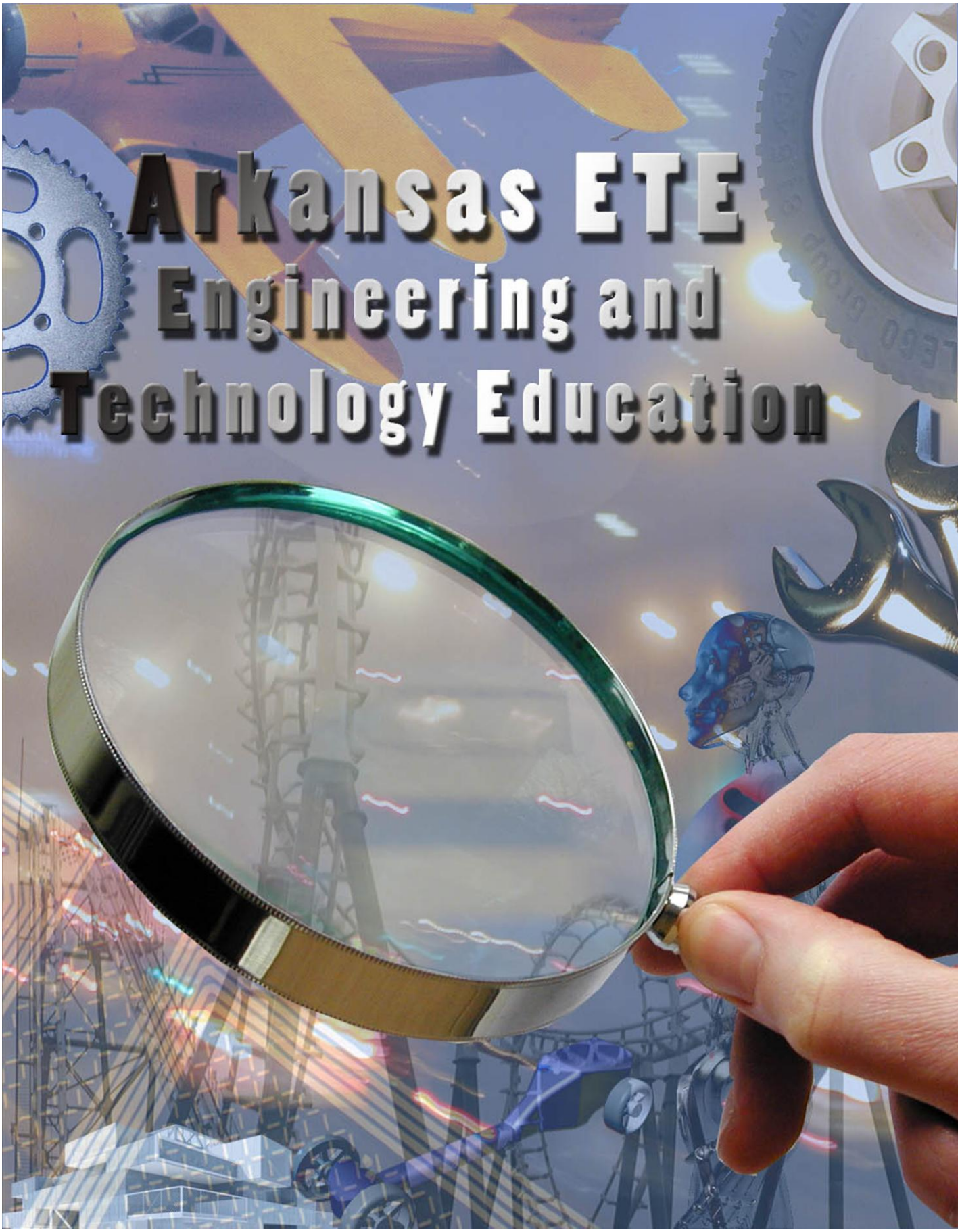
Arkansas ETE
Engineering and Technology Education



Engineering and Technology Education Contents

Engineering and Technology Education Courses

7th and 8th Grade

- Introduction to Engineering and Technology Education - 18 weeks
- Fundamentals of Engineering and Technology Education - 18 weeks

9th Grade

- Design Application in Engineering and Technology Education I - 18 weeks
- Design Application in Engineering and Technology Education II- 18 weeks

Program Description

The Engineering and Technology Education (ETE) program is designed for all students to develop technological literacy and stimulate interest in pursuing a career in a technological field. Focusing on the practices, skills, and knowledge necessary for employment in the numerous industries associated with engineering and technology, this course may be sequenced with a variety of career and technical courses to form a specialization to prepare students for careers and support additional education and training in engineering and technology.

Specifically, the ETE program will

- Provide classroom and laboratory learning experiences that will help students develop technological literacy.
- Provide an introduction to the practices, skills, and knowledge necessary for employment in engineering and technology careers.

Student Learning Outcomes

The ETE program is guided by the student learning outcomes outlined below. Specifically, students completing coursework in the ETE program will:

1. Demonstrate the ability to work in teams, think critically, identify problems, and propose solutions to design problems;

2. Acquire knowledge in the primary disciplines of technology and engineering, and understand the interrelationships among them;

3. Communicate effectively in written, oral and electronic formats;

4. Understand the practices, knowledge sets, and skills necessary in the various industries;

5. Utilize technology to enhance decision-making skills, solve problems, identify flaws, and improve productivity;

6. Identify questions that can be addressed and answered through scientific inquiry and technological design;

7. Demonstrate the ability to think critically and logically to draw explanations from gathered evidence;

8. Write descriptions, explanations, predictions, and make models that are based on inquiry and evidence.

Introduction to Engineering and Technology Education

Text: *Technology: Design and Applications (Wright and Brown)*

Course Description: This 18 week course is designed to provide 7th and 8th grade students with an introduction and comprehensive overview of the fields of information and communication, construction, manufacturing, energy, power, and transportation technologies. Students will also develop an understanding of the history of technology and how the design loop is used to solve technological problems. Emphasis will be placed on the exploration of principles and concepts as well as the application of technological and engineering concepts and practices through the completion of experiments, learning exercises, field trips, writing activities, and design projects.

Course Assignments: Projects, design problems, quizzes, and other team-based activities will be completed during the course. Your instructor in this course, much like employers in industry, reward students who arrive on time, fully engage in activities, and those who exhibit enthusiasm about the course content.

Course Objectives:

Upon completion of this course students will:

1. Understand the history and significant milestones, and impacts of technologies;
2. Demonstrate a basic understanding of the core concepts of technological systems within the fields of information and communication, construction, manufacturing, and energy, power, and transportation;
3. Identify careers, career fields, and educational requirements for numerous occupational areas within the fields of technology and engineering;
4. Use basic hand and power tools to perform simple operations related to problem solving and design;
5. Use software to complete tasks and solve problems;
6. Demonstrate the ability to utilize the design loop to solve engineering and design problems.

Course Outline:

- The History of Technology
- Defining Technology and Technological Literacy
- A Society Defined by Technology
    - Unintended Consequences
    - Tradeoffs and Impacts
    - Cultural and Ethical Implications
    - Human Needs and Wants
    - Technology, History, and Society
- The Engineering Design Process
- The Design Loop
- The Fundamentals of Design
    - Introduction to Information and Communications Technologies
        - Graphic Communications
        - Audio and Video Technologies
    - Introduction to Construction Technologies
        - Human Built Structures
        - Civil Structural Systems
    - Introduction to Manufacturing Technologies
        - The History of Manufacturing
        - Product Design and Development
    - Introduction to Energy, Power, and Transportation Technologies
        - Energy and Power Systems
        - Transportation System Design and Development

Unit 1 History of Technology

Students will complete an introductory unit on the history of technology and the significance of technological advancements. During this unit, students will be exposed to the nature of technology, the influence of technology on history, and how technology influences society.

Estimated Duration:

It is estimated that this unit will require 5 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Describe technology and the role that technology plays in society, culture, and history;
- ☐ Define technology and technological literacy and describe how a society can become more technological proficient;
- ☐ Identify and describe the unintended consequences of technology;
- ☐ Describe the core concepts and essential characteristics of technology; and
- ☐ Describe the innovations and contributions of significant inventors and innovators.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on technology and technological literacy using the definitions below:
  - Technology is the modification of the natural environment in order to satisfy perceived human needs and wants.
  - Technological Literacy is the ability to use, manage, assess, and understand technology.

- Technologically literate people evaluate technological information, form opinions about technology, assess technological value, are neither afraid of nor infatuated with technology, understand how technology is created, exhibit a level of comfort with technology, and understand how it shapes and is shaped by technology.

*Common misconception: Equating technology with computers only. Technology is any device or system created by humans.

- ☐ The course instructor will use a video to highlight the evolution of technology(many of these can be found on the History Channel® or the Discovery Channel® or most cable television networks);
- ☐ In many instances during the course curriculum, students will be asked to work in small teams. Many instructors are beginning to use team-based assignments as a major learning tool in school. One advantage of this instructional strategy is that it helps students to develop the social skills and abilities needed to effectively communicate in today's technological industries. It also promotes independent thinking, collaboration, and problem-solving skills. Any instructor who has used team-based assignments in the classroom or laboratory knows that these assignments can be difficult to manage or evaluation. Please review ***Appendix B*** for strategies on implementing team-based activities in the classroom.
- ☐ Students will work in pairs to conduct an Internet search to gather the information needed to create a Technology Timeline that details the evolution of technology or of a given technological device (i.e., the cotton gin, barbed wire, the automobile, the light bulb, the airplane);
- ☐ Students will work in pairs to conduct to gather the information needed to make a presentation about an inventor (i.e., Archimedes, da Vinci, Whitney, Edison, Tesla, and Franklin);
- ☐ Students will use the on-line resource entitled, *How to Create an Electronic Portfolio* ***(See Appendix B)*** to create a web-based on-line electronic

Technology Portfolio that will be used throughout the remainder of this course and subsequent courses to record homework, tests, written papers, photographs, illustrations, etc. For more information on the *Technology Portfolio* please review the guidelines outlined in ***Appendix B*** of this document.

- Students will select a field of technology (i.e., Energy and Power, Information and Communication, Transportation, Manufacturing, or Construction) and work individually to develop an historical timeline illustrating the major milestones of development and exploitation of this technological system. Individual students will present this timeline to the class in the form of a PowerPoint® presentation. Students will add the finished product to the *Technology Portfolio*;

Machinery/Equipment/Materials:

Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 2 The Engineering Design Process

Students will complete an introductory unit with accompanying learning experiences and activities designed to explore the concepts of the design process.

Estimated Duration:

It is estimated that this unit will require 10 hours of classroom and laboratory time for the average student to complete. The number of hours required to complete this unit may increase substantially if a team competition is added (see *Suggested Learning Activities* outlined below).

Unit Competencies:

Upon completion of this unit the student will:

- ☐ Understand the importance of the design process
- ☐ Identify the steps in the design process
- ☐ Recognize the importance of sketching in the design process
- ☐ Understand the importance of measuring accurately
- ☐ Demonstrate the ability to apply the steps of the design process to an invention, innovation, or design problem.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on the design loop:
  - The Design Loop is a guide that helps make engineering design problems a more effective learning tool. It is a structure for thinking and doing—the essence of design and problem solving. Designing is not a linear process. When you design and make something, you do not think and act in separate, sequential steps. Rather, you complete activities that logically lead to additional activities--sometimes they occur in the order outlined below and sometimes they occur more randomly, but in almost all cases all of

the activities outlined below occur during the engineering design process.

*Note: It is a good teaching tool to require students to document their passage through all phases of engineering design.

- Steps in the Design (Loop) Process:

1. Identifying Problems and Opportunities:

   Central to the process of designing is the identification of a problem in need of a solution. On the surface, this appears to be a simple task, but it requires careful observation and a critical eye. For example, ask students to consider problems that they encounter daily (i.e., my backpack is too heavy and it hurts my back to carry it).

2. Clarifying the Design Problem:

   Here the student designer attempts to clarify, understand the specifications, and detail exactly what it is that they intend to do. At this point, the student begins to ask a number of questions (i.e. What are my limits? How much time do I have? To what materials do I have access?). For example, is the backpack too big or too heavy, or are the contents too heavy? Can it be made of lighter materials? Can books be carried in another way? Can the load of the backpack be moved to rest on the legs rather than the back? Can wheels be added? etc.

3. Investigating and Conducting Research:

   In order to solve problems, all pertinent information must be gathered and documented for possible future reference. The importance of investigation and research cannot be overemphasized. Few solutions are new. Most new inventions involve many previously known principles and concepts. For example, students may investigate how similar problems have been solved in the past (i.e., heavy luggage was improved by adding wheels and a retractable handle)

4. Generation of Alternative Solutions:
   Generating a number of alternative solutions is one of the most important steps and often the most difficult to do. Although it seems to be human nature to latch on to your first idea and try and make it work. More ideas equal better solutions. Techniques: Brainstorming, sketching, doodling, attribute listing, and forced connection.
5. Choosing a Solution:
   Choosing the best among a number of ideas is less straightforward than it may appear. Two strategies: (1) Listing the attributes (good and bad points) of the ideas and comparing them; and (2) Developing a decision matrix that compares attributes to design criteria. The evaluation process may indicate a way to combine features of several solutions into an optimum solution.
6. Developmental Work:
   The student designer begins working on the myriad of sub-problems that need solutions. This involves modeling, experimentation with different materials, and fastening techniques, shapes, and other things that need to be done before actual construction of the final design is undertaken.
7. Modeling and Prototyping:
   At this point the student designer begins to develop models and prototypes that represent their idea. Two-dimensional and Three-dimensional models, computer models, and mathematical models are commonly used. A model is a non-operating representation and a prototype is a working model.
8. Testing and Evaluating:
   This may be as simple as applying the specifications to the end product to see if it does all the things that it is supposed to do. But more often it is performance testing, as in the case of a practical

device. For example, does the improved backpack actually reduce strain on the back?

9. Re-designing and Improving:
   After evaluating the design, student designers begin implementing what they have learned from the evaluation—an effort to improve the product.
10. Presenting & Producing:
    All design problems should end with a culminating event. This could be a formal presentation of the production of the product or system.

- ☐ The instructor will lead a discussion on the importance of sketching during the design process.
- ☐ The students will practice sketching (orthographic and pictorial views) and understand the importance of sketching in communicating ideas with others.
- ☐ Students will learn to accurately read different measuring devices in both imperial and metric units.
- ☐ Students will work independently to use the design process to complete the activity 'Inventing a New Kind of Pencil'. See ***Appendices B and D*** for student activities.
- ☐ Students will create an invention or innovation using the design process and will complete a design log for their invention.

Machinery/Equipment/Materials:

Measuring Devices, Microsoft Office software tools, and the *Technology Portfolio*.

*Assessment Strategies**:***

Student performance in this unit should be assessed using one or all of the following assessment tools: *Writing Rubric, Oral Presentation Rubric, Problem Solving Rubric*, and the *Technical Problem Solving Checklist* and various worksheets from the course text. See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions, as well as ***Appendix B*** for student portfolios and activities.

Unit 3 Introduction to Information and Communication Technologies

Students will complete learning experiences and activities designed to explore the concepts of information and communication technologies.

Estimated Duration:

It is estimated that this unit will require 15 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand information and communication technologies using a systems model that includes inputs, processes, and outputs;
- ☐ Explain that technological knowledge and processes are communicated using symbols, measurements, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli;
- ☐ Demonstrate the ability to communicate effectively using multiple types of media; and
- ☐ Utilize a *Technology Portfolio* to record ideas, projects, presentations, and other written work.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on evolution of information and communication technologies:
  - Allow information to be transferred from human to human, human to machine, machine to human, and machine to machine.
  - Are designed inform, persuade, entertain, control, manage, and educate.

- Components of a communication system including the source, encoder, transmitter, receiver, decoder, storage, retrieval, and destination.
- How symbols, measurements, conventions, icons, graphic images, and languages that incorporate a variety of visual, auditory, and tactile stimuli are used to more effectively communicate a message.

☐ The students will complete a systems model outline for a given communication scenario.

☐ Students will create a chart outlining and categorizing the four types of communication.

☐ Students will create a multimedia presentation on a form of communication technology and present it to the class.

- Students will evaluate their peers on the use of effective communication.

☐ Students will develop a Technology Portfolio that demonstrates understanding of information and communication systems and their importance in career choices.

Machinery/Equipment/Materials:

Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 4 Introduction to Construction Technologies

Students will complete learning experiences and activities designed to explore the concepts of construction technologies.

Estimated Duration:

It is estimated that this unit will require 15 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Identify and describe the core concepts of human built structures;
- ☐ Identify materials used in construction;
- ☐ Identify and describe civil structural systems
- ☐ Create a structural model, test a design, and optimize a design

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on the core concepts of construction technology:
  - Construction is the systematic process of erecting structures to meet human needs and desires. It reflects cultural norms, environmental conditions, and the requirements of enterprises and institutions.
- ☐ The instructor will lead a discussion on the evolution of human built structures (temporary structures such as tents, tepees, and lean-tos), sod homes, log homes, and modern day human dwellings.
- ☐ The instructor will present students with an overview of the materials and construction of human dwellings.
- ☐ Students will build a model of a log or sod home out of found materials.

- ☐ Students will design a personalized brick or stepping stone mold out of mud or concrete.
- ☐ The instructor will present students with an overview of civil structural systems.
- ☐ Students will work in small groups to identify important civil structures in the community and within the state and region.
- ☐ Students will design a model of a civil structure, such as a bridge or tower, with predetermined limitations and constraints.
- ☐ Students will test and evaluate their structures.

Machinery/Equipment/Materials:

Recycled materials for modeling, concrete or mud for brick or stepping stone design, materials to build a mold, West Point Bridge Designer, materials to construct structures (balsa, basswood, etc.) structural tester, Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 5 Introduction to Manufacturing Technologies

Students will complete learning experiences and activities designed to explore the concepts of manufacturing technologies.

Estimated Duration:

It is estimated that this unit will require 15 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand that modern manufacturing technologies produce quality goods at low prices, enhancing the quality of life for many people.
- ☐ Classify manufacturing systems as customized production and mass production.
- ☐ Describe the evolution of manufacturing from the early trades and crafts to modern day production.
- ☐ Describe the core materials and resources used in manufacturing.
- ☐ Design and construct a class manufacturing project.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on the evolution of manufacturing:
  - early trades and crafts
  - needs vs. wants in society
  - custom manufacturing vs. mass production
  - production design
  - the materials used in manufacturing: woods, plastics, metals, and composites.
- ☐ Students will create a lifecycle of a manufactured good or product

- ☐ Students will compare and contrast different products, classifying them as customized or mass-produced
- ☐ Students will compare and contrast different products, classifying them in relation to their base materials.
- ☐ Students will design and produce a manufacturing project.

Machinery/Equipment/Materials:

Microsoft Office, Materials to create manufacturing project

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 6 Introduction to Energy, Power, and Transportation Technologies

Students will complete learning experiences and activities designed to explore the concepts of energy, power, and transportation technologies.

Estimated Duration:

It is estimated that this unit will require 15 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Define energy and power.
- ☐ Differentiate between kinetic and potential energy.
- ☐ Identify and describe common sources of renewable and non-renewable energy.
- ☐ Understand the role that transportation plays in the operation of other technologies.
- ☐ Identify and describe different modes of transportation.
- ☐ Design and construct an air-powered vehicle.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on energy power including:
    - energy is the ability to do work.
    - power is the rate at which work is done.
    - potential energy is energy at rest, but able to do work.
    - kinetic energy is the energy that an object has because of its motion.
    - common sources of renewable and non-renewable energy.
- ☐ The course instructor will introduce students to the breadth of energy industries in the community by conducting field trips to energy companies in

the community. The instructor should try to visit different types of companies (energy production, energy transmission, energy technologies, etc.) and visit both private and public energy companies.

- The course instructor should develop a set of questions for the students to answer during the visit;
- Students will take notes during the visit that captures their observations as well as recoding responses to any questions that were asked during the visit;
- Students will develop a report detailing findings from the visit after returning to the school;
    - Students will record photos and other materials for inclusion in the *Technology Portfolio*.

☐ The instructor will present information and lead a discussion on air, land, and water transportation systems.

☐ Students will create a table that categorizes types of energy and power

☐ Students will conduct experiments using both kinetic and potential energy

☐ Students will design a flowchart that identifies their personal use of energy

☐ Students will work in groups to create an advertisement for a freight company that provides all modes of transportation

☐ Students will design an (CO2, pneumatic, etc.) vehicular system with specific constraints and limitations and calculate rate, speed, and velocity using formulas provided in ***Appendix D***.

Machinery/Equipment/Materials:

Microsoft Office software tools, Technology Portfolio, appropriate supporting videos, and Internet access appropriate materials and tools for vehicular design.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 7 Safety

Students will learn all safety procedures and rules to safely operate lab machinery and tools. Further, the students will learn the procedures such as reporting illness and injuries. The students will also learn about using appropriate personal protection equipment.

Estimated Duration:

Safety lessons should be done early in the course and should be covered and enforced throughout the course.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Describe the need for safe work environments in the Engineering and Technology Educational classroom and lab
- ☐ Describe specific procedures such as reporting illness, injuries, safety violations, etc.
- ☐ Use appropriate and required personal protection equipment
- ☐ Describe machine and tool safety practices and procedures.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will teach the students about several safety topics
  - Maintaining personal and workplace safety
  - Hazard avoidance
  - Safety information systems
  - Protective clothing
  - Fall protection
  - First aid
  - Ergonomics
  - Environmental safety

- ☐ The instructor will demonstrate to the students specific work procedures such as reporting illness, injuries, safety violations, etc.
- ☐ The students will practice using appropriate and required personal protection equipment.
- ☐ The instructor will lead a discussion on machine and tool safety and demonstrate how to properly operate machines and tools
- ☐ Students will take and pass safety test to show competency in machine and tool safety.
- ☐ The instructor will design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc.
- ☐ The class will operate tools and equipment in a safe and hazard free manner to the satisfaction of the instructor.

Machinery/Equipment/Materials:

Safety signs, Safety tests and study materials, Machines and tools to demonstrate safe operation, Personal Protection Equipment

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Fundamentals of Engineering and Technology Education

Text: *Technology: Design and Applications (Wright and Brown)*

Course Description: This 18 week course is designed to provide 7th and 8th grade students with a more in depth look at the fields of information and communication, construction, manufacturing, energy, power, and transportation technologies. Students will also further their understanding of technology and the use of the engineering design loop to solve technological problems. Emphasis will be placed on the further exploration of principles and concepts as well as the continued application of technological and engineering concepts and practices through the completion of experiments, learning exercises, field trips, writing activities, and design projects.

Course Assignments: Projects, design problems, quizzes, and other team-based activities will be completed during the course. Your instructor in this course, much like employers in industry, reward students who arrive on time, fully engage in activities, and those who exhibit enthusiasm about the course content.

Course Objectives:

Upon completion of this course students will:

7. Understand impacts of technologies upon the modern world;
8. Demonstrate a basic understanding of the relationship of technological systems within the fields of information and communication, construction, manufacturing, and energy, power, and transportation;
9. Identify careers, career fields, and educational requirements for numerous occupational areas within the fields of technology and engineering;
10. Use basic hand and power tools to perform simple operations related to problem solving and design;
11. Use software to complete tasks and solve problems;
12. Demonstrate the ability to utilize the design loop to solve engineering and design problems.

Course Outline:

- Engineering and Technology Connections
- Engineering Design Process in Technology Systems
- Information and Communications Technologies
  - Global Information and Positioning Systems (GIS/GPS)
  - Computer-Aided Drafting (CAD)
- Construction Technologies
  - Architectural Design
  - Civil Structural Systems
- Manufacturing Technologies
  - Robotics
  - Product Design and Development
- Energy, Power, and Transportation Technologies
  - Energy and Power Systems
  - Renewable Energy Technology

Unit 1 Engineering and Technology Connections

Students will complete a unit on engineering and technology connections. During this unit, students will be exposed to systems thinking and career options.

Estimated Duration:

It is estimated that this unit will require 5 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Define technology and engineering and describe their relationship toward one another
- ☐ Identify the various fields of technology and engineering
- ☐ Develop a Technology Portfolio
- ☐ Describe the concepts of technological systems and systems thinking
- ☐ Identify the parts of a technological system

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on technology and engineering and how they are closely tied together using the following terminology:
  - Technology is the modification of the natural environment in order to satisfy perceived human needs and wants.
  - Engineering is the application of scientific and mathematical principles to the design and operation of structures, machines, processes, and systems.
- ☐ Students will use the on-line resource entitled, *How to Create an Electronic Portfolio* **(See Appendix C)** to create a web-based on-line electronic *Technology Portfolio* that will be used throughout the remainder of this course

and subsequent courses to record homework, tests, written papers, photographs, illustrations, etc. For more information on the *Technology Portfolio* please review the guidelines outlined in **Appendix B** of this document.

- ☐ The instructor will present information on the various fields of engineering.
- ☐ Students will work in small groups to select and research a field of engineering. Each group will develop a presentation and present to the class. Students will add the finished product to the *Technology Portfolio*;
- ☐ The instructor will present information and lead a discussion on technological systems and systems thinking:
    - Technological Systems are used to make the artifacts and services that people want or need.
    - Systems Thinking requires considering how each part connects to another. This can be done by looking at individual parts as well as how the system as a whole interacts with other systems.
    - Parts of a technological system:
        - Goals - the reasons for developing a system
        - Inputs - the resources the system uses to meet the identified goals
        - Processes - the actions taken to use the inputs to meet the goals
        - Outputs - the results obtained by operating the system
        - Feedback - the adjustments made to the system to control the outputs
- ☐ Students will develop a flowchart that demonstrates the key elements of a technological system such as a heating and cooling system.

Machinery/Equipment/Materials:

Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review Appendix B for student *Technology Portfolio* materials.

Unit 2 Information and Communication Technologies

Students will complete a unit information and communication technologies. During this unit, students will be exposed to computer-aided drafting (CADD) and global information and global positioning systems (GIS/GPS) technologies.

Estimated Duration:

It is estimated that this unit will require 20 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Define CAD/CADD - computer-aided drafting and design;
- ☐ Identify how a mathematical grid system is used to create 2-Dimensional and 3-Dimensional drawings using CAD software;
- ☐ Create 2-dimensional and 3-dimensional drawings using CAD software;
- ☐ Define global information and global positioning systems (GIS/GPS);
- ☐ Identify how global information and global positioning systems (GIS/GPS) are used to access and create geographic data; and
- ☐ Access and analyze specific coordinates in a global information system.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on CAD systems and why graphic planning is important in the design process
- ☐ The instructor will demonstrate the difference between 2D and 3D drawings using CAD software such as Google Sketch-Up
- ☐ The instructor will demonstrate how CAD drawings are made using a mathematical grid system using plots on an X, Y and Z axis
- ☐ Students will use CAD software to plot points on an X, Y, and Z axis
- ☐ Students will use CAD software to prepare 2D and 3D drawings

- ☐ The instructor provide students with a demonstration on how mapping software such as Google Earth or Garmin Base Camp is used to access and create geographic data;
- ☐ Students will use a mapping software such as Google Earth or Garmin Base Camp to access and create geographic data
- ☐ Students will use mapping software to access and analyze longitude and latitude coordinates
- ☐ Students will collect materials from this unit to add to their *Technology Portfolio*.

Machinery/Equipment/Materials:

Paper based maps that show longitude and latitude, CAD software (AutoCAD, Inventor, Sketch Up, etc.), Google Earth, Garmin Base Camp, Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using a *Skills Checklist* and *Technology Portfolio.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review Appendix B for student *Technology Portfolio* materials.

Unit 3 Construction Technologies

The student will complete learning experiences and activities designed to explore the concepts of construction technologies.

Estimated Duration:

It is estimated that this unit will require 20 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Identify and describe common types of architectural drawings;
- ☐ Understand the importance of the planning process before construction begins;
- ☐ Develop an architectural floor plan; and
- ☐ Evaluate, design, and plan a civil structure using the engineering design process.

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Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will present information and lead a discussion on architectural drawings, including floor plans, elevations, and schedules, and discuss the following architectural concepts:
  - types of plans required for residential and commercial construction
  - characteristics of architectural drawings
  - features and architectural symbols on a residential floor plan
  - features and architectural symbols on a residential elevation;

- ☐ The instructor will present information about the importance of planning before construction begins and a connection to why technical drawings are an important step in the design process;

- ☐ Students will design a small residential structure, such as get-away cabin or portable disaster shelter, by sketching plan and elevation views of their design;
- ☐ Students will design a scaled or full-size civil structure (such as walking bridge or walking trail in the community using recycled or free materials) with predetermined limitations and constraints;
- ☐ Students will test, evaluate, and present their design to the class
- ☐ Students will collect materials from this unit to add to their *Technology Portfolio*.

Machinery/Equipment/Materials:

Architectural drawings, graph paper, CAD software (AutoCAD, Inventor, Sketch Up, etc.), modeling materials, Microsoft Office software tools, *Technology Portfolio*, appropriate supporting videos, and Internet access.

Assessment Strategies:

Student's level of performance in this unit should be measured using a *Skills Checklist* and *Technology Portfolio.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review Appendix B for student *Technology Portfolio* materials.

Unit 4 Manufacturing Technologies

Students will complete a unit on manufacturing technologies.

Estimated Duration:

It is estimated that this unit will require 20 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand how robotics and automation is used to manufacture products;
- ☐ I Identify the parts and function of effectors, sensors, controllers, and auxiliary parts in a robotics system;
- ☐ Design a robot that will solve a materials handing problem; and
- ☐ Design a product or system and document the process.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

Upon completion of this unit, the student will:

- ☐ The instructor will present information and lead a discussion on the use of robotics and automation in manufacturing;
- ☐ The course instructor will introduce students to the breadth of energy industries in the community by conducting field trips to manufacturing facilities in the community.
    - The course instructor should develop a set of questions for the students to answer during the visit;
    - Students will take notes during the visit that captures their observations as well as recoding responses to any questions that were asked during the visit;
    - Students will develop a report detailing findings from the visit after returning to the school;

- Students will record photos and other materials for inclusion in the *Technology Portfolio*.

☐ The instructor will present information and lead a discussion on the key elements of a robotics system including: effectors, sensors, controllers, and auxiliary parts in a robotics system;

☐ Students will design a robot that will solve a materials handing problem. If the program does not have access to robotics equipment students should build a syringe robot. See ***Appendix C*** for online resources;

☐ Students will design and manufacture a product, device, or system using the engineering design process; and

☐ Students will document their design and add this information to their *Technology Portfolio.*

Machinery/Equipment/Materials:

Technology Portfolio, appropriate supporting videos, and Internet access, appropriate materials and tools for robotics design, materials to complete the design activity, and power and hand tools.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 5 Energy, Power, and Transportation Technologies

Students will complete a unit on manufacturing technologies.

Estimated Duration:

It is estimated that this unit will require 20 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Define terms associated with basic electronics;
- ☐ Recognize series and parallel circuits;
- ☐ Demonstrate the ability to safely measure voltage using a multi-meter;
- ☐ Identify alternative and renewable sources of energy; and
- ☐ Design an alternative energy device that coverts wind energy into mechanical power.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

Upon completion of this unit, the student will:

- ☐ The instructor will present information and lead a discussion concerning electronics and electrical components including:
  - A circuit is a path for electrons to flow through. The path is from a power sources negative terminal, through the various components and on to the positive terminal.
  - A conductor is a material (usually a metal such as copper) that allows electrical current to pass easily through.
  - A semiconductor is a material having electrical properties intermediate between those of good electrical conductors and insulators.

- The three essential parts of a simple electronic circuit are a power source, a path, a load, a control, and an indicator
- Resistance is anything that causes an opposition to the flow of electricity in a circuit. It is used to control the amount of voltage and/or amperage in a circuit.
- The main purpose of the ground wire is to always ensure that the chassis of the appliance remains at zero volts;

☐ The instructor will show a video concerning emerging renewable and alternative sources of energy; and

☐ Students will design an alternative energy device that converts wind energy into mechanical power.

Machinery/Equipment/Materials:

Electronic components, digital multi-meters, *Technology Portfolio*, appropriate supporting videos, and Internet access appropriate materials and tools for electronics, materials to complete the design activity, and power and hand tools.

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 6 Safety

Students will learn all safety procedures and rules to safely operate lab machinery and tools. Further, the students will learn the procedures such as reporting illness and injuries. The students will also learn about using appropriate personal protection equipment.

Estimated Duration:

Safety lessons should be done early in the course and should be covered and enforced throughout the course.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Describe the need for safe work environments in the Engineering and Technology Educational classroom and lab
- ☐ Describe specific procedures such as reporting illness, injuries, safety violations, etc.
- ☐ Use appropriate and required personal protection equipment
- ☐ Describe machine and tool safety practices and procedures.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will teach the students about several safety topics
  - Maintaining personal and workplace safety
  - Hazard avoidance
  - Safety information systems
  - Protective clothing
  - Fall protection
  - First aid
  - Ergonomics

- Environmental safety

- ☐ The instructor will demonstrate to the students specific work procedures such as reporting illness, injuries, safety violations, etc.
- ☐ The students will practice using appropriate and required personal protection equipment.
- ☐ The instructor will lead a discussion on machine and tool safety and demonstrate how to properly operate machines and tools
- ☐ Students will take and pass safety test to show competency in machine and tool safety.
- ☐ The instructor will design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc.
- ☐ The class will operate tools and equipment in a safe and hazard free manner to the satisfaction of the instructor.

Machinery/Equipment/Materials:

- ☐ Safety signs, Safety tests and study materials, Machines and tools to demonstrate safe operation, Personal Protection Equipment

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Design Applications in ETE I

Text: *Technology: Design and Applications (Wright and Brown)*

Course Description: This 18 week course is designed to provide 9th grade students with a more in-depth look at the application of engineering and technology in the fields of construction and information and communication technologies. Students will also further their understanding of technology and the use of the engineering design loop to solve technological problems. Emphasis will be placed on the further exploration and application of engineering and technology through experiments and design projects.

Course Assignments: Projects, design problems, quizzes, and other team-based activities will be completed during the course. Your instructor in this course, much like employers in industry, reward students who arrive on time, fully engage in activities, and those who exhibit enthusiasm about the course content.

Course Objectives:
Upon completion of this course students will:

1. Understand the various applications of design in the fields of construction and information and communication technology.
2. Understand how the Engineering Design Process works and how this process can be used in all design applications.
3. Learn to use the correct tools and materials in construction and how to follow building codes and standards.
4. Understand the role that information and communication plays in our lives.
5. Learn how to safely work in a lab setting and to safely operate the machines and tools within the lab.

Course Outline:

- Design Applications of Construction Technologies
  - Engineering Design Process in Construction Technology
  - Using Appropriate Measuring Device
  - Tools and Materials
  - Building Codes and Standards
  - Designing a Structure
  - Design Applications of Information and Communication Technologies
- Role of Information and Communication in Our Lives
  - Format and Purpose of Information and Communication Systems
  - The Elements and Principles of Design
  - The Elements of a Corporate Identity Package
  - Compose and Assess a Design Portfolio
- Safety
    - The Need For Safe Work Environments
    - Specific Procedures
    - Personal Protective Equipment
    - Machine and Tool Safety Practices

Unit 1 Design Applications of Construction Technologies

Students will complete a course focusing on the use of design in the world of construction. During this unit, the students will learn about using proper measuring devices, which tools and materials are used in construction, and building structures according to codes and standards.

Estimated Duration:

It is estimated that this unit will require 45 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand how the engineering design process is used in construction technology
- ☐ Identify the appropriate measurement device for the application
- ☐ Identify common construction tools and materials as well as appropriate techniques and applications
- ☐ Recognize the importance of building codes and standards in construction
- ☐ Identify, design, and construct a structure to serve a need in the community.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ Students will be presented with a real world construction technology problem and will use the engineering design process to research potential solutions
- ☐ The instructor will lead a discussion about the types of drawings required for residential and commercial construction
- ☐ Students will connect the principles of measurement to real world applications by;
    - Estimating the amount of material needed for a given project

- Calculating quantity of materials needed in nominal and standard material sizes

☐ Students will use correct dimensions to accurately cut materials and construct a small scale structure that includes a window and door.

☐ The instructor will lead a discussion on the importance of city codes and covenants

- The students will apply this knowledge to their small scale structure

☐ Students will design and construct a structure to serve a need in the community.

Machinery/Equipment/Materials:

Materials and tools needed for students to construct a small-scale structure and for a structure to help the community

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 2 Design Applications of Information and Communication Technologies

Students will complete a course focusing on the applications of information and communication technologies. During this unit, the students will learn about the impact of communication, the purpose of information and communication systems, and how to compose and assess a design portfolio.

Estimated Duration:

It is estimated that this unit will require 45 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand the impact, significance and role that information and communication systems play in our daily lives
- ☐ Recognize the format and purpose of information and communication systems
- ☐ Identify and explore the elements and principles of design in various applications and types of media
- ☐ Recognize the elements of a corporate identity package
- ☐ Compose and assess a design portfolio.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will lead discussions that explore the control and influence that information and communication systems have on a given audience
- ☐ Students will identify and categorize specific examples of media formats
- ☐ Students will compare and contrast the structure, intended audience, and purpose for using a specific media format

- ☐ Students will collect and classify examples of various media types.
- ☐ Students will experiment with line, shape, color, and texture to familiarize themselves with the elements of design
- ☐ Students will create a 3D model that uses the elements and principles of design
- ☐ Students will participate in discussions regarding printing and the various methods of digital publishing
- ☐ Students will design a corporate identity package for a school event.
- ☐ Students will compile a design portfolio including items such as logos, trademark application, t-shirt, poster, etc. and present the portfolio to the class.

Machinery/Equipment/Materials:

Microsoft Office, Design programs (Gimp, Paint.net, Corel, Adobe Photoshop, Illustrator, etc.)

Assessment Strategies:

Student's level of performance in this unit should be measured using the Presentation Rubric and the Writing Rubric. See Appendix A for assessment rubrics, checklists, guidelines, and suggestions. Review Appendix B for student Technology Portfolio materials and Appendix C for online resources.

Unit 3 Safety

Students will learn all safety procedures and rules to safely operate lab machinery and tools. Further, the students will learn the procedures such as reporting illness and injuries. The students will also learn about using appropriate personal protection equipment.

Estimated Duration:

Safety lessons should be done early in the course and should be covered and enforced throughout the course.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Describe the need for safe work environments in the Engineering and Technology Educational classroom and lab
- ☐ Describe specific procedures such as reporting illness, injuries, safety violations, etc.
- ☐ Use appropriate and required personal protection equipment
- ☐ Describe machine and tool safety practices and procedures.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will teach the students about several safety topics
  - Maintaining personal and workplace safety
  - Hazard avoidance
  - Safety information systems
  - Protective clothing
  - Fall protection
  - First aid
  - Ergonomics

- Environmental safety

☐ The instructor will demonstrate to the students specific work procedures such as reporting illness, injuries, safety violations, etc.

☐ The students will practice using appropriate and required personal protection equipment.

☐ The instructor will lead a discussion on machine and tool safety and demonstrate how to properly operate machines and tools

☐ Students will take and pass safety test to show competency in machine and tool safety.

☐ The instructor will design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc.

☐ The class will operate tools and equipment in a safe and hazard free manner to the satisfaction of the instructor.

Machinery/Equipment/Materials:

Safety signs, Safety tests and study materials, Machines and tools to demonstrate safe operation, Personal Protection Equipment

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Design Applications in ETE II

Text: *Technology: Design and Applications (Wright and Brown)*

Course Description: This 18 week course is designed to provide 9th grade students with a more in-depth look at the application of engineering and technology in the fields of energy, power, and transportation and manufacturing technologies. Students will also further their understanding of technology and the use of the engineering design loop to solve technological problems. Emphasis will be placed on the further exploration and application of engineering and technology through experiments and design projects.

Course Assignments: Projects, design problems, quizzes, and other team-based activities will be completed during the course. Your instructor in this course, much like employers in industry, reward students who arrive on time, fully engage in activities, and those who exhibit enthusiasm about the course content.

Course Objectives:

Upon completion of this course students will:

1. Understand the various applications of design in the fields of energy, power and transportation technologies, as well as manufacturing technologies.
2. Develop an understanding of basic electricity and circuitry principles and concepts.
3. Understand how manufacturing functions in today's society.
4. Learn to apply manufacturing concepts to a personal product design.
5. Learn how to safely work in a lab setting and to safely operate the machines and tools within the lab.

Course Outline:

- Design Applications of Energy, Power, and Transportation Technologies
    - Electricity Principles, Concepts, and Systems
    - Electricity Generation, Distribution, and Consumption

        - Circuitry Schematics
        - DC Motors and Generators
        - Design Applications of Manufacturing Technologies
    - Modern Manufacturing Systems
        - Mass Production in a Global Society
        - Planning and Communication During Product Design
        - Criteria and Constraints
        - Materials and Processes in Manufacturing
        - Design and Produce a Product
    - Safety
        - The Need For Safe Work Environments
        - Specific Procedures
        - Personal Protective Equipment
        - Machine and Tool Safety Practices

Unit 1 Design Applications of Energy, Power, and Transportation Technologies

Students will complete a course focusing on the design applications of energy, power, and transportation technologies. During this unit, the students will learn about alternating and direct currents, basic circuitry, and understanding how DC motors and generators operate.

Estimated Duration:

It is estimated that this unit will require 45 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand basic alternating current (AC) and direct current (DC) electric principles, concepts, and systems
- ☐ Understand how AC and DC electricity is generated, distributed, and consumed through circuitry.
- ☐ Understand how basic circuitry is represented on paper
- ☐ Understand how DC motors and generators are constructed and how they operate.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will lead discussions of basic electrical and electronic principles, systems, and concepts.
- ☐ Students will diagram how electricity is generated, transmitted, and delivered to the electrical circuit in their home.
- ☐ Students will use basic hand tools to wire and solder simple AC and DC wiring circuits.
- ☐ Students will use a multi-meter and various other electrical measuring devices

- ☐ Students will create a pictorial sketch, a schematic drawing, and a materials list for a DC electric motor
- ☐ Students will design, construct, and test a DC electric motor that is capable of transferring mechanical power for a given task.

Machinery/Equipment/Materials:

Hand tools and soldering materials, Batteries, Wires, Light bulb or other load for wiring circuits, Multi-meter and other electrical measuring devices, DC motor

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 2 Design Applications of Manufacturing Technologies

Students will complete a course focusing on the design applications of manufacturing technologies. During the unit, the students will learn about the components of modern manufacturing, describe the need for mass production of goods, learn about planning and communicating during product design, and will design and produce a product to serve a need.

Estimated Duration:

It is estimated that this unit will require 45 hours of classroom and laboratory time for the average student to complete.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Understand the components of modern manufacturing systems
- ☐ Describe the need for mass production of goods in a global society
- ☐ Recognize the importance of planning and communication during the process of product design
- ☐ Identify the need for criteria and constraints within the designed world
- ☐ Define the materials and processes used in the manufacturing enterprise
- ☐ Identify, design, and produce a product to serve a need in the community.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ Students will participate in discussions and readings concerning modern manufacturing systems
    - Specifically, how technologies can be broken into systems in order to understand their purpose, operation, and maintenance
- ☐ Students will identify the origin and lifecycle of daily household goods
- ☐ Students will research ways that quality goods are manufactured at low prices

- ☐ Students will create and analyze how sequential instructions can be used to make an everyday process or task more efficient
- ☐ Students will create pictorial sketches of geometric shapes and apply concepts of measurement to product design
- ☐ Students will identify the constrains and limitations of an engineering design problem
    - Students will analyze and solve an engineering design problem through systematic analysis
- ☐ Students will identify and categorize resources into people, materials, tools, processes, energy, and information.
- ☐ Students will design, produce, and market a manufacturing project.

Machinery/Equipment/Materials:

Microsoft Office, Measuring tools, Materials for manufacturing project, Internet access

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

Unit 3 Safety

Students will learn all safety procedures and rules to safely operate lab machinery and tools. Further, the students will learn the procedures such as reporting illness and injuries. The students will also learn about using appropriate personal protection equipment.

Estimated Duration:

Safety lessons should be done early in the course and should be covered and enforced throughout the course.

Unit Competencies:

Upon completion of this unit, the student will:

- ☐ Describe the need for safe work environments in the Engineering and Technology Educational classroom and lab
- ☐ Describe specific procedures such as reporting illness, injuries, safety violations, etc.
- ☐ Use appropriate and required personal protection equipment
- ☐ Describe machine and tool safety practices and procedures.

Suggested Learning Activities:

The following student activities are suggested to support the content of this unit:

- ☐ The instructor will teach the students about several safety topics
    - Maintaining personal and workplace safety
    - Hazard avoidance
    - Safety information systems
    - Protective clothing
    - Fall protection
    - First aid
    - Ergonomics

- Environmental safety

☐ The instructor will demonstrate to the students specific work procedures such as reporting illness, injuries, safety violations, etc.

☐ The students will practice using appropriate and required personal protection equipment.

☐ The instructor will lead a discussion on machine and tool safety and demonstrate how to properly operate machines and tools

☐ Students will take and pass safety test to show competency in machine and tool safety.

☐ The instructor will design and post a set of rules for machine safety, personal safety, hazard safety issues, rules for horseplay, materials safety, combustible materials, etc.

☐ The class will operate tools and equipment in a safe and hazard free manner to the satisfaction of the instructor.

Machinery/Equipment/Materials:

Safety signs, Safety tests and study materials, Machines and tools to demonstrate safe operation, Personal Protection Equipment

Assessment Strategies:

Student's level of performance in this unit should be measured using the *Presentation Rubric* and the *Writing Rubric.* See ***Appendix A*** for assessment rubrics, checklists, guidelines, and suggestions. Review ***Appendix B*** for student *Technology Portfolio* materials and ***Appendix C*** for online resources.

APPENDIX A

ENGINEERING AND TECHNOLOGY EDUCATION

ASSESSMENT GUIDE
&
ASSESSMENT TOOLS

PERFORMANCE-BASED ASSESSMENT GUIDE

Performance-based Assessment

While standardized tests are the hallmark of public school assessment, because they are inexpensive and easy to administer, they are less than a perfect fit for a course like this one. While standardized tests are effective at measuring factual and contextual knowledge, they are largely ineffective in measuring students' skills or ability to apply concepts. Performance-based assessment techniques provide the teacher with a better tool for measuring both student understanding and ability.

Performance-based assessments allow for the student to be evaluated against a set of previously identified criteria while performing a task reflective of the intended learning. Performance-based assessment provides the teacher with information about how a student understands and whether the student can apply the newly gained knowledge. These assessments are often used to evaluate student application, performance, values, skills, and abilities against a given criteria. By their nature, performance-based assessments require the student to use higher-order thinking skills than do traditional standardized tests. Performance-based assessment is best suited for measuring student cognitive application and psychomotor ability. For example, performance-based assessment is very well suited for use during oral presentations, while working as a member of a team, while operating a piece of equipment, or while defending an action.

How is student performance measured?

Student performance is best measured using performance criteria. By creating performance criteria upfront (prior to the test) and sharing that information early, students understand exactly what will be expected of them on the performance test. Additionally, these criteria allow the instructor and student to evaluate the task as objectively as possible. The measure of well-designed performance criteria is criteria that would allow a substitute instructor to evaluate the student performance as accurately as the person who developed the performance criteria.

Four tools for performance-based assessment:

- Rubric: A rubric is a rating scale that shows to what degree a criterion is met. Most rubrics use a three to five column scale that allows the teacher to indicate whether the criteria were "not met" to “superior."
- Checklist: A checklist is a simpler version of a rubric and usually documents only whether or not certain criteria were met during the task.
- Portfolio: A portfolio is a graphic record of projects and activities completed by the student over a given period of time that illustrates how well a student has met the performance criteria.
- Project: A project is a tangible item that can be assessed based on performance criteria established at the beginning of the project assignment.

TEAM PERFORMANCE RUBRIC

The following rubric is designed to be used to assess student performance in teams.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category.* Criteria: 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Individual Responsibility: ***Contributed to the team and helped others in the group when finished with*** *their own tasks.*	**20**	**15**	**10**	**5**	**0**	
Individual Contribution: *Contributed to the success of the team and offered constructive feedback to other members during completion of team tasks.*	**20**	**15**	**10**	**5**	**0**	
Team Performance: *The team completed a task or finished a project accurately, on time, & according to specifications.*	**20**	**15**	**10**	**5**	**0**	
Team Function/Collaboration: *The team functioned at a high level—with all members carrying out specific roles and contributing equally.*	**20**	**15**	**10**	**5**	**0**	
Team Communication/Presentation: *Each member of the team contributed to an effective team output, presentation, or communication of effort.*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

ORAL PRESENTATION RUBRIC

The following rubric is designed to be used to assess student presentation performance.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category.* Criteria: 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Organization: ***Presentation was organized in a logical, coherent, and interesting sequence which the audience could follow.***	**20**	**15**	**10**	**5**	**0**	
Depth of Coverage: *Presentation demonstrated a full knowledge of the subject, and included explanations and elaboration—when appropriate.*	**20**	**15**	**10**	**5**	**0**	
Mechanics: *Presentation was free of errors, misstatements, misspellings, or grammatical errors.*	**20**	**15**	**10**	**5**	**0**	
Communication Aids: *Communication aids were clear, useful, and helped to explain or reinforce the content or idea.*	**20**	**15**	**10**	**5**	**0**	
Effectiveness: *Presentation was effective. The intended message was clearly delivered through the presentation.*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

WRITING RUBRIC

The following rubric is designed to be used to assess student presentation performance.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category.* Criteria: 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Content/Ideas: ***Writing is purposeful, confident, and clearly focused. It holds the reader's attention and includes relevant details and technical details when needed.***	**20**	**15**	**10**	**5**	**0**	
Organization: *Writing includes a strong beginning, middle, and end with clear transitions and a focused closure.*	**20**	**15**	**10**	**5**	**0**	
Mechanics: *Written work was free of errors, vocabulary errors, misspellings, or grammatical errors and included effective and engaging use of word choice.*	**20**	**15**	**10**	**5**	**0**	
Sentence Fluency: ***Consistent variety of sentence structure throughout****.*	**20**	**15**	**10**	**5**	**0**	
Content Knowledge: ***Demonstrates a thorough knowledge of the subject matter****. The intended message was clearly delivered through the written work.*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

FIELD TRIP/TOUR RUBRIC

The following rubric is designed to be used to assess student performance after completing a field trip or tour.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category.* Criteria: 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Field Trip/Tour Notes: *The notes are complete, accurate, based on the fieldtrip and class discussion, and or**ganized in a logical, coherent, and interesting sequence.***	**20**	**15**	**10**	**5**	**0**	
Written Report: *The written field trip/tour report was fact-based and contained no grammatical, capitalization, punctuation, or spelling errors.*	**20**	**15**	**10**	**5**	**0**	
Power Point Presentation: *The created Power Point presentation was based on a written report and included at least one picture from clip art, slide transitions, preset animation for each bullet, and a total of six slides.*	**20**	**15**	**10**	**5**	**0**	
Oral Presentation: *The oral presentation was enthusiastic and presented to the instructor and peers with a strong clear voice. Speaking at an understandable rate.*	**20**	**15**	**10**	**5**	**0**	
Effectiveness: *Presentation was effective. The intended message was clearly delivered through the presentation.*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

EQUIPMENT OPERATION PERFORMANCE RUBRIC

The following rubric is designed to be used to assess student performance when operating tools, machinery, and equipment.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category and then calculate the total score.* <u>Criteria:</u> 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Safety: *Demonstrated knowledge of appropriate safety practices and practiced using safe operating procedures.*	**20**	**15**	**10**	**5**	**0**	
Quality: *Produced products and projects of high quality while completing assigned tasks.*	**20**	**15**	**10**	**5**	**0**	
Accuracy: *Accurately completed assigned tasks within timeframes established by the instructor.*	**20**	**15**	**10**	**5**	**0**	
Operational Procedures: *Demonstrated accurate and appropriate use of the machine, tool, or process.*	**20**	**15**	**10**	**5**	**0**	
Craftsmanship: *Exhibited a level of craftsmanship expected of accomplished professionals in this area.*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

PROBLEM SOLVING PERFORMANCE RUBRIC

The following rubric is designed to be used to assess student performance when solving problems and case studies related to engineering and technology education.

Student Name:

Instructions: *Using the right-hand columns, mark the highest level achieved in each category and then calculate the total score.* <u>Criteria:</u> 20 = Superior Level Performance 15 = Accomplished Level Performance 10 = Intermediate Level Performance 5 = Beginning Level Performance 0 = Unacceptable Level of Performance						**TOTAL**
Function: *Does the solution meet original parameters and does it perform the intended function appropriately?*	**20**	**15**	**10**	**5**	**0**	
Quality: *Does the completed solution meet or exceed written or implied standards.*	**20**	**15**	**10**	**5**	**0**	
Accuracy: *Accurately completed assigned tasks associated with the problem within timeframes established by the instructor.*	**20**	**15**	**10**	**5**	**0**	
Craftsmanship: *Exhibited a level of craftsmanship expected of accomplished professionals in this area.*	**20**	**15**	**10**	**5**	**0**	
Response to Design Questions: *Did the team provide adequate responses to any questions (listed below)?*	**20**	**15**	**10**	**5**	**0**	
TOTAL POINTS						

SKILLS CHECKLIST

Write each learner's name in the column on the left. Write the process skills and content-area knowledge that learners should be able to apply to solve technological problems across the top row. Indicate the degree to which each learner can use the process and content skills to solve technical problems by making the following notations in the boxes where the columns and rows intersect:

"U" (Unacceptable) = Learner can't apply content and solve technical problems
"I" (Intermediate) = Learner can apply content
"S" (Superior) = learner can apply content to solve problems at a high level

PROCESS SKILLS/CONTENT AREA KNOWLEDGE

LEARNER'S NAME								

APPENDIX B

ENGINEERING AND TECHNOLOGY EDUCATION

INSTRUCTOR GUIDES, WORKSHEETS, ON-LINE RESOURCES, AND ACTIVITIES

INSTRUCTOR'S ROLE DURING PROBLEM SOLVING ACTIVITIES

The role of instructor once involved being the "bearer of information" or "imparter of knowledge." However, knowing all that we do about the best way to help people learn, your role as an instructor is more like that of a facilitator. You are there to direct and guide; to help learners question and interpret. Some of the responsibilities of instructors when facilitating are as follows:

- Provide the foundation for learning experiences. Instructors are responsible for setting up learning activities, providing learners with objectives, and then encouraging learners to explore and learn;
- Being a resource for learners. By helping learners find answers for themselves and directing them to information sources, facilitators encourage learners to become more autonomous learners – and less reliant on instructors;
- Maintain a safe environment in which learners can experiment;
- Lead discussions. Helping learners attain their goals without telling them the answers. By asking a learner to demonstrate a skill or state a principle, the facilitator is encouraging the learner to synthesize his own understanding and share that knowledge with their peers. Some questions that instructors might use to enable learners to express their ideas and reactions are:
    - "Are you saying that...?" (Asking about the learner's reasons)
    - "Why do you think…?" (Asking about the validity of the learner's statements)
    - "Couldn't it be right that...?" (Asking for supportive evidence)
    - "How do you know that ...?" (Asking for supportive evidence)
    - "How might we find out whether...?" (Asking for alternative possibilities)
- Ask questions. Believe it or not, this is one of the most difficult skills for instructors to develop. It takes a great deal of planning and effort to master the skill of questioning. Here are some strategies that many instructors have found helpful:

- When conducting a demonstration or discussion, prepare several key questions to get things rolling. This will also help assure that key points will be addressed;
- Ask open-ended questions; avoid those that can be answered with "yes" or "no;"
- Ask questions that require learners to think critically to explain their observations and draw conclusions. For example, in addition to asking recall questions (e.g., "How many bulbs lit up with one battery?"), ask learners to explain what they have observed (e.g., "Why is there a limit to the number of bulbs that will light up with one battery?"); synthesize what they have learned (e.g., "What can you generalize about all circuits?"); develop predictions based on what they understand to be true (e.g., "What would you predict will happen when more batteries are used?"); and apply what they have learned to other situations (e.g., "When planning electrical circuitry for a new building, what do engineers need to consider?");
- Sometimes try answering a learner's question with a question. This causes learners to think more critically and to solve problems on their own (or with other classmates);
- After asking individual or groups of learners a question, allow 5-10 seconds of wait time before talking, providing a hint, or calling on someone. This allows all learners to respond – even those who may be unsure of themselves and those who prefer to think answers through before talking about them.

STRATEGIES TO IMPROVE STUDENT TEAM PROJECTS

Many instructors are beginning to use team-based assignments as a major learning tool in school. One advantage of this instructional strategy is that it helps students to develop the social skills and abilities needed in today's energy industries. It also promotes independent thinking, collaboration, and problem-solving skills. Any instructor who has used team-based assignments in the classroom or laboratory knows that these assignments can be difficult to manage or evaluation. To overcome these potential problems, I suggest the following guidelines for team-based activity:

1. Generate Commitment: In many cases, the problems that occur during team-based activity can be traced to the lack of student commitment to the project. To generate commitment, try some of the following techniques:
   - At the beginning of the course, ask students to write down some transportation topics that they would like to work on during the course and then tie all team-based activities back to this list;
   - Use a similar technique to identify specific student interest areas and make team assignments based on that interest. For example, students particularly interested in GIS or GPS technologies could be grouped together on a team;

2. Teach the Teams to Manage: Another reason teams fail is that they do not know how to manage the affairs of a team. In short, they do not innately know how to use time wisely or how to divide tasks equitably. To develop these skills, spend time after the design activity has been assigned assisting the teams as they organize for the task. Specifically, ask the students to:
   - Elect a Team leader who is responsible for keeping the team moving;
   - List their respective skills and talents;
   - Identify majors tasks to be accomplished;
   - Establish a timeline, reporting times, meeting times, etc.;
   - Divide the labor that needs to be accomplished;

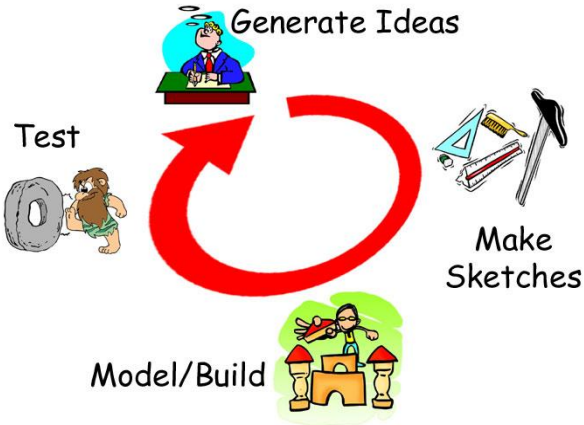
3. Trust Students to Manage Groups: Team conflicts can arise during activities and these can be consuming a great deal of time. One effective solution is to encourage students to manage their own team. If, for instance, a student is not completing their tasks because they are not attending school every day, inform the remaining team members that they should make decisions about whether that person should remain on the team. If they elect to remove that student from the team, they must make certain that they have documented the student's negligence of duties, and inform the student of their decision.

4. Involve Students in Grading: Grading team work can be a problem because students are accustomed to being graded as individuals. To overcome this problem, use the Team Performance Rubric **(see Appendices)** to evaluate both individual and group accomplishment. This rubric should be provided to the teams on the first day of the assignment and teams should be asked to review the evaluation criteria paying special attention to the fact that they will be evaluated both on individual performance and team function.

In conclusion, effective team-based projects build both knowledge and social skills. They also mirror in many respects the ways in which team function in the transportation environment. Seldom are managers excessively involved in micromanagement of workers, and workers are commonly involved (formally and informally) in the evaluation of each other. So, team-based learning help prepare the students for the workplace of the twenty-first century.

DESIGN BRAINSTORMING WORKSHEET

Directions: Complete the steps outlined below as you work with your team to design solutions to the transportation problem. Carefully consider the design challenge that you have been given, the research you have conducted, the questions you have asked and generate/record as many ideas as possible during the limited class time you have been provided. Record your ideas in the spaces below:



Sketches: After completing the brainstorming process, combine and refine ideas to make a final drawing or sketch as specified by your instructor.

Modeling/Prototyping: Use the drawing or sketch above to construct a model or prototype of your team product idea.

ENGINEERING AND TECHNOLOGY EDUCATION

LABORATORY REPORT FORMAT

Writing the Lab Report

In ETE classes, you will be conducting experiments that will require you to document what you have tried, things that you have learned, procedures that you have tried, discoveries made, as well as failures that may have occurred. The ETE Report Format will help you catalog all of your activity and document your learning experiences.

All lab reports must always be word processed or typed. In all cases where it is possible, figures and graphs should be generated on the computer and must be properly labeled with appropriate units titles.

Every lab report must consist of the following elements:

1. **Title:** Use a key word or phrase to describe the nature of the experiment, test, or laboratory activity;
2. **Purpose:** Using no more than one paragraph, explain the goals and objectives of the experiment. At some point in this paragraph, a hypothesis should be clearly stated;
3. **Introduction:** In no more than one paragraph, describe the experiment, how it was conducted, what materials were used, etc.;
4. **Methods:** In this section, include a step-by-step outline of the steps completed during the experiment;
5. **Results/Findings:** In this section, describe your findings, summarize any data generated, discuss whether or not the hypothesis can be supported, and include any tables or graphs needed;

6. **Conclusions:** In one paragraph or less, describe the most important things learned from the experiment, what the results told you, what else needs to be done in the future.

Note: Make sure that the author or authors properly sign the lab report and double check for any spelling or grammatical errors before submitting the report to your instructor.

TECHNOLOGY PORTFOLIO

Student *Technology Portfolio's* will be an invaluable part of all courses in the Engineering and Technology Education program. They will provide the course instructor with insights into the talents and abilities of individual students, and allow the student to validate and prove their work in these courses. It is recommended that these *Technology Portfolio's* be electronic, but they may be maintained in a binder as well. By using an electronic format, these student portfolios can include written papers, scanned or digital photos, laboratory reports, video and sound clips, drawings, animations, and student recordings.

The *Technology Portfolio's* should be concise, organized, and demonstrate the accomplishments of the student in the courses that they have completed. They should include the following components:

- A table of contents page that includes a photo of the student, a biographical sketch, a resume, and general information as well as folders for each course in the curriculum;
- Each course folder should include the following sections:
    - Written papers;
    - Homework;
    - Oral report outlines;
    - Multimedia presentations;
    - Photographs and animations;
    - Graded work;
    - Safety tests;
    - E-mail correspondence;
    - Test results
    - Career information;
    - Honors received.

- A summary page that is continually updated as the student progresses through the curriculum.

Use the following on-line resource to create student Technology Portfolio's for all students in your courses: http://electronicportfolios.com/portfolios/howto/index.html

This web site will walk students through the stages of development and allow them to end with a portfolio that they can use in all courses.

APPENDIX C

ON-LINE RESOURCES

ON-LINE RESOURCES

The following on-line resources are referenced in this document:

- A Brief History of Tools: http://www3.hants.gov.uk/museum/community-history/social-history-collections/hand-tools-history.htm
- All About Circuits: http://www.allaboutcircuits.com/vol_1/index.html
- Alternative Energy: (http://video.nationalgeographic.com/video/player/environment/energy-environment/alternative-energy.html)
- Alternative and Advanced Fuels: http://www.afdc.energy.gov/afdc/fuels/properties.html
- CareerSafe: http://www.careersafeonline.com/
- Classroom Energy: http://www.classroom-energy.org/energy_101/aaas_module/index.html
- Electricity Projects: http://www.allaboutcircuits.com/vol_6/index.html
- Electric Bike: http://www.electric-bikes.com/motor/cycles.html
- Energy Transformations: http://www.pbs.org/americanfieldguide/teachers/transportation/transportation_sum.html
- Garmin Base Camp: http://www8.garmin.com/support/download_details.jsp?id=4435
- Gears Invention and Design System: http://www.gearseds.com/curriculum/images/figures/Ojectives_Competenciesrev3.pdf
- General Safety Jeopardy Game: http://www.scribd.com/doc/5574327/Shop-Safety-JEOPARDY-TEMPLATE
- Geocaching: http://www.geocaching.com/
- GIMP - GNU Image Manipulation Program: http://www.gimp.org/
- Google Earth: http://earth.google.com/
- How to Create an Electronic Portfolio: http://electronicportfolios.com/portfolios/howto/index.html
- Microsoft Robotics Developer Studio: http://www.microsoft.com/robotics/#GetStartedStep1

- OSHA Power Tools Safety Handbook: http://www.osha.gov/Publications/osha3080.pdf
- OSHA Fact Sheets: http://www.osha.gov/pls/publications/publication.html
- Paint.net - Free Software for Digital Photo Editing: http://www.getpaint.net/
- Rotating Barrel Composter: http://www.solidwastedistrict.com/projects/bin_barrel.htm
- Rube Goldberg Design Challenge: http://nrc.ien.gatech.edu/sites/default/files/education/Design_Challenge_NT_Teacher_Prep.pdf
- Salary Expert: http://www.salaryexpert.com
- Simple Electric Motor: http://www.hilaroad.com/camp/projects/magnet.html
- Stirling Engine: http://www.geocities.com/therecentpast/
- Syringe Robot Activity: http://www.kyrene.org/staff/sreed/AMSITECH/activities/syrrob/syrrob1.htm
- The BOE-BOT: http://www.parallax.com
- Virtual Tourist: http://travel.excite.com
- West Point Bridge Designer: http://bridgecontest.usma.edu/
- Workmanship (NASA): http://workmanship.nasa.gov/
- World Trade Organization: http://www.wto.org