# HOW DO PEOPLE USE ENERGY RESOURCES?



## Overview

In this lesson students will build simple electric circuits in series with a variety of energy sources, and compare the advantages and disadvantages of each energy source.

## Objectives

On successful completion of this lesson, students will be able to:

- construct a series electrical circuit;
- classify renewable and nonrenewable resources that are used to produce electricity; and
- identify potential advantages and disadvantages of energy sources.

## Alaska Standards

### Alaska Science Standards / Grade Level Expectations

[4, 5] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

[4] SA1.2 The student demonstrates an understanding of the processes of science by observing, measuring, and collecting data from explorations and using this information to classify, predict and communicate.

[4] SA2.1 The student demonstrates an understanding of the attitudes and approaches to scientific inquiry by supporting the student's own ideas with observations and peer review.

[5] SA1.2 The student demonstrates an understanding of the processes of science by using quantitative and qualitative observations to create inferences and predictions.

[5] SB2.1 The student demonstrates an understanding of how energy can be transformed, transferred, and conserved by classifying the changes that electrical energy undergoes in common household appliances.

## Alaska Cultural Standards

[B] Culturally-knowledgeable students are able to build on the knowledge and skills of the local cultural community as a foundation from which to achieve personal and academic success throughout life. Students who meet this cultural standard are able to:

[B3] make appropriate choices regarding the long-term consequences of their actions;

[B4] identify appropriate forms of technology and anticipate the consequences of their use for improving the quality of life in the community.

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## Bering Strait School District Scope & Sequence

4th Grade Sequence #2: Making & Using Electricity

A. Understands what electricity is

C. Creates series circuits and parallel circuits

E. Use scientific processes and inquiry to directly support concepts on conserving natural resources

5th Grade Sequence #10: Conserving Natural Resources

A. Understand how people conserve natural resources

C. Use scientific processes and inquiry to explore conserving natural resources

## Materials

- LED light bulb, 3V (two)
- AA battery (two)
- Battery housing (one)
- Solar Panel, 1.5V (two)
- Green Science Windmill Generator Kit (one)
- Small Phillips screwdriver (one)
- Fan (one)
- Plastic drink bottle (empty and rinsed, one)
- Aquarium gravel (one cup)
- Red insulated wires, 12-18", with alligator clips (two)
- Black insulated wires, 12-18", with alligator clips (two)
- Additional insulated wire (yellow, white, or green), 12-18", with alligator clips (one)
- STUDENT WORKSHEET: Circuit Stations

## Multimedia

REACH Multimedia 4-6: "Conserving Fuel"
Available at: www.k12reach.org

## Additional Resources

HSP IV: Ch. 5, Lesson 3

HSP IV: Ch. 15, Lesson 1-4

HSP V: Ch. 6, Lesson 3; Ch. 10, Lessons 1-2; Ch. 15, Lesson 1-4

HSP V: Ch. 16, Lessons 1-3

# HOW DO PEOPLE USE ENERGY RESOURCES?



## Activity Preparations

1. Read through the entire lesson, including the teacher background information in the Whole Picture section.
2. If you are unsure of how electricity is produced in your community, ask and find out.
3. Make copies of the STUDENT WORKSHEET: Circuit Stations (one per student).
4. Get a plastic drink bottle and rinse it out. This will be the stand for the Green Science Windmill. Add gravel for weight, to keep it from tipping over.
5. Assemble the Green Science Windmill.
6. Set up stations and ensure equipment is working properly.
    a. Battery station – set out two AA batteries, one battery housing, one light bulb, one red wire, and one black wire.
    b. Solar station – set out two solar panels, one light bulb, one red wire, one black wire, and one additional wire (yellow, white, or green). You should set up this station near a window if possible.
    c. Wind power station – set out the Windmill Generator and the fan. (The windmill kit includes a light bulb and wires). You will need to set up this station near an outlet, so that students can plug in the fan to simulate wind.

## Whole Picture

Every day, people use natural resources for a variety of purposes. One main use is for energy. People need energy to power their homes, fuel their vehicles, grow their food, make the textiles for their clothing, and to provide heat when the weather turns cold.

Energy sources can be split into two main groups: renewable and nonrenewable. Those that are renewable can be used conservatively again and again without fear that they will disappear. These include solar, wind, geothermal, hydropower, and biomass energy. Nonrenewable sources are those that take millions of years to replenish, and as such, once today's humans have exhausted them, they will disappear. These include oil, coal, and natural gas.

Modern society relies heavily on nonrenewable resources to provide electricity, heat, and fuel for travel. Scientists and elders alike know that the extraction and use of these energy sources are contributing to climate change (Fienup-Riordan and Rearden, 2012; Krupnik and Jolly, 2002). As a result, people around the globe are beginning to develop renewable resources for energy — including in the expansive state of Alaska! Many villages are experimenting with renewable resources, such as biomass, wind, geothermal, and solar, as a way to reduce their dependence on pricey fossil fuels.

Biomass is carbon-rich material from living, or recently living organisms, that is (typically) burned for energy. While the plants are growing, they take carbon out of the atmosphere, and when they are burned, the carbon is released back into the atmosphere. Sometimes, materials used for

biomass energy are grown specifically for that purpose, such as grasses and hemp. Other times, biomass energy materials come from the waste products of other sources. For example, waste wood can be used for wood burning boilers, though it is prudent to know how the wood has been treated, so as to avoid toxic off-gassing and ash (Biomass Energy Centre, 2011). In several rural Alaska villages, wood-burning boiler systems are being installed to ease the high cost of using heating fuel — though many of these villages are in interior and southeast Alaska, where wood is a plentiful resource.

The sun is also a source of renewable energy. Solar arrays, designed to capture the sun's energy, are becoming more popular around the globe. Because Alaska is "The Land of the Midnight Sun," many believe that solar energy would be a profitable alternative energy resource. However, due to the long periods of darkness during winter, and the difficulty in storing solar energy long term, "utility-scale solar power plants are uneconomical in Alaska" (REAP, 2015). Nevertheless, stand-alone solar grids in remote areas are useful, and much of the solar development in the state is being done on small scales. In Nome, for example, the Bering Straits Native Corporation has a solar array on their office building, and they are able to offset about "1,000 gallons of diesel fuel annually" (REAP, 2015).

Another useful renewable energy resource in Alaska is wind. Turbines placed in strategic locations can harness the power of the wind, which is then used for electricity, heat generation, and therefore displacement of diesel fuel use. The first wind program in Alaska was installed in Kotzebue in 1997. Since then, additional turbines have been added, and "the wind farm displaces 80,000 gallons of diesel every year" (REAP, 2015). Wind turbines have also been installed in Gambell, Savoonga, Shaktoolik, and Unalakleet, in addition to other villages in the state. These turbines help reduce the price of electricity for villagers, help villages meet their electric demands, and provide the heat for water treatment and drinking water plants.

Other renewable resources, like geothermal and hydropower, are also being developed in Alaska (and are already in use in many parts of the world). Geothermal energy is the heat energy that comes from the earth itself. Steam and hot water reservoirs can be used directly for electric generation, direct heating, and for carbon dioxide for greenhouses, as is the case at Chena Hot Springs, near Fairbanks (REAP, 2015). Hydropower is the energy produced by moving water — rivers and the ocean. As in other instances, this energy is captured and used to generate electricity and heat. Most of the hydropower in Alaska comes from projects in Southeast.

Traditional uses of solar and wind energy include much more than power. In addition to the ways mentioned above, Alaska Native people have for millennia been using energy sources in ways that some westerners might consider uncommon. "According to oral tradition, the sun is a transformed woman who fled to the skyland while being chased by her brother, who became the moon and continues to pursue her" (Fienup-Riordan and Rearden, 2012, p. 61). Like all other things, people believe that the sun and the wind have animate spirits, and which tell us what to expect from the landscape.

For example, the sun plays an important role in helping people know what to expect from the weather. John Phillip, from Kongiganak, and Paul Kiunya, from Kipnuk, agreed that "dawn shows what the weather will be like during the entire day … They tell us that when the sun rises causing the clouds to turn red, even though the weather is good, it will get bad before day's end. But when the horizon is bright in the morning, the weather might be good all day" (Fienup-Riordan and Rearden, 2012, p. 62–63). Too, when it is going to be very cold, people say that the sun puts on its mittens, as a warning to people of coming temperatures.

Similarly, the winds have the power to indicate what to expect from the ocean and sea ice, as well as the arrival of subsistence animals. If the wind continues for two or three days, people on St. Lawrence Island know to expect sea ice to be blown in. This can be dangerous for hunting, and can make it difficult to bring harvested animals to shore (Krupnik and Jolly, 2002). In the winter, an easterly wind can herald the coming of spring sea mammals; and summer winds might mean that fish are being blown into the rivers (Fienup-Riordan and Rearden, 2012). The wind is also important for knowing whether the weather will be good or bad for fishing. A story told by elders of Tununak recounts how Edward Hooper's grandmother bequeathed a southerly wind to the villagers before she died, "so they could fish during good weather" (Fienup-Riordan and Rearden, 2012, p. 84).

Traditional ways of using energy resources compliment more contemporary uses. While the sun and the wind continue to be faithful companions in indicating what to expect from the weather, they also provide important ways to power our lives. We depend on energy sources for electricity, for heat, and for fuel, as well as for shelter and protection from the elements.

## Vocabulary

| | |
|---|---|
| **electricity** | a form of energy produced by moving electrons |
| **electric circuit** | the path an electric current follows |
| **nonrenewable resource** | a resource that, once used, cannot be replaced in a reasonable amount of time |
| **renewable resource** | a resource that can be replaced within a reasonable amount of time |
| **resource** | any material that can be used to satisfy a need |

## Activity Procedure

1. Ask students how they use electricity in their daily lives, and list their examples on the board.
2. Explain that today we are first going to focus on lighting our homes. Lights are important, allowing us to get work done and also enjoy hobbies during dark times, especially in Alaska where we have long winters. How did people light their homes in the past, before electricity was discovered or introduced to rural Alaska? If necessary,

prompt students to think about seal oil lamps.

3. Have students look up the definitions of renewable or nonrenewable in HSP V textbook or another source, and then discuss: Would seal oil be an example of a renewable or nonrenewable resource?
4. Explain that electric current is produced by moving electrons, and many different energy sources can be used to generate this movement. For the electrons to flow, they must have a complete path, or circuit to follow. Demonstrate how to create a series circuit with the batteries, wires, and light bulb. Instruct students to connect the wires red to red, and black to black. Demonstrate again for the solar station: the light bulb requires 3V and each solar panel is 1.5V, so you will use the additional wire to connect the two solar panels in a series circuit. Also, demonstrate how the windmill generator works. Instruct students in safety rules for handling all the equipment (they will be working with a very small amount of electricity, and while it is not dangerous, it is a good idea to instill safe practices when working with electricity). You may want to display the Student Information Sheet – "Safety Considerations" found in the Appendix as a visual reinforcement of the safety considerations, and/or include with their STUDENT WORKSHEET.
5. Divide students into groups and introduce the procedure for rotating between stations. Distribute the STUDENT WORKSHEET: Circuit Stations. Give guidelines for safe handling of the equipment, and then direct them to investigate on their own. Be available to answer questions, but do not give them specific instructions for each station. Keep the group size for each station to about four students or less. If necessary, have some groups doing an additional assignment or reading at their seats, rather than assign larger groups to each station. Give the groups 5-10 minutes at each station; ensure all students are able to experiment with the materials and construct a circuit.
6. Gather the whole group together and discuss their observations and responses from the STUDENT WORKSHEET.

## Extension Activity

- Students can build their own robots by connecting a circuit to a small hobby motor and adding some simple craft supplies. The "Jitterbug" lesson plan from the Exploratorium uses old CDs as the body of the robot. Accessed at: http://stem4all.edc.org/node/887

## References

Biomass Energy Centre. (2011). "What is BIOMASS?" Accessed from: http://www.biomassenergycentre.org.uk/portal/page?_pageid=76,15049&_dad=portal

Fienup-Riordan, Ann, and Alice Rearden. (2012). Ellavut: Our Yup'ik World and Weather. Continuity and change on the Bering Sea Coast. Seattle and London: University of Washington Press.

Krupnik, Igor, and Daynna Jolly. (2002). The Earth is Faster Now: Indigenous Observations of Arctic Environmental Change. Arctic Research Consortium of the United States and Smithsonian Institution Presses.

REAP (Renewable Energy Alaska Project). (2015). Accessed from: http://alaskarenewableenergy.org/why-renewable-energy-is-important/

## Sample Answers: Circuit Stations

**Name**_____

**Station 1**


Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?
   *Battery, chemical energy*

2. Is it a renewable resource or nonrenewable resource? Explain why.
   *Nonrenewable. The metals for the battery must be mined. The acid loses concentration / the battery "goes dead". EXCEPTION: If you used a rechargeable battery, depending on what source of electricity is used to recharge it, it could be a mostly renewable energy source.*

3. Were you able to get the LED to light up?
   *Yes/No – answers may vary.*

4. Is there anything you can do to make the bulb glow brighter or dimmer?
   *No – the light is on when the circuit is connected and off when disconnected.*

5. What are some advantages for this energy source?

   *Readily available, we already have batteries or know where to get them, we know how to use them, they work consistently year round.*

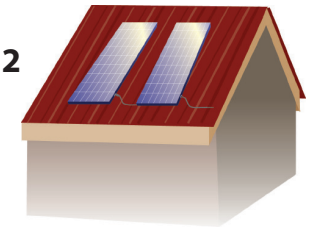
6. What are some disadvantages for this energy source?

   *When the battery goes dead it has to be thrown away, battery acid can pollute soil and water, replacing batteries is expensive.*

## Sample Answers: Circuit Stations

**Name**_____

**Station 2**



Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?
   *Solar*

2. Is it a renewable resource or nonrenewable resource? Explain why.
   *Renewable. The sun's energy does not get used up. The sun will provide the Earth with energy for a very, very long time.*

3. Were you able to get the LED to light up?
   *Yes/No – answers may vary.*

4. Is there anything you can do to make the bulb glow brighter or dimmer?
   If *you adjust the distance or angle of the solar panel closer to the window or the classroom lights, the light bulb glows brighter. If you move it away, the light bulb glows dimmer.*

5. What are some advantages for this energy source?
   *Sunlight is free, sunlight does not cause pollution.*

6. What are some disadvantages for this energy source?
   *In Alaska we do not get a lot of sunlight in the winter; solar panels have to be used with a back-up source, such as tying into the grid, a generator, or battery bank, so that people still have electricity when there is no sun. Solar panels are also expensive to buy initially.*

## Sample Answers: Circuit Stations

**Name**_____

**Station 3**

Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?
   *Wind*

2. Is it a renewable resource or nonrenewable resource? Explain why.
   *Renewable. Wind does not get "used up".*

3. Were you able to get the LED to light up?
   *Yes/No – answers may vary.*

4. Is there anything you can do to make the bulb glow brighter or dimmer?
   *If you turn the fan on high, the light bulb glows brighter. If you turn it on low, it glows dimmer.*

5. What are some advantages for this energy source?

   *Wind is free, wind does not cause pollution.*

6. What are some disadvantages for this energy source?

   *Wind does not always blow or always blow from the same direction. Wind turbines are expensive to install. Also, as an intermittent resource, people who use wind need to also have va "back-up" plan, either tying into the grid or buying a generator.*

## Student Worksheet: Circuit Stations

**Name**_____

**Station 1**


Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?

2. Is it a renewable resource or nonrenewable resource? Explain why.

3. Were you able to get the LED to light up?

4. Is there anything you can do to make the bulb glow brighter or dimmer?

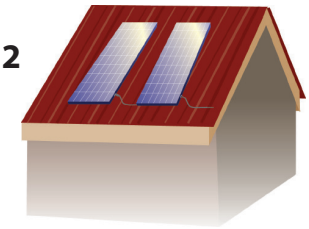
5. What are some advantages for this energy source?

6. What are some disadvantages for this energy source?

## Student Worksheet: Circuit Stations

**Name**_____

**Station 2**



Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?

2. Is it a renewable resource or nonrenewable resource? Explain why.

3. Were you able to get the LED to light up?

4. Is there anything you can do to make the bulb glow brighter or dimmer?

5. What are some advantages for this energy source?

6. What are some disadvantages for this energy source?

## Student Worksheet: Circuit Stations

**Name**_____

**Station 3**

Construct a circuit connecting the energy source and the light bulb. Each member of your group should take a turn connecting and disconnecting the circuit. Answer the following questions.

1. What is the energy source?

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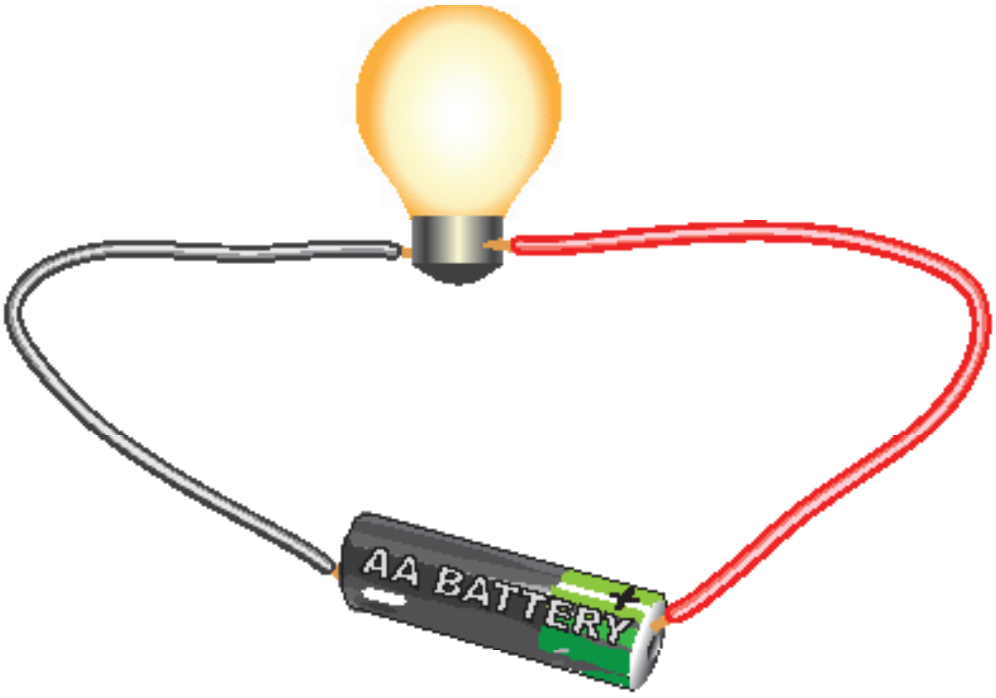
3. Were you able to get the LED to light up?

4. Is there anything you can do to make the bulb glow brighter or dimmer?

5. What are some advantages for this energy source?

6. What are some disadvantages for this energy source?

## Student Information Sheet: Safety Considerations




1. When the wires are connected to a power source, do not touch the metal alligator clips or bare wires.

2. Connect red wires to red wires and black wires to black wires. You may use an alternate wire (white, yellow, or green) for connecting two solar panels.

3. Do not connect the two terminals of the battery to each other with one wire – this will short out the battery.

4. Use only the lab materials provided at each station.