Western Engineering

Outreach

The Power Behind Paddle Boats

Grade 6-8

Meet Today's ENG HERO!

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Dr. Kurowski's teaching responsibilities and expertise are in the general field of product design, design analysis and solid mechanics. Prior to joining the Faculty of Engineering at the University of Western Ontario, Dr. Kurowski had worked for over 20 years as a design engineer and R&D engineer in automotive, defense and heavy equipment industries. His is a member of the Society of Automotive Engineers and the Association of Professional Engineers of Ontario.

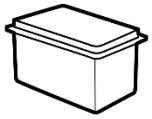
To learn more about Dr. Kurowski visit: https://www.eng.uwo.ca/mechanical/faculty/kurowski_p/index.html

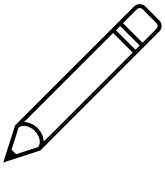
Learning Goal:

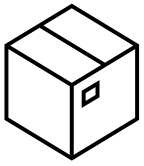
Students will consider how the theory of conservation of energy can be applied to everyday processes
Curriculum Connections:
Grade 7 - Understanding Structures and Mechanisms
Grade 8 - System's in Action

Materials Needed:

- shallow plastic container
- 3 large rubber bands
- 2 pencils / popsicle sticks
- cardboard, thick piece of paper or foam shapes
- Large Bucket of Water or Bathtub







Engineering and Science Connections:

Today we will become mechanical engineers. Mechanical engineers deal with problems that involve moving things. They typically work on cars, planes, trains, and other things that move.

One thing Mechanical Engineers have to consider when designing something is how much energy is required to move something. What is energy? Energy is the ability to do work. Energy is how things change and move. It's everywhere around us and takes all sorts of forms.

These are many forms of energy, here is a list of all of them!
Chemical - Chemical energy comes from atoms and molecules and how they interact.
Electrical - Electrical energy is generated by the movement of electrons.
Gravitational - Large objects such as the Earth and the Sun create gravity and gravitational energy.
Heat - Heat energy is also called thermal energy. It comes from molecules of different temperatures interacting.
Light - Light is called radiant energy. The Earth gets a lot of its energy from the light of the Sun.
Motion - Anything that is moving has energy. This is also called kinetic energy.
Nuclear - Huge amounts of nuclear energy can be generated by splitting atoms.
Potential - Potential energy is energy that is stored. One example of this is a spring that is pressed all the way down.

The law conservation of energy says that the amount of energy in a system never changes. No new energy is created, and no old energy is destroyed. This means all the energy is converted into another form of energy. An example is when you eat food your body transforms the chemical energy in the food to kinetic energy and allows you to move your body.

Our activity today focuses on the use of paddle boats. Paddle boats were widely used in the early 19th century as a unique form of marine transportation. A steam engine was used to drive a paddle wheel for propulsion and so they were called steamboats. A steamship or steamboat was powered by a steam engine that drives paddle wheels to propel the craft through the water. In the activity today we will be using an elastic band instead of steam to create motion in the paddle to move the boat.

Video Recommendation: *The Law of Conservation of Energy | Forms of Energy*

https://www.youtube.com/watch?v=_8EEnMwkmZk

Activity:

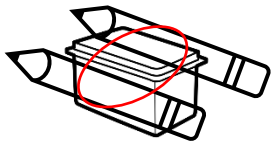
Get a glow stick and crack it so it starts to glow. What energy transfer is this? What is happening when you crack a glow stick and it starts glowing?

THE POWER OF PADDLE BOATS

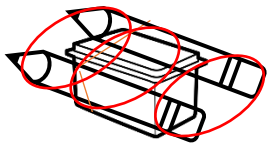
The energy transfer taking place is chemical energy to light energy. A glow stick consists of 2 isolated substances (diphenyl oxalate compound and hydrogen peroxide) that, when combined, make light through chemiluminescence, so it does not require an external energy source. The light cannot be turned off and can be used only once. Glow sticks are often used for fun at night can also be used light during military, police, fire, or emergency medical services operations.

Time to Begin

1. Using a rubber band, wrap the two pencils onto the plastic container, one on each side.



2. Put one more rubber band binding the two pencils behind the boat, and another one in front of the boat for balance.

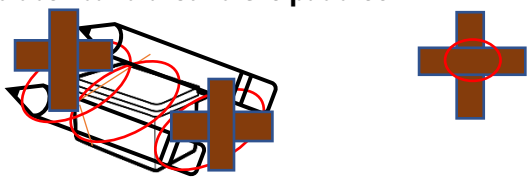


3. Cut the cardboard into 4 small pieces that are small enough to fit in the space between the two pencils.

4. On each cardboard, make a cut in the middle but stop half the way (do not cut it all the way).

5. Put 2 pieces of cardboard together by sliding one slit onto the other to make a rotating paddle. Do the same to the other 2.

6. Fit the paddles onto the front and back rubber bands. This will be done by using the slits on each piece of cardboard to allow you to twist the rubber band around the paddles.



7. To make them rotate, twist the paddles on the rubber bands to wind them up.
8. Although you have two different paddle wheels on each side of the boat, you can use only one of them if you want or both. The second wheel is there for balancing the boat, so it does not tilt. If you use both wheels make sure to twist both wheels in the same direction.

9. Without releasing the twists, place the boat on the water and then let go.
10. Observe which direction the boat goes.

Debrief

You have just built a paddle boat! In a real paddle boat, the spinning drum of paddle boards acts as oars, pushing against the water as it rotates. In this experiment, the paddles were driven by the unwinding rubber band, which you manually winded before putting it into the water. When we wound up the elastic band using out own kinetic energy from your hand and was converted into the potential energy in the winded rubber band. This potential energy was then converted into the kinetic energy of the band as it unwinds, and the paddles move as a result.

What Did You Learn?

- What is Mechanical Engineering?
- What types of things do Mechanical engineers make?
- What is conservation of energy?
- What is kinetic energy?
- What is potential energy?
- What is a paddle boat?

Future Learning

- Do power plants "produce" electricity? Why or why not?
- Can you think of a device that converts electrical energy into heat? How about into light? Sound?
- Observe around your house energy transfers happening around you everyday, Fridge? Car? Air conditioner?

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

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Thanks for discovering with us!