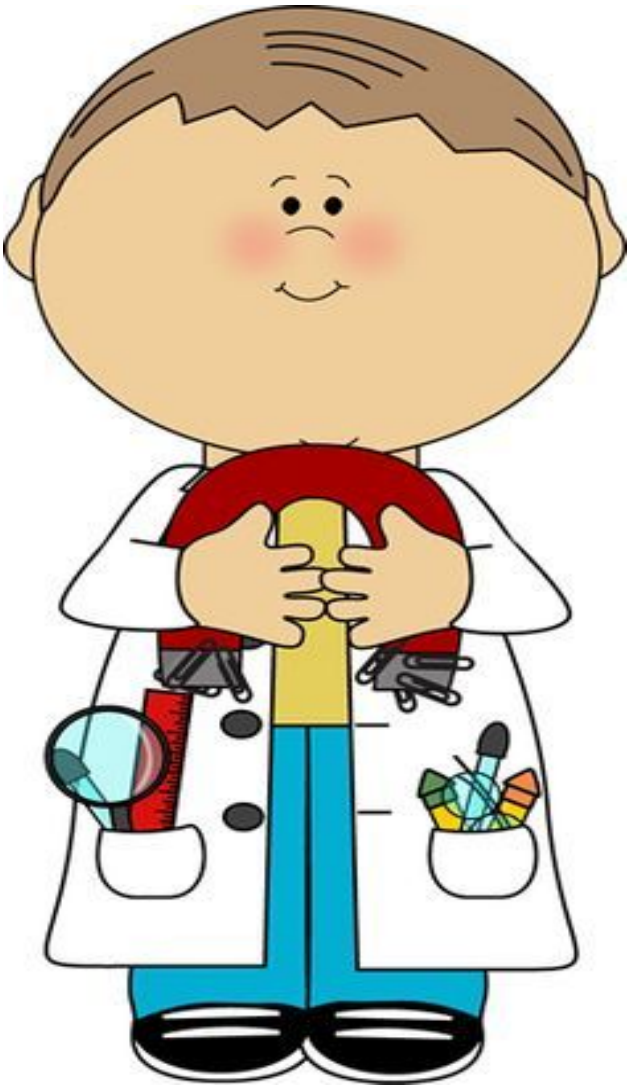
What's the Attraction?
THE SCIENCE of MAGNETS
and
MAGNETIC FORCE



What's the Attraction?

Data Recording Sheet

Investigation 1: Identifying Properties

Directions: First make some observations of the object you are given. Make some observations about what the object does. Record your observations by writing or drawing your observations below.

Based on the investigation just conducted, what do you wonder? Write your questions here.

_____
_____
_____
_____

<u>Investigations Based on Wonderings</u>

Directions: Make observations and conduct the investigations based on the questions you now have about bar magnets. Write or draw your observations here.

MAGIC JAR PHENOMENA

STEP 1: Make observations and record your wonderings...

STEP 2: Draw a model of what you think is happening in the jar!

STEP 3: Make a claim that is support and evidence and reasoning!

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Data Recording Sheet

Investigation 2: Describing Properties of Different Magnets

Directions: Record your observations of its **non-magnetic** properties here:

Bar	
Ring	
Horseshoe	
Rubber	

What do you wonder about these magnets? Write your questions here.

Question 1: _____

_____

Question 2: _____

_____

Question 3: _____

_____

Investigate your questions! Write or draw your observations here.

Bar	
Ring	
Horseshoe	
Rubber	

Does the magnetic force increase when you combine magnets? Work with another team to combine magnets and record your data here.

Type of Magnet	How may clips were you able to pick up when you combined…	
	2 Magnets	3 Magnets
Bar		
Ring		
Horseshoe		
Rubber		

Which type of magnet could pick up the most clips when combined together? _____

Which was more effective at picking up the clips, 2 magnets together or 3 magnets together?

_____

_____

Thinking About It: How Do Magnets Interact with One Another?

Interactions are the ways things can affect each other. One of the interactive relationships magnets have is known as cause and effect. A cause is why something happens. An effect is what happens as a result. Did you observe some cause and effect relationships between magnets in these first two investigations? List them here:

_____

_____

_____

_____

_____

_____

Inquiry Investigation Stations: What Other Properties Do Magnets Have?

Station 1: Magnetic Attraction - What Will the Magnet Attract?

Step 1: Predict by sorting the items into two groups according to whether you think "YES", they will be attracted to the magnet or "NO" they will not. Record your predictions here:

YES					
NO					

Step 2: Test your objects!

Step 3: Record your results here:

YES					
NO					

What did you observe? _____

_____

_____

What do you wonder? _____

_____

_____

Station 2: Levitating Magnets

Part 1: Predict!

How could you make one magnet levitate above the other?

_____

_____

_____

Part 2: Investigate!

Directions: Place two ring magnets on the pencil. What did you need to do to make one magnet levitate over the other? Draw a model of what you did in the box below. What is happening to make the magnets levitate? Label your model to show what is happening to make the magnets levitate and write an explanation.

1.

Flip one of the magnets over. What happened?

_____

_____

2. What happens when you flip both magnets over?

_____

_____

Part 3: More Investigating!

Directions: Conduct each of the tests in the table below. For each test, use a ruler to measure the distance between the magnets. Record your data and any observations in the "Results" column.

Test		Results (Distance between magnets)
1.	Place 2 magnets on the pencil. Levitate 1 magnet over the other.	
2.	Add 20 paper clips to the top magnet.	
Now make observations and record your data as you investigate the following…		
3.	Stick 2 ring magnets together. Levitate these 2 magnets on top of the on top of the 1 ring magnet.	
4.	Switch the magnets so the 2 ring magnets stuck together are at the bottom. Levitate the one ring magnet above the two that are stuck together.	
Finally, what happens when you…		
5.	Place a square of manila folder between 2 levitating magnets.	
6.	Remove the folder and replace it with a square of foam.	

If you remove the pencil, do the magnets keep levitating? Why or why not?

_____

_____

_____

Part 4: Properties of Magnets

Directions: Identify 3 properties of magnets that you observed during this investigation. Explain how each property helped you to levitate the magnets.

Property #1:

_____

_____

_____

_____

Property #2:

_____

_____

_____

_____

Property #3:

_____

_____

_____

_____

What do you now wonder?

_____

_____

_____

_____

Station 3: Mighty Magnets

Directions: Conduct this investigation using the directions posted at the station to guide you. Record your results in this table.

Distances	12 cm.	10 cm.	8 cm.	6 cm.	4 cm.	2 cm.	0 cm.
Number of Clips							

Data Analysis: What happened as the magnet got closer to the clips? Why did this happen? _____

_____

_____

What do you now wonder? _____

_____

_____

Station 4: Magnetic Tug of War

Between two magnets, which is stronger, a magnetic push or its pull? I predict:

_____

_____

What happens when the magnet is lying flat on the table?

PULL	Distance apart when Magnet A moves
Trial One	
Trial Two	
Trial Three	

PUSH	Distance apart when Magnet A moves
Trial One	
Trial Two	
Trial Three	

What happens when the magnets are standing on its edge?

PULL	Distance apart when Magnet A moves
Trial One	
Trial Two	
Trial Three	

PUSH	Distance apart when Magnet A moves
Trial One	
Trial Two	
Trial Three	

I now think: _____

_____

I now wonder: _____

_____

Station 5: Draw a Magnetic Force

Draw a diagram of what the magnetic fields look like here:

Describe what you now know about magnetic force fields here:

_____

_____

_____

_____

_____

_____

What do you now wonder?

_____

_____

_____

_____

_____

_____

Station 6: Make Your Own Magnet

1. How many clips could you pick up with your magnetized nail? _____

2. Predict and describe how you can make the nail a stronger magnet:

_____
_____
_____
_____

3. Test your idea! How many clips could your magnetized nail pick up this time?

_____

What Happened?

Describe the way that the filings lay along the test tube:

_____

What happened when you brought the tube near a compass?

_____

Describe the way the iron filings lay after you ran the magnet under it:

_____

What happened when you brought the test tube near the compass after you ran the magnet under it?

_____

What has happened to the test tube?

_____
_____
_____

What do you now wonder?

_____
_____
_____
_____

Thinking About It (one more time): How Do Magnets Interact with One Another?

What are some of the cause and effect relationships between magnets you observed in this set of investigations? List them here:

_____

_____

_____

_____

_____

_____

_____

_____

Engineering Design Challenge (Performance Task)

Performance Task

Your class is on a field trip to Makapu'u. You are all standing on the pier to take in the view and look at the fishes when your teacher accidentally drops his/her keys into the ocean! You can hardly see the keys…the water is murky and the tide is coming in!

You run quickly to the nearest hardware store for a solution and all they have for you to purchase are the following types of magnets:

- Rubber ($.50)
- Horseshoe ($1.00)
- Ring ($1.00)
- Bar ($10.00)

Luckily for you, the store owner is willing to give you string, masking tape, straws, chopsticks. and recycled materials for free because you only have $20.00 to spend! Can you design and create a device to retrieve the most keys without jumping off the pier into the water? Think about it!

Identify:

What is the challenge?

_____

_____

What criteria do you have to work with?

_____

_____

What are the constraints?

_____

_____

STEP 1: ASK: What questions do you have about engineering a device to retrieve the most keys? Write them here.

_____

_____

_____

STEP 2: IMAGINE: Use your background knowledge of magnets and magnetic forces to create your device. You will need to consider the materials available to you. Draw your possible designs and label the parts. Be ready to share and discuss your design and explain the rationale for your design and material choices. In the next step, your design team will be choosing one design to develop. Remember, there are no bad ideas at this time.

Supplies	Cost
Total Cost for Supplies:	

STEP 3: PLAN: After hearing and discussing the ideas with your teammates, select and draw the diagram of your team's prototype. Label each part as well as the materials you will be using and possible measurements and cost. Make sure each person in your team has the same plan here.

Supplies	Cost
Total Cost for Supplies:	

STEP 4: CREATE: Show your plan to your teacher before you begin. Build your device following your team's plan. What modifications did you need to add in order to be sure that your design would hold together and work? Be sure to record these modifications on your plan.

STEP 5: EXPERIMENT: Does your device meet the following criteria?

	Meets Criteria	Does Not Meet Criteria
Supplies stays within $20.00 cost		
You cannot jump off the pier to retrieve keys – device must be used from higher ground		
Your device can only use the supplies provided to you		

Record your data

Trial	# of Keys retrieved	Observational Notes
1		
2		
3		

STEP 6: IMPROVE!

- **ASK:** Based on your experiences building your prototype and the criteria table above, answer the following questions:

  - What worked? Why?

    _____

    _____

    _____

  - What didn't work? Why?

    _____

    _____

Can you now improve your design by making it more effective/efficient?

- **IMAGINE:** What improvements might you make to enhance the effectiveness of the device? Sketch your ideas and explain why this improvement would enhance the effectiveness of the device.

Supplies	Cost
Total Cost for Supplies:	

- **PLAN:** Draw a diagram of your team's 2nd prototype design. Remember to label your parts, including the materials you will be using.
-

Supplies	Cost
Total Cost for Supplies:	

- **CREATE:** Be sure to show your plan to your teacher again before you begin. Create your improved device by following your team's revised plan.

- **EXPERIMENT:** Does your 2nd device still meet the following criteria?

	Meets Criteria	Does Not Meet Criteria
Supplies stays within $20.00 cost		
You cannot jump off the pier to retrieve keys – device must be used from higher ground		
Your device can only use the supplies provided to you		

Record the data for your improved design:

Trial	# of Keys retrieved	Observational Notes
1		
2		
3		

IMPROVE: If you had more time and materials, what are some other ways you could optimize your device to retrieve the keys? Explain your thinking.

_____
_____
_____

CONCLUSION (What did we learn?): How do magnetic forces affect the motion of objects? _____

_____

How can scientific discoveries and new and improved technology be influenced by the Engineering Design Process?

_____
_____