T&E Education Unit and Project Based Lesson Plan Template

Unit Plan	
Unit Topic: Wind Turbines	**Grade Level(s):** 7th

Introduction/Context of the lesson:

This unit of study introduces students to the Engineering Design Process through a project-based curriculum which uses the design and construction of a wind turbine to facilitate students' understanding of:

- Renewable & nonrenewable energy resources
- Electrical energy & electricity generation (develop understanding of what it is and how it works.)
- The physics of wind
- How wind energy is converted to mechanical and electrical energy.

Students will complete research, mini-labs, and the engineering design process through completion of the tasks outlined in their STEM journals (see accompanying journal inserts).

Time Requirements:

- 9 class periods / 70 minutes

Overall/Main Learning Objectives:

- Identify different sources of energy and that wind is a renewable energy source.
- Describe how a wind turbine works.
- Demonstrate how engineers work to monitor wind and design technology to capitalize on wind energy.
- Apply the engineering design process.

Unit Phases

GOAL
- What is the problem you must solve?

ASK
- What are the criteria for solving the problem?
- What information do you need to solve the problem?
- What are the constraints?

IMAGINE
- What are some solutions?
- Brainstorm designs.
- Choose the best one.

PLAN
- Make lists of materials you will need.
- Write a description of your solution/prototype.
- Draw and label a diagram of your prototype.

CREATE
- Follow your plan and construct it.

EXPERIMENT
- Test it out! Did the prototype do what you need it to do?

IMPROVE
- Talk about what works, what doesn't, and what can you change to make it work better.
- Troubleshoot your design/prototype to make it better.
- Retest it!

RE-EXPERIMENT
- Retest it! Analyze the results.

PRESENT
- Share the process and your findings

Challenge: Wind Turbines

Challenge Information	
Topic: Wind Energy	**Grade Level(s):** 7th

Introduction/Context of the lesson:
Essential Question: How can renewable resources be transformed into useful energy forms?
Enduring Understanding: Renewable, clean energy technologies can improve our quality of life, our future, and create significant economic opportunities.
Focus Question: How can I convert the energy of the wind into other forms of energy?

Challenge (Problem):

Your challenge is to design a device that uses the power of the wind to generate electricity. Your group will build your prototype using the supplied materials.

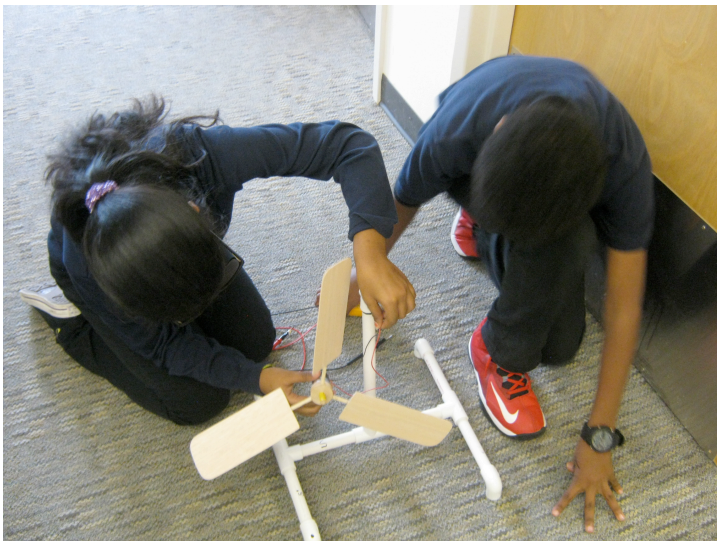
You will research types of energy, renewable and non-renewable energy sources, electrical energy measurement and transformations, wind turbines, and how wind turbines function. On completion of this project you will be able to explain the use of wind power as a renewable resource, build a model windmill and test the types of changes that will increase efficiency. Your group will be will be assessed on the prototype's performance, use of the engineering design process, teamwork, and a group presentation.

Time Requirements:

- 9 class periods / 70 minutes

Learning Objectives:

- Identify different sources of energy and that wind is a renewable energy source.
- Describe how a wind turbine works.
- Demonstrate how engineers work to monitor wind and design technology to capitalize on wind energy.
- Apply the engineering design process.
- Research designs of wind turbines and blade designs.
- Analyze the advantages and disadvantages of different blade designs.
- Identify the name and function of the parts of a wind turbine.
- Construct and describe a electric circuit.
- Identify at least 5 sources of renewable energy.
- Evaluate the advantages and disadvantages of 5 renewable energy sources.
- Design and construct a unique wind turbine.
- Measure the electrical current generated by the wind turbine with a multimeter.
- Improve the quantity of electricity generate and calculate the efficiency of the wind turbine.
- Troubleshoot and redesign the turbines to make them more efficient.



Standards Addressed: (Maryland)
STANDARDS COVERED

ELA
SL4 CCR Anchor Standard
Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style that are appropriate to task, purpose, and audience.

Math
7.EE.3: Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically; apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

7.G.1: Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Science
Core Idea ETS1: Engineering Design
ETS1.A: Defining and Delimiting an Engineering Problem
ETS1.B: Developing Possible Solutions
ETS1.C: Optimizing the Design Solution
Core Idea ETS2: Links among Engineering, Technology, Science, and Society
ETS2.A: Interdependence of Science, Engineering, and Technology
ETS2.B: Influence of Engineering, Technology, and Science on Society and the Natural World

Maryland State STEM Standards of Practice
1. Learn and Apply Rigorous Science, Technology, Engineering, and Mathematics Content
2. Integrate Science, Technology, Engineering, and Mathematics Content
3. Interpret and Communicate Information from Science, Technology, Engineering, and Mathematics
4. Engage in Inquiry
5. Engage in Logical Reasoning
6. Collaborate as a STEM Team
7. Apply Technology Strategically

School Library Media State Curriculum
1.0 Define and Refine Problem or Question: Students will be able to follow an inquiry process to define a problem, formulate questions, and refine either or both to meet a personal and/or assigned information need. (AASL 21st 1)
2.0 Locate and Evaluate Resources and Sources: Students will be able to follow an inquiry process to identify, locate, evaluate, and select resources and sources in a wide variety of formats to meet the information need in an ethical manner. (AASL 21st 1)
3.0 Find, Generate, Record, and Organize Data/Information: Students will be able to follow an inquiry process to find, generate, record, and organize information relevant to the information need in an ethical manner. (AASL 21st 1)
4.0 Interpret Recorded Data/Information: Students will be able to follow an inquiry process to interpret recorded data/information to create new understandings and knowledge related to the information need in an ethical manner. (AASL 21st 2)
5.0 Share Findings/Conclusions: Students will be able to follow an inquiry process to share findings/conclusions in an appropriate format to support written, oral, and multimedia information products and evaluate the products and the processes in an ethical manner.

STL Content Standards
Design
Standard 8. Students will develop an understanding of the attributes of design.
Standard 9. Students will develop an understanding of engineering design.
Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Background/Prior Knowledge/Prerequisite

- General knowledge of wind energy
- General knowledge of renewable and non-renewable resources

INSTRUCTIONAL DETAILS

Suggested Materials and Resources (list ALL resources needed to teach the Unit):

- Computer and access to the internet for students to conduct research.
- Projector and document camera for demonstrations.
- Wind Turbine materials - (balsa wood sheets – variety of thickness, dowel rods, hubs – Tinker Toys work well)
- Tools - hot glue guns, coping saws, wire strippers, needle nose plyers, multi-meters, scissors, rulers, carpet fan)
- Electric circuit materials – motors, wires
- Wind gauge

Instructional/Pedagogical Strategies (list all used):

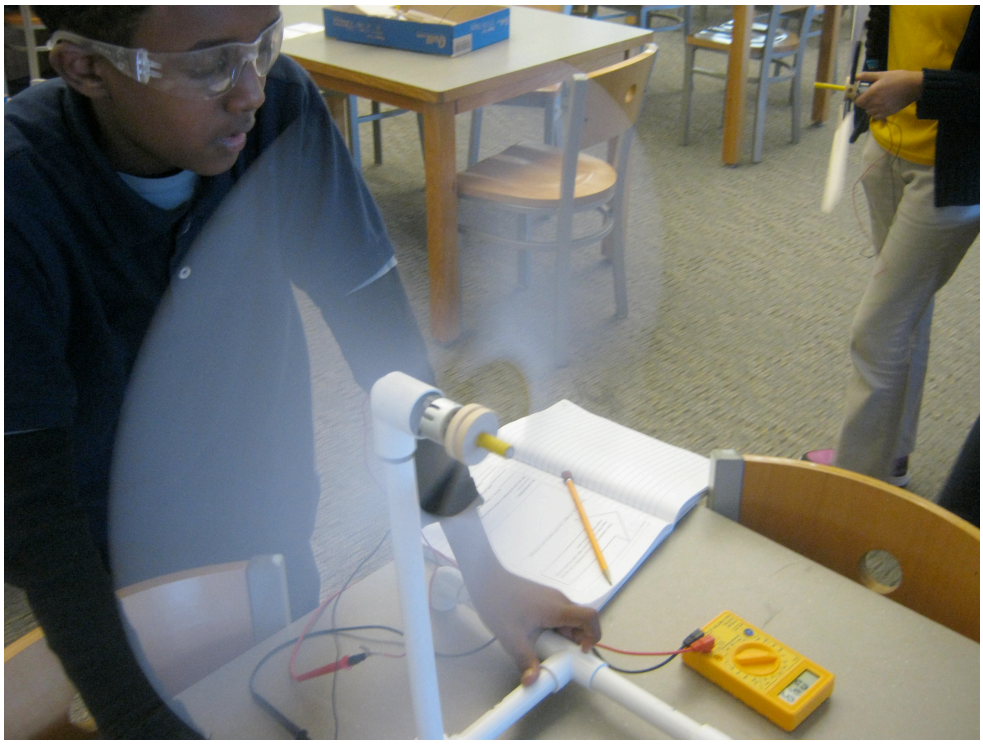
- Project Based- Project-based learning (PBL) is a student-centered educational approach that organizes learning around projects. When engaged in PBL, students in small learning groups work together to meet a specific outcome/goal over a period of time through asking and refining questions, debating ideas, making predictions, collecting and analyzing data, drawing conclusions and communicating their ideas to an audience. In PBL, the project is central to the curriculum and is thought to drive the learning. To be considered PBL, projects must be structured in a manner which engages the students in a community of inquiry. Together in this community the students focus on questions that drive them to encounter the central concepts and principles of a subject. Essentially, the project must help students to meet a complex challenge, develop and present an answer to a central question. The overall goal is to create a high quality product and/or performance which will be delivered to an audience. Projects are to include authentic, engaging content which help students to build 21st Century skills such as collaboration, critical thinking and communication. (http://www.udlresource.ca/?p=2822)
- Mini-labs & demonstrations as needed

Teacher Preparations:

- Gather materials, tools & build wind turbine stand.
- Set up mini labs.
- Make copies of handouts for students.

Accommodations/Modifications:

- Small group and individualized instruction.



5E LESSON PHASES	
Explain What Teacher Does (Include time needed)	**Explain What Student Does** (Include time needed)
ENGAGE: DAY ONE - *Attention Grasping Activity (The hook)* • View a brief video clip on renewable energy resources. (Part Fourteen: Fleeting Energy – Wind Power) • http://www.gdse.gov.mo/eng/GDSE_Pages/vdo/gs/gs.htm • As a group - Discuss role of renewable resources in our world today. • Introduce challenge.	*Shows interest* • As a group establish the GOAL (Big Idea), criteria and constraints for the challenge. Generate questions about the process, content and/or product.
EXPLORE: DAY TWO - *Testing Prior Knowledge* • Monitor students' progress as they research wind turbines, renewable energy and electricity through simulations, websites and hands-on labs.	*Generates Ideas/Reaffirms prior knowledge or informs misconceptions* • After reviewing the challenge students supply the GOAL, criteria and constraints for the challenge. • Students collect information through research, video clips, animations, simulations and mini-labs.
EXPLAIN: DAY THREE - *Deliver Content/Inform Students* • As students progress monitor for misconceptions and provide mini-lessons to whole, or small groups. • Model steps of the engineering design process.	*Develops New Knowledge* • Complete the background and vocabulary sections of their journals. • Students document their learning in their STEM journals.
EXTEND: DAYS FOUR & FIVE- *Application of the Content* • Assess students' understanding of the engineering design process through observation and evaluation of their STEM journals. • Model steps of the engineering design process.	*Applies content knowledge through the engineering design process* • Students apply the IMAGINE (brainstorm), PLAN (design), and CREATE (construct) steps of the engineering design process and record the steps of the process in their STEM journals.
EVALUATE: DAYS SIX, SEVEN & EIGHT *Checking for Understanding* • Monitor students' progress as they test their prototypes and gather data. • Model next steps of the engineering design process. • Review rubric for the presentation with the whole group. • Provide support and mini lessons as needed.	*Demonstrates knowledge gained* • Students will test their prototype to evaluate if it meets the criteria of the challenge (EXPERIMENT), identify modifications (IMPROVE), and test the iteration (RE-EXPERIMENT). • Students will plan and create a presentation to share the prototype, the data, and the content on day nine.
Helpful Hints? • Establish a timeline to guide students' work pace. • Teach safety procedures and expectations. Use a safety contract. • This project progresses best in a workshop type atmosphere. Meet at the beginning of each class to review progress and set daily goals.	