INNOVATION AT PLAY

TEACHER ACTIVITY

INVISIBLE FORCES

Do you think you have what it takes to summon up the power of invisible forces?

In this activity, you and a teammate will create a tabletop game, complete with electromagnetic game pieces that can repel and attract other players and objects.

STEP 1: CONNECT

The world as we know it exists thanks to invisible forces. Take a moment to look around the room. Can you think of any forces that are acting around you?

STEP 2: INVESTIGATE

A force is a push or pull that either changes the motion of an object or maintains it. A force can change something's direction, speed, and/or shape. There are several invisible forces that are acting on the world around us… even though we can't see them! Gravity is one example of these forces and magnetism is another.

Follow the steps below to take a closer look at one force that you may be less familiar with: *electromagnetism*!

You'll need a large iron nail (about 3 inches long), copper wire, a D or 9-volt battery, electrical tape, and some paper clips.

The first step is to wrap the wire tightly around the nail from end to end. But, before you begin, leave a wire tail of about three inches coming off the nail. This will eventually attach to the battery!

When the wrapping is complete, leave another three-inch tail at the opposite end. Then cut the wire.

Next, make a tiny loop (about one centimeter wide) at the very end of each piece of wire. Then use a small piece of electrical tape to secure one loop to each end of the battery.

Finally, pick up the nail and bring it close to the paper clips. What happens?

GO FURTHER!

Want to investigate more? Swap out the materials listed here for new ones—such as different sized nails and batteries, or nails made out of different materials. Then see what happens to the electromagnetic force.

STEP 3: DISCUSS

The force of **electromagnetism** occurs when electricity flows through metals. The magnetic force begins when the electricity starts flowing and it stops when the electricity is disconnected.

With this in mind:

- Why is your nail able to pick up paperclips?
- How could you stop the electromagnetic force and demagnetize the nail?
- Why and when may electromagnetism be useful? (Think specifically about its ability to be turned off and on!)

STEP 4: MATERIALS

Today, you're going to use electromagnetism to create a tabletop game. To prepare for the challenge, gather the following materials:

- Thick posterboard, foamboard, or cardboard
- Art supplies, such as markers, paint/paintbrush, etc.
- Super glue or hot glue
- Tape
- Scissors
- Gloves (to handle materials)
- Your electromagnetic rod (i.e., your wire-covered nail), plus another set of wire, tape, battery, and nail if you'll want a second rod
- Wooden dowls
- Strong magnets
- Small toy cars and/or other game pieces
- Additional materials to create the game you envision

STEP 5: THE CHALLENGE

Ready to create a tabletop game powered by invisible forces?

First, grab your board. This will be your game board!

Now brainstorm what kind of tabletop game you want to create. You could create a racetrack, reinvent pinball, or transform another favorite board game. No matter what, part of your game must be powered by your electromagnetic rod.

Then design your game board and your game pieces, using the paint, markers, glue, magnets, and/or any other materials that will help your game play as planned. Test your game as you go to make sure it functions as you hope. Once it's complete, play it several times and make improvements as needed.

STEP 6: SHARE

Film your game in play-mode once it's complete, and be sure to explain the invisible forces at work.

Wrap up your video with a quick reflection on how these forces could be used to reduce the work needed to complete different tasks in everyday life.

Then share your video with others by posting the video to your Instagram story or TikTok. Use the hashtags #InnovationAtPlay and #InvisibleForces so others can learn from your design, too!

NGSS STANDARDS

- HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. [Assessment Boundary: Assessment is limited to designing and conducting investigations with provided materials and tools.].

COMMON CORE ELA STANDARDS

- CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

REMEMBER

Remember that electromagnetism isn't the only type of invisible force. Your game can rely on gravity and magnetism, too!

TIP

Your electromagnetic rod should be used to repel or attract other objects or game pieces. It can be used above or below the gameboard.