

# Canyon Springs STEM Academy

## STEM Lesson Plans

**Lesson Plan Title:** Wind Turbine Design Challenge

**Date(s):** 2-3 Weeks

**Grade Level:** 5th Grade

**AZ State Standards:** **Next Generation Science Standards:** 3-5th Grade: 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. 3-5-ETS1-2: Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment. HS-PS3-3 Energy: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

**Social Studies: 5th Grade. Strand 5: Economics; PO 4.** Describe ways in which entrepreneurs take risks to develop new goods and services

**Math: 6th Grade. Geometry. 6.G.A.4** Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques to solve mathematical problems and problems in real-world context.

**Other Concepts addressed:** angles, scale, measurement, renewable and non-renewable energy resources

**State the Problem Students will Attempt to Solve:** **DOK (Check or bold all that apply)**

A young boy in Malawi, Africa designed and built a wind turbine to help his village (we will read a story about why and how he did it). Students- You must now utilize the materials that we give you (like what William (the young boy) had. You must now figure out: How can we harness wind energy to produce the most electrical energy?

- 1: Recall & Reproduction** (list, ID, repeat, tabulate, recognize, match, measure, illustrate, label, name)
- 2. Basic Application of Skills & concepts** (infer, modify, predict, construct, interpret, cause/effect)
- ✓ **3. Strategic Thinking** (revise, assess, construct, compare, hypothesize, formulate, critique, investigate)
- ✓ **4. Extended Thinking** (design, connect, synthesize, apply concepts, create, analyze, prove)

**STEM Practices (Check or bold all that apply)**

### Science

- ✓ Ask Questions
- ✓ Develop and use models

### Technology

- ✓ Access and gather information
- ✓ Conceptualize,

### Engineering

- ✓ Define the problem
- ✓ Research the problem

### Math

- ✓ Make sense of problems and persevere in solving

- |  |                          |                                 |  |
|--|--------------------------|---------------------------------|--|
| ✓ Plan and carry-out investigations            | model and solve problems | ✓ Brainstorm possible solutions | them   |
| ✓ Analyze and interpret data                   | ✓ Communicate findings   | ✓ Choose the best solution      | ✓ Reason abstractly and quantitatively   |
| ✓ Use mathematical and computational thinking  |                          | ✓ Build a model or prototype    | ✓ Construct viable arguments and critique the reasoning of others              |
| ✓ Construct explanations                       |                          | ✓ Test solutions                | ✓ Model with mathematics   |
| ✓ Engage in arguments from evidence            |                          | ✓ Communicate solutions         | <input type="checkbox"/> Use appropriate tools strategically                   |
| ✓ Obtain, evaluate and communicate information |                          |                                 | ✓ Attend to precision  |
|  |                          |                                 | <input type="checkbox"/> Look for and make use of structure                    |
|  |                          |                                 | <input type="checkbox"/> Look for and express regularity in repeated reasoning |

### Learning Activities

**Imagine:** Students will read the story about William Kamkwamba in Malawi, Africa and then design and create a Wind Turbine given specific tools.

**Plan:** Students will research and participate in different stations to build background knowledge: Station 1: Exploring electrical energy by building a simple circuit. Station 2: Creating light by using a hand generator, then distinguish the difference between a generator and a motor. Station 3: What is a windmill and what is the main use? Station 4: What is a wind turbine? After completing discussion questions citing research and experience, students will design a roto system design. What are some of the challenges? What is a complete electrical circuit? How do generators work? How can we transform energy? Which blade shape will catch the most wind?

**Create:** Students will be given specific materials and utilize exact measurements from their design to create blades specific to the designed surface area, as well as build the wind turbine to catch wind from a fan and generate electricity.

**Improve:** Students will test and analyze their wind turbines at four different fan speeds multiple times, collecting mV and mA data. Once the data is analyzed, students will suggest areas for improvement and redesign/make improvements.

Next Steps: Students will code, design, and print actual blades on our 3-D printers to scale.

**Materials Needed:** Cardboard, tape, skewers, washers, cup, platform, small engine, multi-meter, leads, load

**Performance Task** (Assessments: What are the key observable indicators of progress? What will count as evidence of success?)

## Turbine Design Rubric

### Criteria: 10pts

How well does the turbine fit the competition criteria?

### Use of Time: 15pts

How much productive time did you spend working on the challenge? Did you work until the time ran out?

Did you work extra hours (for bonus points)? Regular Points= 0-15. Bonus Points= 16-18.

### Revisions: 15pts

What was the quantity and quality of your design revisions?

### Innovation: 20pts

How unique and creative was your design and revisions? Regular Points= 0-20. Bonus Points= 21-15.

### Performance: 15pts

How did your turbine output compare to the output of other turbines in your class? Higher Output = More points.

### Documentation: 15pts

Did you carefully document the engineering process using note sheets?

### Spirit: 10pts

Did you demonstrate energy and enthusiasm for the project? Were you cooperative and helpful to your teammates and competitors?

**Student Provided Score (Self-Score):**

**Teacher Provided Score:**