Bay Area Scientists in Schools Presentation Plan

Lesson Name Energy: The Currency of Chemistry
Presenter(s) Daniel Goldman
Grade Level 3rd Standards Connection(s) Life Science: (1) Energy comes from the Sun to the Earth in the form of light. (2) Energy can be stored in many forms (food, fuel, batteries) (3) Energy can be converted to motion, and heat by living things and machines.

Next Generation Science Standards:

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.

Science & Engineering Practices	***Disciplinary Core Ideas***	***Crosscutting Concepts***
Asking Questions and Defining Problems Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships. ▪ Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (**4-PS3-3**) **Obtaining, Evaluating, and Communicating Information** Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluate the merit and accuracy of ideas and methods.	**PS3.B: Conservation of Energy and Energy Transfer** ▪ Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (**4-PS3-2**),(**4-PS3-3**) ▪ Light also transfers energy from place to place. **PS3.D: Energy in Chemical Processes and Everyday Life** ▪ The expression "produce energy" typically refers to the conversion of stored energy into a desired form for practical use. (**4-PS3-4**)	**Cause and Effect** ▪ Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1) **Energy and Matter** ▪ Energy can be transferred in various ways and between objects. (**4-PS3-1**), (**4-PS3-2**),(**4-PS3-3**),(**4-PS3-4**)

Common Core Standards:

ELA/Literacy:

SL.4.5 Add audio recordings and visual displays to presentations when appropriate to enhance the development of main ideas or themes.

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 in the text.

Mathematics:

MP.2 Reason abstractly and quantitatively.
MP.5 Use appropriate tools strategically.
MP.4 Model with mathematics.

FOSS Connections:
Grade 3 Module: *Matter and Energy*
Investigation 1: *Energy*

Abstract: During the lesson, we will become familiar with the idea that energy is exchanged and conserved in chemical reactions, and can be stored in different forms. We will explore some important and interesting examples of how energy is exchanged and stored in biology and the environment. In order to illustrate these principles, we will do a fun group activity that will demonstrate how energy flows from the sun to plants to other organisms in the food chain.

Vocabulary/Definitions: *3 – 6 important (new) words*

- **Conservation of Energy**: Energy is never destroyed or created; it is only exchanged (or moved)
- **Solar Energy**: Energy in the form of light from the sun
- **Photosynthesis**: The process by which plants take in carbon dioxide and water and use them to make food and grow
- **Food chain** – the path of energy from one food to another
- **Food web** – overlapping food chains, with multiple paths for the flow of energy
- **Producers**
- **Consumers**

Materials:
What will you bring with you?

- Matches
- Energy currency
- Potato chip
- Aluminum pan
- Tongs

What should students have ready (pencils, paper, scissors)? None

Classroom Set-up: *Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed*
The students should be assigned to one of three groups; the first and second groups should consist of about 3-4 students each, and the third group will consist of the remainder of the class.

A chalkboard or dry erase board for writing.

Classroom Visit

1.Personal Introduction: _____5___ Minutes
Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

I am a student studying chemistry at UC-Berkeley. I am especially interested in energy and biology.

I like science because I get to learn about how things work and do interesting experiments.

2. Topic Introduction: __10-15__ Minutes

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

Today we are going to learn about energy and how it is exchanged among living (and non-living things). Ask students what they think energy is and why it is important. [define vocabulary words & write definitions on board] What are some examples of energy in everyday life? (list suggestions on board)

Burn the potato chip over the aluminum pan. Ask the students what is happening when the chip burns (stored energy is being released). Where does the stored energy come from? (make a diagram on the board)

People need energy to stay alive. Where do we get it from? What your body does when you eat a potato chip is a lot like what we did when we burned the potato chip – both are converting the energy in the chip into other forms of energy, like heat and mechanical energy (movemement).

All energy comes from the sun. How does it get from the sun to plants, animals and people? Has anyone heard of photosynthesis? In what form is energy stored in plants? (use board to draw a diagram of energy flow). Can you think of a form of energy that does not come from the sun?

3. Learning Experience(s): ____20____ Minutes

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

Students are divided into groups as indicated above. The students are told that they are either plants (the large group), animals, or humans. The teacher will play the role of the sun. Ask the students why the plants are a big group, while the humans are a small group. The teacher is given a stack of "energy currency". Tell the students that this currency represents the amount of energy that the sun provides the earth with. It is a bright and sunny day. The teacher divides the currency evenly between all of the plants. Ask the students what happens when the plants receive energy from the sun. Where does it go? The plants have to pay one unit of currency as a "toll". Ask the students why? Where does this energy go? Now tell the animals that they can each "eat" two plants. Have them choose two plants to "eat". The plant must give his/her energy to the animal. Ask the students what happens when the animals eat the plants. Where does the energy go? Now the animals must pay four units of currency as a toll, and the plants pay one unit again. Why do the animals have to pay more energy than the plants? Now tell the people that they can each "eat" either one animal or two plants. The animal or plant must give his/her energy to the person. Where does this energy go? Now count the money that each "human" has. The "humans" who chose to eat two plants should have more energy currency than the "humans" who chose to eat one animal. Why is this true? (because an animal requires much more energy to live than a plant, so it uses up most of the energy it consumes)

4. Wrap-up: Sharing Experiences _____ Minutes

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

What did we learn about energy? How does energy get from the sun to people? What are some human activities that require energy and where do we get that energy from? What are some other ways of storing energy. (Briefly mention solar, wind, nuclear energy as different ways of storing energy for humans to use) How is energy similar to money in a bank account?

5. Connections & Close: _____ Minutes

What else might kids relate this to from their real-life experience? How can they learn more? Thanks and good-bye! Clean-up.

What did you have for lunch today? For each lunch item, explain how the energy gets from the sun to your body. Draw a picture showing how the energy flows from the sun to a human.

Total 50 – 60 Minutes

Differentiated Instruction:

English Learners: Repeat directions, if necessary, and physically model how to exchange energy in group task. Pair English Learners with fluent speakers during class activity. Write vocabulary, e.g. energy, photosynthesis, on the board and read words aloud. Vocabulary words can also be visually demonstrated, e.g. using an illustration, and/or redefined in very simplistic terms.

Advanced Learners: Have students think of different ways that energy is transferred between organisms and/or objects.

Follow-up Possibilities

ELA Activity:

Students answer the following prompt:

"Write a letter explaining how we learned about how energy comes from the sun?"

Reading Connections:

- Energy Makes Things Happen by Kimberly Brubaker Bradley - Simple language and humorous illustrations show that energy comes originally from the Sun and transfers from one thing to another. http://www.amazon.com/Energy-Things-Lets-Read-Find-Out-Science/dp/0060289082

Mathematics Activity:

Have students write the class' numerical energy equation for the group activity. For example: plant starting energy – energy to animals = ? Fill in the equation with actual numerals.

Other:

What Does Life Need to Live? (NASA) - In this astrobiology activity (on page 11 of the PDF), learners consider what organisms need in order to live (water, nutrients, and energy). Learners select an environment at random and identify what they must provide in order to

keep their organisms alive. This lesson guide includes background information, handouts, and a math extension. http://nai.arc.nasa.gov/library/downloads/ERG.pdf

Food Webs Alive (BASIS with Entomology Student Organization) - Are you struggling to explain the complexities of food webs in a creative, interactive manner? Active and engaging, this lesson will cover important curriculum standards while leaving your students with a memorable experience. Concepts covered include energy transfer, types of eaters, and the broad implications food webs have on entire communities of organisms. Your students will play an active role in creating food webs and discussing the vital role each of the organism plays in maintaining a food web, and will be left with a greater appreciation of their role in maintaining ecosystems. http://www.crscience.org/lessonplans/4_foodwebsalive_ESO4_07-08.pdf

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