Energy Sources and Resources

Enduring Understandings:

- Not all parts of the world have electricity.
- Even countries with access to electricity might not have regular, continuous service.
- Many activities we do on a daily basis require electricity, but several of those activities could be accomplished through alternate means requiring little or no electricity.

Essential Questions:

- How much do we rely on electricity?
- What are the differences between renewable and non-renewable electricity sources?
- What problems do parts of the world face when electricity is in short supply, and what can they do about it?

Notes to the Teacher:

This lesson provides students with an opportunity to understand that what we take for granted in North America may be in short supply elsewhere in the world. Students examine our daily reliance upon electricity and look at alternatives to their daily activities. They learn how commercial electricity is generated through spinning turbines that power generators, sending power through transmission lines. They also come to understand the concept of sustainability of electrical energy and the issue of renewable vs. non-renewable sources

The purpose of Activity 1 is to allow students to see the extent to which their daily activities rely on electricity and to allow them to imagine a life that is less reliant on electricity. Much education around energy conservation is focused on strategies for urban life such as purchasing newer, power-saving devices, turning out lights when not in use, only running the dishwasher when it is full. The purpose of this activity is not to reiterate strategies for using electricity with conservation in mind, but rather to give students a glimpse into a world *without* electricity and to have students realize that there are enjoyable alternative activities they could choose that require *no* electricity.

In Activity 2, students compare and contrast energy sources – renewable and non-renewable. This activity is designed to have students thinking about trade-offs when it comes to electrical power. Renewable energy sources, such as solar and wind, are available for an indefinite length of time, but often these sources are not continuously available. For example, solar energy

depends on the amount of sunlight available and wind energy requires moving air. By contrast, non-renewable energy sources, such as fossil fuels and batteries work predictably and consistently until they run out, at which point there is no more energy.

Living with an electricity "budget" because demand exceeds supply is the topic of the Activity 3. This activity is a quick, physical demonstration of the constraints that some cities experience regarding electricity. Many students in your classroom may not have experience with restrictions on when or how long they can use electricity. This activity will demonstrate the idea of scheduling tasks around the availability of electricity. Throwing the balls will represent using electricity, and waiting for the balls to be returned to the students will represent waiting for the next available window of electricity.

A practical note: If you buy new decks of cards for this activity, be sure to shuffle each deck before class starts.

Duration of lesson:

Two periods

Assessment:

Class discussion
Student summations

Engineering Standards
Indicators addressed by this lesson

Standard 5: Understands energy and power types, sources and conversions

Level IV: (Grades 9-12)

1. Understands how power is derived from mechanical, chemical, nuclear, and alternative energy sources.

Science Standards
Indicators addressed by this lesson

Standard 9. Understands the sources and properties of electricity.

Level III: (Grades 6-8)

5. Knows that electrical circuits provide a means of transferring electrical energy to produce heat, light, sound and chemical changes.

Standard 6. Understands relationships among organisms and their physical environment

Level IV, Grades 9-12

5. Knows ways in which humans can alter the equilibrium of ecosystems, causing potentially irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution

Materials:

ACTIVITY 1: Paper and writing utensils for each student
ACTIVITY 2: A pinwheel, an inexpensive mini (personal) battery-powered fan, and batteries for each group
ACTIVITY 3: Three sheets of paper, a writing utensil, and a deck of cards for each group. Use a different color of paper for each group.

Procedure:

ACTIVITY 1: With and Without Electricity

1. Ask students to list 10 things they normally do in a day on a piece of paper. This could be 10 things they most like to do, 10 things they did today or last weekend, or the first 10 things they did this morning.

2. Have students go through their lists and eliminate each activity that requires electricity, including battery power. Ask students to report how many items now remain on their lists.

3. For every eliminated item, ask students to replace each spot with an activity that *does not* require electricity. Invite students to share their ideas with the class.

4. Have students move into groups of 3 or 4 and tell the groups they will have 3 minutes to generate a list of as many activities as possible that do not require electricity. Each group will receive a point for each item on their list that *no other group* has listed. This scoring is similar to the game "Boggle" where players only receive points for being the only person to write an answer down. For example, a group may write "play soccer" as an answer, but if any other group has written "play soccer", then no one receives a point for this answer. This will encourage students to be creative and think of answers that they believe no other team will have written. It might also be a good idea for student groups to identify a 'scribe' who can write exceptionally fast.

5. After students have had 3 minutes to write answers, take turns having each group read out its list. As each answer is read out, other students whose group also has that answer should raise their hands. In this case, everyone crosses out that answer, and no group receives any points. If no other group has the answer being read out, then the group circles that answer and scores one point.

6. All subsequent groups should read out only the answers they have remaining that have not yet been crossed out.

7. Continue until all groups have had an opportunity to read out their unique answers and total points to see which group won.

ACTIVITY 2: Continuous and Noncontinuous Power Sources

1. With students still in their small groups, distribute mini battery-powered fans and pinwheels to each group. Make sure each group has at least one of each item.

2. Explain to students that commercial power plants work by having some energy source spin a **turbine**, which powers a generator, which then sends power out through transmission lines. So, all the electricity we use in our homes depends on keeping a turbine spinning. (Note: a turbine is a machine with fan-like blades attached to a central shaft. The pressure of water, wind, gas or steam on these blades causes the turbine to spin.) Ask students to imagine how each

energy source could spin a turbine. Water and wind should be easy to imagine, but what about steam and gas? Where would the steam and gas come from? (Heating water or burning something to create steam; releasing a stream of gas). The three most common ways of generating power in North America are by hydroelectric power (moving water can spin a turbine); nuclear power (the energy released by a nuclear reaction can spin a turbine) and fossil-fuelled power (the energy released from burning fossil fuels such as coal and oil can spin a turbine.) Can students imagine any other way of spinning a turbine?

3. Inform students that the items in front of them will represent two different turbines that will power generators for the group. As long as the fan or pinwheel is spinning, it is generating power.

4. Allow students to make each item spin and ask them to identify the power source in each case (battery in the fan and wind/breath in the pinwheel).

5. Encourage students to discuss for a few minutes, in their groups, the pros and cons to each power source.

6. As a class, explore questions such as:

   a. Which source is better if you need power for 5 minutes? 5 hours? 5 weeks? 5 years?

   b. Which source is more *predictable*? More *reliable*? Answers will vary as students debate what it means to be reliable–if it's not sunny out today, you can't rely on solar power today, but you know that the sun will never run out, so you can rely on solar power in the long run.

   c. Which source is *continuously* available? (The battery provides continuous power, until it runs out.) Which source is not *continuously* available? (Wind or breath will never run out, but you could have an entire day with no wind, and you may need to stop blowing for a while to catch your breath.)

7. Discuss issues from the film involving electricity:

   a. When did the characters in the film need or use electricity? Did they use electricity on a daily basis, or for special activities only?

   b. Did they have any problems using electrical power? If so, what?

   c. How much electricity did the monks and students use to perform their daily activities? It may be worthwhile to revisit the lists of activities from Activity 1 and demonstrate to the students that the characters in the film probably performed the same categories of activities (cooking, eating, bathing, entertaining themselves, schooling) your students listed themselves, even though the specific actions may have been different.

   d. From the background information on the making of the movie, where might energy sources (or the lack of energy) have challenged the filmmakers?

Activity 3: Budgeting Electricity

1. While students are still in their small groups, tell them that for the next activity they will have to perform three tasks: Write the numbers from 1 to 100 on a sheet of paper; hit 10 "bull's-eyes" on the chalkboard with crumpled balls of paper and organize a deck of

cards in numerical order (all the 2's together, then all the 3's, 4's all the way up to Aces).

2. Each group will be allowed to have 2 pieces of paper to crumple into a ball, one piece of paper and a pen/pencil to write the numbers 1 to 100 and a shuffled deck of cards.

3. The teacher will draw a big "bull's-eye" on the chalkboard.

4. When the teacher says, "Go" each group may begin any or all of the three tasks. While students may write numbers or organize cards without any restriction, the students are *not* allowed to retrieve their balls once thrown at the chalkboard. Instead, the students must wait for the teacher to return balls to the groups, at which point they may be thrown again. As before, students must wait for the teacher to return the paper balls before they may be thrown again.

5. Allow groups to continue managing all three tasks simultaneously until all three goals have been achieved.

6. When the groups have finished, discuss as a class how it felt to have only a limited opportunity to throw the balls. What kinds of strategies did the groups use to complete the tasks? (Students will likely say that they managed their time so that they did the number or card activity while they were waiting for their balls to be returned.)

7. Remind students that in some places of the world, power is limited to only a few hours per day. Just as students had to wait for an opportunity to score their bull's-eyes, some people have to schedule their daily tasks requiring electricity. The time between power usage windows is filled with tasks that do not require electricity. So, people might very well choose alternative methods that do not require electricity to get the job done because they can be done at any time and because they won't take up valuable electricity. For example, instead of using a dishwasher, one might choose to wash dishes by hand.

8. Play the game again, (or imagine as a class that you did so) but this time, allow students the opportunity to earn a "bull's-eye" by having the entire group count together to 30, using a standard counting time of one number per second. How does having this alternative change the game? Students may comment that it's not as much "fun" counting as it is throwing the ball and it takes longer to count to 30 than it does to just hit the bull's-eye. However, the students are no longer dependent upon the teacher to complete their activities. By putting forth a little more effort themselves, they can improve how quickly the overall task is completed and they do not have to depend on an external source.

9. Discuss the effects of these variations on the game:

   a. The teacher "gets tired" and sits down halfway through the game, taking a 10 minute nap.

   b. The teacher is "unreliable" and sometimes skips over a group when returning the balls.

   c. The teacher "quits" partway through the activity, and the class is forced to wait until the principal notices that the class needs a replacement teacher.

   d. A fourth task is added that involves the teacher for which there is no other alternative (such as counting to 30).

e. One member of each group is allowed to go and collect the balls instead of waiting for the teacher

10. Describe that last scenario as providing an "alternative energy source" – another student. This student can only collect his/her own group's balls and cannot help another group. So, the student cannot do as much work as the teacher can, but by doing his/her own share, can help reduce the strain on the teacher, and in turn, can help each group go more quickly. In North America, a small number of people use alternative energy sources (usually only for their own personal use) that are less powerful, but the small bit of help it provides can have an impact on the larger system.

Activity 4: Closure

1. Quickly have students count off by threes. Ask all the "1" students to write a few sentences summarizing the main ideas they learned from Activity 1; the "2" and "3" students should do the same for Activities 2 and 3. You may have to remind them briefly about each activity.

2. Give each set of students a chance to share their summaries with their neighbors. Collect the summaries when they are finished.

Extension Activities:

1. Research an alternative energy source (solar energy, wind energy, geothermal energy) and create a poster or brochure to advertise the benefits of the energy source.

2. Build a "potato clock." (See Internet resources.)

3. Create an advertisement for an alternative energy product (e.g., jacket with solar panels for charging your cell phone as you walk; solar paint/wallpaper that reduces heating and cooling costs) such as those found at **http://treehugger.com**, an online alternative energy magazine.

Additional Internet Resources:

www.treehugger.com
An online magazine with environmentally-friendly articles and products.

http://www.kidzworld.com/site/p4726.htm
Easy directions for making a potato clock.

http://www.peacecorps.gov/wws/cybervol/2004-5/lams_Nov_Letter.html
A Peace Corps Volunteer in Nepal tells about his experiences building an alternative stove (story plus lesson plan).

http://www.eia.doe.gov/kids/glossary/
A glossary of energy-related words for students.

http://www.eia.doe.gov/kids/energyfacts/sources/renewable/wind.html
A page on wind energy and windmills.

http://www.leeric.lsu.edu/educat/lesson3.htm
A simple experiment in cooking with solar power.

http://www.energywhiz.com/teachers/find.htm
A collection of solar energy lesson plans, plus information about a solar soap-box derby.

http://eartheasy.com/Newsletter_tidwellarticle.htm
Mike Tidwell tells about his energy-saving house, which runs almost entirely on alternative renewable fuels.