Western Engineering

Outreach

Extreme Roller Coasters

Grades 3-5

Meet Today's ENG HERO!

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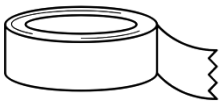
Dr. Lalone co-directs the Musculoskeletal Biomechanics Laboratory at Western. Her research focuses on biomechanics, kinematics, contact mechanics, musculoskeletal imaging, orthopaedic biomechanics, and rehabilitation sciences. She is involved in developing medical and assistive devices that help with patient diagnosis, treatments, and therapies. To learn more about Dr. Lalone's research, visit: https://www.eng.uwo.ca/hbl/

Learning Goal:

- Students will learn about the conservation of energy principle
- Students will learn about different types of potential energy
- Investigate the relationship between potential and kinetic energy
- Curriculum Connections: Grade 5: Conservation of Energy and Resources

Materials Needed:

- Marble, Toy Car or similar
  - to test your coaster
- Straws
- Construction Paper
- Newspaper
- Cardboard
- Tape and/or Hot Glue Gun
- Popsicle Sticks
- Skewers



Engineering and Science Connections:

Today we will be talking about the principle of conservation of energy as well as the relationships between several types of energy. These concepts are fundamental to physics and many types of engineering.

Conservation of Energy

The conservation of energy is a rule in physics that states that energy cannot be created or destroyed, but can be transformed from one form to another.

Potential Energy

This type of energy can be stored and used later. There are many types of potential energy such as gravitational, chemical, elastic, and nuclear.

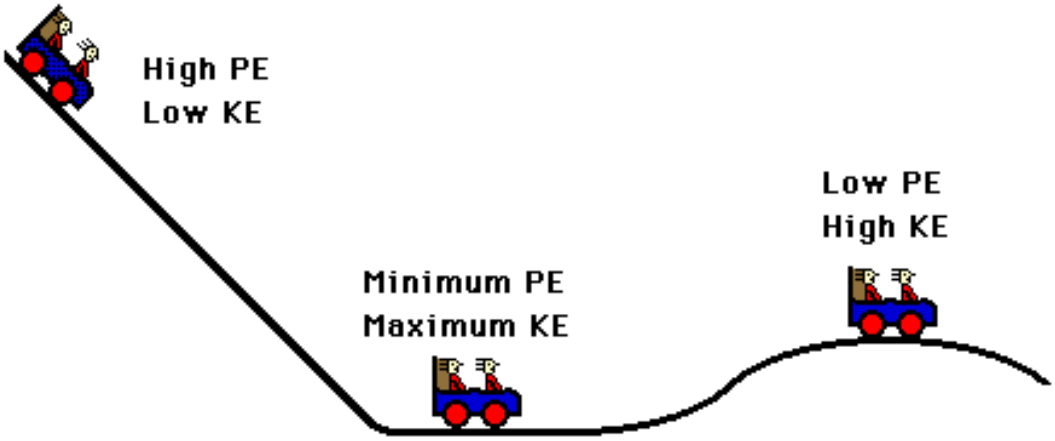
Kinetic Energy

Kinetic energy is the energy of movement. All of the subtypes of kinetic energy depend on some sort of movement, either on the mechanical level or atomic level. Thermal, mechanical, electrical, and magnetic energy are all types of kinetic energy.

Thought Exercise: If you pushed a car on a flat road, what would happen? How about if you pushed the same car off the top of a hill? Which car would go farther? Why?

The car pushed on the flat road would go a small distance then stop. However, the car pushed off the hill would roll down the hill and continue for a long distance. This is because of the conservation of energy principle! When the car was at a great height (at the top of the hill), it had a high **gravitational potential energy**. Once the car is pushed at it starts to travel down the hill, its potential energy will decrease as its distance from the centre of the Earth decreases. But, wait! That energy can't just disappear! Instead, it will change form and become **kinetic energy**, which is why the car will go faster and continue rolling much farther than the one pushed on flat ground.

Let's apply this idea to a roller coaster:



As a coaster car loses height, it gains speed; PE is transformed into KE. As a coaster car gains height it loses speed; KE is transformed into PE. The sum of the KE and PE is a constant.

As you can see, as the height decreases, the gravitational potential energy must also decrease, meaning that the energy that existed in that form must now transform into another type (kinetic). Understanding this is key for engineers designing structures such as roller coasters.

Video Recommendation: *The Difference Between Kinetic and Potential Energy*

https://www.youtube.com/watch?v=eBsU9DVa7ws

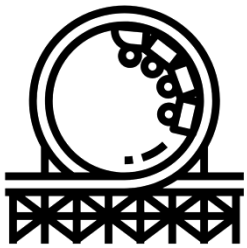
Activity:

Before you start, think about the following questions:

- How can you use hills and points of high potential energy in your designs?
- When do you need the highest kinetic energy? How will you plan your roller coaster features (ie a hill or loop) to occur at the points of highest kinetic energy?

Wonderland Ride Design Contest

There's a new roller coaster coming to Wonderland! The engineers have asked for inspiration from the bright young minds of local students. You've been selected to draw up a plan for a roller coaster ride (or section of a roller coaster ride) and create a prototype using a marble or toy car as the riders to show the engineers and win the contest! Challenge: use the materials on the approved list and add a loop-de-loop to your design.



What Did You Learn?

- What are the types of potential energy?
- What is the conservation of energy principle?
- How can we use gravitational potential energy to create speed?
- How does energy change forms?

Future Learning

- Challenge yourself to add more than one loop in your design within a certain distance
- What kind of engineers design roller coasters?

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!