

Grade Level:
Grades 5 - 12

Activity Time:
1 hour

Preparation Time:
5 minutes

The Challenge: Imagine you are a roller coaster engineer and must design a new roller coaster. Design and build a roller coaster for marbles to travel on. The goal of this activity is to be resourceful and creative with your given materials.

Materials:

- 1) Any random materials that you can find around your house (pipe insulation, cardboard, foam sheets, etc.)
- 2) Masking tape
- 3) Stopwatch or something to keep time
- 4) Calculator
- 5) Cup
- 6) Marble
- 7) Ruler
- 8) String
- 9) Marble Roller Coaster Handout

Introduction (5 mins):

1. Explain to your child that today they will be roller coaster engineers and will need to use their design and engineering skills to build a roller coaster that fits a certain criteria using only the materials provided.
2. Review definitions of design and engineer through the following questions:
 - *What types of things do engineers work on?*
 - *What are some things that people have to take into consideration as they are designing something?*

Brainstorm and Design (10 mins):

3. Give your child their materials and the Marble Roller Coaster Handout.
4. Ask your child to sketch a drawing of their roller coaster. Roller coasters should include at least 2 hills and 1 loop (maybe modified for younger ages- i.e. 1 hill/1 loop, or just 2 hills).

Build

5. Once your child has finished designing their roller coaster, provide them with the materials to build their roller coasters.
6. Instruct them to use their environments (i.e. desks, chairs, the floor) to build their roller coasters.
7. Check in with your child throughout the building phase with these questions:
 - *Tell me about the different parts of your roller coaster, what is each part supposed to do?*
 - *What do you predict is going to happen when you test your roller coaster?*

Test

8. When they have finished building their roller coaster, have them test out the worksheet. They will need to do the following:
 - a. Time how long the marble takes from the start of the roller coaster to the end. Take a total of 5 time trials.
 - b. Find the average of the 5 time trials.
 - c. Figure out how far the marble traveled, by measuring the tubing they have been given.
 - d. Use the average time and the distance traveled to calculate the average speed of the marble.
 - e. Make a drawing/diagram of their marble roller coaster and label specific points.

Reflection and Discussion:

9. Once your child has completed the challenge, spend some time discussing the roller coaster design/engineering process. Some possible discussion questions include:
 - *What are some improvements that you can make to your design?*
 - *How could you increase the speed of your roller coaster?*

Redesign (if time allots)

10. Have your child redesign their roller coasts to try to make the marble travel faster. Have them incorporate their new understandings from the reflection and discussion.

Activity - Marble Roller Coaster

Today you will be a roller coaster engineer and will get to design your very own marble roller coaster. Here are some guidelines for building your marble roller coaster:

- Your marble must not fall off until it gets to the end of the track.
- The marble must land in the cup at the end of the run.
- You may only use the materials provided (exception: if you need to, you may tape your roller coaster to furniture).

Challenge 1: Build a roller coaster that has 2 hills (*including the initial hill*) and 1 vertical loop.

Sketch some ideas for how you might want your roller coaster to look:

Once you have completed your roller coaster answer the questions below:

Time Trial

Time the marble from start to finish five different times. Start the time when the marble is released at the beginning of your track and end when it lands in the cup.

Trial	Time (in seconds)
1	
2	
3	
4	
5	

Activity - Marble Roller Coaster

Average Time: Calculate the Average Time.

A) Add all your trials:

$$\frac{\quad}{\text{Trial 1}} + \frac{\quad}{\text{Trial 2}} + \frac{\quad}{\text{Trial 3}} + \frac{\quad}{\text{Trial 4}} + \frac{\quad}{\text{Trial 5}} = \boxed{\frac{\quad}{\text{Trial Total}}}$$

B) Take the Trial Total time and divide by the number of trials (5) to get the average:

$$\frac{\quad}{\text{Trial Total}} \div 5 = \boxed{\frac{\quad}{\text{Average Time}}}$$

Average Speed: Calculate the Average Speed of your marble.

A) How far did your marble travel?

Using a piece of string measure out the length of the track.

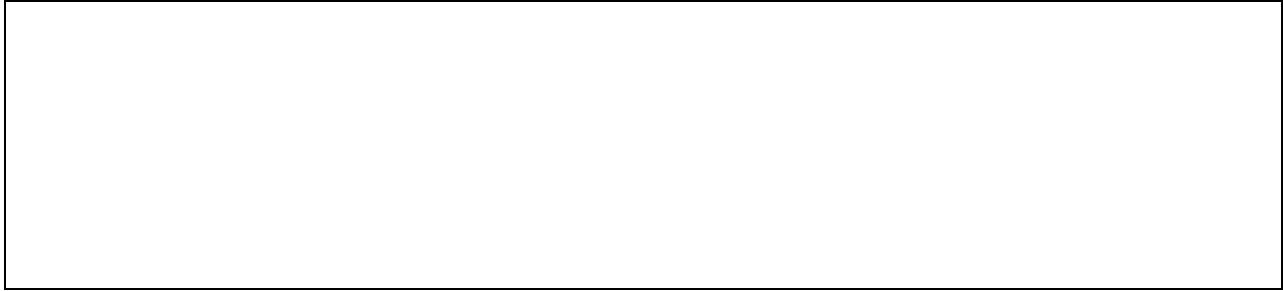
$$\boxed{\frac{\quad}{\text{Track Length}}}$$

B) To calculate speed, you need the distance the marble traveled (the length of the track) and the time it took to travel:

$$\frac{\quad}{\text{Track Length}} \div \frac{\quad}{\text{Average Time}} = \boxed{\frac{\quad}{\text{Average Speed}}}$$

Activity - Marble Roller Coaster

Diagram: Make a drawing of your roller coaster.



- Label the highest point.
- Label the point where the marble goes slowest.
- Label the point where the marble goes fastest.