AMUSEMENT PARK SCIENCE

Learn The Science Behind Fun!

⚠️ WARNING:
CHOKING HAZARD - Toy contains small parts and marbles. Not for children under 3 years.

⚠️ WARNING:
CHOKING HAZARD - Children under 8 years old can choke or suffocate on uninflated broken balloons. Adult supervision required. Keep uninflated balloons from children. Discard broken balloons.

Instructions and more!
Amusement Park Science Kit

Amusement parks are fun and exciting and sometimes even a little scary. Do you know what else they are? Science labs!

How do roller coasters go up and down? How do swings fly through the air? How do carousels spin? What makes bumper cars glide across the floor? These wild rides use science to do things they’re not supposed to do.

In this kit, you’ll find everything you need to create your own amusement park. You’ll learn how to build all kinds of rides—from swings to coasters—and along the way, you’ll discover the secrets behind the science that makes these rides so thrilling!

In each activity, you’ll get to act and think like a real scientist. You’ll compare things, you’ll ask questions and you’ll also make observations using your different senses.

Let’s go for a ride!

### What You’ll Find in Your Kit:

- 4 Balloons
- 1 Steel Ball Bearing
- 1/4” Hex Nut
- 2 Pieces Swing Top Canopy
- 1 Swing Disc
- 1 Dowel Rod
- 4 Pieces of String - 8 in (20 cm) each
- 2 Pieces of Tubing
- 4 Washers
- 8 Swing Labels for Washers
- 2 Bumper Car Assembly Discs
- 2 Water Bottle Caps
- 2 Bumper Car Labels
- 4 Foam Bumpers
- 1 Roller Coaster Assembly
- 1 Magnetic Wand

### Fun Fact:
The idea for roller coasters came from something called “Russian mountains.” A long time ago in Russia, people built tracks out of ice, with hills as tall as 80 feet. In many countries outside the United States, the term for roller coaster is still Russian mountain.

### Activity #1: The Force Is With You

What makes rides go round and round? Let’s find out!

### Fun Fact:
The oldest amusement park opened in Denmark more than 400 years ago!

### Activity #1: The Force Is With You

What makes rides go round and round? Let’s find out!

### What you need from your kit:

- 2 Balloons
- Metal Ball
- Hex Nut
**Let's get started!**

NOTE: You may want to ask an adult to help blow up the balloon for you.

**Step 1:** Let’s make some observations! Take the metal ball and roll it on the floor. How does it move? Does it roll in a line or circle? Can you get it to roll in a circle?

**Step 2:** Take the ball and put it inside the balloon. Make sure the ball slides all the way down to the bottom of the balloon.

**Step 3:** Hold ball down in the base of the balloon as you begin to inflate so it does not contact your mouth. Blow up the balloon and tie it off at the end.

**Step 4:** Grip the narrower end of the balloon—the end that you tied—with your palm and fingers (like you’re palming a basketball). Now give the balloon a swirl, twirling it around. What’s going on with the ball?

**That’s Amusing!**

When you rolled the ball on the floor, it moved in a line, but inside the balloon, the ball moved in a circle. Why did that happen?

A famous scientist named Isaac Newton studied how things move. He discovered that objects in motion tend to stay in motion, moving in a straight line. To get an object—like your ball—to change direction, you have to apply a force to it. The force that gets things to move in circles—like amusement park swings and carousels—is called **centripetal force**. It pushes or pulls an object toward the center to get it to move in a circle. In the experiment, the balloon is the centripetal force, pushing on the ball and causing it to move in a circle around the center of the balloon instead of a straight line.

**Fun Fact:** The next time someone in your house does a load of laundry, check out the washing machine. Notice how the clothes all stick to the sides of the washer. They just went on a wild ride thanks to centripetal force!

**Fun Zone!**

Let’s use centripetal force to make your balloon scream! With a new white balloon repeat the experiment above, only this time put the hex nut (This is a small piece of metal that has six sides instead of a smooth round shape) in the balloon instead of the metal ball. Tie the balloon and give it a swirl. Can you hear the balloon screaming? That sound is the sides of the nut vibrating against the balloon.
Activity #2: Get Into the Swing of Things

Lots of people have swing sets in their back yard. Amusement parks take this idea and turn it into something that will blow you away!

What you need from your kit:

- 4 Strings
- 2 pieces of Tubing
- 4 Washers
- 8 Swing Decals
- Swing Disc
- 2 Swing Crown Pieces
- Dowel rod

Let’s get started!

Step 1: Let’s make some observations! Pick up a piece of string and grab an end between your fingers. Swing it back and forth. This is how a normal swing works. Let’s take the string and turn it into a thrill ride!

Step 2: Tie a washer to one end of each piece of string with a very tight double knot.

2A: Place round swing labels on each side of the washer.

Step 3: Attach the string assemblies onto the disc. Thread each string through the punched hole in each one of the folded tabs on the disc, loop the string and tie a very tight double knot. See inset right.

Step 4: Insert one of the tubing pieces over the top of the dowel rod. Now insert the dowel rod through the center hole of the swing disc assembly and place the other tubing piece over the top of dowel rod. The swing disc should be sandwiched between the two tubing pieces.
**Step 5:** Place crown piece #1 on top by sliding dowel through two slits. Place crown piece #2 over #1.

**Step 6:** Now you have swings. Do they move? Tap one of the washers with your finger to set the swing in motion. Does it move in a line or a circle? Put the dowel rod between the palms of your hands and roll the dowel rod back and forth. What happens to the swings?

**That’s Amusing!**

This activity is another example of centripetal force. Normally a swing would move in a straight line. But when you set the stick in a swirling motion, the swings flew out in a circle. That’s because of the strings. The centripetal force of the strings pulled the swings toward the stick—the center of the disc—and kept them moving in a circle instead of a straight line.

**Fun Fact:** Some amusement parks have rides that swing people 300 feet up in the air at 30 miles per hour! Do you have what it takes to give it a whirl?
Activity #3: Driving on Air

Rules were made to be broken at amusement parks. What’s one thing you never want to do in a car? Crash. What’s one thing you totally want to do in a bumper car? Crash!

What you need from your kit:

- Bumper car discs
- Bumper car labels
- Foam bumpers
- 2 Balloons
- Water bottle caps

Let’s get started!

NOTE: You’ll need an extra pair of hands for this activity. Ask an adult or friend to help you.

Step 1: Let’s make some observations! Try sliding one of the discs across a smooth surface, like a wood or tile floor. What happens? Does the disc move very far or fast? Let’s change that!

Step 2: Take the bumper car labels and apply one label to one side of each disc.

Step 3: Now take the foam bumper rings, remove their backing and stick them around the outside edge of the label on the top of each disc, as shown.

Step 4: Screw the caps on to your bumper car assembly disc.

Step 5: Check to make sure the caps are closed (in down position). Put the discs on a smooth surface, like a hardwood floor or tabletop. Now blow up one of the balloons and stretch its mouth over one of the caps. Try to do this as quickly as possible, without letting too much air escape from the balloon. At the same time, have an adult or friend blow up the other balloon and stretch it over the cap on the other disc. It might help to twist the balloon at base to keep air inside. (Again, make sure nozzle caps are closed, in down position)
**Step 6:** Aim the discs toward each other. Hold the bumper car at base of sport cap and gently pull up on nozzle of sports cap to open. Give the car a gentle push and watch your discs fly across the floor and crash into each other!

**Step 7:** Let’s make some observations! Did your discs go farther and faster with balloon power? What happened when the discs crashed into each other?

**That’s Amusing**

Why did the discs glide better under balloon power? Because the balloons created a cushion of air under the discs, which reduced a thing called friction. Friction is the rubbing of one object against another—in this case, that would be your discs rubbing against the floor or tabletop.

This rubbing will slow down an object in motion. The balloon created a layer of air between the discs and the floor, cutting down on friction and allowing them to move faster and more smoothly.

Now what did you notice when your discs crashed into each other? Did they give each other a bump? This is another law of motion discovered by Isaac Newton (remember him from Activity 1?). Newton’s Third Law of Motion says that whenever an object pushes another object, it gets pushed back in the opposite direction equally hard. So when one disc crashed into the other, the second disc pushed back at the disc that bumped it first. Both discs received a jolt.

**Fun Fact:** You don’t see balloons attached to bumper cars, so how do amusement parks deal with friction? They sprinkle graphite on the floor of their bumper car rides. Graphite is a mineral that has a special power called super lubricity (it’s really, really slippery), which gets rid of friction.

**Fun Fact:** Bumper cars are also called “dodgem cars.”

**Activity #4: What Goes Up Must Come Down**

We saved the best for last. Are you ready for the biggest thrill ride of them all? Roller coasters! Roller coasters are like wild and crazy trains. Their tracks take you up super high hills and then drop you so far and so fast, your stomach feels woozy. Some coasters loop upside down and some even leave you hanging. Let’s find out how they work!

**What you need from your kit:**

- Roller Coaster Assembly
- Magnetic wand
Let’s get started!

The first roller coaster tracks were made out of wood, but now most of them are made out of tubular steel. Unlike wood, tubular steel can be bent and that’s why newer roller coasters have all kinds of loops and corkscrews instead of just going up and down.

**Step 1:** Take the magnetic wand and push it up against the roller coaster assembly. Notice anything? How about when you get close to the metal ball inside?

**Step 2:** Keep the magnetic wand in contact with the metal ball and pull it around to Start Point #1. Once at this point, pull the wand away to release the ball. What happened?

That’s Amusing!

Every roller coaster is designed to take advantage of gravity. Gravity is what pulls all masses toward each other. The gravity of the earth is constantly pulling you down—that’s why you don’t float off into space. You don’t feel it because you’re used to it, but gravity is always there. This constant force of gravity is called **1G**. So here’s what happens on a basic, single hill roller coaster: There are no motors in the cars. A cable or pulley brings the coaster train to the top of a really high hill. As it climbs this hill, the coaster gains potential energy, or stored energy. At the top of the hill, as the coaster begins to fall, this potential energy changes to kinetic energy—motion energy. The coaster swooshes down the hill, pulled by gravity. The higher the hill and the longer the fall, the faster the coaster will roll, because objects move faster the longer gravity pulls on them. This is why the last car in a coaster train moves the fastest down the hill—because it takes the longest to fall. This is called the **Long Train Effect**.

**Fun Fact:** Roller coasters are getting taller and taller. Mega Coasters have a height or drop greater than 200 feet. The Magnum at Cedar Point in Ohio was the first Mega Coaster. Giga Coasters have a height or drop greater than 300 feet. Strata Coasters have a height or drop greater than 400 feet. There are only two of these in the world, including Kingda Ka in New Jersey. At 456 feet, it’s the tallest coaster in the world! Bet that will make you lose your stomach!

**Activity #5: Double the Fun!**

Now you’re ready to try a more complicated coaster. Let’s add a second hill!

**What you need from your kit:**

- Roller Coaster Assembly
- Magnetic wand
Let’s get started!

Step 1: Place the magnetic wand in contact with the metal ball and pull it around to Start Point #2. Once at this point, pull the wand away to release the ball. What happened?

That’s Amusing!

Most roller coasters have more than one hill to put energy back into the ride. Remember from Activity 1, the coaster stores energy as it moves up a hill, then changes that to motion energy as it swoops down, gaining speed with gravity. This speed carries it up the second hill, where it stores energy again, and then changes to motion energy and picks up speed as it plunges down the second hill. Coasters gradually lose speed and energy during a ride because of friction (the train rubbing against the track) and air resistance, which is a kind of friction that happens when objects move through air (think about riding your bike into the wind). That’s why your second hill needed to be shorter than the first—the cars wouldn’t have enough energy to make it up a taller hill.

Fun Fact: Do you feel the need for speed? Roller coasters are getting faster and faster. The fastest wooden coaster travels almost 80 miles per hour. The fastest steel coaster goes 150 miles per hour!

Activity #6: In the Loop

You’re an expert at coasters that go up and down. Let’s see one that goes up, down and around!

What you need from your kit:

• Roller Coaster Assembly
• Magnetic wand

Let’s get started!

Step 1: Place the magnetic wand in contact with the metal ball and pull it around to Start Point #3. Once at this point, pull the wand away to release the ball. What happened?

That’s Amusing!

You already know how coasters work going up and down hills. What keeps coaster trains on the tracks during loops? Our old friend centripetal force! The track is the centripetal force that keeps the cars moving in a circle as they go around the loop.

That’s what happens to the coaster during a ride, but what about the people? What’s happening to them? Roller coasters change the way people experience gravity. Remember, normally you don’t feel that constant 1G pull of gravity. When you’re on a coaster and it’s climbing a hill, you feel gravity trying to pull you back down. You feel more than 1G, like you weigh more and you’re pulled to the back of your seat. As you drop down the hill, you fall with the coaster train. It feels like you’re floating—like you’re being pulled out of your seat—because now there’s less than 1G acting on you. All the excitement you feel on a coaster is really just a change in the way gravity pulls on you—sometimes more than 1G and sometimes less than 1G.
Fun Fact: As coasters keep adding more hills and loops and corkscrews, they’re also getting longer. The track of the longest steel coaster measures more than a mile and a half!

Fun Zone! Now that you’ve learned the basics of roller coasters, let’s try a challenge. Grab a few friends or family members along with a stop watch or timer. Decide who will be the first person to attempt the challenge. The first challenger will take the magnetic wand and roller coaster assembly. Place your magnetic wand on the front of roller coaster plastic and raise the ball to the starting point of hill #1. Another person should set the timer to zero and then say….. Ready…Set….Go! The timer should be started on Go and the first challenger should release the roller coaster (ball) down the first hill. While timer is still ticking, pull the roller coaster (ball) up to the starting point at hill #2 and release. Once that is completed, pull the roller coaster (ball) up to the starting point at hill #3 and release. Once the roller coaster reaches the end of the loop, stop the timer and record the time. Repeat with each challenger. The goal is to have the fastest time. Keep taking turns to try to achieve your best time and beat the record!