**Lesson 2: Diving Into Poop**

**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 understand that electricity requires energy.

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

**NGSS**

* 4-PS3-1 - Use evidence to construct an explanation relating the speed of an object to the energy of that object.
* 4-PS3-2 - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
* 4-ESS3-1 - Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.

**CCSS**

* CCSS.ELA-LITERACY.SL.4.1.A Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.
* CCSS.ELA-LITERACY.SL.4.1.B Follow agreed-upon rules for discussions and carry out assigned roles.
* CCSS.ELA-LITERACY.SL.4.1.C Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.
* CCSS.ELA-LITERACY.SL.4.1.D Review the key ideas expressed and explain their own ideas and understanding in light of the discussion.
* CCSS.ELA-LITERACY.W.4.8 Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

**Soft skills:**

Listening, troubleshooting, working independently, collaboration, transferring information and using it for personal application, communication (written and oral)

**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:**

* Team Folders from Lesson 1
* Consensus List from Step 6 of Lesson 1
* Way to show Bill Nye Youtube video: <https://www.youtube.com/watch?v=8qmSzMwTkpk>
* Bill Nye Handout

**Lesson preparation:**

**Time required:** 45-50 minutes

**Grouping of students for instruction:**

Students will be in the previous groups from Lesson 1. Grouping should be heterogeneous, based on participation and language needs.

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

**Understanding the Problem**

|  |  |
| --- | --- |
| **Teacher** | **Student** |
| 1. Reread the Problem Statement and revisit Lesson 1 Designs. 2. Revist guiding question from Lesson 1:  “Now that you’ve come up with these great designs for your sustainable homes, we need to determine how much power we need for our homes. What items in your home will need power?” 3. Compile class list of household appliances and items that require energy. Start a list of these on a chart with students (3-4 items from each group; chart responses that are items powered by electricity).  \*If students suggest items that are not powered by electricity, have guided discussion questioning if it belongs on the list of electrical items.    1. If necessary for your class, you might consider having students generate list of appliances by room. For example, “What appliances might you want in the kitchen? Living room? Bathroom?” etc. (See sample list at the end of this lesson plan.) 4. Ask students, “What powers these things?” 5. Ask students, “Where does electricity come from?” | 1. Revisiting Problem Statement as a whole class.   2. Students will sort or highlight items that require energy from their list of items (from Lesson 1) to help them identify the items that require energy. First they will work in small groups to organize the list, then they will share their thinking with the whole class.  3. Each group shares out 3 to 4 items of electrical items for their designs.  4. Answer: Electricity  5. Facilitate student led discussion on what their best description is for electricity and where it comes from. |
| **6. Bill Nye video about Energy**  <https://www.youtube.com/watch?v=8qmSzMwTkpk>  Bill Nye video: start at 7 min 40 seconds; stop video at 9 min 50 seconds   * Do a turn and talk: Ask “where does energy/electricity come from?” * Students should name:   + falling water (hydro)   + Solar   + Heat from burning coal   + Nuclear power and atoms   + Wind * Energy from these sources move a “turbine.” The turbine spins and generates electricity   Bill Nye video: start again at 11 min 10 sec; end at 12 min 15 sec (discussion on how electrical energy is transformed to other types of energy - example light, heat, and motion)  \*\*Optional: Bill Nye video (at 9 min 50 sec to 11 min 10 sec): talks about dams and how they generate electricity\*\*  \*\*Optional: Bill Nye video: start again at 14 min 59 sec; end at 16 min 4 sec (discussion of energy from oil/fossil fuels)\*\*  \*\*Optional: Bill nye video: start at 16 min 4 sec; end at 18 min 16 sec or end of video (at 22 min 52 sec) - discussion on human body generating energy from food\*\*  \*\*\*Optional: Energy 101 Electricity Generation Video\*\*\*  <https://www.youtube.com/watch?v=20Vb6hlLQSg> | 6. Students receive handouts  Students watch (Bill Nye video) and work on handouts |
| **7. Debrief video: Make it about ENERGY**  Teacher will give students 2-3 minutes to reflect on the information they saw in the video and complete the worksheet.  **Teacher will engage in group-wide discussion to review the answers to worksheet.** | 7. Students will take 2-3 minutes to finish the handout based on the information from the Bill Nye video.  Students will share out their responses. |

**Potential Videos:**

**Off-Grid Living:** [**https://www.youtube.com/watch?v=aansFzgV1SQ**](https://www.youtube.com/watch?v=aansFzgV1SQ)

**Self Built and Off the Grid:** [**https://www.youtube.com/watch?v=T8sIoACCN2Y**](https://www.youtube.com/watch?v=T8sIoACCN2Y)

**Accommodations:**

Heterogeneous groups and partnerships

**Extensions:** Ask students to research where their state (or community) gets most of its energy or electricity from, i.e. the state of Washington gets its power mostly from hydropower.

Optional Hands-on Activity: Homemade Turbines (modify as needed)

https://frugalfun4boys.com/2017/04/07/weather-science-build-wind-turbine/

**Assessment:**Formative Assessment: Observation of student conversations during before, during, and after the Bill Nye video.

**References/Resources:**

YouTube Video Resource: Bill Nye the Science Guy: Energy

<https://www.youtube.com/watch?v=8qmSzMwTkpk>

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