Western Engineering Outreach

Catapults
Grade 6-8

Meet Today's ENG HERO!

James Johnson - **Professor with Western Engineering**

James Johnson is a professor with the Mechanicals & Materials Engineering Department at Western University. He has a PhD and a Professional Engineering degree! He has interests in fracture fixation and joint load transfer mechanisms! Dr. Johnson is also a part of The Bioengineering Research Laboratory at Western.

To learn more about Dr. Johnson visit:

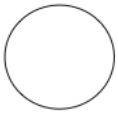
https://www.eng.uwo.ca/chemical/faculty/ray_m/index.html

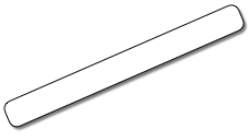
Learning Goal:

- **Students will expand their knowledge about the different kinds of energy.**
- **Students will discuss the law of conservation of energy.**
- **Curriculum Connections: Grade 6 - Flight; Grade 7 - Form and Function; Grade 8; Systems in Action**

Materials Needed:

- **Several popsicle sticks**
- **Minimum 2 large popsicle sticks**
- **Small ball(s)**
- **Elastic bands**
- **Glue**
- **Cups**





Engineering and Science Connections:

Today, we will learn about different kinds of energy, the law of conservation of energy and how these can apply to everyday life!

Kinetic Energy

What is kinetic energy? Kinetic energy is the energy of an object that is in motion. An object will maintain kinetic energy unless it encounters a change in speed. Speed is the most important part of an object's kinetic energy, with mass being the second most important.

Potential energy

Potential energy is energy that is stored and can be turned into **kinetic energy**, the energy of motion. A ball held at some height above the ground has potential energy caused by gravity; when the ball is dropped, it falls at an increasing rate, increasing its kinetic energy while decreasing its potential energy. The potential energy is converted to kinetic energy during the fall. On the other hand, a ball resting on the level ground has no gravitational potential energy; it has no potential for movement unless acted on by an outside force (other than gravity). Potential energy can come from gravity, but also from **elasticity**, such as a rubber band. When a rubber band is stretched, its potential energy increases; when it is released, it snaps back (kinetic energy), and its potential energy returns to zero.

Engineers must understand both potential and kinetic energy. A simple example is the design of a roller coaster–a project that involves both mechanical and civil engineers. When the roller coaster reaches the highest point (before the biggest drop), the cars must have enough potential energy to power them for the rest of the ride. This is done by raising the cars to a great height, increasing their gravitational potential energy. Then, the potential energy of the cars is converted into enough kinetic energy to keep them in motion for the length of the track.

Law of Conservation of Energy

The Law of Conservation of Energy is one of the fundamental principles of the universe. Energy cannot be created or destroyed, it can only be transformed. All of the energy within the universe at the beginning is the same as the amount of energy there is now and will be at the end. This makes calculations of energy transformations relatively simple, as long as one accounts for each aspect of the transformation; this could include energy loss due to friction, creating heat or thermal energy, gravitational potential energy or elastic potential energy turning into kinetic energy, and so on. The term "lost" is used to describe energy associated with friction because that energy normally becomes unusable. Energy is measured in Joules (J).

Video Recommendation: Work, Energy, and Power

https://www.youtube.com/watch?v=w4QFJb9a8vo

Activity:

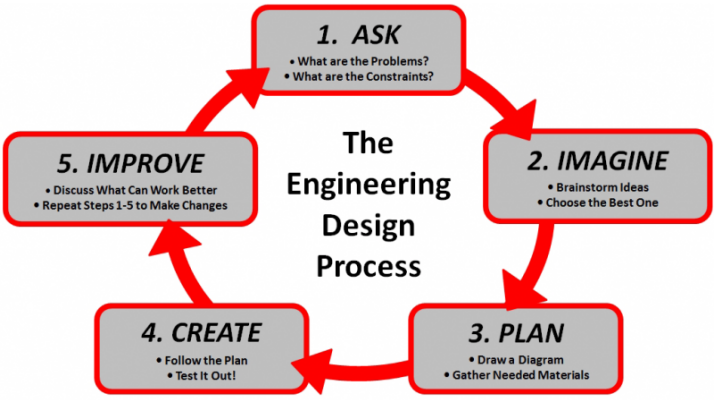
Before beginning, think about the following questions:

- What will help me get the most energy?

- What kind of catapult do I want to make?
- Can I swap out materials to make my catapult better?

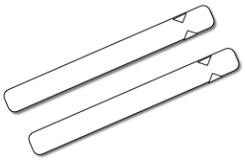
Part 1: Design

There are many different ways someone may make a catapult, and that is up to you! Engineers use something called the engineering design process when creating new things. The first thing an engineer will do is ask "what is/are the problem(s)?" Then an engineer would try and imagine by brainstorming some ideas. Once the best idea has been chosen, a plan is devised usually in the form of a diagram. Now it's time to create and bring your plan to life! Engineers almost never only make one iteration of their design, they usually continue around this process until they achieve the best result.



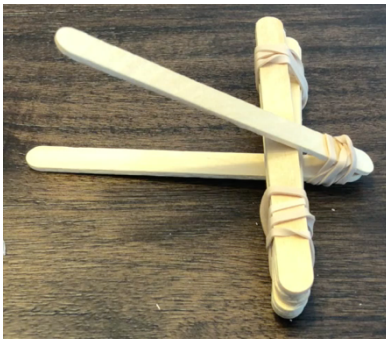
Part 2: Catapult(s)

The design of the catapult is ultimately up to you! We are just going to leave some examples with instructions here for you to follow along with or alter if you'd like! Make it a competition by trying to see which catapult is the best by trying to have them launch a ball into a hula hoop or another target. Do not aim at people or animals!



(1) This catapult involves the conversion of energy from kinetic→ elastic→kinetic→potential→kinetic energy

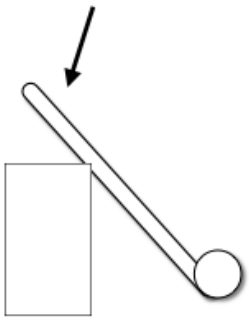
- Put the large popsicle sticks on top of each other and create a groove on each side
- Put 6-8 regular sized popsicle sticks together and hold them in place with two elastic bands
- Stick one of the large sticks through the bottom stick in the stack with the grooved end sticking out the other side
- Attach the second large popsicle stick to the other large one using an elastic band
- Push the pair back into the stack, with the one stick sliding overtop and the other going through
- Now when you push the sticks down, you can launch a ball



(2) This catapult just involves the conversion of kinetic→gravitational→kinetic energy

- Set a cup face down
- Put a large popsicle stick up against it at an angle
- Glue a pop bottle cap to the end of the stick and place a ball in it

- You should be able to launch the ball by hitting the stick



There are so many different ways to make a catapult! Look online for more inspiration and send us what you make! Try and apply the concepts you learned about energy to your catapult!

What Did You Learn?

- What is energy?
- What are kinetic and potential energy?
- What is the law of conversation of energy?

Future Learning

- Try and build a lot of different catapults! Turn this activity into a competition! Try and build the same catapult and see who made theirs better! Try and build different kinds of catapults. Try and achieve different goals with the catapults like distance, speed and height of the launch! Try different materials! Is it better to have a longer or short stick for launching? Does a larger or smaller ball work better? Light or heavy? Try different elastic sizes!

Share your creations!

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

Instagram: @westernueng
Twitter: @westernueng
Facebook: @westernueng

Thanks for discovering with us!