is completed, groups make a sketch of the roller coaster they want to build. Migdol argues that sketching gets students involved in the engineering design process as it helps with team building and collaboration. After sketching, students get to use a computer simulator that shows them how their roller coaster will actually work when built. This allows them to make changes accordingly as they learn about potential and kinetic energy, rise, and run. Migdol has a great STEM classroom, and is a great example of useful and effective strategies.

Resource URL: https://www.teachingchannel.org/videos/teaching-stem-strategies#header

Taylor Christian

Strategies for teaching STEM

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STEM 4033

October 10, 2013

Topic #1: Strategies for teaching STEM; Resource Procurement Assignment

The website, National Education Association (NEA), has created a whole page entitled, *The 10 Best STEM Resources*, to assist teachers implementing STEM within their classrooms. This website is a great resource for teachers to use because it provides information regarding grades preK-12 on what the objectives of STEM are and how it should be used within the classroom. This website is not only informative, but it also provides interactive games that are designed to allow the students to have a fun and positive experience with STEM. This website also has links to other websites, which is useful for teachers who truly want to expand their knowledge on the development of STEM. Some of the topics of the links include lesson plans, classroom activities, video clips, games, and strategies for teachers. One of the links brings you to the site, PBS Teachers, which has a page titled *STEM Education Resource Center*, which provides videos and information on lesson plans that teachers can use within their classroom that are engaging and create an authentic learning experience. I truly gained a better understanding of what STEM is and techniques I could use as a teacher to create a learning environment that implements STEM in a creative, exciting, and engaging environment for students.

Reference Citation:

Nast, Phil. "The 10 Best STEM Resources ." *National Education Association (NEA)*. n.d. n. page. Web. 8 Oct. 2013. <http://www.nea.org/tools/lessons/stem-resources.html>.

Ally England

October 10, 2013

Resource Procurement Assignment #1

Topic # 1: Strategies for teaching STEM

http://www.pbs.org/teachers/stem/

PBS Teachers STEM Education Resource Center

The PBS Teachers STEM education website was the one website in particular that I found to be the most helpful as well as the most fun to be as a developing and future educator. The PBS STEM website catered to the needs and questions of both teachers and parents. The website offered a wide variety of pictures and videos that better explain what exactly STEM is and how that looks in schools today. I enjoyed watching several of the videos and they really put emphasis on how STEM should be looked at by teachers and parents and how teaching STEM in schools is very beneficial to students because it connects the subject areas and makes learning science, technology, engineering and math not so intimidating. The PBS STEM resource center also offers a good number of potential STEM lessons for all grade levels ranging from preschool to high school. These lessons are very detailed and they explain why the lessons are appropriate for STEM education. Each lesson combines the elements of science, technology, engineering and math in a way that is understandable for children. One of my favorite parts of the website is the professional development tab. This link offers many professional development lessons for middle to upper grades and provides detailed description of each lesson. It also identifies the common core standards that are addressed in each lesson and how those standards are met throughout the activities and instruction.

Topic #1: Strategies for teaching STEM

At the ISEA conference, Lindsey Swagerty presented a Lightening Session on "Online Resources for STEM Curriculum, Lessons, and Ideas". A top strategy for teaching STEM was the "PBS: STEM Education Resource Center" created by the PBS website. The website has approximately 4,000 science, technology, engineering, and math resources for teachers from a variety of grades (preK-12) to use. The website states that "more teachers than ever before are turning to digital media resources to help their students understand concepts, practice new skills and engage in exciting, authentic learning experiences". Therefore, the STEM Resource Center has activities, videos, and professional developments for the educators to extend the STEM classroom experience. A science resource was "What Sounds Animals Make" where students can watch a video clip and hear the sounds that animals can make rather than reading about it. "STEM Resources From PBS" is a pdf profile with hyperlinks for each acronym of STEM targeting the grades preK-12 for students to interact with on the link. The "PBS: STEM Education Resource Center" is a fantastic way for STEM educators to help construct lesson plans or let the students explore the activities on the website. The website is sure to help new or seasoned educators of STEM in public schools help come up with new innovated ways to teach science, technology, engineering, and math. The "PBS: STEM Education Resource Center" has a multitude of various directions teachers can incorporate strategies in teaching STEM.

Works Cited

Lindsey M. Swagerty. *Online Resources for STEM Curriculum, Lessons, and Ideas*. Fayetteville: Lindsey M. Swagerty, 2013. Print.

"STEM Education Resource Center." *PBS*. PBS, n.d. Web. 10 Oct. 2013.

Kirstie Hesseltine

Resource Procurement Assignment #1

October 10, 2013

Strategies for teaching STEM

The article 10 “STEM Teaching Practices” is written by a middle school teacher, Anne Jolly. The author explains that since she has integrated a STEM curriculum, her students have become natural scientists. Jolly explains that students need to become proficient in the 4 C’s: “Creativity, Critical thinking, Collaboration, and Communication”. She states that since we live in such a fast paced world, we must be prepared to develop new teaching skills about what constitutes good teaching. Lastly, the author provides “10 Essential STEM Teaching Practices.” I believe that this is the most useful part of this article. The teaching practices she provides are very useful strategies for teachers to utilize when teaching STEM. For example, one of the strategies is to “Accept failure.” This is important as a teacher and for your students. Accepting failure is about experimenting and learning that you may not always be right. It is an essential part of a project-based learning curriculum. Another strategy that the author provides is “Increase collaboration among students.” For a STEM curriculum to be a success, students should be working in teams and interacting with others. This article also provides these additional resources for teachers to use in the classroom: a student teamwork guide, an online commentary about failure, and an article about piquing curiosity in your students. Overall, this article provided so many different strategies for teachers to use when teaching STEM. I would definitely be able to make use of these teaching practices in any grade-level classroom.

http://www.middleweb.com/6624/10-stem-teaching-practices/ Retrieved 10/8/13

Mary Caroline Nolan

October 10, 2013

Strategies for teaching STEM

Teachers are one of the following: There are those who believe and understand STEM, but aren't sure how to integrate it in the classroom or think it is too much work. There are those who don't believe it is necessary, which is a shame. There are those who attempt to provide problem-based learning opportunities that aren't truly. In November of 2009, PBS published an article that provides links to STEM activities for K-12 students. These are categorized by science, technology, engineering or mathematics.

Many teachers would rather avoid integrating STEM into their classroom, but this PBS publishing allows them to easily, quickly, and efficiently integrate STEM in their lesson plans. This compilation of links and their brief explanations of what the link will offer is a great resource for teaching STEM. Not only is it just one website, it provides eleven pages of links. For example, in the K-5 grade science category, there is a link called SciGirls.

> *SciGirls* is out to change how tweens think about science, technology, engineering and math, or STEM! In each episode, join bright, curious *real* girls in putting STEM to work. Then check out the website to play games, watch episodes, share projects, and connect with other SciGirls in a totally safe social networking environment! (PBS 3)

PBS provides this article with intention for teachers to have easy access to STEM problem-based learning. The teacher has minimal planning, can understand from seeing examples, and lead students to the great website links provide, age appropriate.

Lyndsey Strange

Resource Procurement Assignment Topic #1

Strategies for teaching STEM

http://www.pbs.org/teachers/stem/

The PBS website had a STEM education resource center. There are many videos, interactive webcasts, webpages, and documents that can be used to augment lessons in STEM. Most videos and webpages are either taken directly from or adapted from PBS's educational programming. I really liked this website because you can search it by subject or grade level or media or resource type. There are even lesson plans. I found a lesson plan on teaching children electrical circuits and a video illustrating the route of electricity from its generation to the home. This website could be very useful in STEM education. There is also a section on professional development and it is all research based.

Morgan Bayley
"The Teacher's Quick Guide to STEM Education"
October 10, 2013

Resource Procurement Assignment 1

While researching for good teacher resources, I came across many helpful resources available for teachers who want to integrate STEM into their classroom. The one I found most helpful to me as a future teacher is an article titled "The Teacher's Quick Guide to STEM Education". This article explains the importance of STEM and what it stands for. The article is broken down into four headings and those are "Integration of Curriculum", "Benefits of Program", and "Our Role and Responsibility". In the first paragraph it is a simple description of what STEM is and what each letter stands for. "STEM Education attempts to transform the typical teacher-centered classroom by encouraging a curriculum that is driven by problem-solving, discovery, exploratory learning, and require students to actively engage a situation in order to find its solution." This statement gives teachers an idea on how STEM can help students with planning activity based projects in the classroom. The article explains that all students benefit from STEM because it teaches the student to use their own creativity and explore new ideas with the skills they have learned. As the article states, more jobs in America are requiring good teamwork skills and being able to work in groups with others well. In the last paragraph, it gives a few statistics on how more and more people are choosing majors that do not deal with science or technology because there is such poor preparation in high school. This is why schools need to develop curriculum that has more standards for teachers to integrate STEM into the classrooms. I believe this is one of the most helpful resources because it gives teachers a clear idea of what STEM is and how to use it in the classroom along with some statistics.

"The Teacher's Quick Guide To STEM Education." *Edudemic*. N.p., n.d. Web. 10 Oct. 2013

Alexis Hennessy

Topic# 1

October 6, 13

http://pbskids.org/scigirls/

On this website called Scigirls, there are multiple episodes of real girls using STEM in the classroom. This is a good resource-incorporating STEM, because it has episodes for the children to watch, and then it has games for the kids to play so they can become more familiar with STEM. This website also provides a safe environment for children to connect with others and talk about what they have learned, or share new information through social networking.

Hillary Walker

10/9/13

STEM 4033

Strategies for Teaching STEM

Topic#1: Exploratorium

In the education section of this website, there are several different activities and strategies for teaching STEM to students. There are hundreds of different activities broken into different categories and topics such as astronomy and space, human body, culture, earth, etc. In the “explore” section of the website, there are links to hundreds of different printable lessons, which include content information down to a list of materials needed to perform the activity. Since the website is broken into categories, the site would be a great supplement to any unit. The activities in each section could easily tie into lessons. The site also has great articles that discuss why STEM is important and how it can best be taught and integrated into a classroom. There is a section on Exploratorium titled “Digital Library”, which includes videos, pictures, audio files, and links to other resources as well. Examples of the lessons and activities are included at the bottom of the page.

http://www.exploratorium.edu/

Accessed on 10/9/13

Topic #1: STEM Teacher Resource

http://www.nationalstemcentre.org.uk/elibrary/collection/208/teaching-resources

After reviewing several websites that incorporated STEM, such as PBS, NASA, and National Geographic, I found this website to be the most helpful. The National STEM Centre website is originated in the UK. The website has a variety of options to choose from. There are 6 tabs that teachers can search under. One is all subjects, the other is science, then technology, then engineering, then math, and lastly there are careers. When you click on each subject, the page is broken up into several categories on the left hand side. You can filter as much as you want. When you search, you can make it grade and age specific, you can chose a particular subject, you can choose a range of publication years, and you can pick the type of work you want done, for example, do you want an activity sheet or an experiment. It is a very simple website to use, and it has its own search engine. I noticed when trying to look up lesson plans, you must be registered to view them. Also, if you click on the STEM link at the top of the page, it gives you tons of information about STEM. It tells you what STEM is about, the curriculum, planning tools, case studies, promoting STEM, and how STEM should be brought into schools and colleges. The website also gives links to other websites that help you as well. I found this website to be very helpful! I would register to use the website as a helpful resource.