CLASSROOM VISIT
SUPERCONDUCTIVITY

NATIONAL HIGH MAGNETIC FIELD LABORATORY

Center for Integrating Research & Learning
1800 East Paul Dirac Drive
Tallahassee, FL 32310
(850) 644-7191
nationalmaglab.org/education

Pre-Outreach Activity: What Do We Already Know?

NATIONAL MAGLAB

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 WE KNOW	WHAT WE WANT TO KNOW	WHAT WE 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 temperature experts were here, what questions would you ask them?

   If you were a scientist, what would you like to discover about heat?

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.

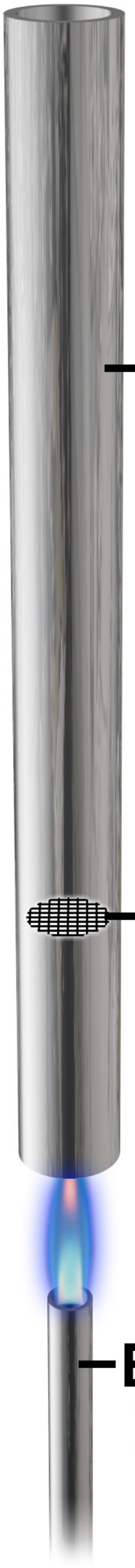
NAME: ____________________ DATE: ____________

TOPIC: ____________________

TEACHER: ____________________

K — WHAT DO YOU KNOW	W — WHAT DO YOU WANT TO KNOW	L — WHAT HAVE YOU LEARNED

Post-Outreach Activity:
Thermal Oscillations (The Rijke Tube)



Teacher Background:

One of the concerns when dealing with Superconductivity is the characterization of the materials when cooled to cryogenic temperatures. Metals contract when they freeze, and these contracted metals behave differently than they do at room temperature. It is one of the reasons that superconductivity works, but also a hindrance to its development.

Hot air rises since the heating of the air makes it expand. As the air expands it becomes less dense than the cooler air around it. The less dense hot air then floats above the more dense cold air. While all gases will expand when they are heated, the same is not true for all compounds. Nearly every material will expand when heated, but not all do. A common example is water. Most materials will expand when heated and contract when cooled. Water, however, will expand as it boils into steam, and also expand as it freezes into ice.

The Rijke Tube is a great demonstration used to teach students about sound waves and thermal expansion. The piece of metal pipe sings as the escaping heat vibrates. Since this demonstration requires the use of fire, it must be done by an adult.

Post-Outreach Activity:
Thermal Oscillations (The Rijke Tube)

MATERIALS:

- Heavy wire screen mesh
- Bunsen burner (or Propane torch)
- Long metal tube (5 cm diameter, 45 cm long (or longer))
- Heat resistant gloves

ACTIVITY INSTRUCTIONS

1. Fold the piece of heavy wire screen mesh several times to make it just small enough to fit in the metal tube. Position the screen about 10 cm from the end of the tube.
2. Light the Bunsen burner. Adjust it until you have a blue flame.
3. Wearing heat-resistant gloves hold the metal tube vertically over the Bunsen burner flame to directly heat the wire disks inside the tube.
4. Heat the wire disks approximately 15 seconds. Try to evenly heat the entire disk. If you could see the screen it should be red hot.
5. Remove the tube from the flame and hold it vertically. The tube should begin to sing. The sound will last for several seconds. What variable affect how long the tube sings for?
6. Try this: After heating the wire disks, remove the tube from the burner flame and immediately tip the tube over so it is parallel to the ground. What happens?
7. Now rotate the tube so it is perpendicular to the ground. The sound gradually increases in volume as you rotate the tube. This should be done quickly, before the wire disks cool off.
8. For an added variable, try freezing the wire mesh instead of heating it. Have the students predict what they think will happen.

Next Generation Sunshine State Science Standards

6th Grade:
SC.6.N.1.1, SC.6.N.1.2

7th Grade:
SC.7.N.3.2

8th Grade:
SC.8.P.8.1, SC.8.P.8.4, SC.8.P.8.6, SC.8.P.8.7, SC.8.P.8.8, SC.8.P.8.9, SC.8.P.9.1, SC.8.P.9.2

High School:
SC.912.N.1.2, SC.912.N.1.7, SC.912.N.3.3, SC.912.N.3.5, SC.912.P.8.1, SC.912.P.8.2, SC.912.P.8.3, SC.912.P.8.4, SC.912.P.8.5, SC.912.P.8.6, SC.912.P.8.7, SC.912.P.8.12

Next Generation Science Standards

NGSS:
5-PS1-1, 5-PS1-3, 5-PS1-4, MS-PS1-2, MS-PS1-5, HS-PS1-2, HS-PS1-5, HS-PS1-7

VOCABULARY LIST

Critical Temperature	*The temperature at which a superconductor, when cooled, loses its electrical resistance.*
Electron	*The temperature at which a superconductor, when cooled, loses its electrical resistance.*
Magnetic Flux	*The temperature at which a superconductor, when cooled, loses its electrical resistance.*
Meissner Effect	*The temperature at which a superconductor, when cooled, loses its electrical resistance.*
Resistance	*Negatively charged subatomic particle*
Superconductor	*The temperature at which a superconductor, when cooled, loses its electrical resistance.*