

Lesson Plan

Assessment
Cross-curricular

Experiment, handout

Big Ideas

- Energy can neither be created nor destroyed, but it can be transformed.
- Choices about using energy and resources have both immediate and long-term impacts.

Learning Goals

- Understanding energy transformation in a variety of systems.
- Know that water expands when heated, and why climate change leads to rising ocean levels.

Specific Expectations:

- 1.1** analyse the long-term impacts on society and the environment of human uses of energy and natural resources, and suggest ways to reduce these impacts
- 2.2** use scientific inquiry/research skills to investigate issues related to energy and resource conservation (e.g., interview an Aboriginal person about his or her traditional teachings on conservation)
- 3.4** recognize that energy cannot be created or destroyed but can only be changed from one form to another (e.g., chemical energy in a battery becomes electrical energy)
- 3.5** explain that energy that is apparently “lost” from a system has been transformed into other energy forms that are not useful to the system

Description:

This is the **second** lesson in a set of five, with a focus on energy storage. In this lesson we take a closer look at energy transformation and how energy can be stored.

Materials/Resources:

- Beaker, test-tube or tea light container
- Stopper with hole in it (for beaker and test-tube setups only)
- Candle or a light that gets hot
- Retort stand and Water

- Springs, elastics, wind-up toys, solar calculator, anything that makes sounds
- Handout (Energy Transformations)

Safety Notes

Be careful if using an open flame.

Introduction

We have already seen in yesterday's lesson that energy can be transformed from one type into another. Today we will investigate this some more.

- If you did not do the food burning experiment in the last class you may want to do this to start the class. Otherwise refer to any example of burning, such as a log of wood.
 - Let's start with yesterday's example, when we burned a piece of food. How was energy transformed in that experiment?
 - The chemical energy of the food was turned into heat energy. There may have also been a small amount of sound energy.
 - Where did that chemical energy come from? (Solar – so energy was transformed from solar to chemical before – through photosynthesis).
 - Now it's the student's turn to figure out the energy transformation(s) that take place in several processes.
-

Action

Transforming Energy

Students select from the following items: springs, elastics, wind-up toys, solar calculator, anything that makes sounds – for example greeting cards, toys, crinkly materials. **Give them the handout (Energy Transformations) to fill out as they go.**

Doing the experiment:

- Groups of 2 or 3 will work well for this activity.
- Almost ANYTHING you can think of will involve energy being transformed. (Give some hints/ideas if necessary).
- Students come up with a procedure of an experiment to take your item through (e.g. drop it, wind it up and release, etc.).
- Do the experiment several times. Think carefully of all the things that happen. What form of energy is involved with each step?
 - Circulate to help students understand the energy transformations taking place in their experiment.
- Write down the energy transformations you think take place.

Discuss the results:

- Ask for volunteers or pick students to explain what they did and how energy was transformed in the process.
- As you go you will have to explain what some of the different forms of energy are those you might not have defined yet the previous day. For example, potential energy is the energy possessed by a body by virtue of its position relative to others, stresses within it, electric charge, and other factors. In other words, the object has the POTENTIAL to do something, when it is released etc.
- Here are some common experiments that are very good to discuss:
 - **Dropping an object.** Energy is transformed from gravitational potential energy to kinetic energy. Once it lands it may bounce back – energy transforms back into potential from kinetic etc. Eventually all energy of the object is lost. Well actually it has been released as sound, heating (a small amount), maybe by moving carpet

hairs, and certainly by creating air flow – i.e. moving air molecules (that is air resistance, a type of friction)

- **Making a sound.** Energy is transformed from chemical (in the body) to mechanical (moving our body) to sound energy (or to electric and then to sound energy if using a gadget). In your ear mechanical energy is created as your eardrum moves!
- **Extending something elastic (also applies to wind-up toys).** Energy is transformed from mechanical (moving your body) to Elastic potential energy. Then the potential energy is transformed into kinetic energy when we let the object go.

Heating Water Demo

Heating water is a great example of an energy transformation. It is also an example that has great relevance as our oceans are heating due to climate change. As water heats it expands, which are the main reason oceans are rising (melting glaciers are also contributing, but to a lesser extent).

- **If you have a beaker or test-tube:** Fill it with water. Place the stopper (with hole in it) on it. Insert straw through the hole and seal with putty or glue if necessary. Attach beaker to retort stand and place over a candle (for quick results) or shine a light on it (and give it about 10 minutes)
- **If you have a tea light container:** secure the empty container above an unlit tea light (for example using a retort stand). Fill the container with water TO THE BRIM but don't let it overflow. Light the tea light under it.
- **What happens?** After a while you should see the water rising through the straw or overflowing the tea light container. It is expanding! Heat is transferring from the candle to the water. As water heats up it expands.
 - This is in fact the main reason oceans will rise due to climate change! As the Earth's atmosphere heats up due to trapped greenhouse gases, the oceans absorb some of this extra heat and also get warmer. They then expand.
 - At the time of the dinosaurs our oceans were over 300 metres higher at one time!
 - What would the world look like if the water levels rose? Have a look here: <http://geology.com/sea-level-rise/>
- **Energy is being STORED in the oceans.** Just as energy is being stored in the hot water we made in the classroom. Tomorrow we will explore the topic of energy storage in many more examples!

Consolidation/Extension

Steam Powered Rocket-Boat

- To end the class you can do an experiment to really capture the students' interest. We suggest running a steam-powered rocket boat!
- This is a great application of the concept of energy storage in hot water and steam.
- Instructions can be found here: <http://www.energyquest.ca.gov/projects/steamboat.html>

Wrap-Up Discussion

- Energy transformations happen all the time.
- It is of great benefit to store energy. Humans have sought better ways to do this for a long time (ever since they put rocks into a fire to heat them to use later to keep warm!).
- We can see that energy SEEMS to get lost. To create better efficiency and conserve energy we want to eliminate those energy drains into friction, sound, escaped heat etc.