Community in the Classroom Presentation Plan

Lesson Name Energy, Energy Conversion, and Efficiency

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Grade Level 3 **Standards Connection(s)** energy from sun, energy storage, combining substances makes new substances, energy can be converted into many forms

Abstract:

This activity will teach kids where energy comes from and how it is stored, some ways energy is transformed from one form to another, and introduce the idea of "efficiency" when transforming energy. We'll do small group experiments with common materials (candles, lightbulbs, batteries) to demonstrate changing states of matter and energy transformations.

Vocabulary/Definitions:

Energy – we get this mostly from fossil fuels – can be electricity, light, heat, motion
Fossil Fuels
Efficiency
What scientists do – hypothesis, observation, experiment

Materials:

- *Handout for students to take home with them about ways to be more "efficient"—it's really conservation, but the idea is similar.*
- *(Students don't need to bring any supplies)*

For stations:

- *Vinegar, baking soda, bucket if there's no sink, a clear tube to do the reaction in, small piece of paper*
- *Compact fluorescent and incandescent lightbulbs with sockets on cords. 2 thermometers. Electric outlet*
- *Battery with extended wire leads. Small container with tap water. Lighter.*
- *Candle. Salt solutions (1 molar is about the right concentration). Qtips.*

Classroom Visit

1. Personal Introduction: 5 Minutes

Hi, we're students at UC Berkeley! We really like science, and get to do experiments in school! (each person says a sentence about what they do). Today we're going to learn about energy.

Topic Introduction: 5 Minutes

What is energy? Energy is the ability to produce heat, light, or do useful work.
Where does it come from? Energy comes from the sun originally, but we turn that energy from the sun into many different forms.
What are some ways energy is stored? In plants, and we eat the plants to get energy for our bodies. In fossil fuels like coal and oil. In chemicals, electricity, heat, and light.

2. Learning Experience(s): 35 Minutes

4 stations, each for about 5-10 minutes. Lets investigate how energy is transformed from one type to another. Emphasize lab safety, like tying long hair back and keeping lose clothing out of the way.

1. (Oz) Transforming states of matter through chemical change. Mixing vinegar and baking soda in a clear glass over a bucket or sink. Use a spoon to stir so everything reacts. Explore concepts: solid, liquid, gas. Sometimes when you combine substances (a liquid and a solid here) you can get a new substance (here it's a gas). Let's observe what happens here: what do you see forming when we combine the solid and liquid? (bubbles) What's in a bubble? Is it a solid or a liquid? How else could we test for a gas? (get ideas from kids) If you have a long tube you can put a piece of paper over the end and see the gas expand to move the paper. Have the students put their

hands over the tube. [The reaction releases heat, so hopefully they'll feel the tube warm up. This is an example of combining substances to get a new substance, and transforming the energy in the chemicals to heat.] Also combine water and baking soda to show that not all solids and liquids react. The reaction occurs because there's energy in each of the chemicals.

2. (Allen) Transforming electricity to light and heat (efficiency) Compare the temperatures of a CFL and incandescent lightbulbs. Lightbulbs use electricity, a form of energy. What do we use lightbulbs for? (to produce light) Do we use lightbulbs to produce heat? No, in this case, heat is not good. So which lightbulb do you think works better, one that produces more heat or one with less heat. The one that produces less heat. These two lightbulbs use the same amount of electricity coming from the electric outlet in the classroom. Look at them to see they're the same brightness (some students say the CFL is brighter, but just tell them they're actually the same). Put the lightbulbs into glass with a little water at the bottom (less than 1 cm so it heats quickly), then after a few minutes feel the temperature differences between the two bits of water, or the lamps surrounding the lightbulbs. Make sure the lamps are steady in the glasses. You see the lamp and water that was with the incandescent bulb is warmer than that from the CFL. We had thermometers to measure the temperatures, but having the students just stick their hands in worked better and was more hands-on. If something is warmer, that means it has more heat. If they both use the same amount of electricity, and both lightbulbs give off the same light, but one produces more heat we call that lower "efficiency". Here we convert electricity to light and heat. This experiment takes the longest, so make sure this is run really fast. Preheating the water during the introduction will cut down on the time it takes for the kids to feel the temperature difference.

3. (Matt) Transofrming states of matter through electrical. Attach 9V battery to wire leads. Let the students see and touch the battery and leads, but don't let them put them together because shorting the leads can create a spark. Take two pencils sharpened at both ends. Put each battery leads onto the graphite of one pencil, putting the other end of the pencil into the cup of water. Have the students add salt to the water and swirl. Discuss how the salt disappeared by "dissolving", which is different from "making mud". Watch the battery's energy turn water (liquid) into hydrogen and oxygen (gases) at the submerged end of the pencils. Energy in the form of electricity is going into the water to change the substance. Repeat the experiment using tap water that does not have any salt added. Before inserting the pencils, ask the students to make a hypothesis about what will happen in the un-salted water. Since the water doesn't conduct electricity, there are no bubbles of hydrogen gas in the un-salted water. If the students are really bright, you can explain electrical conductivity to them—both in the water and the graphite of the pencil.

4. (Lucy) Transforming states of matter through heat energy, and transforming different chemicals (gas and liquid) to light. Light a candle. Why does the candle burn? Is it the wick that is burning? Light a Q tip or slow burning string to see that the wick alone isn't a sustainable flame. Try to burn the solid wax by holding the lighter to the side of the candle. It melts, but doesn't ignite. Try lighting the liquid wax that runs down the side of the candle. Again, it melts more, but doesn't ignite. That means the wax is becoming a gas and then burning. The wax is transforming chemical energy into heat and light. We tried the colored flame test (dip a Qtip into a saturated salt solution and then hold the wet Qtip in the flame and watch the new colors from the ionization of the salts) but that didn't work. Watching the candle and Qtip burn was more than enough pyrotechnic excitement. There's also an experiment at HowStuffWorks.com that we might try.

3. Wrap-up: Sharing Experiences and Building Connections **5-10** Minutes

Putting the pieces together – how will students share learning, interpret experience, build vocabulary?

What did you learn about energy today? Review the energy transformations and key concepts from each of the four lab stations. Can anyone tell me now what efficiency means? What happens to things when you add energy? (they change, sometimes heat, sometimes light, etc) – opportunity to get more questions, clarify misconceptions. Where have you seen things like this in your home? Where do you think people could be more efficient in their use of energy?

TOTAL 55 Minutes