Phenomena Explored — The Energy We Use

Try this! (1-2 minutes)

1. Place the Bristlebot down on a flat surface
2. Slide the switch on top of the Bristlebot to the other side
3. Observe what happens
4. Slide the switch back the other way
5. What happens to the Bristlebot when you first slide the switch? Why do you think this happens?

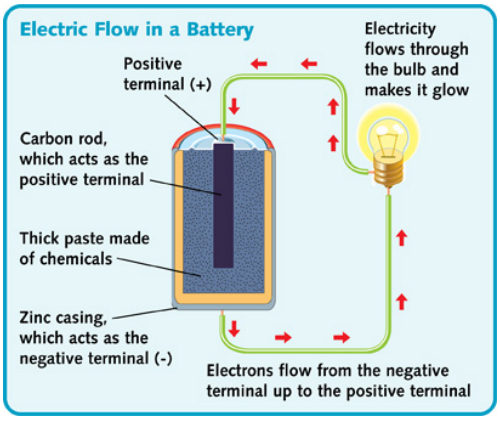

Figure 1: Electricity flowing through a battery

What's going on?

A traditional battery stores electricity to provide a mobile source of power for our electronic devices. One side of the battery, known as the cathode, has a positive charge while the other side, known as the anode, has a negative charge. These two sides are separated by an electrolyte, which prevents them from touching. When a load, such as a light, is placed between the cathode and anode to complete the circuit, an electromagnetic reaction takes place, producing electricity and giving off the light we use to read our books in a darkened room.

Now try this! (5 minutes)

1. Remove the batteries from the Bristlebot
2. Go outside
3. Place the Bristlebot on a flat surface and aim the two solar panels as shown in Figure 2
4. Observe what happens
5. Slide the switch back to the other position
6. What happens to the Bristlebot now? Why does this happen even though you removed the batteries from under the Bristlebot? Are the results the same or different on sunny vs. cloudy days?

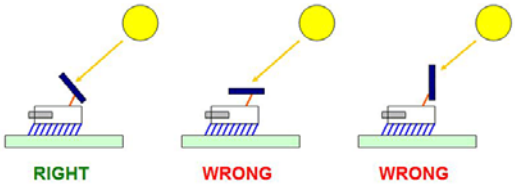

Figure 2: Correct aim of solar panels

What's going on?

Sunlight contains energy that is converted into heat when it hits an object. But when sunlight hits certain substances such as the silicon that makes up the photovoltaic cells you aimed at the sun earlier, the light is converted into electricity for use in powering our electronic devices, homes and businesses. Modern solar power tends to use smaller, cheaper materials that are flexible, but they continue to work the same way as the older silicon solar panels.

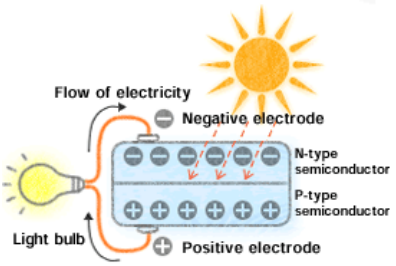

Figure 3: How solar power works

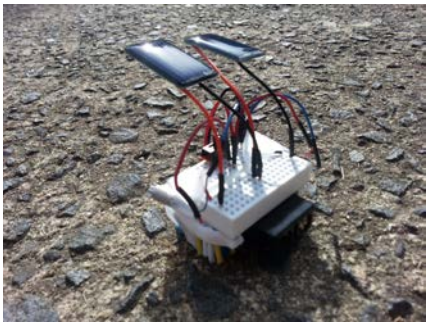

Figure 4: Solar powered Bristlebot

How is this nanotechnology or ASSIST?

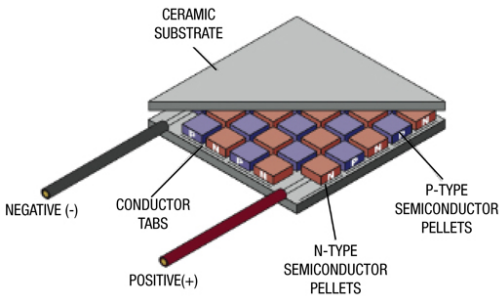

Figure 5: Thermoelectric generator

While alkaline batteries and solar panels can be used to power our portable electronics, they are too large to be used by wearable devices like the ones being designed at the ASSIST Center at North Carolina State University. However, these devices still require energy to function. One solution to this problem is to use small thermoelectric generators which convert body heat to electrical energy by dispersing the heat through a series of semiconductors from one side of the generator to the other.

As research on wearable devices continues to progress, giving us insight into monitoring our own bodies better, new and exciting ways of harvesting energy without the need for charging or replacing of batteries will keep improving. As researchers continue to learn more efficient ways of using smaller technologies to generate power, such devices will become more commonplace in our daily lives.

Learning Objectives

1. Participants will gain a basic understanding of mobile sources of energy
2. Participants will be able to describe three different mobile power sources and how they operate

Materials

- *Bristlebot Advanced Kit*
- 2 AAA Batteries per kit

Notes to the presenter

Before doing this activity:

- Purchase and build one BristleBot Advanced Kit for each student/group taking part in the activity
- While you can purchase the simple kit for general electrical discussions, they do not come with the photovoltaic cells needed for the second part of this activity
- Kits can be purchased from Science Buddies at:
    - https://store.sciencebuddies.org/JAM-6200-KIT/Advanced-Bristlebot-Kit.aspx

Tips: Make sure the toothbrushes used for each side of your Bristlebot are identical and contain flat, solid surfaces on the back of the bristles. Instructions on building are located at the link below.

SAFETY: This activity does not present any safety issues.

Related educational resources

For further research:

- Students can research the following topics if interested in generating electricity: hydroelectric power, nuclear power, electromagnetic induction, piezoelectric effect, electrochemistry

Credits and rights

Robert Bourgeois, ASSIST Center at North Carolina State University.

This activity was adapted from *Comparing Battery and Solar Power*, developed by Science Buddies.
The original program is available at http://goo.gl/ILfdB3

Image Credits:

Figure 1: Electricity flowing through a battery - http://goo.gl/0tH6VJ
Figure 2: Correct aim of solar panels - http://goo.gl/ILfdB3
Figure 3: How solar power works - http://goo.gl/gvJKkn
Figure 4: Solar powered Bristlebot – Personal photo, Robert Bourgeois
Figure 5: Thermoelectric generator - http://goo.gl/XvViRU