Children's Discovery Museum of San Jose

Current Connections

Teacher's Guide: Grade 2 – 3

California Content Standards

Grade Two:

- Science 1a, 1b, 1c, 1d, 4a, 4b, 4e, 4g
- Mathematics – Statistics, Data Analysis, & Probability 1.1, 1.2, 1.3, 1.4

Grade Three:

- Science 1c, 1d, 5a, 5c, 5d, 5e

What's Going On?

In the ***Current Connections*** exhibit, Power Girl learns about energy and uses her own ingenuity to design human-powered machines that perform common tasks. In the activities described in this guide, children design their own machines to harness and use energy.

Before You Visit

Before You Visit CDM, explore the simple power of a spring to harness energy. A spring is something that bounces back after you push or pull on it. It stores the energy from your push or pull and you can use it to move by itself or to move something else. When the class visits the Museum, they will see many other examples of machines that use the energy from people pulling or pushing to move something else.

During Your Visit

During Your Visit to CDM, remind the children of the spring experiment and how it transfers energy from a person's pushing or pulling to motion.

After Your Visit

After Your Visit, create a boat that uses stored energy to motor around a tub of water. Children may choose to use the power of a spring, wind power, or water power to make their boats move.

Before You Visit
How Springs Transfer Energy

What you'll need:

For each pair of students –

- ❑ 3 – 2' long pieces of wire
- ❑ Pencil
- ❑ Magic marker
- ❑ 4' long piece of string
- ❑ Tape measure or yard stick
- ❑ Round color-coding labels (1 of each, blue, red and yellow)
- ❑ Student Recording Sheet

Additional materials –

- ❑ Broom handle – as many as you can locate, pairs can share
- ❑ Spring Collection – Gather many examples of springs, such as, Slinky, Jack-in-the-Box toy, stapler, clickable ballpoint pen, flashlight, clothespins, binder clips, homemade springs made from metal notebook coils
- ❑ Chart made to look like the sample in step three

Objective:

Observe and measure the motion of objects.

What to Do:

1. Gather the students together. Show them some different types of springs. Pass them around and let the children handle and play with them. Some of the objects, such as the flashlight or the stapler, may need to be taken apart so that children can see where the spring is and what it does.
2. As children are exploring, tell them that each of the objects is an example of a spring. Ask children the following questions: What does the spring look like? What happens if you pull it? What happens if you push on it? Could the tool work without the spring? What function does the spring perform?
3. Tell the children that they will experiment with coiled springs by making three different springs, each from the same type of wire, but with different coil diameters. Show them the data collection chart where the class will record the results of the experiment.
4. Demonstrate the steps involved:
   a. First, wrap two feet of wire tightly around the pencil to create a spring. Try to make the coils very close together.
   b. Next, wrap two feet of wire around a magic marker to create a new spring.
   c. Make a third spring by wrapping wire around a broom handle.
   d. To test the springiness of the different springs, one partner ties one end of a piece of string to a chair or table leg and stretches the string taut. That same partner threads the loose end of the string through a spring, pushes one of the springs back against his or her hand and releases it. The second partner should be ready to pinch the string where the spring stops and measure the distance it travels.
   e. Before testing the other two springs, predict how far you think they'll each travel. Students should keep track of their data on their Student Recording sheets.
5. Pair the students, distribute the materials, and give children time to complete the experiment.
6. When pairs have completed their experiment, they can transfer their data to the class chart using the round color-coded labels. Blue dots represent the distance the pencil coil traveled, red dots represent the marker coil, and the yellow dots represent the broom handle coil. Ask students to cluster their dots close together if necessary, but not to place them on top of each other.

How Springs Transfer Energy (continued) ☞

7. When everyone is finished, gather the class together again to discuss the results recorded on the class chart. How far did each spring travel along the string? Does the diameter of the coils seem to make a difference? What do you think would happen if you made another spring using thicker wire? Were there differences among the data gathered by different pairs?

Assessment:

As the class is debriefing the experiment, take note of which children understand how to read a cluster graph and which children need more practice.

Extensions:

- Have the children go on a spring scavenger hunt in the classroom, around the school, or at home. They can "collect" springs by drawing or listing the places they find them.
- Repeat the experiment with thicker or thinner wire.

During Your Visit
Guided Exploration of the Exhibit

What you'll need:

- ❑ Pencils (optional) - 1 per student
- ❑ Clipboards or other sturdy writing surface (optional) – 1 per student
- ❑ Student Guide (optional) – 1 per student or group of students

What to do:

Before entering the Museum, remind the children of the spring experiment and how it transfers energy from a person's pushing or pulling to motion. There are many exhibits in the Museum that are powered by people-generated energy or energy from another source. Use your Student Guide to keep track of the many examples of energy use throughout the Museum. (Note: Teachers or parent chaperones may choose to use the categories as oral discussion topics as they and their class travel through the exhibit or may choose to copy the student sheet for the children to find their own examples of these machines. Some of the machines are found within the "Current Connections" exhibit, but others are found throughout the Museum.)

Guiding questions:

- Can you find examples of these machines that use people –generated power?
  (Power Girl asks for help using a pulley to lift a heavy ball to the ceiling; Pulleys are used in the ***Secrets of Circles*** exhibit to lift fruits and vegetables; Power Girl asks for help using a treadle. As children cooperate to move the treadle back and forth, they activate a lever which in turn winds a wheel; Power Girl asks for help turning a crank to make a toy airplane fly.)
- Can you find examples of machines that use air or wind power?
  (Some examples are the Bernouli blower that holds balls in the air and the tubes in the Waterways exhibit.)
- Can you find examples of machines that use water power?
  (There are many examples in the Waterways exhibit – the water wheel, the fountain, and the current channel.)

After Your Visit
Making a Boat

What you'll need:

For a basic spring-powered boat –

- ❑ Styrofoam trays cut to match the Sample Boat Shape. See attached lesson plan. Save extra pieces of Styrofoam to build with.
- ❑ Rubber bands of various sizes (springs)
- ❑ Paperclips
- ❑ Scissors
- ❑ Pencils
- ❑ Rulers

Additional Boat building materials (for wind or water powered boats) –

- ❑ Tape
- ❑ Waterproof glue
- ❑ Balloons (jet propulsion)
- ❑ 7" squares of water resistant cloth, such as nylon or vinyl (wind)
- ❑ Small wooden dowels, cut in different lengths
- ❑ Corks
- ❑ Overnight mail envelopes (waterproof envelopes)
- ❑ Straws
- ❑ String
- ❑ Stapler
- ❑ Large tubs of water (storage containers, baby pool)
- ❑ Small fans

Objective:

Children will use the discoveries they made at the Museum to design a toy boat that moves through a tub of water. They will use knowledge about stored energy and simple machines to design their boats.

What to Do:

1. Lead children in a discussion about what they learned at the Museum. Next, talk about energy and motion. (For example: What is the relationship between inertia and effort (force)? How does friction affect the speed of an object?)
2. Challenge children to design a toy boat that will move without pushing – i.e. they need to harness energy and transfer it to the boat.
3. Give children ample time to build their boats, test them in the tubs, and make changes. "Ample time" may mean more than one class session. It may also mean that after students are given time for initial exploration and trials, you bring the class back together to discuss their work, learn from each other, and provide some feedback from the teacher before proceeding with the building of their boats.

   Some possible ways children can build "energy-powered boats" include:

   a. creating a sail for the boat with fabric or overnight envelope pieces and harnessing wind power

   b. creating a paddle for the boat using a cut out Styrofoam piece attached to the hull by a rubber band and then twisting the rubber band to harness spring power

   c. attaching an inflated, but not tied-off, balloon to the boat with a straw and then releasing the air to create jet propulsion
4. Once all of the children have completed their boats, have a celebration by letting each child explain his or her design and then launching the boats in the tub or a natural water source.

Assessment:

Invite each child to explain how he or she made particular design choices. Note whether the choices reflect accurate knowledge about the physics of energy.

Extensions:

- Challenge the children to determine which method of harnessing energy is the most efficient, makes the boats travel the farthest, or propels them the fastest.
- Create other vehicles that can be powered by harnessing energy.

Making a Boat (continued) ☞

Related CDM lesson plans:

- Boing!: Wind Me Up
- Boing!: All Coiled Up
- Boing!: Scavenging for Springs
- Boing!: Springboarding

Web Links:

- www.teachingtools.com/Slinky/slinky.html

Additional reading for children:

- *Forces Make Things Move*, by Kimberly Brubaker Bradley
- *Energy Makes Things Happen*, by Kimberly Brubaker Bradley
- *Energy: Simple Experiments for Young Scientists,* by Laurence B. White

Student Recording Sheet

Name _____

Type of Spring	My Prediction Distance it will Travel	My Results Distance it Traveled
Pencil Coil		
Magic Marker Coil		
Broom Handle Coil		

Current Connections Student Guide

Name _____

Can you find examples of machines that use people –generated power?

Can you find examples of machines that use air or wind power?

Can you find examples of machines that use water power?

Sample Boat Shape