Western Engineering Outreach

Marble Run Roller Coaster

Grade SK-2

Meet Today's ENG HERO!

Hamid Abdolvand – Assistant Professor in Mechanical and Materials Engineering at Western University

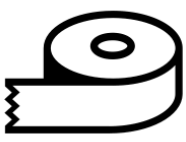
Dr. Abdolvand's research focuses on deformation and failure mechanisms of engineering materials across length and time scales. Before joining Western Engineering, he was a postdoc researcher at the University of Oxford where he spent three years working on electron and synchrotron x-ray diffraction analysis of engineering materials. Dr. Hamid Abdolvand received his Ph.D. in 2012 from Queen's University, Kingston, Canada. During his Ph.D., he developed a series of finite element codes for modelling deformation of polycrystalline materials such as zirconium. To learn more about Dr. Abdolvand please visit https://www.eng.uwo.ca/mechanical/faculty/abdolvand_h/index.html

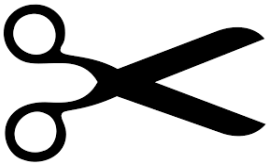
Learning Goals:

- Students will learn about Mechanical Engineering and the conservation of energy
- Students will explore different types of energy (e.g. potential and kinetic energy)
- Curriculum connections: Students will develop critical and creative thinking skills with the application of those skills to Materials, Objects, and Everyday Structures as well as Movements as recommended in the Ontario Science and Technology curriculum

Materials Needed:

- Marble
- Paper or construction paper
- Pencils and markers
- Decorations materials (pom-pom, tissue paper, etc.)
- Popsicle Sticks





- Tape or hot glue
- Scissors
- 2 Toilet Paper Roll



Engineering and Science Connections:

Mechanical Engineering

A mechanical engineer is the type of engineer that designs and builds anything that is moving such as buses, planes, trains, cars, etc. Mechanical engineers can design power-producing machines, such as electric generators, internal combustion engines, and steam and gas turbines, as well as power-using machines, such as refrigeration and air-conditioning systems.

What is Energy?

Energy is the ability to work. For example, you need energy to cook food, to take the bus to school, to play, to do homework, to run and to be able to do so many more things in life.

Law of Conservation of Energy

The law of conservation of energy states that energy can't be created or destroyed it can only be converted from one form of energy to another. There are numerous forms of that energy can be changed.

Forms of Energy

Let us learn together about some of the different forms of energy that exist in our world!

- Electric Energy: There is an electric energy in electrical fields. It is the energy in electricity that gives us power. You use power in your phones, lights, and computers.
- Kinetic Energy: Have you ever been so tired you don't want to move? The form of energy needed for movement is called kinetic energy. When I am running, I am using kinetic energy to give me the ability to move.
- Wind Energy: Wind Energy is a renewable energy that helps in producing electricity. Wind turbines that are present onshore or offshore have blades that catch the wind and then with a generator at the base of the turbine that produces electricity.
- Thermal Energy: Thermal energy (also called heat energy) is produced when a rise in temperature causes atoms and molecules to move faster and collide with each other.
- Potential Energy: When an object is at really high up, it has more energy than an object close to the ground. This is called "potential energy". The higher an object is the more potential energy that it will have.

MARBLE RUN ROLLER COASTER

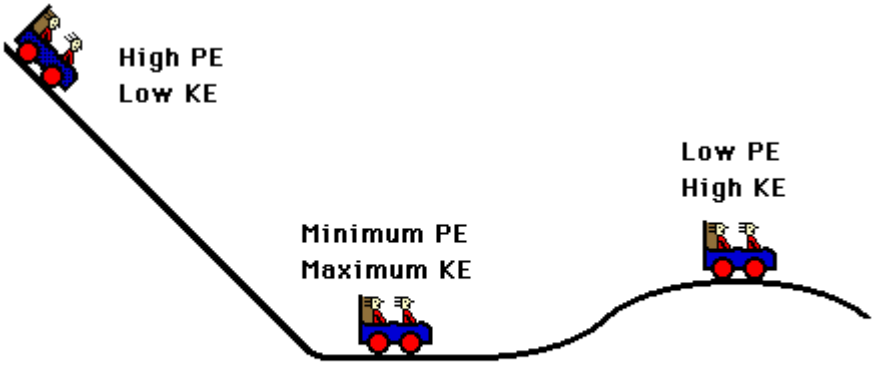
Picture a car. If you put the car on a flat road and gave it a small push, what would happen?
It would move a short distance then stop. That means the car will have very little kinetic energy because it will be moving a short distance only.

Now if you put that car on the top of a hill and gave it the same small push, what would happen? The car would roll down the hill, and keep rolling for a long distance.

Which car moved farther? Why?
The car on the hill rolled father. By being higher up it has more energy. This is a form of energy called potential energy, it depends on the height of the object. The higher the object the more potential energy it has. Then following the law of conservation of energy, this potential energy has converted into kinetic energy, this is why the car on the hill rolled for a bigger distance. Always remember that energy can't be created or destroyed, only changed form.

Conservation of Energy on a Roller Coaster

1. When the car is at the top of the ride it slows down and is very high up.
   It has high potential energy
2. As the car goes down the ride, it becomes closer to the ground and speeds up.
   The potential energy is changed into kinetic energy.
3. When the car gets to the bottom of the ride it is going fast but is low to the ground.
   Q: The car now has high kinetic energy. Is the potential energy now high or low?
   A: Low because the potential energy was changed to kinetic energy.
4. In each case the energy that was at the beginning of the system is still there in the end it just changed to another form of energy.



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.

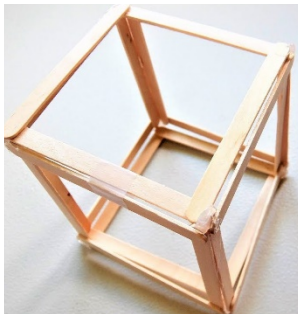
MARBLE RUN ROLLER COASTER

To always keep in mind!

- When I am high above the ground what form of energy is high? Potential
- When I am moving quickly what form of energy do I have? Kinetic
- Does energy ever disappear? No, it changes form

Activity:

In today's activity, Canada's Wonderland has heard from its customers that they are bored of the current roller coasters! They have already ridden them thousands of times and are looking for something new. In this time of need, Canada's Wonderland is desperate for an exciting engineer to make a fresh, new ride to keep their customers happy! CW has just approached you and your engineering consulting team to make this happen. Let us get started with designing our roller coaster.



Step 1: Making the base

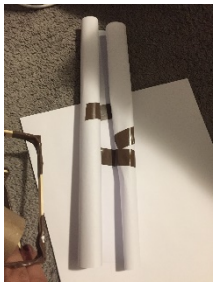
- Using popsicle sticks and tape or hot glue make the base of the roller coaster, it's the shape of a cube.

Step 2: Making the tube

- Tape your toilet paper rolls together to make a long tube.

Step 3: Assembling together

- Place the toilet paper roll tower in the popsicle stick cube and make sure to secure it with tape.



Step 4: Making the slides

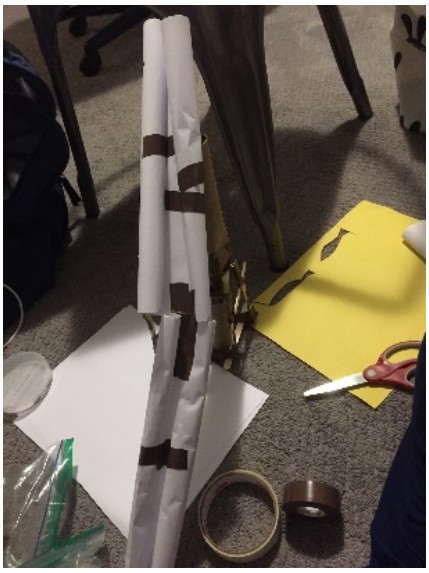
- Roll your construction paper in the following shape or a tube shape.

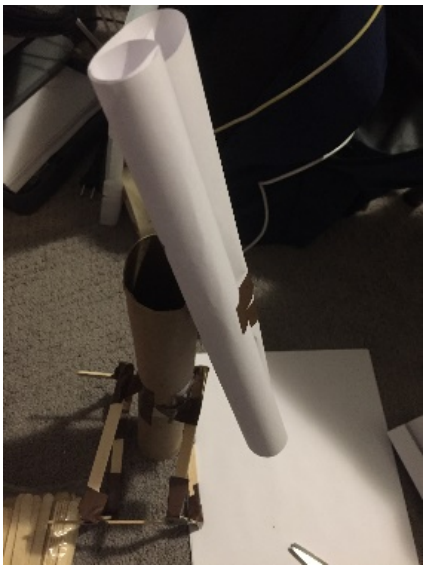
Step 5: Tape the rolls of construction paper on the toilet paper roll

Step 6: Attach more paper rolls together to make your roller coaster longer and decorate!

Step 7: Let the passengers go on the ride!

- Place the marble on the roller coaster, because the marble is your passengers!





Recommended Video:

Watch the following video about wind energy.
https://www.youtube.com/watch?v=niZ_cvu9Fts&feature=emb_logo

Watch the following video about the Yukon Striker at Canada's Wonderland
https://www.youtube.com/watch?v=JOzWTlFfl0o&feature=emb_logo

What Did You Learn?

- What is energy?
- Law of Conservation of Energy
- Forms of Energy
- Mechnical Engineering

Future Learning

- Turn this design activity into a project! Try to be creative and add twists to your roller coaster by adding more paper rolls together. This will make your roller coaster so much more adventurous and more special.

Share your creations!

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

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

Thanks for discovering with us!