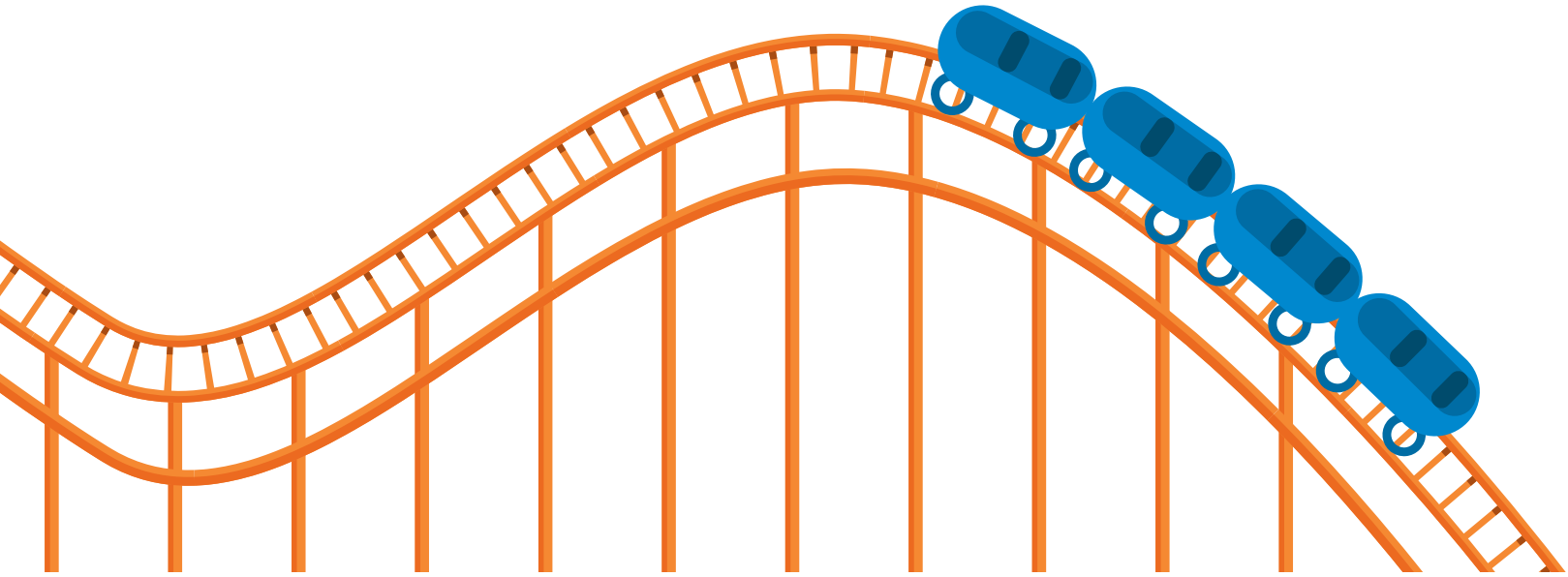
The Tech Interactive at Home

Roller Coasters

Who says all the fun has to happen at The Tech Interactive? This DIY engineering activity can be done with inexpensive store-bought supplies and things you find around the house!



Introduction

In this design challenge, you will create your own roller coaster, using a marble or small ball as your cart. This activity is a great introduction to hands-on engineering for children 6 and up, and it can be used to introduce connections of energy and friction for older children. While the activity can be completed in around 20 minutes, don't be surprised if your family spends 45 to 60 minutes perfecting their creations, or building an entire amusement park in your living room!

Roller Coaster Design Challenge: Create a coaster that will deliver your 'cart' safely into a cup at the end of your track.
Bonus challenge: Make your coaster stand up on its own.

Materials

The roller coaster track can be built from all types of materials, depending on what you want it to do (note: use more flexible yet sturdy materials if you are going to include loops). Explore your junk drawer or recycling bin to find unique items.

Subject:
Engineering design challenge, Physics

Ages:
6-12

Time:
20+ minutes

Key terms:
Design, iteration and problem-solving
Gravity
Potential/kinetic energy

Things you can use

Don't limit yourself to the items on this list. Use whatever you have on hand — be creative! (For younger participants you can cut these into smaller pieces so they can build more easily)

To build the track	To add stability or structure, or create rails
• Thin cardboard: card stock, empty cereal boxes • Paper, junk mail • Cardboard tubes — from toilet paper, paper towels, gift wrap • Thicker card: cardboard boxes • Pool noodles, or other foam tubes • Plastic tubes or pipes	• Wooden craft sticks • Straws • Pencils
Optional materials	**Tools and peripherals**
• Use building kits from around your house: LEGO® bricks, Tinker Toys™, K'nex™, wooden blocks — to take the design further • Things to decorate your roller coaster: crayons, tissue paper, feathers, pom-poms, pipe cleaners • Timers, string, ruler or tape measure and kitchen scale — for the science section activities (at the end).	• Your roller coaster cart (the marble!) • A plastic cup to end the ride in • Tape • Scissors • Hot glue (older engineers only)

Instructions

Collect the materials and set them out on a floor or table so you can see what you have to work with. Use a table or chair to support the top of your coaster.

Building and testing

There are a million ways to engineer a successful ride. As you begin to build, consider how far or fast you want it to go, whether it needs to go through a loop. Remember that your 'cart' (marble/ball) has to safely survive your roller coaster and land in the cup at the end. Other things to consider:

- Are your materials durable and sturdy — would they withstand an earthquake or a strong wind without falling over?
- How can you stop your marble falling out of the track?
- If you build a loop, how can you make sure you have enough energy to successfully go around it and get to the end of the track?

Once you have engineered your contraption, it's time to test it out and iterate! Place the marble at the top of the track, and let it ride the roller coaster.

- Was the ride bumpy or smooth?
- Did the cart reach its destination (the cup) or did something else happen? Why do you think that happened?

Use what you observed to make changes to your design, then keep testing, observing and iterating.

Science!

Explore energy by building tracks at different heights and comparing how the speed of your cart changes. Add loops and vary their size then alter your track to see what you need to do to have your cart make it around safely.

Still engaged? Let's do some physics! Use timers and measurements to calculate **velocity**. Measure your coaster — pro tip: use a piece of string or yarn (bendy) to get the length of your coaster and then measure that with a ruler or tape measure (not bendy) — and record that length, time your cart moving through the coaster and record. Calculate: velocity=distance/time or in this case length of coaster/travel time for cart.

Use a kitchen scale and equations to calculate the **potential energy** of your cart at the top of your coaster. Measure the height of the start of your coaster in cm (and convert to meters), measure the weight in grams on your kitchen scale (and convert to kg). Use P.E. = mgh where m is the mass of your cart in grams, h is the height of your track and g=9.8 N/kg to calculate the potential energy.