TWO BASIC ENERGY PRINCIPLES

Adapted from the California Energy Commission

Overview: Students work backwards from an item (such as a pencil or hamburger) to its components, to where those components originated and what kinds of energy were needed to make those components into the final item. Then, they will act out the flow of energy through each step from the sun to the pencil and observe what happened.

Objectives: Students will…

1. Draw or identify the path of energy from the sun to the pencil
2. Observe that most of our energy sources originate from the sun
3. Make operational definitions of embodied energy or embedded energy
4. Infer that energy must be transformed to be useful
5. Observe that in every transformation, some energy is lost/wasted
6. Infer that observation of energy loss provides opportunities for energy savings

Grouping: Can be done in small groups of four to six students; or can be done with one person drawing and the class brainstorming the steps. Whole class acts out the flow of energy through the steps.

Time: 50 minutes

Subjects: Science

Suggested Grade Level: Can be modified for grades 3 – 12 (although this is written for younger grades, it effectively communicates the concept of an energy system)

Vocabulary: Embedded energy, energy transformations, energy efficiency

Materials: Drawing paper, oatmeal or popcorn.

PREPARATION & BACKGROUND

Discuss how we use many things in our every day life, but we do not think about what goes into making them, delivering them to us, and disposing of them when we are finished using them.

Choose an item with a short "history" as an example, for example, a hamburger in a bun. Draw the sun in one corner of the board or chart paper and draw the hamburger in its bun at the diagonally opposite corner. With the whole group, draw the steps in the path from the sun to the hamburger. Draw the raw materials, the collection process, the machinery used in manufacturing, the transportation, marketing, delivery, and disposal of the item. Number all the steps where energy is transformed.

Explain to students that in a natural system like this one, for example, the sun gives off energy that is used by plants. However, the plants do not use all the energy the sun produces. Only 2% of the sun's energy is used by plants in the process of photosynthesis. Animals then eat plants to get their energy however, not all of the energy that was captured by the plant is still in the plant, since it had to use

some for its own growth and reproduction. You can follow this through the transfer of energy when an animal is eaten by another animal. Students are about to find this out for themselves.

PROCEDURE

1. Divide students into groups of 4 to 6.

2. Give each group a large piece of paper and an assortment of drawing instruments.

3. Distribute an object to each group (sometimes I give every group the same object--I usually use a pencil). Ask them to draw a map connecting the item to its raw materials (don't forget to include the sun). Using arrows, lines, etc., ask them to show all the energy inputs in the process of transforming the raw materials to the finished product. Don't be afraid to speculate

4. Ask groups to present their charts to the class when they are finished.

5. Select one chart as an example. (I usually choose the one with the most well-defined pathways.) With the class, number each step where there is an energy transformation.

6. Ask one student to take the place of each numbered transformation from the drawing. If there are, for example, 15 steps, with a class of 30, there would be two lines in each of which one student would represent the transformations in the drawing. Each student should stand a distance away from the next—several feet in between each would be ideal. It might be easiest to do this outside.

7. Start with the first person—this should be the sun. Ask them to put their hands together and fill their hands to overflowing with the oatmeal. (After all, the earth does not receive all the energy of the sun.)

8. The sun provides the energy needed to the energy chain. So the sun runs to the plants, who take as much of the sun's energy (oatmeal) as they can.

9. The plants turn in place (they cannot move, after all), and the next person in line runs up to them and the plants pass the energy to them.

10. Each student in turns runs to the next person in line and passes the oatmeal. At the end, the last person holds what's left of the oatmeal above their heads to signal that they are finished.

FOR DISCUSSION

AFTER THE DRAWINGS ARE COMPLETE

1. Could you figure out all the energy that went into your object?

2. Think of something in the classroom that has lots and lots of energy inputs, the longest energy path. Now think of something with very few energy inputs, the shortest energy path. Which item costs more? Why do you think that's so?

3. How can individual students help save energy at school? At home?

AFTER THE DEMONSTRATION

1. Look on the ground. What happened to the energy during transformation?
2. Compare the amount held by the first person and the last person.
3. If there were fewer transfers, how much energy would the last person have? How could we make fewer transfers in obtaining energy in our lives?

ASSESSMENT

FOR DRAWING THE ENERGY CHAIN

1. Ask students to make a map from an object at home. Act out the map.
2. Have students write an essay about what they think the money saved should be spent on.
3. Students could prepare a pamphlet on simple ways to save energy at school and distribute it to all classes.
4. Make posters on how to save energy at school and post them around campus.

FOR THE DEMONSTRATION

Use a shorter energy chain and compare the amount of energy left at the end.