MAGLAB FIELD TRIP
ELECTROMAGNETS

NATIONAL HIGH MAGNETIC FIELD LABORATORY

FSU FLORIDA STATE UNIVERSITY

NSF

Center for Integrating Research & Learning
1800 East Paul Dirac Drive
Tallahassee, FL 32310
nationalmaglab.org/education

Pre-Visit Activity: What Do We Already Know?

Teacher Background: A simple, yet effective learning strategy, a K-W-L chart, is used to help students clarify their ideas. The chart itself is divided into three columns:

K	W	L
WHAT DO YOU KNOW	WHAT DO YOU WONDER	WHAT HAVE YOU LEARNED

MATERIALS: > Chart Paper > Markers

ACTIVITY INSTRUCTIONS

1. Copy the K-W-L chart and pass out so that each student has their own sheet. Explain how the chart is to be filled out, then brainstorm with the class and have the students list everything that they know about magnets and magnetism. There are no right or wrong answers.

2. Next have the students list everything that they want to know about magnets and magnetism. You may need to provide prompts such as:

   If magnet experts were here, what questions would you ask them?
   If you were a scientist, what would you like to discover about magnets?

3. Keep the chart accessible so that you and the students can enter ideas, new information, and new questions, at any time. The class can return to the K-W-L chart after completing the activities. As students learn the answers to their questions, list the answers in the L column of the chart.

4. K-W-L charts are useful in identifying misconceptions that students have about magnets and magnetism. Once the misconceptions are identified, have students design a way to test their ideas, reflect on what they observe, and refine the original conclusion.

5. Periodically, return to the K-W-L chart during the activities to check off items from the W column and to add to the L column. Students may want to add items to the W column to further their explorations.

NAME: _____

TOPIC: _____

TEACHER: _____

NATIONAL HIGH MAGNETIC FIELD LABORATORY

K	W	L
WHAT DO YOU KNOW	**WHAT DO YOU WONDER**	**WHAT HAVE YOU LEARNED**

Pre-Visit Activity: What is a Magnet?

Teacher Background:

We know essentially what magnets do. Magnets attract and repel. Materials with magnetic qualities have domains made up of billions of atoms that are configured in certain ways. Materials with strong magnetic characteristics have atoms with magnetic polarities mostly aligned. Each magnet has a north and a south pole, the regions where the magnetic force created by the magnet is strongest. Like poles repel and opposites attract. Magnetism is the force of attraction and repulsion of the magnets. This activity is designed to provide opportunities for your students to explore and discover through hands-on experiences the properties of magnets and magnetism:

Each magnet has a north and a south pole.

Like poles repel.

Opposite poles attract.

Magnets attract some materials and not others.

MATERIALS: *> Magnets > Compasses > A variety of classroom objects, not all metal > K-W-L Chart*

ACTIVITY INSTRUCTIONS

1. Review the K-W-L chart with your students.
2. Distribute magnets, compasses, and the variety of objects to students. Each student should have at least two magnets. Students can share compasses and the other materials.
3. Give students ample time to explore and play with the materials freely.
4. Challenge the students to test what they previously listed in the K column of the K-W-L chart, reflect on what they observe, and refine the original preconceptions if needed.
5. Challenge the students to discover the types of materials that magnets attract. The students can prepare a chart listing the objects that are attracted to magnets and those that are not.
6. Challenge and guide the students to use the compass to discover the polarity of the magnets in terms of north and south poles.
7. Introduce the terms *attract, repel, like,* and *opposite* in a discussion of how magnets interact with each other.
8. Challenge your students to feel and describe the force of magnetism. Introduce the term *magnetic force* to describe the forces of repulsion and attraction.

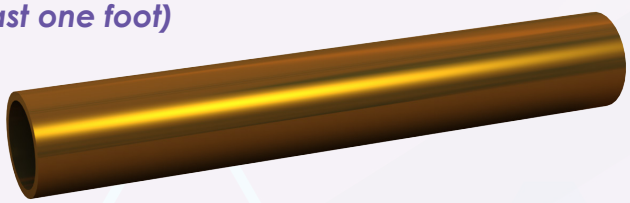
Post-Visit Activity: Eddy Currents

Teacher Background:

It has been shown that a magnetic field can be created from a flow of electricity. Likewise, the opposite can also be done: Electricity created from a magnetic field.
An eddy current is one of these. They are created in a conducting material (such as copper or aluminum) by a changing magnetic field. The eddy currents flow in circular paths in the conductor and within planes perpendicular to the direction of the magnetic field line.

MATERIALS:

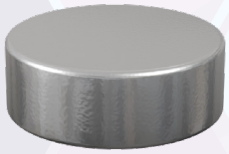
> *1 copper pipe of any length (at least one foot)*



> *1 stopwatch*

> *1 paper clip*

> *1 neodymium magnet to fit inside the copper pipe*



> *1 plastic pen*

ACTIVITY INSTRUCTIONS

1. Hold the pipe and the magnet near each other. Is there any attraction present?
2. Hold the pipe vertical and drop the plastic pen through it. Record any observations. (You can use the stopwatch here to record data on the speed of the falling pen).
3. Repeat the previous step, but drop a paper clip through the pipe. Again, records the observations.
4. Now drop the magnet through the pipe. Once more record any observations.
5. Try to use the explanation of eddy currents, as well as the explanation of the electric motors activity to try to explain what is going on.
6. For more on Eddy currents, please see: https://nationalmaglab.org/education/magnet-academy/watch-play/interactive/dc-motor

Florida's State Academic Standards for Science

4th Grade:
SC.4.N.1.1, SC.4.N.1.2, SC.4.N.1.4, SC.4.N.1.5, SC.4.N.1.7, SC.4.N.1.8, SC.4.P.8.1, SC.4.P.8.4

5th Grade:
SC.5.N.1.1, SC.5.N.2.1, SC.5.N.2.2, SC.5.P.8.3, SC.5.P.10.2, SC.5.P.10.4, SC.5.P.11.2, SC.5.P.13.1, SC.5.P.13.2, SC.5.P.13.4

6th Grade:
SC.6.N.1.5, SC.6.P.13.1

7th Grade:
SC.7.N.1.6

8th Grade:
SC.8.N.1.2, SC.8.N.1.3, SC.8.N.1.5, SC.8.P.8.4

High School:
SC.912.N.1.1, SC.912.N.1.7, SC.912.N.2.1, SC.912.P.10.10, SC.912.P.10.16, SC.912.P.10.17

Next Generation Science Standards

NGSS:
3-PS2-3, 3-PS2-4, 4-PS3-4, MS-PS2-3, MS-PS2-5, HS-PS2-5

VOCABULARY LIST

Magnet	*An object that is surrounded by a magnetic field and that has the property, either natural or induced, of attracting certain metals. magnets have a North and South pole.*
Magnetic field	*A region around a magnet in which objects are affected by the magnetic force.*
Attract	*To cause to draw near by a force.*
Repel	*To push back or away by a force.*
Permanent Magnets	*A piece of magnetic material that retains its magnetism after it is removed from a magnetic field.*
Temporary Magnets	*A piece of magnetic material that demonstrates the properties of a permanent magnet only while in a magnetic field.*
Electromagnet	*Created when a temporary magnet is placed into a coil (solenoid) that is carrying current.*

If you have any questions, please contact Carlos Villa: **villa@magnet.fsu.edu**