INNOVATION AT PLAY

TEACHER ACTIVITY

HEAVY LIFTING

You've heard the saying that opposites attract. But have you ever really thought about magnets and the effect they have on our lives?

In this challenge, you and a partner will create a game that incorporates a crane that uses magnets to lift loads!

STEP 1: CONNECT

Magnets are used all around us to make our lives easier and safer. Cars use magnets on everything from door locks and seat belt detectors to braking. The black strip on the back of credit cards is magnetic and used to store each card's data. Vacuum cleaners even have magnets—They're part of what creates the suction! And construction equipment uses magnets too… They are often used to lift heavy materials.

Can you think of other examples of magnets in your everyday life?

STEP 2: INVESTIGATE

Magnets come in all different strengths. Some are strong enough to lift a car. Others can barely stay attached to your fridge.

With your partner, make sure you have an understanding of how magnets work by browsing the different pages of this website: tinyurl.com/northeasternmagnet.

Then get some hands-on experience! Gather magnets of at least three different strengths and a handful or two of paperclips.

Using *only* these materials, can you figure out how to compare the strength of these magnets?

DID YOU KNOW?

According to Coulomb's Law of Magnetism, the force between two poles of magnets increases as their poles' strength increases and decreases as the distance between them increases.

STEP 3: DISCUSS

Did you use the magnets to pick up the paperclips—either in a chain or otherwise?

Which magnet was the strongest?

Why do you think this magnet was stronger than the others?

There are two main factors that determine a magnet's strength:

1. The material that the magnet is made out of. The main metals that are magnetic are iron, cobalt, and nickel. Alloys, or a combination of two or more metals, can also be magnetic.

   Do you know what your magnets are made of?

2. The strength of the external magnetic field. In other words: How strong is the magnetic field of the *other* material?

   Paperclips are an alloy of iron and carbon. They are not magnetic on their own, but they can become magnetic depending on the external magnetic field they are exposed to.

STEP 4: MATERIALS

To prepare for this challenge, gather the following materials:

- Popsicle sticks
- Ruler
- Pencil
- Glue and tape
- 2 spools of thread
- String
- Cereal box
- Scissors
- Toothpicks
- Magnets of various sizes
- Paperclips
- Additional materials, to be determined based on the game you choose to create
- Paper and pencil for recording rules

STEP 5: THE CHALLENGE

Cranes are used to lift heavy objects and move them to other places. Often, cranes lift with a hook. Other times, the cranes are magnetic! These magnetic cranes tend to carry heavy metal around junkyards and recycling plants.

Today's challenge is twofold:

1. To create a magnetic crane out of the materials listed above.
2. To develop a game, complete with rules, that uses this crane as part of its gameplay!

First, examine the image of the crane and brainstorm how you can use the materials above to create a magnetic device that can be used to lift and lower materials.

Then create (or reinvent) a game that uses the magnetic crane as part of its gameplay.

For instance, the crane could drop pieces in a game like Tic Tac Toe or Connect 4 or it could pick up pieces in a matching memory game. Or, maybe your team has an idea for a brand-new crane game! The choice is yours.

No matter what, be sure to write down the rules so it's clear how to play once your crane and game is complete.

STEP 6: SHARE

Once your crane is built and your game is designed, film it! Explain your design decisions as you demonstrate how your crane functions. Then describe, in a nutshell, how to play your game. Once your video is filmed, share it with others by posting the video to your Instagram story or TikTok. Use the hashtags #InnovationAtPlay and #MagneticCrane so others can learn from your design, too!

Then wrap up by taking turnings playing your new games with your classmates!

NGSS STANDARDS

- PS2.B: Types of Interactions
    - Newton's law of universal gravitation and Coulomb's law provide the mathematical models to describe and predict the effects of gravitational and electrostatic forces between distant objects.
    - Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space. Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

COMMON CORE ELA STANDARDS

- CCSS.ELA-Literacy.CCRA.R.1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.
- 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.

CRANE