Quarantine Theme Park Adventure

Welcome to **Fysical Science Phridays**. As you watch our video follow along with this worksheet.

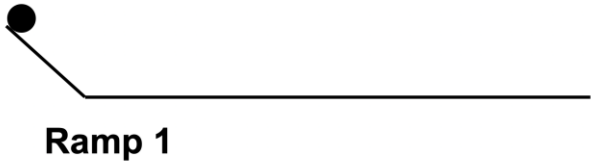
Today you'll learn about **conservation of energy, what aspects go into motion**, and at the end we will challenge **YOU** into making your very own **Quarantine Rollercoaster!**

Keywords: inertia, speed, velocity, acceleration, mass, height, distance, gravity, force, friction, potential energy, kinetic energy, and law of conservation of energy.

After building your own roller coaster you will be able to:

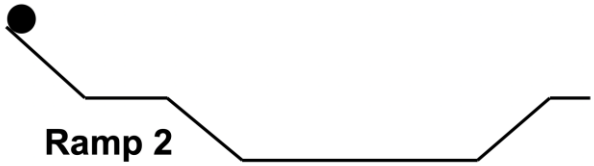
- Identify positions where the marble has maximum or minimum potential and kinetic energy.
- Illustrate a force body diagram of the marble.
- Explain how gravitational pull and friction will affect the motion of the marble.
- Apply the work and energy theorem, and conservation of energy physics principle.
- Visualize the concept of momentum when the marble goes up and down the ramp.
- Visualize the concept of centrifugal force when the marble goes in circular motion.
- Demonstrating the law of inertia by moving the marble down the roller coaster; there are no other unbalanced forces acting upon the marble, which will make the marble stay in motion after putting it inside the roller coaster.

Mini Lesson 1: Marble Race



Ramp 1

1. If marbles are released simultaneously on both ramps, which marble will reach the end of its ramp first?

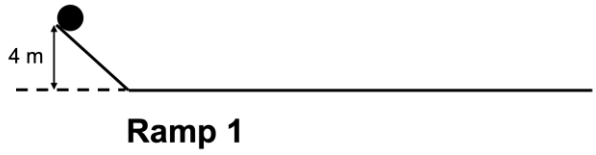


Ramp 2

2. Describe your observations. Was your prediction in #1 correct? Write the physics expert explanations.

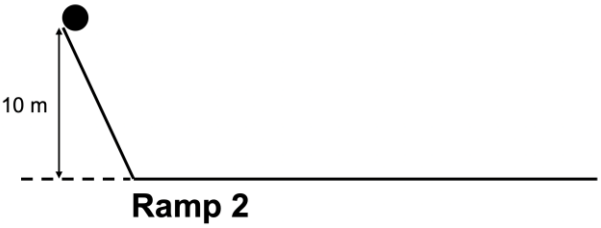
3. How does the shape of an object's path affect its speed and time of travel?

Mini Lesson 2: Marble race with different Height or Angle



Ramp 1

1. If marbles are released simultaneously on both ramps, which marble will reach the end of its ramp first?

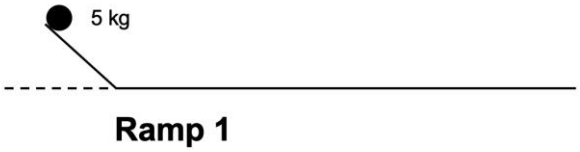


Ramp 2

2. Describe your observations. Was your prediction in #1 correct? Write the physics expert explanations.

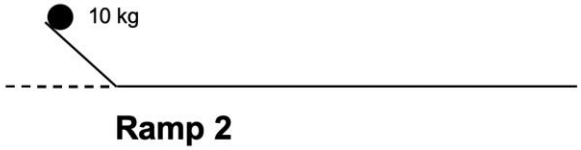
3. How does the height of an object's path affect its potential energy, kinetic energy, and speed?

Mini Lesson 3: Marble race with different mass



Ramp 1

1. If marbles are released simultaneously on both ramps, which marble will reach the end of its ramp first?



Ramp 2

2. Describe your observations. Was your prediction in #1 correct? Write the physics expert explanations.

3. How does the mass of an object's path affect its potential energy, kinetic energy, and speed?

4. Bonus Question: What if we released 2 identical marbles simultaneously with the same mass, at the same height or angle, but one marble will be on the Moon and the other marble will be on Earth, which marble will reach the end of its ramp first? The one on the Moon or the one on Earth? Why

Quarantine Roller coaster challenge:

Materials:

- Insulated foam pipe (found at a local hardware store, like Lowes or Home Depot) or something similar
- Marbles (variety of marbles would be recommended) or spherical objects
- Masking tape or glue
- Utility safety knife or scissor
- Paper
- Smartphones or video camera (with slow-motion mode preferably)
- Landing target or cup
- Various household items!

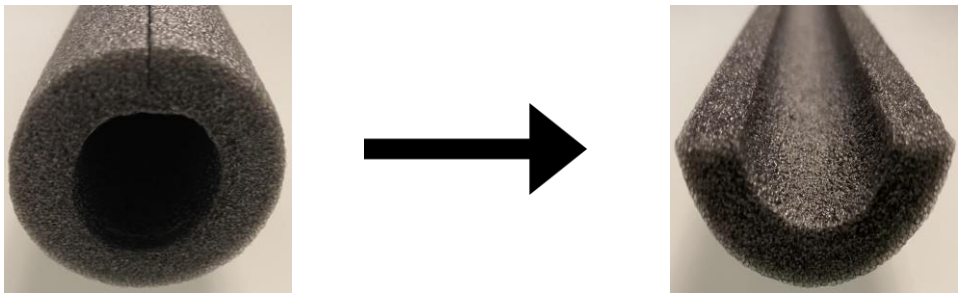
Most supplies can be replaced with household items! Be creative and show us what you make.

Safety:

- Stay 100% focused while using the knife or scissors. Never touch a knife's blade. Remember to cut away from your body. Keep all fingers out or your cutting line. We would recommend you ask for an adult to assist or facilitate you when working with a knife or a scissor.
- Marbles are one of the most common choking hazards. So please do not swallow or throw the marbles. Also, slipping on marbles on the ground could be dangerous.
- Make sure that the marble does NOT hit anyone when it goes off of the ramp.
- Do NOT have a rollercoaster cart that is bigger than the tracks; you may ruin your whole design or even hurt yourself

Directions:

1. Gather your materials from the list above.
2. Find a place that you can start to build your roller coaster, this can be a wall, a countertop, wherever you think your coaster can work!
3. Have a parent supervise as you cut the foam pipe open in half lengthwise using a utility safety knife or scissor, so the inside groove can act as a guided track for the marbles to travel. Example below.



4. On a piece of paper, design your dream roller coaster. Be creative. You can incorporate any household items to make your roller coaster unique and innovative.
5. Set up a target at the end of your roller coaster to see if you can get your marble to land on it after it takes a ride.
6. Once this design is done, build it! Try to see what changes or adjustments you can make in order to make sure that your roller coaster is generating the most energy for your marble and is able to hit the target.
7. After giving your coaster a few test runs and thinking about what is helping the marble hit the target or what may be causing it to not work or not work as well as you'd hope.
8. Continue making new designs and builds till you have been able to hit the target at a couple different spots and keep all your design drawings and take pictures as you test to post and share later!
9. As you test your roller coaster take a few videos (maybe even in slow motion!) to share your best and not so best designs!

Mini Challenges: See how many you can do!

- ☐ Add at least 1 loop to your rollercoaster
- ☐ Add multiple loops to your roller coaster
- ☐ Add a jump or a gap between your roller coaster
- ☐ Add a hump to your roller coaster
- ☐ Add multiple humps to your rollercoaster
- ☐ Add a sharp turn to your rollercoaster

Experimental Questions to think about while making your rollercoaster:

1. If you don't have the specific materials listed, what replacement household items could you use?
2. What would happen if the marble had more mass, then will it go faster or slower?
3. What can you do to make your roller coaster go faster?
4. Is the rollercoaster staying on your track? If not, what can you do to make it stay on the track?
5. Were you able to incorporate any of the mini challenges to your rollercoaster?
6. Does adding more dips to your roller coaster make it go faster or slower? Why?
7. Did your roller coaster land on your target? If not, what changes could you make to see that it does?
8. What form of energy or energies is being converted throughout the entire roller coaster?

Conceptual Questions:

1. What causes the marble to set in motion?
2. Where on your roller coaster do you think the marble has the highest Potential Energy? Lowest?
3. Explain how the potential energy and the height are related.
4. Explain how the kinetic energy and the speed are related.
5. How can we increase the speed of the marble?
6. Explain the principle of energy conservation between potential and kinetic energy.
7. Would adding loops affect the kinetic and potential energy of the marble?