3-PS2-3	Gr. Level: 3rd	Creation Date: 05-11-15	Edit Date/Time: 11/1/2018 2:29 PM	Writer(s): 1

Title: Cause and Effect—Magnetic/Electric Interactions

Objective:

Ask questions to determine cause and effect relationships of electric or magnetic interactions between two objects not in contact with each other. Includes objective of 3-PS2-4

Preloading:

Vocabulary: Academic Language - force, attract, repel, pole, static
Scientific Language - cause and effect, evidence-based account

English-Learner Scaffolding Focus:

Wait time - remember to give students enough time to find meaning in your question. (often, Language Learners are translating question and answer from and back to English)
Sentence Frames - Use these to provide context for the learner to insert academic language.

Introduction (25-35 minutes):

Whole-group - one HSE speaking at a time (Have Magnetic Pendulum exhibit in front)

Introduce yourself and your group to the class.

Show short static Monsters Inc video. https://www.youtube.com/watch?v=cUFJ1yVhJ6g&feature=youtu.be

Talk to your neighbors about the sock and why it was stuck to the monster.

Quickly take ideas

Boys and girls today we are going to explore the power of forces that can't be seen. I'd like everyone to watch this really cool pendulum. What do you notice is on the top of the table? (magnets) ***Why does the pendulum arm go crazy when it passes them?*** (there is another magnet on the bottom of the pendulum)

Talk to the people around you about this…..Does the pendulum magnet (point to it) and the magnets below (point to them) ever touch? Then why do you think the pendulum is going crazy?

This is intended to make them wonder, don't need to explain this in detail. They will learn why this is later!

Introduction (cont.)

Now we are going to break up into groups and rotate to three different stations. In each of the stations you will observe how two things interact with each other.

Group A over with ……..

Now one HSE with each group speaking **(8-10 minutes/station)**

1. Magnetic Pendulum Stations (2 of them): One HSE/group

Using a small magnetic pendulum as a model...

Okay guys, this magnetic pendulum is just like the big one earlier….just smaller.

Before we test with our magnetic pendulum, I'd like you to see what happens when there is NO magnet on the base.

Take off magnet from the base. Swing from the start line and have students observe the setup with only one magnet on the pendulum. Have recorder record number of complete swings until the pendulum is inside the lines.

Now put the base magnet back on. Swing and have students observe the difference.

Now we know that there is something making the pendulum go crazy when we swing it.

I'd like the investigator (doer) to swing the pendulum a couple of times. Let's observe what happens. Okay, materials manager take a couple of swings.

If time permits, allow each member to do a swing.

What are some things that might change the motion of the pendulum? brainstorm

Pause to take a few ideas. Steer them to, ***What happens when we change the distance the pendulum magnet is to the other magnets?***

Okay, so let's figure out how we can answer this question…...ideas? Brainstorm

Pause to take a few ideas on this…...***Okay so we will need to change the distance of the pendulum magnet from the base magnet and record how many complete swings the pendulum makes until it reaches the inside of the line(s).***

Good, so data collector, first measure the distance the pendulum magnet is from the base magnet is now, then tell the recorder to write the measurement on the recording sheet.

Now investigator move the pendulum arm up to the start line and let it go.

Everyone can help the data collector count the swings until it reaches the inside of the line(s).

Activity (10 minutes)

Do this for 2 additional pendulum lengths, having the recorder write down the data.

Good job group. Now let's think about what happened to the number of swings when we changed the distance between our magnets.

I want you to talk about this as a group….then record your conclusion or answer on your sheet.

When the distance was _____ the number of swings _____.
more / less increased / decreased
+ -

We believe that the distance between the magnets changed the number of swings because_____.

Spend a few moments reviewing the group's response to the frames.

Nice work group…….So we just saw that even though the magnets did not touch they were attracted to each other. Now what happened when we changed the distance the magnets were from each other.

2. Static Electricity Stations (2 of them): One HSE/group

Now let's see if we can have another experience with a force we can't see. Can anyone think of an example of static electricity?

(touching a doorknob after walking on carpet, lightning, going down a slide, hair sticking up on a dry day, socks sticking to the laundry, pulling covers up at night and seeing little sparks…)

Watch as I rub this balloon to my hair.

Rub the balloon 10 times to your hair. Now put the balloon up to your hair to show the effect of the rubbing.

What did you notice about what happens when I put the balloon up to hair?

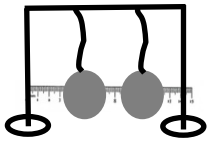
Students give observations.

When I rubbed my hair with the balloon we created a small static electrical charge on the balloon. Because my hair had an opposite static charge, my hair and the balloon attracted each other.

Introduction - continued

By our table you have two balloons hanging next to each other. We know we can charge a balloon with our hair.

Do you think we would need to charge both balloons or only one to make them react to each other?



Take predictions. ***You will need to experiment to find out for sure!***

1. Rub one on hair—check for a reaction between the balloons.
2. Rub the other on hair—check for a reaction (should only have reaction (repel) with both charged)

So now we know that both balloons must be charged for the balloons to repel each other.

Now I need the doer and the materials manager to experiment with rubbing wool cloth, fur, cotton cloth, newspaper, and carpeting to the balloon…...remember to rub them all around the balloon 10 times.

Recorder, be sure that you work with your group to get your data written on your group's recording sheet in the table.

Okay group get started…..don't forget to do your recording.

IMPORTANT: After each material is tested, you must remove the static charge by lightly spraying water on the balloon and wiping it with a cloth or paper towel. You can reuse the paper towel as long as it is not saturated with water. (you can have students do the wiping, but they need to do a complete job.)

As they are experimenting with the items, be sure to ask whether they needed to charge both balloons or only one to have them react to each other.

During activity, ask questions like: Did the balloons repel (push away) or attract (come together)? Which material seemed to make the balloons react the most? So on

You may need to work with the recorder and data collector on data recording.

After all materials have been used and the data has been recorded, ask the reporter the following questions:

1. ***Which material gave the balloons the greatest charge? How do we know this?***
2. ***Did both balloons need to be charged in order for them to react to each other?***
3. ***Ask members what would happen if we rubbed the object less than ten times or more than ten times. Have them test to find out.***

If time permits allow the group to play (controlled) with materials and balloons to create static charges.

3. Magnetic Interaction (orientation and materials attracted) (2 of them): One HSE/group

Now we're going to do some work with magnets. On the table you will find horseshoe, bar, and disc magnets. Also, you see many objects that are made of different materials.

First I think we should get to know how the magnets work when they are close together or touching.

Now we will need to work as a group to show how two magnets act when brought together. Boys and girls I want you to move the magnets around touch two together and pay careful attention to the N and S poles on each magnet and the way they react when brought close together.

We'll need to fill in the rec. sheet working as a group. Everyone can have a turn. Recorder get ready to record on your sheet when your group discovers a reaction on the magnets.

We noticed that when the _____ pole got close to the _____ pole the magnets _____.
(three identical sentences on recording sheet) repelled - attracted

Alright….remember to work as a group to get your data recorded correctly. Give them a few minutes to interact with the magnets and fill in blanks.

Okay, now we will need to use our data to make a statement about how magnets behave. Work as a group to fill in the last two sentences.

When the poles on two magnets are _____ the two magnets will _____.
different - the same repel - attract

When the poles on two magnets are _____ the two magnets will _____.
different - the same repel - attract

Give a minute or two to allow the group to discuss this and come up with what they now know to be true.

Great job group! Now we are going to do some testing of materials and magnets. You see many objects on the table. They are made of different materials. Some will be attracted to the magnet, some will not.

Okay this time only the doer will test the objects with the magnets. Data collector work with the recorder to write your data on your data sheet. Group, be thinking about what type of object is being attracted.

Give the group a little time to test all objects.

Okay, good now work as a group to figure out what all the objects that were attracted had in common (the same). Fill in the sentence with your groups idea.

We noticed that the objects that were made of _____ were attracted to the magnet.

Spend a moment going over their idea. We want them to notice that the objects attracted were made of iron, a type of metal.

Great job group! Now were going to listen to the HSE in front to learn about a challenge for us.

Activity (10 minutes)

One HSE addressing all the groups throughout the room

Wait until you have the attention of the students - may need to temporarily remove items on tables if needed.

Okay, we learned about forces between two objects that aren't touching. What we have learned will help us with the challenge I'm going to give you.

Your HSE has a small container with salt, pepper and iron filings mixed in them. Your challenge is to separate the three from each other. So we want just salt, just pepper, and just iron.

You will only have a balloon, a magnet inside rubber or plastic, and a plate, Take a few minutes to make a plan for the challenge. Remember, what you have seen today will help with this challenge. Reporter, be sure you are able to tell your HSE what your group's plan is.

Individual HSEs addressing one group only now
Interact with them to refine their plan. Offer encouragement and leading questions if necessary.

Okay, let's take just a moment to review our plan. Reporter how will your group beat the challenge?

Let's put the plan to work. I'd like the Materials Manager and the Doer to work together on this. Others help them with getting the salt, pepper and iron filings in their containers. Data Collector and Recorder be sure your writing the results of your plan.

First, our group used a _____ to attract the _____.
magnet - charged balloon salt - pepper - iron filings
Next, our group used a _____ to attract the _____.
magnet - charged balloon salt - pepper - iron filings
Finally, our group _____.

Great job group!

Wrap-up (10-15 minutes)

One HSE to whole group.

I'd like a reporter from a group tell us how they beat our challenge.

Take one or two depending on time.

Nice, well today we learned that there are forces that act on objects even when they aren't touching. I'd like a volunteer reporter to answer this question.

- ***What did we learn about the way magnets behave when put close together?***
- ***Great, when we rubbed the balloon together with other materials and then put it up to hair - what happened?***
- ***The electrical force was seemed greatest after rubbing the balloon together with what object?***

You guys did an awesome job here. Have a great day at Discovery Zone!

Name:_____

Data—Magnetic Pendulum

1.

Distance pendulum from magnets:	Number of swings:
no base magnet	
cm.	
cm.	
cm.	

2. When the distance was _____ the number
lesser / greater
of swings _____.
increased / decreased
\+ -

3. We believe that the distance between the magnets changed the number of magnetic pendulum swings because _____
_____
_____

Magnetic Pendulum

Data—Static Electricity

What did your group find out about charging one or both balloons? _____
_____

What Happened?	unchanged balloons	green wool cloth	white fur	cotton cloth	newspaper	carpet
Distance from each other	cm.	cm.	cm.	cm	cm.	cm.
Attracted →←		yes or no	yes or no	yes or no	yes or no	yes or no
Repelled ↔		yes or no	yes or no	yes or no	yes or no	yes or no
Nothing happened						

Static Electricity

Data—Magnetic Interaction

We noticed that when the NORTH pole got close to the SOUTH pole the magnets (repelled/attracted) each other.
↔ →←

We noticed that when the NORTH pole got close to the NORTH pole the magnets (repelled/attracted) each other.

We noticed that when the SOUTH pole got close to the SOUTH pole the magnets (repelled/attracted) each other.

When the poles on two magnets are _____ the two magnets will _____.
different - the same repel - attract

When the poles on two magnets are _____ the two magnets will _____.
different - the same repel - attract

Magnetic Interaction

Data—Magnetic Interaction

Attract?	NO	YES
aluminum can		
nail		
fabric		
paper clip		
washer		
seashell		
chair frame		
plastic pipe		
key		

We noticed that the objects that were made of _____ were attracted to the magnet.

Magnetic Interaction

Salt, Pepper, and Iron Separation Challenge

First...	Next...	Last...

First, our group used a _____ (magnet - charged balloon) to attract the _____ (salt/pepper/iron filings). Next, our group used a _____ (magnet/charged balloon) to attract the _____ (salt/pepper/iron filings). Finally, our group _____

_____

_____

Challenge

Name _____ Test 3-PS2-3

Student Sheet

Carefully read or listen to the questions. Be sure you read and think about all choices before picking one.

Static Electricity Test on balloons:

1. When your group rubbed and charged only one balloon what happened?

- O Both balloons repelled each other, since they were both charged.
- O Both balloons attracted each other, since they were both charged.
- O Nothing moved, both balloons must be charged for them to repel.
- O One balloon popped.

Static Electricity Test on balloons:

2. Which of the choices below should cause the balloons to repel less?

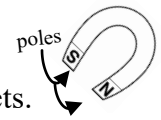
- O Rub the fur around each balloon 20 times instead of 10.
- O Rub the fur on only one balloon 30 times instead of 10.
- O Rub the fur around each balloon 5 times instead of 10.
- O Rub the fur around one balloon 20 times and the other 30 times.

Magnetic Pendulum Test: Make a choice for each blank. (more than one correct answer)

3. The number of magnetic pendulum swings _____ when the distance between magnets _____?

O Increased +	O Increased, +
O Decreased, -	O Decreased, -
	O Stayed the same

4. Pretend you had six horseshoe magnets. Write a few complete sentences about how you could connect (put together) them into three pairs of magnets.



_____

_____

_____

Now draw a picture of the three pairs of magnets. Hint…..Don't forget to label the poles!

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		Materials List **Cause and Effect-Magnetic/Electric Interactions**	Date _____
	✔	Description	Number needed
Introduction –			
1		Full size Magnetic Pendulum	1
2		Monsters Inc. video (on web site)	3 x 2
Activity -			
2		Small magnetic pendulums for station work	2 ea
3		Measuring tool	2 ea
4		Timer	2 ea.
5		Balloon for intro—rub on hair	1 ea.
6		Balloon rack—2 balloons hanging from rack, cm. ruler behind	2 ea.
7		Cotton, wool, fur, newspaper, carpet	2 sets
8		Assorted horseshoe, bar and disc magnets	2 sets
9		Assorted objects: alum can, nail, fabric, paper clip, washer, seashell, chair frame, plastic pipe, key	2 sets
10		Salt, Pepper, Iron filings mixture with container — Challenge	6 sets
10		Containers to hold separated salt, pepper, Iron materials	6 sets of 3