**Lesson 6: Evaluate Farm Design**

**Problem Statement:**

“Dear Diary,

Mom and Dad said that we have to move to the country because we want more space and they want to be someplace quiet. I don’t know where we are planning to move but I know I’m sad that I’m leaving my friends. Mom says I can still chat with them online, and my computer and XBOX will be powered by poop! LOL!!

I’m really wondering how I can power my XBOX with poop. Do I just plug it into a pile of poop? I think living on a farm I’ll have a lot of chores. I wonder what I’ll have to do.

My parents said there will be lots of ways for us to get power for our house. We can use solar panels, wind turbines (whatever those are!) and even something called a “digester” that can break down poop (and some other materials) and use it for power. Wow! We can even use falling water to make power. Mom and Dad says we will be able to get all the power we need without even needing to get electricity from the city. They even said living like this will be better for the environment and we’ll be polluting less. How in the world will we be able to do this?

I’m really excited to learn about how sun, wind, and poop can make power. I also can’t wait to have so many animals! Plus, my parents said I get to actually help design the self-sustaining farm! I guess I’ll give it a try.”

**Learning objectives:** Students will be able to evaluate how much electricity their farm house items are consuming and how their renewable energy sources are supporting.

**Lesson standards (NGSS, CCSS, CTE):**

**NGSS**

* 4-PS3-4. Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.

**CCSS**

* 4.NBT.B.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations.
* W.4.7 - Conduct short research projects that build knowledge through investigation of different aspects of a topic
* RI.4.3 - Explain events, procedures, ideas, or concepts in a historical, scientific, or technical text, including what happened and why, based on specific information.

**Soft skills:**

Collaboration, information literacy, oral & written communication, creative thinking, environmental awareness

**Locally and/or personally relevant for students:**

* Personally Relevant: materials used to build a home, knowledge of the standard Western lifestyle
* Locally Relevant: begin to think about different sources of energy; where their own energy may come from; generating interest and knowledge for future job opportunities

**Connections to career and educational pathways:**

* Students are engaging in the engineering and design processes by developing solutions to a problem and testing the theory to refine their designs.
* Students will gain an interest in STEM fields by designing sustainable homes and learning about the benefits of renewable energy versus the way we use energy in our traditional homes.

**Materials:**

* Pencil/eraser
* Science notebook
* Farm Design from Lesson 5
* Wattage estimations from Lesson 5
* Power Demands of Household Items sheet, 2 per group

**Lesson preparation:**

**Time required:** 45 minutes

**Grouping of students for instruction:**

Same groups as Lesson 5

**What is the instruction? Consider the PBL Procedure that is being addressed here:**

**Understanding the Problem**

|  |  |
| --- | --- |
| **Teacher** | **Student** |
| 1. Tie-in from lesson 5    1. Teacher will explain that today the class will compare and contrast the amount of energy that is consumed with the amount of energy that is being generated.    2. Teacher will ask how that connects to the previous lesson.   1.1 Career option: Electrician - what is wattage? | Students will briefly turn and talk. They should make the connection that Lesson 6 is an extension of Lesson 5’s activity where they calculated the amount of energy that would be used in their farms. |
| 2. Teacher will provide groups with an energy consumption table with wattage AND renewable energy estimation table. Use teacher example to show how to calculate using the tables. | Students will work in assigned roles within each group. Each person will have specific household items to look up based on their previous lesson’s farm design. Students will write down the energy consumption of each item on a sheet of paper.  After looking up all of the household items on their list from Lesson 5, students will calculate the differences between their energy consumption and renewable source generation.  NOTE: Encourage students that need additional math support to work with a partner so they can calculate accurately and efficiently. |
| 3. Have students calculate their total energy consumption and compare with their total energy generation. | Students will brainstorm what they already know about energy consumption and energy generation (from previous lessons or from real-world experience) that will help them make accurate predictions about how these things will compare. |
| 4. Ask “What observations do you have on the difference between the amount of generated energy vs. the amount of consumed energy? Give 3 examples.” Teacher will display this question for the class to see, either using a projector or a whiteboard.  Teacher will circulate the room, checking in with each group to listen to their observations. The teacher should also ask students which items on their list they are going to pick and why.  Teacher will engage in a class-wide discussion and ask the class to share their findings on popular household items.   1. Ask “Why is there a difference? Is that ok?”    1. Teacher will record students’ predictions on why there are differences between the consumed energy and the produced renewable energy. | Students will talk in their small groups to discuss what they notice. Then, each group will identify 2-3 items on their list of home items that support their thinking.  Students will share their observations with the class. Their comparative research should show students that that the consumed power exceeds the renewable energy.  Students will brainstorm as a class what they already know and what they need to know to identify the difference. Solve the problem of having a gap. |
| 5. Ask “What kind of items would you add or remove from your farm house in order to make it all work?”  Next lesson - Revise Design | Students will work in their small groups to identify the household items that would be absolutely necessary for their household. |

**Accommodations:** Heterogeneous groupings and partnerships

**Extensions:**

Research additional energy consumption of items not listed. Perform as needed

Energy Use Calculator website (see below)

**Assessment:**

* Formative Assessment: Check for understanding--students can make revisions to designs based on calculations to have enough energy to power their designs.
* Summative Assessment: Revisions produce enough power to power their designs.

**References/Resources:**

Power demands of household items chart

[Solar Panels Photovoltaic](http://solarpanelsphotovoltaic.net/author/SolarPanelsPhotovoltaic/) On November 18, 2013 [http://solarpanelsphotovoltaic.net/power-consumption-101-typical-household-appliances](http://solarpanelsphotovoltaic.net/power-consumption-101-typical-household-appliances/)Power

Energy Use Calculator: http://energyusecalculator.com/index.htm

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