Please mute your microphones.
You may keep your video on if you wish.
We will begin shortly.

Thank you.

FYS

Balloon-Powered Car

Engineering

Materials

Plastic Bottle

Bottle Caps (4)

Straws (3)

Skewers/Sticks (2)

Balloon

Rubber band

Tape

Scissors

FYS

Let's Think:

Can you name some innovations and inventions?

Innovations

- Throughout history, the creation of new technologies and inventions through innovative techniques have proven to be extremely impactful to the development of our world!

- Important Innovations:

- Light Bulb
- Car
- Printing Press
- Telegraph

Principles of Engineering

- To be a good innovator, one must be creative and have grasp of important concepts in physics
- Creativity is something that comes naturally
  - Music
  - Art
  - Out-of the Box thinking
- Physics is something that can be learned, and we will be going over today before our experiment!

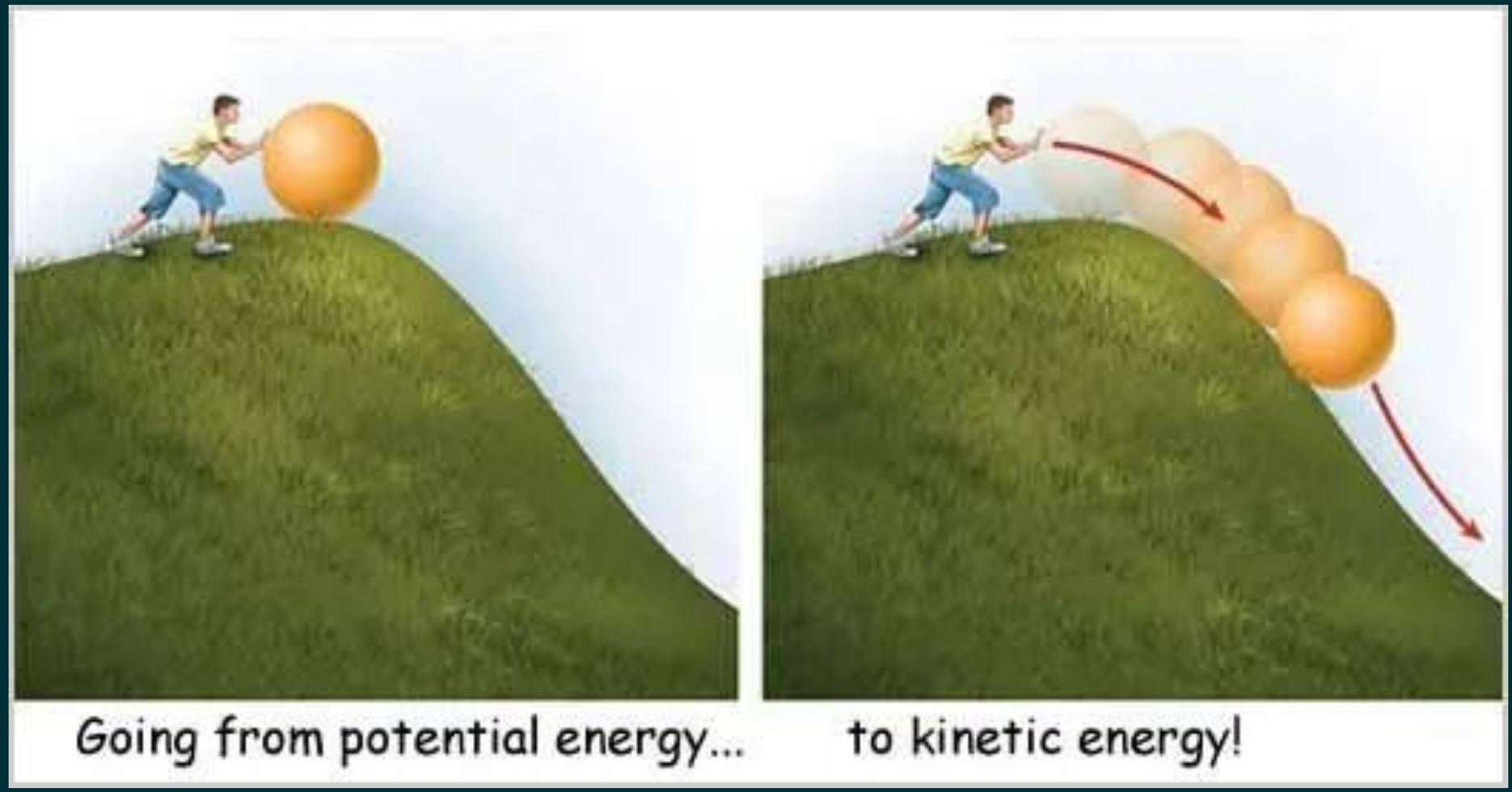
FYS

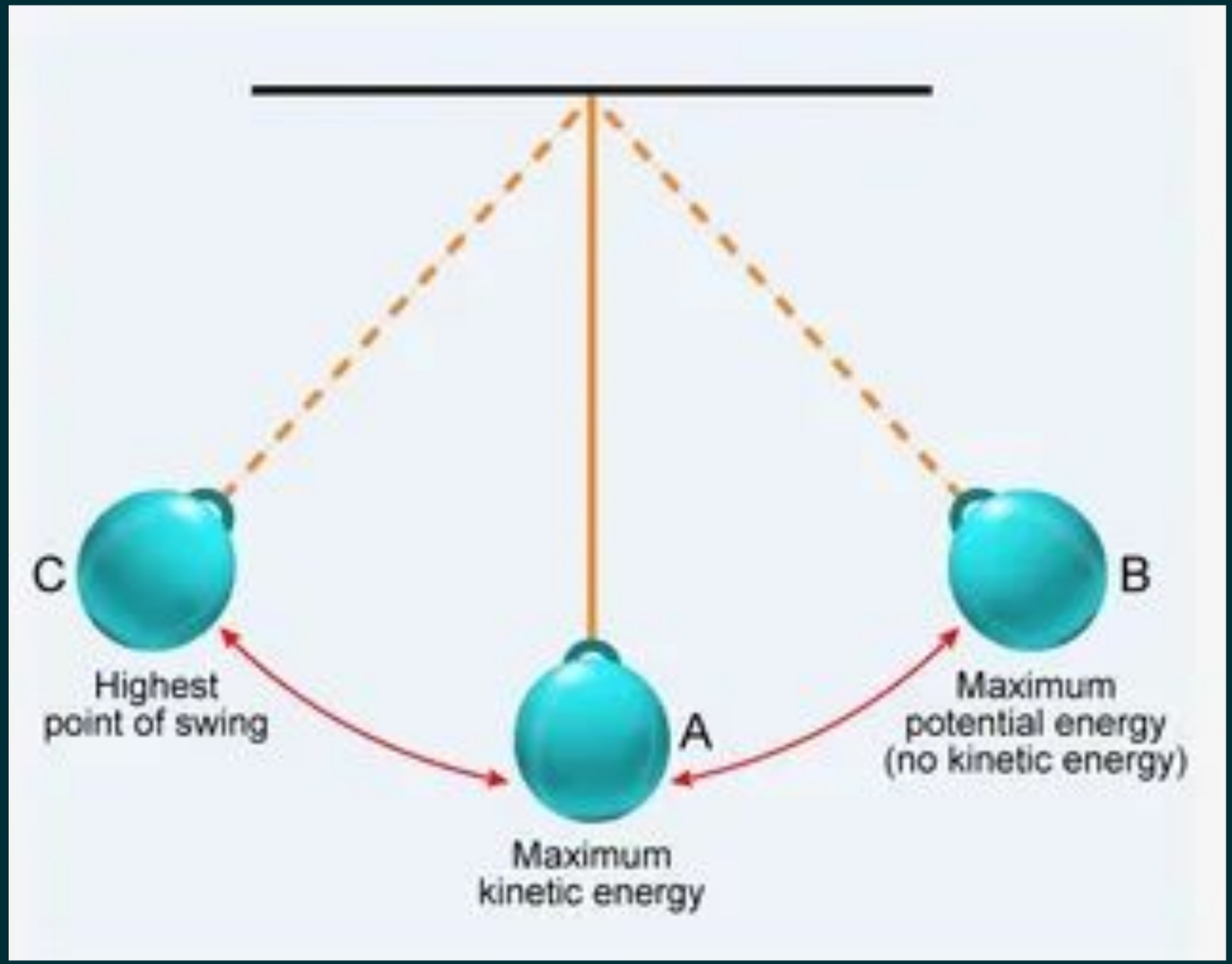
Let's Think:

What is energy?
What are the two types?

Energy

- In many physical situations, there is a conversion, or transfer, between potential energy and kinetic energy.
- **Kinetic Energy:** the energy of motion
- **Potential Energy:** energy stored by an object
- **Mechanical Energy:** potential energy + kinetic energy
- Mechanical Energy is the **total energy** in a system


Going from potential energy...
to kinetic energy!


C
B
Highest
point of swing
A
Maximum
potential energy
(no kinetic energy)
Maximum
kinetic energy

Conservation of Energy

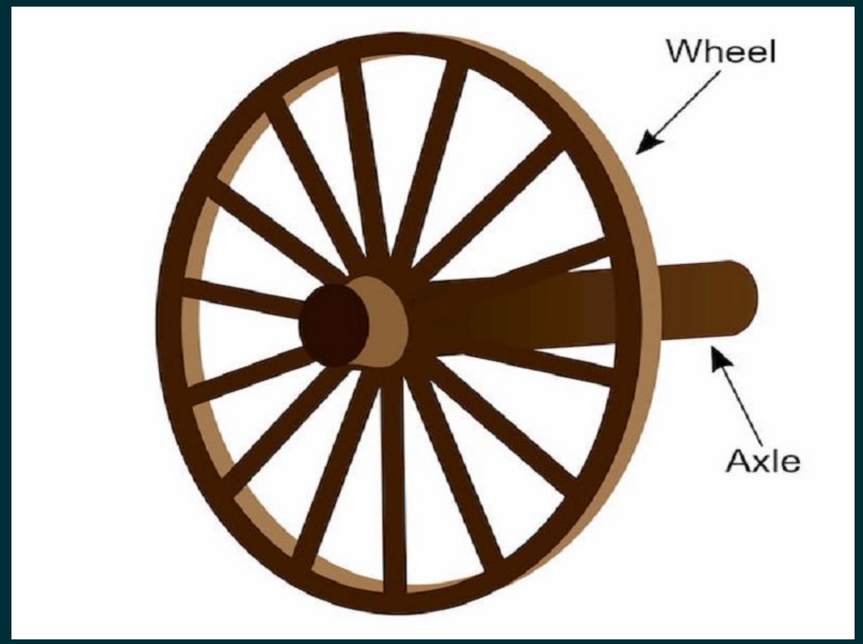
- The **Law of Conservation of Energy** states that energy cannot be created or destroyed.
- So, energy can only transfer between objects or change form.
- The transfer of energy by a **force** is called **work**.

Work

- The formula for work on an object is the following: W = F*d, where F is the force applied to the object and d is the distance that the object travels.
- *So, if we wanted to do the same amount of work while applying a smaller force, what can we increase?*

Person A	**Person B**
Work = 80 Joules	Work = 80 Joules
Force = 20 Newtons	Force = 10 N
Distance = 4 meters	Distance = 8 meters

Wheels and Axles



Which has a larger circumference: the axle or the wheel?

Wheels and Axles (cont.)

- We can think of circumference as the “distance” around the wheel.
- Remember the formula Work = Force * Distance.
- Since the wheel has a larger circumference than the axle, we don’t need to apply as much of a force to do the same amount of work.
- So basically, a wheel allows us to more easily add energy to the car!

FYS

Let's Think:

What eventually happens if you roll a ball on the ground?

FYS

Let's Think:

What happens when you rub your hands together?

Friction

- When the ball eventually comes to a stop, you might wonder where its kinetic energy has gone.
- The force of friction takes kinetic energy and turns it into thermal energy. So, friction is doing work on the object.
- This is what you notice when you rub your hands together; the friction between your hands creates thermal energy, causing them to heat up.

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Let's Think:

What happens when you drive on the highway with the windows open?

Air Resistance

- Air resistance is the type of frictional force between air and an object, also known as drag.
- Vehicles are designed to be aerodynamic, in a way that minimizes drag and makes them as efficient as possible.

Air Resistance

Gravitational Pull

Parachutist skydiving

Greater air resistance

Gravitational pull

Parachute opens up

Questions?

FYS

Let's Think:

How can we model what we just learned regarding energy, friction, and air resistance?

Materials

Plastic Bottle

Bottle Caps (4)

Straws (3)

Skewers/Sticks (2)

Balloon

Rubber band

Tape

Scissors

Preparation for the Procedure

1. Cut one of the straws in half.
2. Tape both pieces of the straw to one side of the water bottle.
3. Cut the wooden skewer in half and push each piece through one of the straws. These will form your axles.
4. Use the scissors or another tool to poke a “+”-shaped hole directly in the center of each plastic bottle cap.
5. Press each bottle cap onto the ends of the wooden skewers. These will form your wheels.

Procedure

1. Tape the neck of the balloon around one end of the other straw. Wrap the tape very tightly so the connection is airtight.
2. Cut a small hole in the top of the water bottle, just big enough to push the straw through.
3. Push the free end of the straw through the hole and out the mouth of the bottle.
4. Use tape to secure the straw to the bottle.

Blow through the straw to inflate the balloon, then put your finger over the tip of the straw to trap the air. What do you think will happen when you put the car down and release your finger?

Put the car down on a flat surface and release your finger. What happens?

See what adjustments you can make to make the car go farther.
What happens if you inflate the balloon more?
What happens if you adjust the direction the straw is aimed? Does it work best if the straw is aimed straight back?

What forces are acting on the balloon rocket car?

Now it’s time for some reflection questions!

Reflection Questions

1. What are some alternative materials you can think of to use instead of the materials we chose? How would this impact the car's efficiency? *For example: What happens if you use a cardboard box instead of a plastic bottle for the body?*
2. What are some of the real world applications to what we've just built?
3. If you could make further improvements to your car, what would you change or add to enhance its performance?
4. What was your favorite part of this experiment?

See you all next week!

Visit our website, **futureforyoungscientists.org**.

If you have any photos from this week, please share these with us by email (futureforyoungscientists@gmail.com) or Facebook, as we would like to be able to share everyone's experience.