

## Lesson Plan

Assessment  
Cross-curricular

Build device, worksheet

### Big Ideas

- Energy can neither be created nor destroyed, but it can be transformed.

### Learning Goals

- To successfully build an energy storage device

### Specific Expectations:

- 2.1** follow established safety procedures for using tools and materials (e.g., use hand drills correctly when making holes in wood)
- 2.3** use technological problem-solving skills to design, build, and test a device that transforms one form of energy into another and examine ways in which energy is being “lost” in the device
- 2.4** use appropriate science and technology vocabulary, including energy, heat, light, sound, electrical, mechanical, and chemical, in oral and written communication
- 3.3** describe how energy is stored and transformed in a given device or system (e.g., in a portable electric device, chemical energy stored in a battery is transformed into electrical energy and then into other forms of energy such as mechanical, sound, and/or light energy)

### Description:

This is the **third** lesson in a unit of five. In this lesson students will now apply what they have learned so far to build an energy storage device. The aim of this lesson is really for the students to use their creativity, and through that also discover how many different ways exist to store energy.

### Materials/Resources:

- Various types of elastics and springs
- Wind-up toys
- String, tape, scissors
- Marbles and/or other small masses
- Small containers (Tupperware or boxes)

- Solar battery charger or solar panel science kit,
- Water, container (pop bottle, large yogurt container etc.), something to plug a hole in container – putty or a stopper
- Bendy materials (tent pole, thin wood, plastic)
- Small windmills
- Poster board and/or cardboard

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## Introduction

Today it is your turn to build something. An energy storage device.

- Yesterday we discussed energy transformation and some ways of storing energy. Who can remember a way we can store energy? What applications can you think of where we use this type of energy storage?
  - Batteries
  - Heating a substance (such as water)
  - Raising a mass to a higher level (gravitational potential)
  - Chemical potential (such as in the human body)
  - Extending something elastic, such as a spring.
- Today you get a chance to store energy. You will get to pick materials and come up with a way to store energy using those materials. We will start by having a look at the materials and thinking about what we could do.
  - Get students to form groups of 2 or 3
  - Let all the **students come up and see the materials** you have for them to use to build their energy storage device with.
    - You can lay out the materials in groupings that you want the students to take as a package or you can let the students figure out, by themselves, exactly what materials they should take. This depends a bit on how much independence you want to give them. We suggest the second, less structured, approach.
    - Potentially give students some ideas on how they could use the materials. For example:
      - Point out how to build a conveyor belt or elevator with string, tape, and plastic cups to raise water or marbles up to a storage tank.
      - Show how you can charge a battery with a solar cell and then use it to power something.
  - Give students a few minutes to discuss which materials they would like to pick. Get them to fill in the **worksheet** section on how they plan on storing energy. This is the hypothesis of how their experiment/device will work.

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## Action

### Building an Energy Storage Device

Instructions:

1. Pick your materials. If you need more, you can come back and get what you need!
  2. Discuss what you want to do and then try it out.
  3. Make sure to test your experiment several times and improve it if you can.
  4. Fill in the **worksheet** for your experiment as you go. (Can be used as formative assessment)
- Students build their energy storage device/perform an energy storage experiment
  - Experiments that may work particularly well (which you may want to guide students towards:

- **Storing marbles or water in a raised tank.** Build a conveyor belt/elevator to raise the marbles or water off the floor onto your desk. Fill a container (say a yogurt container with marbles or water). Create a small hole that will permit the marbles or water to drain. With water this will work particularly well as you will see the pressure created by the full tank.
- **Extending or compressing a spring.** Come up with a way to compress/extend a spring. Could just be done by the students manual force, but they could also use something like a weight hanging from the spring or pushing down on it, toy cars driving attached to it and driving away to create tension etc. An added step might be making a ramp that lets marbles drop into a cup that is attached to a hanging string.
- **Elastics** can be twisted (for example with a windmill, or they can be extended in various ways. By connecting a few elastics students can create a setup that will take longer to fully wind up or extend.
- **Elevators** are a great way to work with gravitational potential. For example students could have two cups connected by a string. One side can be filled with marbles while the other side is being held fixed.
- **Charging a battery.** This is fairly standard, but might appeal to some technically minded students. The battery can then be used to power something.
- **Bending an elastic material.** For example a tent pole, attached at one end, can be pulled down with a string, similar to the arm of a catapult. In fact, students could create a catapult for an object that won't hurt anyone if released.

### Consolidation/Extension

There are many ways to store energy. Being able to store energy is crucial if we want to use more renewable energy sources in our power grid. Think about it.

- Does the sun shine all the time? Does the wind blow all the time? NO!
- This is the advantage of coal, gas and oil. We can burn it anytime we want!
- So how could we make solar and wind energy more reliable? Storage! For example:
  - Use solar/wind energy to charge a battery. The problem is that we need huge batteries. They may discharge, and they may also be VERY expensive to build.
  - Use solar/wind energy to pump water up a hill or mountain (or we could even pump water up from the bottom of a mine shaft). Then release the water to power a water turbine when we need power!
- Another neat application is to use the Earth as storage!
  - In the summer, pump warm air through a tube in the earth. This cools it down to give us a natural air conditioner.
  - This also heats up the Earth, which can store the heat quite efficiently.
  - In winter we can then pump the cold outside air through these same pipes to heat it up. This can then be used as a heat source in our houses.
  - Example of a similar project that uses solar energy to heat up the Earth: Drake Landing Solar Community in Okotoks Alberta: <http://www.dlsc.ca/>. See resources for further information.