NSF Sustainable Energy Grant RET Lesson

Lesson Title: Wind v. Solar Power	**Grade Level/Subject:** 7th Grade Science, Advanced
Maximum # of Students: Students in Classroom	**Total Time Required:** 5 Class Days

Prior Knowledge Needed: Knowledge of Connective and Potential Energy and Energy Transformations: (Chemical -> Mechanical -> Electrical)

Materials and Preparation:

- Pencils
- Scissors
- Pencil Sharpener
- Multi-Coloured Cardstock Paper
- 20"x20" standard box fans)
- Nacelles (tank for something on the outside of a motor vehicle/aircraft)
- Screw hubs
- Mini generators
- Acorn hex nuts
- Propellers
- Tubing
- Solar panels (2V 400mA)
- Multi-meters
- Assorted LEDs
- Solar motors
- Pairs of clamp wires
- Wire strippers
- Protractors

Performance Objectives/Learning Targets:

- Students will design a working wind turbine (Firefly), and a solar power model which will be used to power a source of light.
- Students will use various materials to learn about different wind speeds and how it generates electricity.
- Students will compare the quantitative and qualitative data to construct an argument to justify which of the two power sources is generates the most energy.
- Students will generate as much electricity as possible from their wind wheel designs and solar powered designs and determine which one of these renewable energies provides the most power (electricity).
- Students will create a chart for the data collected throughout the experiment.

Standards:

7th Grade (7) Earth and Human Activity

7.ESS3.4 Construct an argument supported by evidence for how increase in human population and per-capita consumption of natural resources impact Earth's systems.

Clarification Statement: Examples of evidence include grade-appropriate databases on human populations and the rates of consumption of food and natural resources (such as freshwater, mineral, and energy). Examples of impacts can include changes to the appearance, composition, and structure of Earth's systems as well as the rates at which they change. The consequences of increases in human populations and consumption of natural resources are described by science, but science does not make the decisions for the actions society takes.

Assessment Boundary: N/A

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Engaging in Argument from Evidence • Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or model for a phenomenon.	Human Impacts on Earth Systems • Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.	Cause and Effect • Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Lesson Procedure

Before:

- To begin the lesson, the teacher will motivate students by showing two models. One model will be a wind turbine and the other model will be solar panels powering a light. Then ask questions such as: "Do you think solar or wind generates more energy?", "Why do you think Oklahoma uses more wind energy than solar energy?", "What kind of experiment could you do to test the power of a solar model v. a wind model?"

	• Next, students will choose which model they THINK will be the most power generating. (1-2 minutes) (note: they will only be able to observe the models nothing will be touched or handled; lights will be on) • After their choice, the students will then move to opposite sides of the room depending on choice. In their two separated groups, students will discuss their choice, why they chose it, and any other information they know about their choice. (3 minutes) • Then, students will partner up with someone of an opposing view. They must defend their answer! (Make sure students know that this is not to inspire arguments but to inspire different thoughts and views, it is OK to agree to disagree) (5 minutes) • Students may switch sides only once, however, the choice made after the opening is the choice they will base their hypothesis upon. • Teacher will begin lesson presentation. (Wind v. Solar Power Lesson Presentation Link)
During:	• During the first half of the activity, students focus on understanding the fundamentals of a wind turbine through hands-on building and design. The second half of the activity is adjusting variables in design in order to accomplish two goals: 1) getting their Wind Wheel design to spin as fast as possible, and 2) to light the LED with the spinning Wind Wheel. Firefly Activity Guide Link • This is a step-by-step activity guide that will take two 45-minute class periods to complete. During the first-class period, students will learn about solar panels and how to use them, and during the second they will learn how to measure their results. Solar Scavenger Hunt Activity Guide Link
After:	• After students have completed their guided practice, they will then re-evaluate their design and come up with their own ways to improve their design to make it generate more power using a multi-meter to check. Wind: use change blade design, change blade pitch, change distance from fan. Solar: Change distal • Students will demonstrate their solar models and their experiment findings. Their design must also be able to power a light. How much power is needed for making the light bulb light up? (Students will be testing this with the multi meters.) • Students will demonstrate their Firefly models and their experiment findings. How much power is needed for making the light bulb light up? (Students will be testing this with the multi meters.) • To close the lesson, Students will complete a chart throughput the process to change and test three variables to try to receive the highest amount of power from the activity. Once students have performed both activities, they will compare their data to determine which source received the most power. • Throughout this lesson students learned how rotational movement is used to convert wind power into electrical energy, which can power a load like a light. Students now understand how solar panels work, where they work best, and what variables affect their productivity. • Students also compared the power generation of two renewable resources wind and solar. They designed their own models to determine which one generated the most energy and then presented their findings while also conducting their own experiments to improve overall design and power generation.

5E Model: *Engage, Explore, Explain, Evaluate, Elaborate*

- Engage: The *Before* section of the Lesson Plan. Students will be shown two models and be asked inquiry-based questions. Shown Above.
- Explore: The Firefly and Solar Scavenger Hunt Activity (Firefly Activity Guide Link), (Solar Scavenger Hunt Activity Guide Link)
- Explain: Explicit Teaching of Lesson (Wind v. Solar Power Lesson Presentation Link)
- Evaluate: Wind v. Solar Power Lesson Worksheet (attached below)
- Elaborate: Discussion after activities over which source generated more energy.

Extensions:

- To extend the lesson, students they will be allowed to make changes to their design models such as use different materials, design their own blade design, or adjust the pitch speed of their creation.

Differentiation:

- For upper-level students, they can follow the extension above.
- For on level and lower-level students, they will able to make one change to their design models.
- Lower-level students can be paired with upper-level students.
- ELL students will be paired (depending on their level of ELL) with higher level ELL students. I.e.: 2s and 3s paired with 4s and 5s (based on the Language acquisition ACCESS scores)

Wind vs Solar Power lesson worksheet

Wind

Blade design	Distance from Fan (cm)	Pitch Angle (use protractor)	Multi meter reading

Once Chart is completed CIRCLE the highest multi-meter reading!

Solar

Light Source	Distance from light (cm)	Angle to light (use protractor)	Multi meter reading

Once Chart is completed CIRCLE the highest multi-meter reading!