

ELEMENTARY SCIENCE PROGRAM
MATH, SCIENCE & TECHNOLOGY EDUCATION

A Collection of Learning Experiences
PHYSICAL SCIENCE



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PHYSICAL SCIENCE

GRADE 2

Unit Overview

This unit provides students with the opportunity to observe two major types of phenomena in physical science, the states of matter and magnets. Students will observe the three states of matter and how they change from one to another. Students will also explore the properties of magnets. The science skills emphasized in Physical Science are observation, prediction, classifying, creating models, gathering and organizing, and interpreting data.

Scheduling

This unit may take from five to seven weeks to complete depending upon the goals of the teacher and interests of the students. Use of the section included in this manual called More Ideas may extend the time span of this kit.

Materials to be obtained locally:

Please make **one** student activity book for **each** student.

chart paper	ice cubes
felt tip markers	watch/clock
objects from the classroom	paper towels
water	newspapers
construction paper	markers/crayons
glue	sponge
scissors	salt (optional)
pennies	pencils
freezer (if available)	

Caution

Remind students to wash their hands after handling any of the materials in the kit.

About the Format

Each learning experience is numbered and titled. Under each title is the objective for the learning experience.

Each learning experience page has two columns. The column on the left side of the page lists materials, preparations, basic skill processes, evaluation strategy, and vocabulary. The evaluation strategy is for the teacher to use when judging the student's understanding of the learning experience.

The right column begins with a "Focus Question" which is typed in italicized print. The purpose of the "Focus Question" is to guide the teacher's instruction toward the main idea of the learning experience. The "Focus Question" is not to be answered by the students. The learning experience includes direction for students, illustrations, and discussion questions. These discussion questions can be used as a basis for class interaction. A **Student Assessment** has been included in the **Teacher's Manual** and the **Student Activity Manual**. If you do not want the students to have the assessment beforehand, remove it from the **Student Activity Manual** before printing a class set of the student manuals.

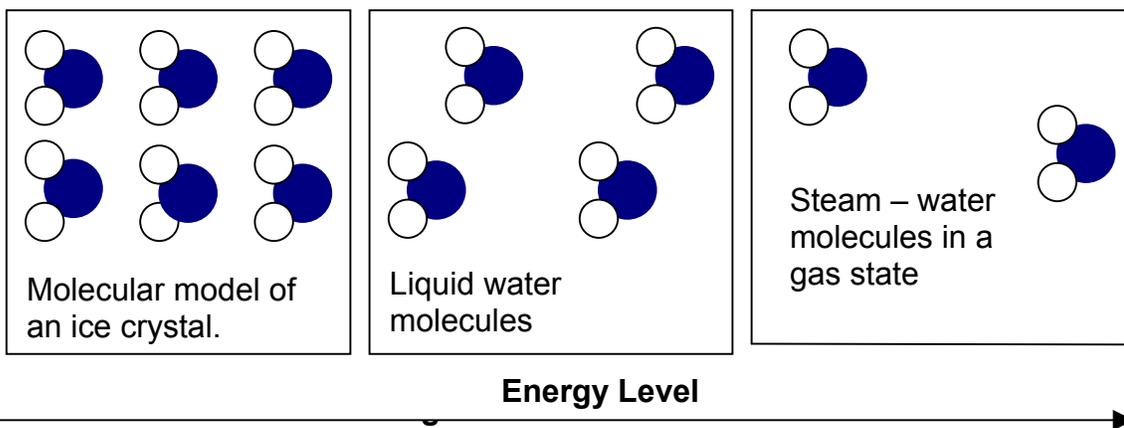
Background Information

Matter makes up the world around us. It is generally stated that there are three states of matter: solid, liquid, and gas. Plasma, a form of matter consisting of electrically charged particles under high temperature, is sometimes referred to as the fourth state of matter. All matter has mass and takes up space, regardless of its state. Each state of matter, however, does have characteristics of its own.

	SOLID	LIQUID	GAS
SHAPE	Definite Shape	No definite shape	No definite shape
SPACE	Takes up definite amount of space	Takes up a definite amount of space	Takes up no definite amount of space
FEEL	Each solid has a different feel, but they are resistant to change due to pressure	Feels wet	Must be moving to be felt

Substances change their state due to changes in their energy. We measure change in energy by measuring temperature. Moving molecules have kinetic energy called heat. The more energy the molecules have available to them the faster they move. The less energy that is available to the molecules, the slower they move. The faster the molecules move, the farther apart they get. If the molecules are spaced wide apart and are moving quickly, the substance is a gas. If energy is taken away, the molecules slow down and move closer together. If the molecules are tightly packed together, the substance is a solid. Even though the molecules of a solid are close together and arranged in a pattern, the molecules are still moving (vibrating) but they do not change their position. Therefore, a solid keeps its shape. The molecules of liquids are not as tightly packed together as those of solids or as loosely as those of gases. Therefore, liquid has no definite shape, and it takes the shape of the container it is in. Liquids do have a definite volume or take up a definite amount of space. Liquids move in a current or stream, and they can be described by their resistance to flow or **viscosity**. The temperature at which a substance changes from a solid to a liquid is its melting point. The temperature at which it changes from a liquid to a gas is its boiling point.

Water Molecules



Changes in States of Matter

Name of Change	Changes in State	Direction of Heat Energy	Example
Condensation	Gas to Liquid	Heat Lost	Water vapor condenses on a cold glass
Freezing	Liquid to Solid	Heat Lost	Water becomes ice in a freezer
Evaporation	Liquid to Gas	Heat Gained	Boiling water evaporates as steam
Melting	Solid to Liquid	Heat Gained	Ice melts at room temperature
Sublimation	Solid to Gas Gas to Solid	Heat Gained Heat Loss	Dry ice sublimates to form carbon dioxide. No liquid is produced.

Change of State

The temperature at which a solid becomes a liquid is called the **melting point**. The temperature at which a liquid freezes is called the **freezing point**. The freezing point and the melting point of a substance is at the same temperature. For water, the temperature at sea level is 0°C. The melting and freezing points of different kinds of matter vary due to the strength of the forces between molecules varies from one kind of matter to another.

A liquid can change to a gas by evaporation or boiling. **Evaporation** takes place at the surface of a liquid of an open container while boiling is in effect throughout the liquid. Bubbles form, rise, and burst on the surface.

The temperature at which a liquid boils is the **boiling point**. The temperature of the boiling point of water is 100°C. The water vapor produced is also 100°C.

Condensation is the reverse of boiling. When a gas is cooled, it loses energy, and its molecules move more slowly. If cooling continues, the gas loses enough energy to change into a liquid. The temperature at which a gas changes to a liquid is called the **condensation point**. Water vapor from boiling water can be condensed into a liquid.

Mass is a measure of the amount of matter in an object. Mass is measured by comparing the object's mass with a standard mass. Therefore, some sort of a balance scale is needed to measure mass. It is important that students understand that mass does not equal weight. Weight is the measure of gravitational pull on an object. Therefore, weight will vary with gravitational force. If you measure the weight of an object on the earth and then measure the weight of the same object on the moon, the object would weigh less due to the fact that the force of gravity is different on the moon versus the earth. However, the mass of the object would be the same on the earth and on the moon because the amount of matter in the object remains constant.

In order for an object to be submerged in a liquid, the object must push aside or displace some of the liquid it is contained in. This is called displacement. Volume of an

object can be determined by displacement. Let's say that 10 mL of liquid is placed in a graduated cylinder. If an object is dropped into the cylinder, the water level appears to go up, even though no more water was added to the cylinder. This is due to the fact that the object has "displaced" or pushed aside some of the liquid when it was put into the container. If the object is submerged, it will displace the object's volume.

Therefore, if there was 10 mL of liquid before the object was placed in the fluid and the measurement of the liquid in the cylinder is 14 mL after the object is placed in the fluid then subtracting 14 mL from 10 mL would equal how much space the object took up in the cylinder. Since the definition of volume is "the amount of space taken up by an object" it can be concluded that the volume of the object placed in the fluid is 4 mL.

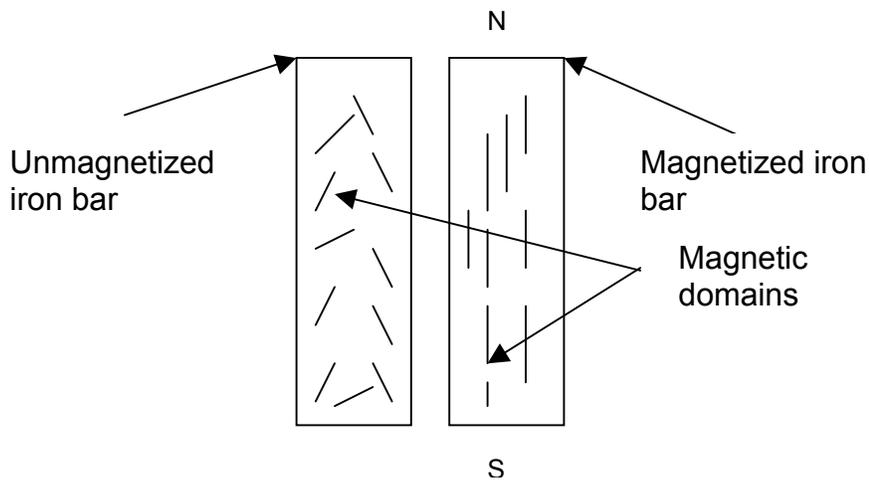
Temperature

The average kinetic energy of the molecules of a substance is its **temperature**. The kinetic energy of a substance relates to how much heat the substance has. An object that has a high temperature has molecules with a high average of kinetic energy. If an object has a low temperature, its molecules have a lower average of kinetic energy.

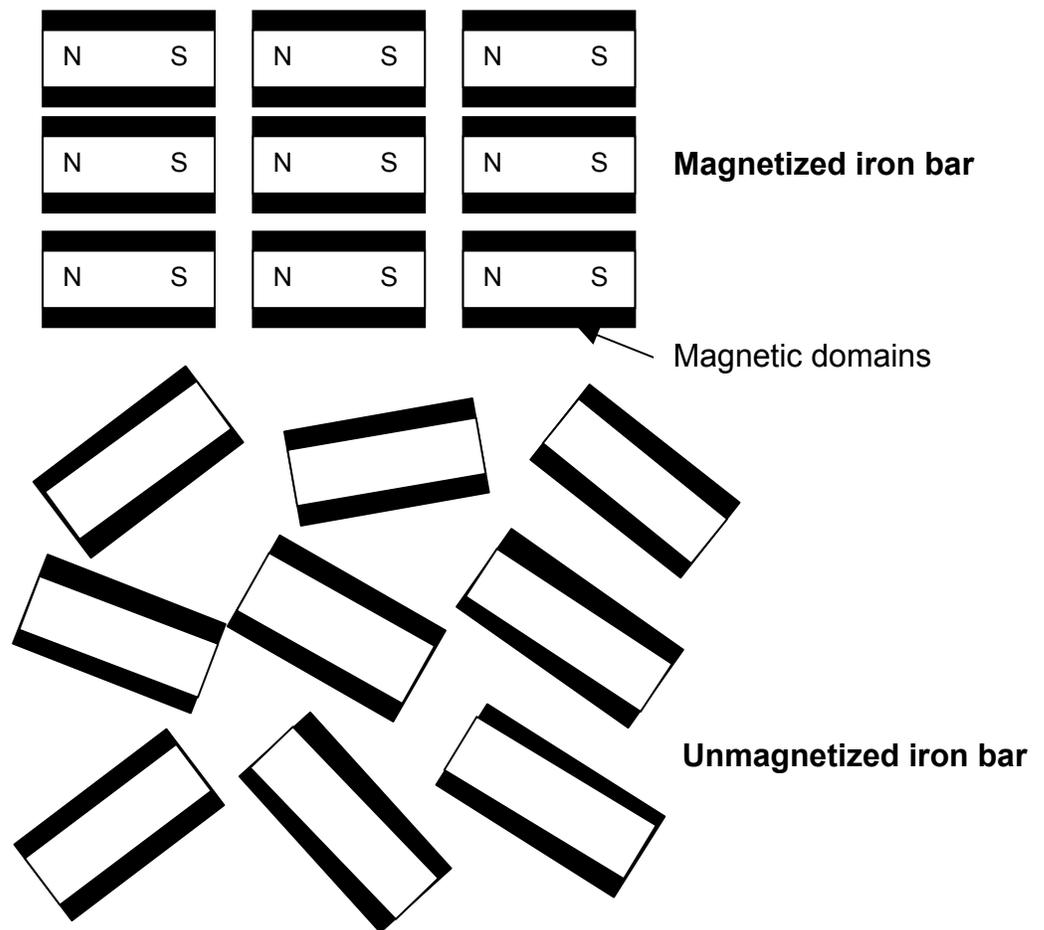
Thermometers are tools that help us measure temperature. Thermometers have a long, thin tube filled with a red liquid that detects changes in some property of matter as a result of internal energy. The liquid in the thermometer rises when the air around it gets warmer (expands). This liquid falls in the tube when the air around it gets colder (contracts). Alcohol is the liquid used in the thermometers in this kit because it expands and contracts at a uniform rate. Fahrenheit and Celsius are two different scales for measuring temperature. These two scales are named after the scientists who developed them, Gabriel Daniel Fahrenheit and Anders Celsius. On the Fahrenheit scale, freezing point of water is 32°F and boiling point is 212°F. On the Celsius scale, 0°C is the freezing point of water and 100°C is the boiling point. In this unit, the Celsius scale is asked for in all responses from the students because it is the scientific scale for measuring temperature. The Fahrenheit scale is on the thermometers because we are aware that students will hear the Fahrenheit temperature in weather reports in the United States. Therefore, you are able to introduce students to both scales if you choose to do so. Remember that when measuring temperature using the Fahrenheit scale each line on the thermometer is equal to two degrees. On the Celsius scale, each line is equal to one degree.

Magnetism

Magnets create a force called **magnetism**. The ends of the magnets attract or repel each other. This is due to its magnetic poles. All magnets have a north pole and a south pole. When two north poles are brought near each other, they repel each other. However, north and south poles attract each other. If you break a magnet in half, each piece is a complete magnet with a north and south pole. Some materials are magnetic and others are not. The electrons of all atoms spin as they move around the nucleus. A spinning electron produces a magnetic field with a north and south pole. Each atom acts like a small magnet. In most materials, the magnetic fields of these atoms cancel each other out, so the material is not magnetic. However in iron, cobalt, and nickel the magnetic field of each atom is so strong that they group together. The poles line up in the same direction in **magnetic domains**. When all domains are arranged with their poles in the same direction, the iron bar becomes a permanent magnet.



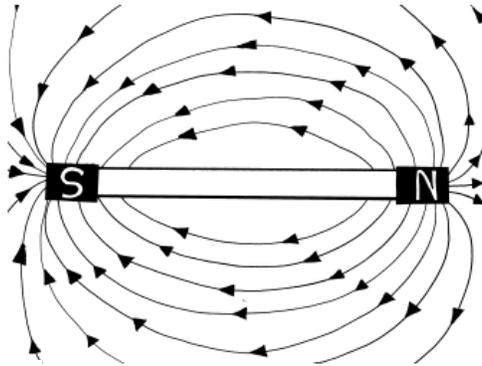
A permanent magnet can lose its magnetism if its domains are pushed out of line. This can happen if the magnet is heated or hit with a hammer. The motion of the atoms increase and the domains are pushed out of line. If a piece of iron is brought near a magnet, the domains in the iron bar line up with the magnetic field lines of the magnet. When the magnet is removed, the atoms return to their normal motion. This may cause the domains to return to their original positions. A temporary magnet is an object that stops acting as a magnet when the magnetic field is removed.



Magnetic Field

All magnets are surrounded by a magnetic region called a **magnetic field**. The magnetic field is strongest at the poles of the magnet.

The magnetic field lines extend from one pole to the other. The arrows show the direction of the magnetic field. If iron was placed near a magnet, it would be most attracted to the north or south pole of the magnet, and it would also be attracted to the field around the magnet.



Earth as a Magnet

If you hang a magnet by a string, the north seeking pole will always point north because the earth itself is a huge magnet. The magnetic field around a bar magnet is similar to the magnetic field. The Earth's magnetic field is caused by the movement of the molten metals near the Earth's core. A compass is an instrument that uses the Earth's magnetic field to establish direction. A compass has a magnetized needle that turns freely and aligns with the earth's magnetic field. So establishing direction with a compass is effective.

Electricity to Magnetism

Hans Christian Oersted was a Danish physicist, who in 1820, noticed that when a compass was placed near an electric current, the compass needle no longer pointed north. It would turn 90 degrees. He concluded that since the compass follows a magnet, the wire with the current flowing through it acts as a magnet. The compass needle will turn in a clockwise direction if electrons flow up the current carrying wire. The magnetic field exerts force in a clockwise direction. When electrons flow down the wire, the magnetic field exerts a force in a counter clockwise direction. Therefore, the compass needle will move in a counterclockwise direction.

Learning Experience 1: What Are The States of Matter?

Objective: Students will give examples of the three states of matter (solid, liquid, gas) and will experiment to discover that all matter takes up space and has mass.

Materials:

For the class:

Balance stand
Balance base
Balance arm
Balance pin
2 baskets
2 large balloons (2 extra balloons)
Jar gram cubes
Graduated cylinder
5 marbles
Modeling clay
2 9 oz. plastic tumblers
Chart paper*
Glue*
Felt tip markers*
Objects from the classroom*
Water*

*provided by teacher

Preparation:

Read background information on pages 4 and 5. The double pan balance will need to be assembled before this learning experience. Add modeling clay to one end of the balance arm if it is not completely horizontal.

Basic Skills Development:

Discussing
Observing
Describing
Brainstorming
Predicting
Measuring
Making Decisions
Gathering Data

Evaluation Strategy:

Students will provide examples of the three states of matter for the class chart and explain the definition of matter.

What is matter?

Create a chart with three columns labeled solid, liquid, and gas.

Solid	Liquid	Gas
-------	--------	-----

Ask students to list items that would fall under each category (water, brick, rock, marble, hot air balloon, oxygen, helium). Students could also find pictures that could be pasted under each category.

Look at each of the lists and begin to describe some characteristics of solids, liquids, and gases.

Discussion Questions:

What words can you think of to describe something that is a solid? Liquid? Gas? How do you know when something is a solid? How can you tell when a gas is present? How can you tell there is a gas in soda? What would some of the solids on the chart look like as liquids? How would that affect the objects around it?

Session 2:

Students are to observe and contribute to a demonstration to show that all matter has mass and takes up space. Gather items from around the room that are "solid" objects. Place an object on one side of the balance and measure its mass using the gram cubes provided. Chart the results.

Learning Experience 1 continued

Page 2

Vocabulary:

solid
liquid
gas
matter
mass
graduated cylinder
space
volume
definite

Place one of the tumblers (solid) on the balance and find its mass. Add a liquid to it (water) and find its mass. Students should see that adding the liquid resulted in more mass on one side of the balance. (If the mass of the tumbler is subtracted from the mass of the liquid of the tumbler, then you can find the mass of the liquid only. (Mass of liquid and tumbler – mass of tumbler = mass of liquid) Chart the results.

Lastly, place a deflated balloon on one side of the balance and an inflated balloon on the other side of the balance. Students should see that side with the inflated balloon is slightly lower than the other which shows that the inflated balloon has a greater mass.

Discussion Questions:

What do all of these states of matter have in common? (All have mass)
How do you find the mass of an object?

Each state of matter also takes up space but the question is, does the state of matter take up a definite amount of space?

When proving that a solid and a liquid take up space, use the large graduated cylinder filled with 50 mL of water, and marbles.

Discussion Questions:

What state of matter is water?
Does the water take up a definite space in the graduated cylinder? (Yes)

Learning Experience 1 continued

Page 3

How much definite space does the water take up in the graduated cylinder? (50 mL)

What is in the rest of the cylinder? (Air)

What state of matter are the marbles? (Solid) How do you know?

What do you think will happen when we place the marbles in the water? Why do you think that will happen?

Drop the marbles in the graduated cylinder one at a time and observe the water level.

Discussion Questions:

What happened to the water level when the marble dropped into the cylinder? (water level went up)

Do the marbles (solids) take up a definite space? (yes)

How do you know? (Water level goes up and marbles take up some of the space where the water was.)

Let's go back to our balloons if you could blow up one of the balloons, what happens to it? (it expands)

What did you blow into the balloon? (a gas)

Does gas take up space?

What would happen if I released the gas from the balloon? (blow into the room)

So does a gas take up a definite space? (only when contained)

What can we say about all matter? (has mass and takes up space, solids and liquids take up a definite space, gas takes up a definite space only when it is contained.)

Create a class definition of matter to keep posted in the classroom.

Learning Experience 2: Solids vs. Liquids vs. Gases

Objectives: Students will create models of the molecules of a solid, liquid, and gas and then compare and contrast each state of matter based on its shape and space it takes up.

Materials:

For each pair of students:

2 Physical Science Student Activity

Books

Construction paper*

Scissors*

Glue*

For the class:

3 large pie tin pans

Graduated cylinder

9 oz. plastic tumbler

Ice cube(s)*

Water*

Chart paper*

Felt tip markers*

Pencil*

*provided by teacher

Preparation:

Read background information on page 4. Create a circle pattern for students to cut fifteen circles out of construction paper. Create a chart to compare and contrast the three states of matter at the end of this learning experience.

Basic Skills Development:

Classifying Creating Models

Organizing Data

Discussing Predicting

Observing Describing

Evaluation Strategy:

Students will accurately create models of the molecules of the three states of matter and explain how they are alike and different.

Vocabulary:

solid	definite	different
liquid	space	molecule
gas	shape	predict
matter	alike	mass
graduated cylinder		

How are the three states of matter alike and different?

Each state of matter is made up of molecules, and it is the arrangement of these molecules that determine if the matter is a solid, liquid, or gas.

Student pairs are going to cut out circles to represent the molecules of matter that they are going to paste on their activity sheet for Learning Experience #2 in the Physical Science Student Activity Book to show the molecules as a solid, liquid, and gas.

Have three tin pans displayed in front of the class. In one tin pan, have ice cube(s), fill the second pan with water, and leave the third pan empty. Take a pencil or similar device and try to poke through the ice cube.

Discussion Questions:

What state of matter is the ice cube?
What do you think will happen if we try to put the pencil through the ice cube?
What happens when we try? (Pencil bounces off of it, the ice cube only chips, it moves around the tray but does not break)
What does that tell you about the molecules of the ice cube (solid)? (They are tight together – will not let the pencil through.)

Try to put the ice cube in the graduated cylinder. It is probably too big to go down into it.

Discussion Questions:

Does a solid have a definite shape?
(Yes)

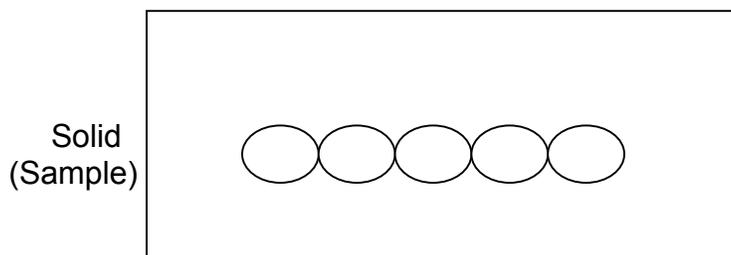
Learning Experience 2 continued

Page 2

How do you know? (Keeps its shape, will not form to the cylinder, molecules packed together.)

To demonstrate this, ask the class to stand up in a uniform line/rows really tight together (molecules in the ice cube). The teacher (pencil) is to get though the molecules but will show students that there is no room between them to move through. Discuss the results.

Students are then to take five of their circles and paste them in the square labeled “Solid” on their activity sheet in the way solid molecules look: closely packed together, organized, arranged in a pattern.



Go next to the pan filled with water.

Discussion Questions:

What state of matter is the water?

What do you think will happen if we try to put the pencil in the pan of water?

Place the pencil in the water and students should observe it go through the water to the bottom of the pan.

Discussion Questions:

What happened when we put the pencil in the water?

What does that tell you about the molecules of the water? (They are not as tightly packed and are able to move around more, more flexible)

Pour the water from the pan into a 9 oz. plastic tumbler then into the graduated cylinder. The liquid pours right into it.

Discussion Questions:

Does a liquid have a definite shape? (No) How do you know? (It pours into various containers and changes shape.)

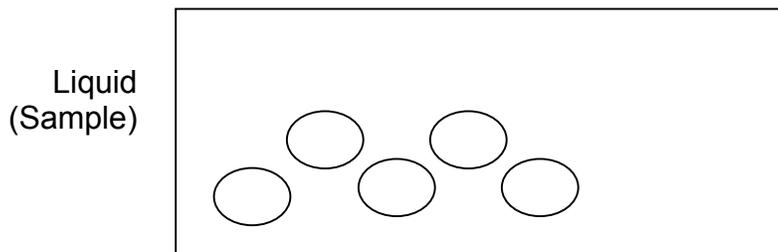
What shape does it take? (It takes shape of its container.)

Again, a demonstration can be done by students standing again but further apart and not completely in straight rows. The teacher, representing the pencil, can move around between the students (molecules) because of the space that is between them.

Learning Experience 2 continued

Page 3

Students are then to take five more of their circles and paste them in the square labeled “Liquid” on their activity sheet in the way liquid molecules look: molecules not as tightly packed, loosely organized, space between the molecules.



Lastly, ask students what is in the last container? (Air)

Discussion Questions:

What state of matter is the air?

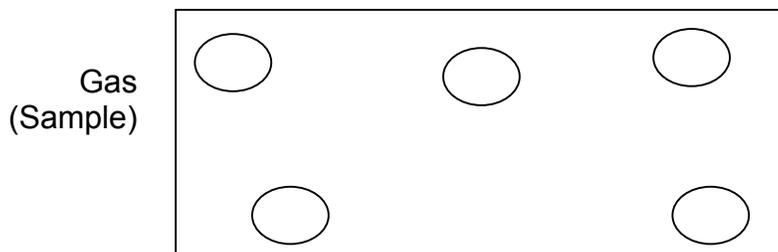
What do you think will happen if we try to put the pencil in the pan filled with air?

Does the air have a definite shape? (No)

What shape does the air have? (Size and shape of its container)

Place the pencil in the pan and students will then again see it fall through the air to the bottom of the pan. To demonstrate, ask the class to really spread out throughout the room. The teacher representing the pencil freely moves around the room.

Students are to take their last five circles and paste them in the final square labeled “Gas” on their activity sheet in the way that gas molecules look: spread wide apart, no organization, moving freely.



To complete this learning experience, create a chart to review with students.

	Definite Shape		Definite Space		Has Mass	
	Y	N	Y	N	Y	N
Solid	X		X		X	
Liquid		X	X		X	
Gas		X		X	X	

This may be confusing for students since they already defined that all matter has space and mass. The key word there is “definite” space. A gas takes up space but not a definite amount of space.

Discussion Questions:

How are the three states of matter alike? Different?

Learning Experience 3: Melting: Changing From A Solid to Liquid

Objective: Students will observe the melting of ice cubes and describe the factors involved that change the ice cube from a solid to liquid.

Materials:

For each pair of students:

2 Physical Science Student Activity

Books

2 double lens magnifiers

Thermometer

Small tin pan

Ice cube*

Watch/clock*

Paper towel*

For the class:

Chart paper*

Felt tip markers*

*provided by teacher

Preparation:

Read background information on page 5. Create an outline of a class diagram before this learning experience that consists of three boxes with arrows between them. See page 17. Students will help fill out the diagram in class discussion throughout the following learning experiences.

Melting an ice cube ahead of time will give you an idea of how long the melting takes. Students may need a mini lesson on how to read a thermometer in Celsius scale. Other work will need to be planned for students while they are waiting for their ice cube to melt.

Basic Skills Development:

Classifying

Organizing Data

Discussing

Predicting

Observing

Describing

Vocabulary:

melting thermometer melting point

Celsius temperature

How does a solid change to a liquid?

Ask students if they have ever seen an object go from a solid to a liquid (ice to water, butter melting, ice cream melting). Discuss with students what they think caused the change in state.

Distribute a thermometer to each pair of students. Students are to read their thermometer (in Celsius) and record the room temperature on the chalkboard. (Be sure students are not holding on to the bulb of the thermometer while reading it or temperature will not be accurate.)

Distribute an ice cube in a small pie tin to each pair of students. Students are to place their pie tin with the ice cube somewhere in the classroom. They are to place their thermometer next to the pie tin in their chosen location. After students find their location, students can read their thermometer again and chart the time they took the reading on their activity sheets and record any observations they make about their ice cube. Students are to periodically check their ice cube and record the time, temperature, and any observations they make about their ice cube. Have students also observe their ice cube with a double lens magnifier. Students should observe that the ice cubes in the warmer locations of the classroom will melt the quickest. The opposite will be true for the cooler areas of the classroom. Students should then conclude that heat is needed to change the solid back to a liquid.

Once all the ice cubes have melted, share results as a class and record.

Learning Experience 3 continued

Page 2

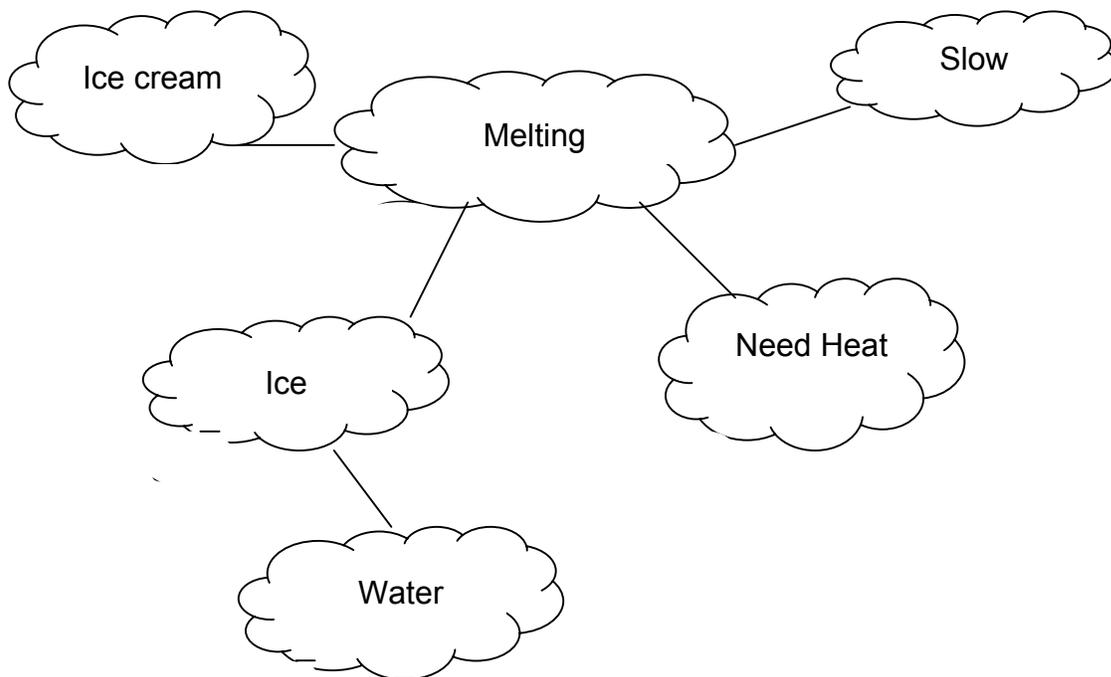
class results on the class chart. A sample chart is shown below. Have student complete the activity sheet for Learning Experience #3 in the Physical Science Student Activity Book.

Group	Location	Melting Time	Temp of Location	Condition of Ice Cube

Discussion Questions:

- Were you surprised at the results? Why or why not?
- Did you notice any special way the ice melted?
- Where did the ice melt the quickest?
- Why do you think it melted the quickest there?
- Describe what happened as your ice cube melted?
- What state of matter is the melted ice cube?
- What causes the solid (ice) to melt into a liquid?
- How can we make ice melt quicker?

Create a word web around the word melting and ask the class to contribute results based on their observations.



Learning Experience 3 continued

Page 3

Begin a Changes in State Class Diagram that will eventually show each state of matter change from one to another and what causes that change.

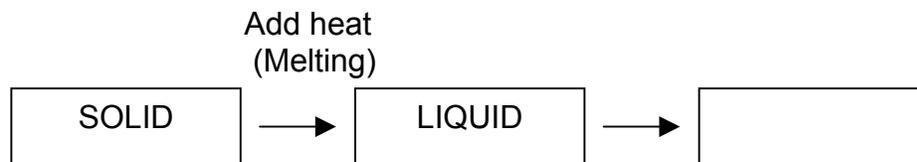
The first two boxes can be filled in with the words “solid” and “liquid.”

Discussion Questions:

What causes a solid to change into a liquid? (Heat)

What did the ice cube do? (Melted when added heat)

Add information to the class diagram. A sample diagram is shown below.



Learning Experience 4: Evaporation

Objective: Students will collect data on the evaporation of a sample of water and Determine and discuss the cause of a liquid turning into a gas.

Materials:

For each pair of students:

2 Physical Science Student Activity

Books

Paper plate

Eyedropper

Thermometer

Water*

Marker/crayon*

For the class:

Small pie tin pan

Clothespin

Candle

5 jars

Matches

Food coloring

Match jar

Sponge*

Changes in State Class Diagram*

Felt tip markers*

Salt (optional)*

Freezer (if access if available)*

*provided by teacher

Preparation:

Read background information on page 5. An observation area in the room will need to be cleared off so students are able to see the demonstration.

Place five jars of colored water into the freezer for Learning Experience #5.

Basic Skills Development:

Observing Describing

Discussing Interpreting Data

Gathering & Organizing Data

Evaluation Strategy:

Students will accurately collect data on the evaporation of their water sample and describe how a liquid changes into a gaseous state.

Vocabulary:

drying

gas

evaporate

water vapor

liquid

steam

fair test

boiling point

What is evaporation and what causes it?

Begin this learning experience by washing the chalkboard with a sponge and water and ask students to observe what happens.

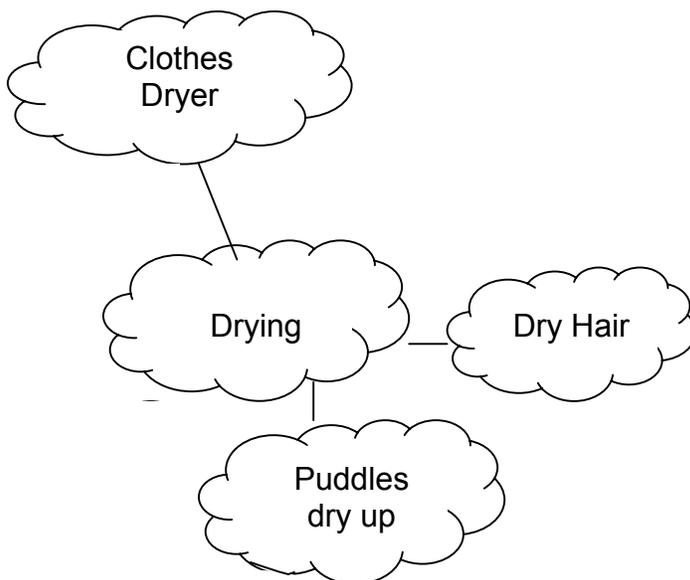
Discussion Questions:

What do you observe is happening with the water?

Where did the water go?

What do you think is causing this to occur?

Create a word web for the word “dry” or “drying.”



Discuss what all these events have in common. Students should begin to see that they all have a source of heat that helps them dry.

Use one of the tin pans students used to melt their ice cube in and add heat to the water by lighting a candle and then holding the pan with a clothespin over

Learning Experience 4 continued

Page 2

the flame. Students should begin to see the water boil and steam begin to rise from the water. The steam is the water vapor rising into the air. Dispose match in the match jar.

Discussion Questions:

What do you think will happen if I place the pie tin with the water over the flame? What is this similar to?

What do you observe happening?

What state of matter is the water? (Liquid)

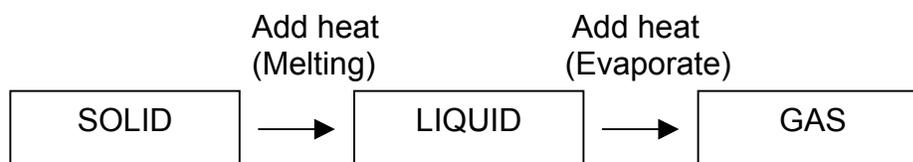
What state of matter is the water changing into? (Gas)

What is causing that change? (Heat)

What is that called? (Evaporation)

What do you notice is happening to the candle? (Changing from solid to liquid) Why? (Added flame or heat)

On the Changes in State Class Diagram, add that the liquid changes to a gas and that, again, heat is the cause. This time its called evaporation.



Discuss with students when they have seen the sun cause a liquid to evaporate. Examples of items drying on clothesline, puddles disappear, etc.

Distribute a plate to each pair of students and ask them to use an eyedropper to place approximately 20 drops of water on their plate. A drop of food coloring can then be added to the water. Students are to place their plate with the puddle of water in a place in the room where they think it will evaporate the quickest (sunny window, near a heater) and take the temperature of the location they placed their plate. Data should be recorded on their activity sheet for Learning Experience #4 in the Physical Science Student Activity Book.

They are to periodically check their puddle to see how the evaporation progress is going. Students can describe in words or pictures on their activity sheet what they observed when they checked their puddle. Students are to keep track to of how long it takes for their puddle to evaporate. A class chart can then be developed and data can be compared. Students should notice that the warmer the location the quicker the evaporation.

Sample Class Chart
Evaporation of 20 Drops of Water

Location	Temperature	Time to evaporate in minutes.
Next to heater	80°F	10 minutes
Near Chalkboard	68°F	20 minutes

Learning Experience 4 continued

Page 3

Discussion Questions:

What is causing your puddle to evaporate? (Heat source)

If we wanted to slow down the evaporation, what could we do? (Remove the heat source)

After your puddle has evaporated, what do you notice on the plate? (Food coloring)

What was left behind? (Food coloring)

Why do you think this happened?

What else could we add to the water to see if it too will not evaporate? (Salt could be mixed into the water and it too would be left behind. Evaporation acts as a purification system for the water on Earth. Students could also be reminded of the saltwater in the ocean. When water evaporates from the ocean, the salt is left behind.)

Why was it important that we all had the same amount of water on our plate? (So we could compare our results and it would be a “fair” comparison or a “fair test.”)

What if one group had 20 drops of water and the other group had 40 drops of water? (We could not compare the results because there was more water on one plate than the other.)

How is that similar to the ice cube test we did in Learning Experience #3 so we could compare the results? (All ice cubes were the same size.)

Learning Experience 5: Gas to Liquid

Objective: Students will observe the evidence of water condensing from water vapor in the air and describe what causes condensation to occur.

Materials:

For each group of students:

Jar filled with colored warm water
Jar filled with colored frozen water
Paper towels/newspapers*

For the class:

Changes of State Class Diagram*

*provided by teacher

Preparation:

Read background information on page 5. Divide the class into five groups for this learning experience. Place paper towels or newspaper on the desks to absorb any excess water. You may want to leave the jars with frozen water out for a while before this learning experience so the condensation can begin to form, especially if it is a fairly dry day. The drier the air is, the less water vapor in the air which results in less condensation.

Basic Skills Development:

Observation
Describing
Predicting
Discussing

Evaluation Strategy:

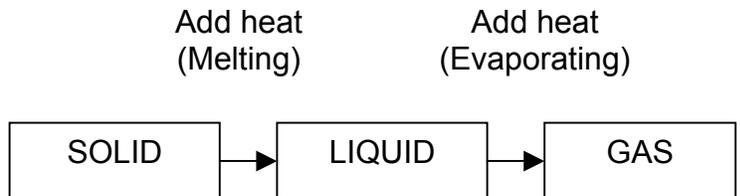
Students will explain that condensation is when a gas turns into a liquid and how it occurs.

Vocabulary:

condensation
water vapor
gas
liquid

Can a gas turn back into a liquid?

Review the chart that was created so far showing the states of matter changing with added heat.



Ask students if they think that we can “go back” from a gas to liquid or from a liquid to a solid and how they think we could do that.

Ask students to observe in their groups a jar filled with frozen water that has been sitting out for a little while, and ask groups to discuss where they think the water is coming from and to share their discussions with the class.

Discussion Questions:

What color is the frozen water inside the jar?
What color is the water on the outside of the jar? (Students can wipe off the water with the paper towel and see no food coloring on the paper towel.)
What do you think this means?
Where does the water on the outside of the jar coming from?
What makes you think that?

Turn the student’s attention to the jar filled with colored warm water and pass it around the room for students to look at and describe what they see.

Discussion Questions:

Do you observe the same results between the frozen jar and the jar filled with warm water?

Learning Experience 5 continued

Page 2

Why do you think you did not see water form on the outside of the jar with warm water?
How might you explain the difference?

Begin a discussion with students that goes back to when we heated the water.

Discussion Questions:

What happened when we heated the water with the candle? (Evaporated – turned to water vapor.)

Where did it go? (Into the air)

Why can't we see it? (Turned into a gas)

Students should begin to understand that there is water vapor in the air all the time.

Discussion Questions:

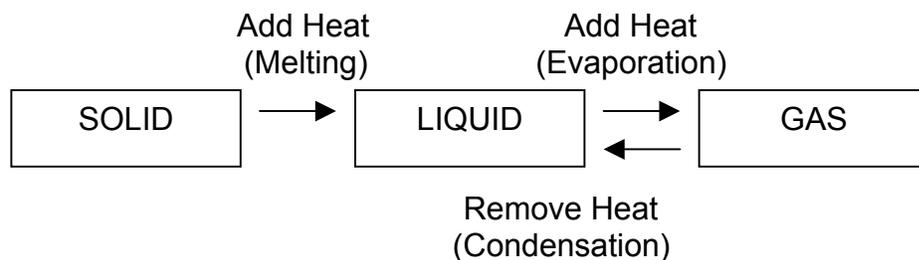
What conditions did we change with the frozen water in the jar? (We cooled the air around the jar.)

So what happened to the water vapor (gas) that is in the air? (Turned back to water (liquid))

Why do you think the same thing did not happen with the warm water?

What other situations help us see water vapor is in the air? (Windows fog up, bathroom mirrors after showers, glass with ice tea in it)

Go back to the [Changes in State Class Diagram](#) that illustrates the states of matter changing. Ask students to help you add to the diagram. Students should notice that the arrow going in the opposite direction and now that the heat is removed.



Learning Experience 6: Liquid to Solid

Objective: Students will observe a demonstration of a liquid changing to a solid and describe a personal experience when they observed a liquid change into a solid.

Materials:

For each student:

Physical Science Student Activity Book

For the class:

Thermometer
Jar filled with water
Changes in State Class Diagram*
Chart paper*
Felt tip markers*
Freezer (if access if available)*

*provided by teacher

Preparation:

Read background information on page 5. If you have access to a freezer, students could be assigned in groups to check the jar of water and take its temperature. Create a chart to record the observations of the water in the freezer.

Basic Skills Development:

Observing
Describing
Discussing
Gathering Data

Evaluation Strategy:

Students will describe and illustrate an event in which they observed a liquid changing into a solid.

Vocabulary:

liquid
solid
solidifying
freezing
temperature
freezing point

How does a liquid change into a solid?

Students are completing the Changes in State Class Diagram by thinking about their own experiences in which they have seen water turn from a liquid to a solid.

If you have access to a freezer, the class can go to the freezer, take the temperature of the inside of the freezer and record it on a class chart. Then record the temperature of the water in a jar when it first goes into the freezer. Then take periodic temperatures of the water when it is in the freezer. Students can remove the jar from the freezer after some time has passed to look for changes in the water. (e.g. crystals forming, ice on the inside of the jar, changes in temperature of water in the jar) Students should see that the removal of heat is causing the water to freeze.

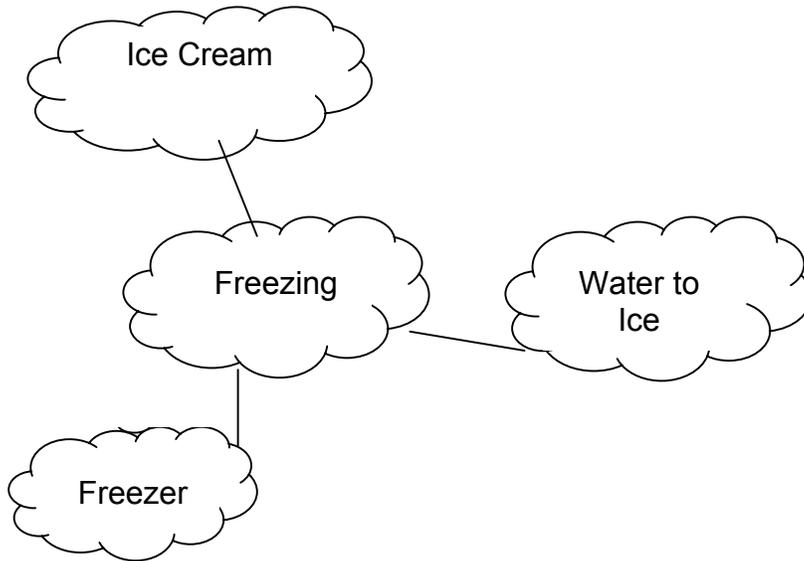
Sample Freezing Water Chart

Temp of Freezer	Time	Temp of Water	Observation

Learning Experience 6 continued

Page 2

Create a word web for the word freezing.



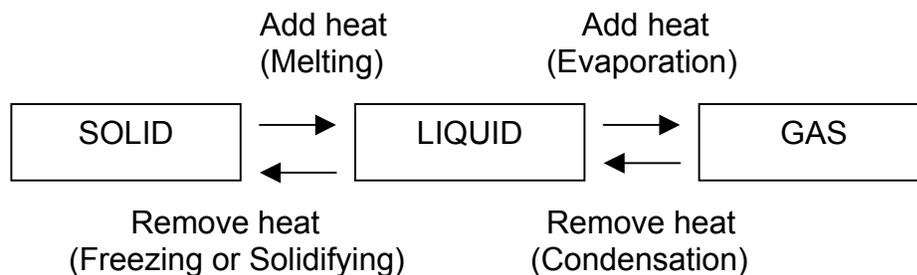
The discussion can also include when things “solidify” like wax candles after dripping or cement. Those items do not actually freeze but when the heat is removed, they return to their solid state.

Discussion Questions:

What experiences have you had with objects freezing and solidifying?
What happens when a liquid freezes into a solid?

Ask students to think about an experience when they observed a liquid change to a solid. Be sure that students include a clear description of the event, what the environmental conditions were, and why the change took place. (e.g. observed a lake freeze over, made ice cubes for a party, observed icicles form on their house in winter) Students can share their experiences with the class.

After students share their experiences with the class, the Changes in State Class Diagram can be completed with the final entry between the liquid changes to a solid. Review the chart as a class.



Learning Experience 7: Magnets Galore

Objective: Students will freely explore with magnets and chart their observations.

Materials:

For each pair of students:

2 Physical Science Student Activity Books

2 rubberized magnets

Marble

Paperclip

Small styrofoam ball

Iron nail

Aluminum nail

Penny*

For the class:

Chart paper*

Felt tip markers*

*provided by teacher

Preparation:

Read background information pages 6 - 8. Prepare a KWHL chart for session 1 of this learning experience.

Basic Skills Development:

Predicting

Discussing

Observing

Manipulating Materials

Gathering Data

Interpreting Data

Evaluation Strategy:

Students will test to see what objects are attracted to magnets then conclude what materials magnets are attracted to.

Vocabulary:

magnet

attract

metal

predict

What do we know about magnets?

Session 1:

Using the KWHL Strategy, students will explore their knowledge about magnets and then expand on it throughout the following learning experiences.

Brainstorm what the students already “**know**” about magnets. Record their ideas on a class-size KWHL chart. Ask students to think about magnets and decide what is it about magnets they would like to know more about and record their ideas under the “**want to know**” column. Now that the students have decided what they want to know, they need to think about “**how they are going to find out**” the answers to the questions they have. After the hands-on activities, maintaining journals, and discussions, students can then record information into the “**what we have learned and still want to learn**” column. This process can also be done in cooperative groups where students gather information in small groups and then share their ideas with the class.

<u>KWHL Strategy</u>			
What do we know about magnets?			
What we know	What we want to know	How are we going to find out	What we learned and still want to learn

Session 2:

Student pairs are to be given two magnets, and they are to freely explore with those magnets. Discuss what the

Learning Experience 7 continued

Page 2

groups observed. Then students are to make predictions on their activity sheet for Learning Experience #7 in their Physical Science Student Activity Book of whether the items listed would be attracted to a magnet based on their free exploration. Then pass out the six objects for students to actually test (other objects can be added to this list such as other coins, staples, crayons, keys, scissors, etc.) Discuss the results with the students.

Discussion Questions:

Do magnets attract all objects?

What were your results and how do they compare?

What were the objects made of that were attracted to the magnet?

Are magnets attracted to all metals? (No)

Were there any objects similar to these that you found were attracted to the magnet in your free exploration? (Metal objects made of iron, steel, cobalt, and nickel.)

Ask students in their pairs to think of ways in which they could use a magnet and list them on their activity sheet. Then discuss these uses as a class.

Learning Experience 8: Magnets Attract Each Other

Objective: Students will observe the properties of magnets and demonstrate that the poles of magnets attract and repel each other.

Materials:

For each pair of students:

4 rubberized magnets
9 oz. plastic tumbler
Paper clip

Preparation:

Read background information on pages 6 - 8.

Basic Skills Development:

Observing
Discussing
Describing

Evaluation Strategy:

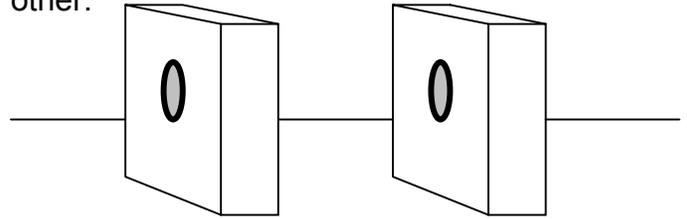
Students will explain and demonstrate that like poles of a magnet repel and unlike poles attract.

Vocabulary:

poles
magnet
attract
repel

What poles of a magnet attract each other?

Ask students to place two of their magnets on their desk facing each other.



Ask students to predict what will happen if you move the magnets closer to each other. Students are to move the magnets closer to each other and observe what happens. Some students will see the magnets join together and some of the magnets will not join together (repel) or flip around so that they can join.

Discussion Questions:

What did you observe when you brought the magnets closer together?
Did the magnets join together?
Was there anything unexpected or unusual happening in how they joined?

Ask students to flip one of their magnets around so the opposite side is facing the other magnet and ask the discussion questions.

Discussion Questions:

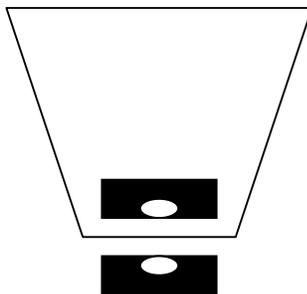
What did you observe when you brought the magnets closer together?
Did the magnets join together?
Was there anything unexpected or unusual happening in how they joined?
What conclusion can you make about what you observed?

Learning Experience 8 continued

Page 2

(Certain sides of the magnet repel each other and other sides attract each other).

Distribute a plastic tumbler to each pair of students. Have them place a magnet inside the tumbler and a magnet underneath the tumbler.



Ask students to explore with the magnets and tumbler by moving the magnet on the bottom of the tumbler around, flipping it over, etc., and observe the magnet inside the tumbler. Distribute two more magnets. Add a magnet on to the magnet inside the tumbler and one to the magnet on the outside of the tumbler. Move the magnets around again to a similar fashion.

Discussion Questions:

What did you observe happening with the magnets inside and outside the tumbler? (Magnetic force goes through the plastic in the cup and the magnet is able to move the magnet inside the cup, the magnet inside the cup flips around so like sides are together.)

How does this compare with the previous learning experience of moving the magnets closer to each other? (The like poles wanted to pull together so the magnet would flip around on its own.)

Does the magnetic power of the magnets go through the plastic of the tumbler? (Yes)

What other material does the magnet force go through? (Students can see if the magnets will attract each other through fabric, a table, multiple pieces of paper.)

Does the magnet's strength make a difference in what the magnetic force will attract through? (Yes) Explain.

Ask students to remove the magnets from the tumbler, and place a paper clip inside. Now move the magnet underneath the tumbler and observe what happens to the paper clip. Students can also try to attract the paper clip through other materials, as well.

Name: _____

Date: _____

Physical Science Student Assessment

Directions: Read the question carefully and answer based on your knowledge about physical science. Circle the correct answer.

1. Matter is made up of tiny particles. Sometimes they are close together. Sometimes they are far apart. These particles are called _____.
2. What form of matter has a shape of its own? _____
3. Which is a unit for measuring temperature?
 - A. Inches
 - B. Celsius
 - C. Liters
 - D. Grams
4. When a liquid is heated and turned into a gas, we call this:
 - A. Freezing
 - B. Melting
 - C. Evaporation
 - D. Poles
5. This word describes two magnets that join together:
 - A. Repel
 - B. Iron
 - C. Attract
 - D. Nail
6. Fill in the chart below. First name the three forms of matter. Write one word in each box on the dotted lines.

-----	-----	-----

7. Now write the names of these items on the chart under the correct form of matter:

- | | |
|--------|--------|
| water | snow |
| pencil | milk |
| ice | helium |
| air | rock |
| honey | butter |

8. Use the thermometer to measure the temperature in the picture. What is the temperature in Celsius? _____



9. Explain what might happen to the water in the cup if you put it in the freezer overnight. What would happen to the temperature? Would there be a change in the state of matter?

10. Why does a person's hand become cooler when they hold a snowball without a glove or mitten on?

- A. The hand is colder than the snowball.
- B. The snowball is warmer than the hand.
- C. Heat is taken away from the snowball.
- D. Heat leaves the hand and goes to the snowball.

11. The same snowball left in a warm room overnight is likely to change from...

- A. Liquid to a solid, and then to a gas
- B. Liquid to a gas, and then to a solid
- C. Solid to a liquid, and then to a gas
- D. Solid to a gas, and then to a liquid

12. Joe is conducting an experiment to find out which room in his house is the warmest. To collect this information, Joe should use:

- A. A thermometer
- B. A balance
- C. An eyedropper
- D. A ruler

Physical Science Student Assessment Key

1. Molecules
2. Solid
3. B
4. C
5. C
6. Solid, Liquid, Gas
7. Answers will vary
8. 20°C
9. Temperature will drop and change to a solid
10. D
11. C
12. A

MORE IDEAS

Language Arts

- ◆ Research icebergs and how they form.
- ◆ Write stories where the world is changed when objects change their state.
- ◆ Describe experiences in writing where they have seen the states of matter change in the real world.

Book Suggestions:

Levine, Shav. The Magnet Book
Flaherty, Michael. Magnetism & Magnets
Edom, Helen. Science With Magnets
Branley, Franklin Mansfield. What Makes a Magnet?
Pfeffer, Wendy. Marta's Magnets
Robinson, Fay. Solid, Liquid, or Gas
Glover, David. Solids & Liquids
Zoehfeld, Kathleen Weidner. What is the World Made Of? All About Solids, Liquids, & Gases
Parker, Steve. Magnets: Young Scientist Concepts and Projects.
Pressling, Robert. First Step Science: My Magnet.
McLuskey, Krista. The Science of Liquids and Solids.
Orii, Eiji and Masako. Simple Science Experiments: Water.

Social Studies

- ◆ Read about the invention of the hot air balloons or blimps.
- ◆ Read about the invention of the refrigerator.

Math

- ◆ Measure different objects and different states of matter, including length, temperature, volume.

Science

- ◆ Ask students to find objects that are of different states of matter. They can write about its characteristics that show what state of matter it is.
- ◆ Discuss ways that we keep objects warm and cold.
- ◆ Discuss how the states of matter relate to weather phenomena. (Formation of clouds, precipitation.)
- ◆ Have students go on a magnetic treasure hunt by hiding metallic objects in a box of sand. They can use the magnet to find the objects.
- ◆ Gather other types of magnets and compare their strength.
- ◆ Make Oobleck out of cornstarch and water (3 boxes of cornstarch and 2 ½ -3 cups of water) and ask students to choose whether they think the substance form is a solid or liquid and defend their choice.

INQUIRY AND PROCESS SKILLS

Classifying	Arranging or distributing objects, events, or information in classes according to some method or system.
Communication	Giving oral and written explanations or graphic representations of observations.
Creating Models	Displaying information by means of graphic illustrations or other multi-sensory representations.
Formulating Hypothesis	Constructing a proposition or assumption of what is thought likely to be true based on reasoning, which serves as a tentative testable theory.
Gathering & Organizing	Collecting information about objects and events which show a specific situation.
Generalizing	Drawing general conclusions from information.
Identifying Variables	Recognizing the characteristics of objects or events which are constant or change under different conditions.
Inferring	Making a statement or conclusion based on reasoning or prior experience to explain an observation.
Interpreting Data	Analyzing information that has been collected and organized by describing apparent patterns or relationships in the information.
Making Decisions	Choosing an alternative from among several and basing the judgment on defensible reasons.
Manipulating Materials	Handling or treating materials, equipment or procedures skillfully and effectively.
Measuring	Making quantitative observations by comparing to a standard.
Observing	Becoming aware of an object or even by using any of the senses to identify properties.
Predicting	Making a forecast or estimate of what future events or conditions may occur.

GLOSSARY

Alike:	in the same manner or form.
Attract:	to cause to join together or unite.
Boiling point:	the temperature at which a liquid changes to a gas.
Celsius:	a temperature scale in which 0° is the freezing point of water to 100° is the boiling point of water.
Condensation:	the process of changing from a gas to a liquid because heat is removed.
Definite:	clearly determined, having fixed limits.
Different:	differing in character or quality.
Drying:	not containing water.
Evaporate:	the process of changing from a liquid to a gas due to heat gain.
Fair test:	to conduct a scientific test where there are specific items that remain the same (constant).
Freezing:	to change from a liquid to a solid because of loss of heat.
Freezing point:	temperature at which a liquid changes into a solid (water: 0°C).
Gas:	a state of matter that has no definite shape and takes up no definite amount of space, must be moving to be felt, and takes the shape and size of its containers.
Graduated cylinder:	a container with marked measurements used to find the volume of liquids.
Liquid:	state of matter that has no definite shape, takes the shape of the container, feels wet, and takes up a definite amount of space.
Magnet:	an object that possesses the property of attracting iron, cobalt, nickel, or steel.
Mass:	the amount of matter in an object (grams).
Matter:	anything that has mass and takes up space; what all substances are made up of.
Melting:	change from a solid state to a liquid state due to heat gain.

Melting point:	the temperature at which a solid changes to a liquid state (water: 0°C)
Metal:	a substance that has a luster, is a good conductor of heat and electricity, and can be pounded into shapes.
Molecule:	neutral particle formed by atoms chemically bonding together.
Poles:	the ends of a magnet, north and south poles.
Predict:	to make an educated guess.
Repel:	to force back.
Shape:	outline of a surface.
Solid:	state of matter that has a definite shape and takes up a definite space, each solid has a different feel to it.
Solidifying:	to make or become solid.
Space:	unlimited area in which all objects are contained.
Steam:	an invisible gas or vapor produced when water boils.
Temperature:	measure of warmth or coldness of an object.
Thermometer:	an instrument used to measure temperature.
Volume:	the amount of space occupied by an object.
Water vapor:	water in a gaseous state.

TEACHER REFERENCES

Changes of State. Education Development Center. Kendall/Hunt Publishing Company

Media Library

Call the media library to order media materials and to check on new materials that are available. The number to be reached is (716) 376-8212.

Web Sites

<http://quia.com/mc/2202.html> (games on states of matter)

<http://chem4kids.com/matter/index.html>

<http://fusioned.gat.com/slideshowfolder/fourstates.html>

<http://execpc.com/~rheadley/magindex.htm>