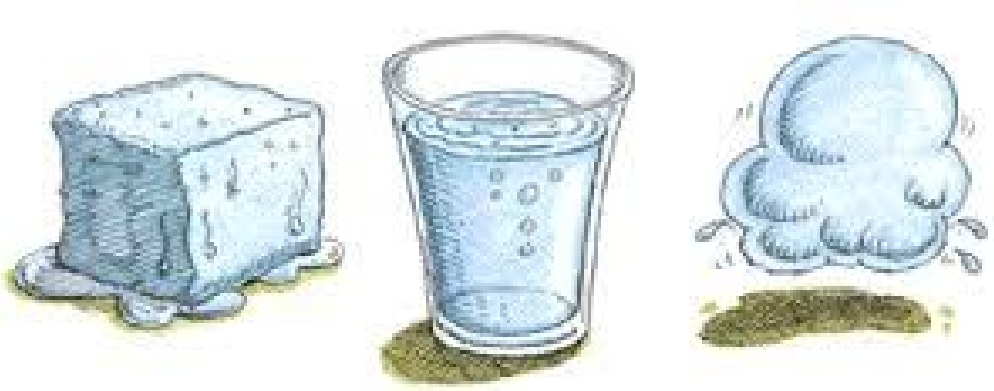

Matter Unit

Fourth Grade Physical Science

Unit Summary: Students will be able to identify different states of matter and their characteristics. The different states include gases, solids, and water. The students will also be experimenting with physical, and chemical changes.

Standards and Unit Objectives:

4.2.1.2.1

4.2.1.2.2

Objectives:

- Students will have hands on experiences with different states of matter to further prove and explain how they are alike, and different.

- Students will also have hands on experience with physical and chemical changes that occur throughout the lab experiments.
- Students will test and observe with their senses, and also with some measurement tools.

Lesson Overview

Lesson One- Properties of balls

Objectives

Affective: Students will observe 6 objects and note how their characteristics are different, and similar to each other.

Psychomotor: Students will drop, and test the balls density, amongst other characteristics.
Materials:

Item	Amount
Science notebooks	

Ball properties chart student handout	50 (in bin)
Ball properties station instructions	1 per station (in bin)
Different types of balls	10 balls (2 sets) (in bin)
Clear container with lids	2 (in bin)
Water (not provided)	(in classroom)
Retractable tape measures	3 (in bin)
Meter sticks (not provided)	(in classroom)
Paper towels (not provided)	(in classroom)
Made balances Washers and paper clips Hooks and pins (to hang balances)	3 (in bin) 1 container (in bin) 1 container (in bin)

Procedure:
Show students the container with the different types of balls to the class. Ask the students to write down in their science notebooks different ways that the balls could be grouped. How are the balls similar? How are the balls different? What else could we do to the balls to test them for differences and similarities? Make a big list on the board of all of the ball properties that the students come up with. The list should include the following: size, color, weight, bounce height, texture, and sinking or floating in water. Discuss the meanings of any of these terms if necessary.

Introduction: Introduce the term property to the class. Explain that objects of the same type have properties that they all share, such as color, size, and shape, and we can tell these objects apart by observing their specific characteristics. Discuss this idea with the class. Discuss the properties of other objects such as books, trees, flowers, stuffed animals, or cars. For the experiment today, explain that the class will be looking at the properties of balls. Make sure to familiarize your class with how to use the balance and how to measure the circumference of the ball.

Activity:
1) Before class, set up 6 different stations (with spots for 2-3 student pairs at each station) around the room, one station for each property. Organize the materials and the

station instruction cards at each station. At the different stations students will do the following:

a. Observe the color

b. Observe the texture (you may want examples of different textures and what they are called)

c. Measure the circumference of the ball (in centimeters)

d. Weigh the ball using a made balance and washers and paper clips (weight will be measured in # of washers and/or paper clips)

e. Use a meter stick to determine how high each ball can bounce.

f. Determine if the ball will sink or float in water (with paper towels to dry the ball). Note: The box of balls that get wet should stay at this station. This may be difficult to organize so consider this station optional.

g. Note: Set up additional stations if the students have other properties that they want to observe.

2) Pass out the Ball Properties Chart to each student. Students will work in pairs to complete the activity, but each student should fill out their own chart.

3) Give each group one type of ball. Let them test the ball at all of the different stations. When they are done, check their chart and then give them another ball. This way, groups can work as quickly or as slowly as they need to. Students that test more than 6 balls can get an additional chart.

4) While the students are observing the properties of different balls, work with individual pairs of students to measure the properties. Ask them questions about what they think will happen and what they observe.

5) Ask each group to choose one ball to present to the class. Each group will describe the properties of the ball to the class, but they should exclude color in their description to make it more challenging for other students to guess their ball. Once students have guessed the correct answers, ask questions and encourage discussion about the differences and similarities between the balls.

6) Discuss the following questions as a class. Why did some balls bounce and some balls not bounce? Why were some balls heavier than others? What makes some objects heavy and some light? Why did some balls sink and some float? What do you think the different balls are made of? How does this affect their properties?

Closure: Ask the students to answer the following questions independently in their science notebooks: What is a property of an object? List the properties of dogs that could be used to tell them apart. (Examples include color, size, type of fur, length of tail, etc.) Ask the students to share their responses with the class and discuss.

Assessment: Science notebook responses, ball chart, ball presentations to the class, participation in class discussions

Lesson Two Introduction to Matter

Objectives

Cognitive: Students will explore physical facts about matter.
Affective:Students will discover something unknown to them before.
Psychomotor: Students will measure and record mass and volume.

Materials:

Item	Amount
Science notebooks	
Containers for water	2 (in bin)
Water (not provided)	(in classroom)
Balls	1-2 (or more) (in bin)
5 x 8 index cards	200 (in bin)
Balloons	1 bag (in bin)
Needle	1 (in bin)
Corn oil	1 (in bin)
Magnifying glasses (Greylock and Brayton)	10 (in bin)
Small plastic containers of salt	1-2 (in bin)
Small plastic containers of water	1-2 (in bin)
Tooth picks	2 boxes (in bin)
Spice drops	1-2 bags (in bin)
Made balances Washers and paper clips Hooks and pins (to hang balances)	3 (in bin from lesson #10) 1 container 1 container

Procedure:
Ask students to make a list of everything in the classroom. Ask the students to work on their list in their science notebooks and share their list in small groups. Then, ask one person from each group to share their ideas with the class and make a master list on the board. Push the students understanding in new directions by asking questions such as, what do we breathe in? What do we breathe out (exhale)? What are the properties of these objects? Leave the list on the board and refer back to it for other parts of the lesson.

Introduction: Explain that all of the objects on the board may seem very different but they also all share some similarities. The main similarity is that everything in this classroom is made of matter. Ask students to write the word matter in their science notebooks, then brainstorm and write down what they know about matter. Get contributions from different students and make a master list of ideas about matter on the board. Then, ask the students to write down the properties of matter in their lab notebooks. Review properties from the last lesson as necessary. Properties of matter include how something looks (size, shape, color), feels (texture), smells, tastes, and sounds. This is information that we gather from our senses. Explain that all matter has properties.

Activity:
1) Start with a definition, explanation, and demonstration of matter. Write the definition of matter (below) on the board. Demonstrate and explain how matter has mass and volume by using a balance to measure the mass of a ball and a full container of water to show the volume of the ball (Drop the ball into the container of water to displace some of the water. Do this demonstration over the sink if possible, or have paper towels on hand).
2) Write the definitions for mass and volume on the board as well. Explain that everything listed on the board (from the focus activity) is matter.
Matter: has mass and takes up space (has volume)
a. Mass: the amount of matter in an object (measure using a balance like the ones used in the ball activity or a triple beam balance)
b. Volume: how much space matter takes up (can use water to see how much is displaced to measure volume)
3) Then do a demonstration with air and balloons that shows how air has mass and volume. Blow up two balloons so that they are roughly equal in size. Tape one balloon to either end of a wooden dowel (balance). Hang the balance so that the balloons are equally balanced. Place a drop of cooking oil on the surface of one of the balloons and insert a long pin into the balloon. Allow the balloon to deflate and make observations as

a class. Discuss the following questions: What happens to the balloon that is punctured? Why? (Relate to volume.) What happens to the balance? Why? (Relate to mass.)

4) Give each student a 5x8 note card and ask them to fold it in half both ways (creating four sections). Instruct them to complete a vocabulary card for matter by doing the following in each section (post these instructions on the board):

a. Write the word: matter
b. Define the word: matter: has mass and takes up space (has volume)
c. Draw a picture showing matter, involving mass and volume.
d. Use the word matter in a sentence.

5) When students are done with the vocabulary cards pass out a magnifying glass to each student. Explain the function of the magnifying glass. Then, provide them with some objects to observe using the magnifying glass such as rocks, leaves, etc. They may also observe their fingers or clothing fabric. Explain that the students just observed the small parts of objects around them. However, all matter is made of even tinier particles that can't be seen, even using a high powered microscope. Write the following sentence on the board. All matter is made of tiny particles called atoms. Tell the students that everything from the list on the board (from the focus activity) and all matter is made of atoms.

6) If possible, use a computer projected on a television screen to show the following website. It starts with a view of the Milky Way Galaxy and magnifies to the level of a quark. You may choose to simply go the level of an atom or show the parts of an atom. You can also show the process in reverse. This is a good way to give students a sense of how much matter exists in the universe and how tiny atoms and molecules are. http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html

7) Students may wonder how matter can be so different if all matter is made of atoms. Tell the students that different objects are made of different types of atoms and some types of matter are made of molecules. Molecules are made of two or more atoms bonded together.

8) Place a container of salt, a container of water, and a balloon that you inflate with your breath (a mixture of carbon dioxide, oxygen, and nitrogen gases) in front of the class. Tell students that they will make models of the molecules of salt, water, and carbon dioxide. Have students make models of molecules using the spice drops and toothpicks provided. Students can work in small groups and each student can make one type of model and then compare and contrast. Write the following information on the board for students to use in constructing their model and designate different colors of spice drops to represent different types of atoms:

a. NaCl – Salt (sodium chloride)
b. H_2O – Water

c. CO_2 – Carbon dioxide - you can also make models of Oxygen ($O_{2)}$ and Nitrogen (N_2)
Ask students to draw a picture of their molecule in their science notebooks and label the different atoms.
9) Discuss the different models with the class. How are the models different? How are they the same? What represents atoms in the models? How do the models represent molecules? How does an atom compare to a molecule? What are the differences between salt, water, and carbon dioxide? This discussion may serve as a hint of what is to come: solids, liquids, and gases.

Closure: Discuss the following questions as a class. What does all matter in the universe have in common? How are you like a glass of water? (Both are matter, made of atoms, have properties, etc.) How are you different from a glass of water? (Different shape, size, color, smell, texture, etc.)

Assessment: Science notebook responses and drawings, matter vocabulary card, molecular models, and participation in class discussions

Lesson Three Intro to States of Matter

Materials:

Item	Amount
Science notebooks	
States of matter overhead	1 (in binder)
States of matter color copies	30 (in bin)
Small plastic containers of salt	8-12 (in bin)
Small plastic containers of water	8-12 (in bin)
Balloons	2 bags (in bin)
Wooden blocks	15-20 (in bin)
Different containers (glass vases, plates)	1 of each, 3 total (in bin)
Paper (not provided)	(in classroom)

Big (adjustable) loop of rope	1 (in bin)
Funnel	1 (in bin)
Erlenmeyer flask	1 (in bin)
Masking tape	1 (in bin)
Beaker	1 (in bin)
Vinegar	1 jug (in bin)
Baking Soda	1 box (in bin)

Objectives
Cognitive: Students will have to predict what will happen when 3 different states of matter are combined.

Affective: Students will develop beliefs of different states of matter.

Procedure:
Focus Activity: Place a small container of salt, a wooden block, a small container of water, and an inflated balloon on each table. Ask students to observe what is inside each container and explain how each thing is similar and how each thing is different in their science notebooks. Students may draw a picture of each object. Lead a discussion as a class reviewing matter, molecules and atoms and introducing the idea that the salt and wooden blocks are solids, water is a liquid, and the carbon dioxide in the balloon is a gas. This should tie in with the atomic models from the last lesson.

Introduction: Write the words solid, liquid, and gas on the board and have students discuss what types of matter belongs on each list. Some students may recognize that water is liquid but it can be a solid too (ice). Gas will probably be the shortest list. Ask students why it is hard to think of examples of gas. Then flesh out the specific characteristics of each state of matter as a class using the materials from the focus activity. Remind students that both the salt and the wooden block are solids. You may let them poke the water and poke the salt to get ideas about how they are different. You can also do some of the simple demonstrations with matter described below.

Solids: shape does not change, volume does not change

Demonstration: cut or tear a piece of paper, or break a stick in half to show that solids can change shape when force is applied.

Liquids: take on the shape of the container, volume does not change
Demonstration: Pour the same amount of water into different sized containers to show that the water takes on the shape of the container. Use glass vases and plates.

Gases: take in the shape of the container, volume spreads out to fill its container
Demonstration: Blow up a balloon in front of the class and then pop the balloon. Ask the students what happens to the carbon dioxide?

Remind the class that all matter has volume and mass and relate this to the states of matter definitions. Ask the class what makes up matter (whether or not it is a solid, liquid, or gas) and review the idea that matter is made of atoms and molecules. Tell them that these atoms and molecules are constantly moving. In a solid they move more slowly because they are packed in close together, in a liquid they move faster because they are less packed together, and in a gas they move very fast because they are spread far apart. Use the overhead and handout about the states of matter to reinforce the definitions of solids, liquids, and gases.

Activity:
1) Move aside the desks and tape a large circle of rope to the floor. Tell the students that this circle represents a container for a type of matter. Ask all of the students to stand in the circle and tell them that they will represent the atoms and molecules that make up matter.
2) First, ask the students to represent the matter in the wooden block. Encourage students to discuss and work together to figure out that they need to stand in one area very close together. However, remind them that they should be moving slightly because all matter at moving at room temperature. Relate this to the characteristics of solids.
3) Then, ask the students to represent the matter in the liquid water. Encourage students to discuss and work together to figure out that they need to spread out to fill the container. Liquids flow. However, remind them that they should be moving more because all matter at moving at room temperature. Relate this to the characteristics of liquids.
4) Finally, ask the students to represent the matter in the balloon. Encourage students to discuss and work together to figure out that they need to spread out to fill the container. However, remind them that they should be moving constantly and bumping off the sides of the container because gas molecules move the fastest. At room temperature, the gas molecules in air move at around 1,000 miles per hour.

Simulate a break in the container and ask the students what the gas atoms and molecules would do in the classroom. Relate this to the characteristics of gases.
5) Have the students return to their seats for a demonstration on changing states of matter. At the front of the classroom, you should have a beaker with a small amount of baking soda and an Erlenmeyer flask with about 50mL of vinegar.
6) Ask the students to describe in their science notebooks the different types of matter that they observe. Ask the students to make a prediction about what they think will happen when all the substances are mixed together.
7) Use a funnel to fill a balloon with baking soda. Then cover the top of the flask with the balloon and pour the baking soda in the balloon into the vinegar. Let the beaker sit, undisturbed, and observe what happens. The solid baking soda and liquid vinegar undergo a chemical reaction to produce carbon dioxide, the gas that fills the balloon. Tell the students to describe and/or draw the results in their science notebooks (again labeling or describing the solids, liquids, and gases present) and explain what they observe.
8) Discuss as a class. Compare the results to the initial student predictions. Why did bubbles form? Why did the balloon fill up? What does that tell you about what happened? You may explain that this is a chemical reaction between the vinegar and baking soda that changes them both into something else.

Closure: Tell the students to draw 3 equal sized shapes in their science notebooks. Students may trace an object or use a ruler to make sure the sizes are the same. Using dots to represent atoms and molecules and arrows of different sizes to represent speed of movement, ask students to draw a diagram of a solid in one shape, a liquid in one shape, and a gas in the final shape. Discuss the diagrams and draw an example on the board.

Assessment: Science notebook responses, states of matter models and drawings, and participation in class discussions

Lesson Four Density

Objectives

Cognitive: Students will predict the outcomes of the different densities between Liquids mixed together.

Psychomotor: Students will create the shape of a square and a circle with their bodies and their classmates.

Materials

Item	Amount
Science notebooks	
Black balls comparison charts	50 (in bin)
Ball properties station instructions	1 per station (in bin from lesson #1)
Black balls (half marked with a white line)	10 pairs (in bin)
Clear containers with lids	2 (in bin)
Water (not provided)	(in classroom)
Retractable tape measures	3 (in bin)
Made balances Washers and paper clips Hooks and pins (to hang balances)	3 (in bin) 1 container (in bin) 1 container (in bin)
Meter stick (not provided)	(in classroom)
Loops of rope Big loop Medium loop Small loop	3 (in bin) 1 (in bin from lesson #3) 1 (in bin) 1 (in bin)
Masking tape	1 (in bin)
Beaker	1 (in bin)
Corn syrup	3-4 bottles (in bin)
Corn oil	1-2 bottles (in bin)
Alcohol	2 (in bin)
Food coloring	5 boxes (in bin)

Different types of balls	10 balls (in bin from lesson #1)

Procedure:

4) Introduce the concept of *density* to the class. Write the word on the board with the definition below. Ask students to relate the idea of density to the black balls. Did they take up the same amount of space or different amounts of space? (What was their size?) What does this tell you about the molecules in Ball #1 compared to the molecules in Ball #2? Are there more or less? Are they closer together or more spread out? Relate this to how the balls bounced and how much they weighed.

Density: the amount of matter in a certain space

5) Tell the students that they will now model the density of different objects. Each student represents one molecule in an object. Ask the students what the mass of this object will be? (The number of students in the class will be the mass of the object.) This mass will not change throughout the experiment. Move aside the desks and tape 3 different sizes of looped string into squares on the floor. Tell the students that these squares represent objects of different sizes.

a. First, ask the students to stand in the smallest square. They should be packed very closely together. Explain and discuss that this is how molecules behave in a dense object.

b. Then, ask the students to stand in the medium square. They should have more room to spread out. Explain and discuss that this is how molecules behave in a less dense object.

c. Then, ask the students to stand in the big square. They should be quite spread out. Explain and discuss that this is how molecules behave in an object that is not very dense.

d. Convert the small square into a circle. Ask the students how they would model the different densities of the two black balls. Try to guide students to the idea that although the balls were the same size, there were more molecules in the heavier ball and fewer molecules in the lighter ball, making it less dense.

6) Tell students that liquids, like solids, also have different densities. Demonstrate different densities of liquids by mixing water, corn syrup, and oil. (Alcohol is included as an optional fourth liquid to add to the mix.) Ask students to write their predictions about what will happen when the three liquids are mixed together in a beaker. Students may make a drawing of their predictions.

7) Pour some of each of the three liquids into the beaker. Color the water using food coloring so that the layers can be distinguished. Let the mixture of liquids sit, undisturbed, and ask the students to observe what happens and record their results in their science notebooks. Then, answer the following questions: Were your predictions

right? Why or why not? Why did the liquids form different layers? Discuss as a class and relate to density. (Objects can also be placed in this experiment and different objects will float between different layers.)

Closure: You can also relate the idea of density to buoyancy from the first lesson. More dense objects sink in water and less dense objects float in water. You can do a simple demonstration in front of the class to explain this point. Ask the students questions about how molecules behave differently in objects that sink versus objects that float. Are they spread out or packed together? How can you tell? As an extension, you can give the students objects to see if they will sink or float in the different liquids. You can try marbles, coins, erasers, corks, rocks, etc. An object may float in a more dense liquid but sink in a less dense liquid. The students can make predictions and record their results as time permits. Discuss these ideas as a class when this experiment is over.

Assessment: Science notebook responses, black balls comparison charts, participation in density activities, and participation in class discussions

Lesson Five Gases

Objectives

Cognitive: Students will predict several outcomes when it comes to dealing with dry ice.

Psychomotor: students will test and experiment dry ice. They will record their findings.
Materials

Item	Amount
Science notebooks	
Room freshener (spray)	1 (in bin)
Plastic bucket	1 (in bin)
Tall drinking glass	1 (in bin)
Paper or paper towel (not provided)	(in classroom)
10 gallon aquarium	1 (in bin)

Bubbles	3 (in bin)
Dry ice* (with tongs, goggles, and gloves)	1 hunk
Balloons	2 bags (in bin)
Film canisters	2 (in bin)

Procedure:
Focus Activity: Spray air freshener on one side of the room. Ask the students to raise their hand when they can smell the scent. Ask students to record their observations about who can smell the scent at what time in their science notebooks and explain the results.

Introduction: Discuss the fact that gases spread out to fill the available space. Starting from one spot in the classroom, the air carrying the scent will spread throughout the classroom, out the door, into the hallway, and eventually outside. This is why smells in the air eventually go away. Relate this to the characteristics of gases:

Gases take on the shape of the container
The volume of gases changes (gases spread out to fill the container)

Activity:
1) Ask students what is all around us and invisible? Get them to start thinking about air (gases). How do we know that there are gases all around?
a. Fill a bucket with water and place it in front of the room.
b. Crumple a piece of paper or a paper towel into a ball and push it into the bottom of the clear glass. Hold the glass vertically with the open end facing down, and push into straight down into the water. Lift the glass straight out of the water. Remove the paper and observe the results.
c. Discuss the following questions and ideas with the class. What happened to the paper? Why didn't it get wet? What was in the glass besides the paper that kept the water from getting in? Discuss that gas takes up space (like all matter) and so the water couldn't fit in the glass.
2) Tell the class that they will be observing and experimenting with a special type of gas. *Dry ice* is solid carbon dioxide and it must be kept very cold. At room temperature, it undergoes sublimation and is converted from a white solid to a clear gas (carbon dioxide). Due to its extremely cold temperature, dry ice can cause damage to the skin if handled directly. Use tongs or insulating gloves when handling dry ice. It is also important not to get any of the dust into your eyes when crushing or grinding the solid.

Wear protective goggles. When you place dry ice in warm or hot water, clouds of white fog are created. This white fog is not the CO_2 gas, but condensed water vapor, mixed in with the invisible CO_2. The fog is heavy, because it is mixed with CO_2, and will settle to the bottom of a container, and can be poured. Make sure students remain at a safe distance for all of the experiments.

a. Hold open a balloon and put a few small pieces of dry ice inside. Tie the balloon closed and ask students to make predictions about what will happen (they may make drawings in their science notebooks). Observe and discuss. Why did the balloon inflate? What is happening to the solid dry ice inside the balloon? Why does the balloon get bigger when the dry ice turns into a gas? How are solids and gases different? Warning: The balloon may pop depending on how much dry ice you add.

b. Place a few small pieces of dry ice in a film canister. Ask students to predict what will happen (they may make drawings in their science notebooks). Observe and discuss. Why does the top of the canister come off? What is happening to the solid dry ice inside of the canister? How does this show how solids and gases are different? How fast do gas molecules move? How fast do solid molecules move? Relate these ideas to volume. Warning: The top of the canister will fly off. Aim the canister away from people.

c. Put some dry ice in a fish tank and then add some warm water. A white fog should form and settle on the bottom of the tank. Tell students that volunteers will blow bubbles into the fish tank. Ask the students to make predictions about what will happen to the bubbles. Observe and discuss. Which gas has a higher density, the breath in the bubbles or the carbon dioxide and water vapor? How can you tell? Relate this to a helium balloon that rises into the air (unlike a balloon filled with breath). Relate to the density of liquids and solids. Warning: No one should breathe in the white fog directly. *Extension: Put some dry ice in a bowl with hot water and then pour the gas onto the floor. Ask the students what happens to the gas? Why? Relate this to the bubble experiment.*

d. Blow up a balloon and then place it in the container with the dry ice. Ask students to make predictions about what will happen (they may make drawings in their science notebooks). Take the balloon out of the dry ice and observe what happens. Discuss with the class. What happens to the gas molecules when they get cold? What happens to the gas molecules when they warm up again?

Closure: Ask students to think back to the first demonstration with the empty glass, ball of paper, and bucket of water. You can do the demonstration again if necessary. Ask students to write in their science notebooks about what this experiment allows them to conclude about the density of air compared to the density of water. Make sure students provide an explanation for their conclusions.

Assessment: Science notebook responses and participation in class discussions

Lesson Six Water (part 1)

Objectives:
Cognitive: Students will create a set of questions regarding how water changes states.

Psychomotor: students will test the waters temperature, and record and create their findings and create a diagram.
Materials:

Item	Amount
Science notebooks	
Hot plate (Greylock only)	1 (in bin)
Empty soda can	3 (in bin)
Tongs	1 (in bin)
Thermometers	15-20 (in bin)
Metal pan	1 (in bin)
Plastic bowls	2 (in bin from lesson #8)
Beakers	30 (in bin)
Glass flasks	3 (in bin)
Clay	2 pack (in bin)
Straws	20 (in bin)
Cups	30 (in bin)
Metal can	1 (in bin)
Freezer (not provided)	(in classroom)
Ice (not provided)	

Markers (not provided)	(in classroom)

Procedure:
Focus Activity: Ask the students to answer the following question in their science notebooks. What are the three states of matter? Does water exist as each state of matter? Give examples of water in nature changing from one state to another (such as a pond freezing in the winter, etc.) Discuss this focus activity in depth and use it as a way to access and explore prior knowledge.

Introduction: Show the students a demonstration with the imploding soda can.
What is all around the can? What is inside of the can? What happens when I heat the can? How do water gas molecules act inside of the can? What happens when I put the can in the ice water?
Tell students that temperature plays a major role in determining the state of matter. What state of matter is water when it is cold? (Solid, ice) What state of matter is water when it is at room temperature? (Liquid) What state of matter is water when it is boiled or gets hot? (Gas, water vapor) The process of water changing states is what we will investigate in class today.
Teacher Explanation: Before heating, the can was filled with water and air. By boiling the water, it changed states from a liquid to a gas. This gas is called water vapor. The water vapor pushed the air that was originally inside the can out into the atmosphere. When the can was turned upside down and placed in the water, the water vapor condensed and turned back into the water. Water molecules in the liquid state are many, many times closer together than molecules in the gas state. All of the water vapor that filled up the inside of the can turned into only a drop or two of liquid, which took up much less space. This small amount of water cannot exert much pressure on the inside walls of the can, so the pressure of the air pushing from the outside of the can is great enough to crush it. The sudden collapsing of an object toward its center is called an implosion.

Activity:
1) Break the students up into small groups and give each group a beaker of water at room temperature and a beaker filled with ice cubes. Boil water in a flask at the front of the room. Ask the students to make observations about each state of water and write them down (with drawings) in their science notebooks. Provide the students with thermometers to make their observations. Remind the students to remember the different properties of the 3 states of matter and relate this to their study of water.

Demonstrate that water is really coming out of the flask by holding a metal pan above the water vapor and watching the water droplets form.

2) Discuss the student observations, measurements, and diagrams with the class. Then, ask the students to write down a few questions in their science notebooks about water and how it changes states.

3) Using a model of a water molecule, remind students what a water molecule looks like. Tell students that when water changes its state of matter, its chemical structure remains the same. Individual water molecules do not change, but their speed and closeness to one another changes.

4) Use the following terms to help the students describe the changes that happen with water. Define these terms with the class: evaporation, condensation, freezing, boiling, and melting. Write the terms on the board and work with the students to come up with working definitions. Most of these terms will probably be familiar.

a. Evaporation: water changes from a liquid to a gas (vapor), this occurs a little bit at temperatures above freezing and more at higher temperatures

b. Condensation: water changes from a gas to a liquid, occurs when warm water vapor gets cold or touches something cold (like when the water in the air becomes clouds)

c. Melting: water changes from a solid to a liquid, ice melts above 32º F, 0º C

d. Freezing: water changes from a liquid to a solid, water freezes at 32º F, 0º C

e. Boiling: heated water molecules become gas (vapor) and this happens at 212º F or 100º C (relate this to the slower process of evaporation)

5) Fill up a metal can with lots of ice cubes. Stand it in a warm place and leave it for a few minutes. Observe the outside of the can and discuss condensation and how the warmer water vapor turns into liquid water when it contacts the cold ice cubes.

6) Tell students that they will now be exploring the changing states of water through a series of week-long mysteries. Have students write in their science notebooks their predictions about what will happen to the water in each mystery. Ask them to try to use the new vocabulary in their descriptions when appropriate. Choose from the following demonstrations. Set up as many demonstrations as many as time permits.

a. Mystery 1: Show that water expands when frozen. Press a piece of clay against the inside bottom of a jar. Fill the jar with water. Add a few drops of food coloring and stir. Slowly lower the straw into the clay and stand it up in the jar. Slowly pour out all of the water in the jar, leaving the water in the straw. Use a pen to mark the height of the water in the straw and observe after the water freezes. Discuss that water is a very special molecule because it actually expands when it becomes solid (freezes) and takes up less space as a liquid. This is because the molecules of water bond together to make structures with more space when the temperature is lower and water freezes.

b. Mystery 2: Set up the same experiment (above) but leave the straw with water at room temperate for several days. Observe what happens to the water level and discuss the process of evaporation (liquid water turns into water vapor slowly, even when water is not boiling).
c. Mystery 3: Get two cups and add about 1 tablespoon of salt to one of the cups. Label the cup with the salt and add water to each cup. Stir the salt water so that the salt dissolves. Put both cups in the freezer and observe regularly over the course of one day or after 24 hours. Salt interferes with the bonding between the water molecules that occurs when liquid water freezes to solid water. Consequently, the water temperature with the salt must be lower before it freezes. Relate this to salting icy roads and walkways during the winter.
Closure: Do the can demonstration again and ask students to consider the different states of matter in this demonstration and apply the new terms they learned to this experiment (condensation, boiling, melting, evaporating, etc.).
More questions for discussion: What are the properties of water vapor? What are the properties of ice? What are the properties of liquid water? Does the water change or stay the same? Explain. Is it still water in each state?

Assessment: Science notebook responses, observations and drawings of water (in each state), participation in class discussions of water definitions, contributions to class questions

Can Crushing Demonstration

Materials:
2-3 empty soda cans
Hot plate
Tongs
A bowl of ice water

Experiment:
1) Fill the bowl with cold water (the colder the better) and add plenty of ice.

2) Add one generous tablespoon of water to the empty soda can (just enough to cover the bottom of the can).

3) Place the can on the burner of the stove and turn on the burner to heat the water. Soon you'll hear the bubbling sound of the water boiling and you'll see the water vapor rising from the can. Continue heating the can for one more minute.

4) Using one swift motion, lift the can off the burner, turn it upside down, and plunge it into the cold water. Get a good grip on the can near its bottom with the tongs held so that your hand is in the palm up position.

5) Repeat as desired.

How Does It Work?
Before heating, the can was filled with water and air. By boiling the water, it changed states from a liquid to a gas. This gas is called water vapor. The water vapor pushed the air that was originally inside the can out into the atmosphere. When the can was turned upside down and placed in the water, the water vapor condensed and turned back into the water. Water molecules in the liquid state are many, many times closer together than molecules in the gas state. All of the water vapor that filled up the inside of the can turned into only a drop or two of liquid, which took up much less space. This small amount of water cannot exert much pressure on the inside walls of the can, so the pressure of the air pushing from the outside of the can is great enough to crush it. The sudden collapsing of an object toward its center is called an implosion.

Lesson 7 Water(part 2)

Objectives

Cognitive: Students will experiment with how temperature affects molecules.

Psychomotor: Students will conduct experiments, and create a drawing to show their results.
Materials

Item	Amount

Science notebooks	
“Water Changing States” overhead	1 (in binder)
“Water Changing States” student handouts	30 (in bin)
Large glass bottle with lid	1 (in bin)
Plastic bowls	2 (in bin)
Balloons	1 bag (in bin)
Food coloring	5 boxes (in bin)
Beakers	30 (in bin)
Baby food jars	2 (in bin)
5 x 8 index cards	2 (in bin)

Procedure:
Focus Activity: Ask the students to answer the following question in their science notebooks. How is temperature related to water changing states? Discuss the student ideas as a class. Tell students that higher temperatures mean faster moving molecules. What does that say about the speed of water molecules in its different states?

Introduction: Tell students that gases have the most energy (gas molecules move the fastest and take up the most volume) and solids have the least energy (solid molecules move the slowest and usually take up the least volume) and that liquids are in between. Tell students that when changing between states of matter, energy is released into the environment if the molecules in the second state of matter move less than the molecules in the first state of matter. If the molecules move more in the second state, then energy is absorbed from the environment. Make a drawing of an ice cube and a water droplet on the board and draw an arrow from the ice cube to water droplet. Ask students what this process is called (melting) and if this process absorbs or releases energy. Do the same with freezing (liquid water to ice), evaporating (liquid water to gas), and condensing (gas to liquid water). Discuss the idea of energy each time.

Activity:
1) Pass out the “Water Changing States” handout and show the colored overhead to the class. Review the way that water changes and how heat is involved. Discuss the

arrows in the diagram and what they represent. Discuss the boiling of water and how this represents a large amount of heat from the environment being absorbed to make water evaporate more quickly than it would at room temperature.

2) Investigate the water experiments from the last week of class and discuss and review the results as necessary. What happens to water when it freezes? Do most liquids expand when they freeze (become solid)? Review the idea that water molecules form special bonds when they get cold that hold them together but also hold them slightly apart. This is why water has more volume as a solid than as a liquid. Why is there less water in the straw left in the room? Where did the water molecules go? Relate these questions to evaporation.

3) Tell the students that they will investigate how heat energy affects molecules. What happens to molecules when they are heated or cooled?

a. Start with a demonstration with a large glass bottle and a balloon. Fill one plastic bowl with water and ice cubes. Fill the other plastic bowl with very hot water. Attach the balloon over the mouth of the glass bottle. Ask students for predictions about what will happen to the balloon when the bottle is placed in the hot and cold water. Place the bottle in the hot water and observe and discuss the results. Place the bottle in the cold water and observe and discuss the results. (Students may make drawings of the results in their science notebooks.) Discuss this experiment as it relates to gas molecules and heat energy. Ask the students questions about their observations.

b. Break the students up into small groups. Give each group a beaker with ice water, a beaker with room temperature water, and a beaker with hot water (labeled). Tell them that they will add a drop of food coloring to each beaker and ask them to make predictions about what will happen. Students may make drawings of their predictions in their science notebooks. Let students conduct the experiment and record their results through drawings and descriptions in their science notebooks. What happened to the food coloring in the cold water? In the room temperature water? In the hot water? What does this tell you about the movement of water molecules at different temperatures? Which beaker had the most evaporation occurring? Why? Relate this experiment to water changing states and ask students to write their final conclusions in their science notebooks.

c. Conduct a final demonstration in front of the class. Get out two baby food jars. Fill one of the jars completely with hot water and add a drop of food coloring. Fill the other jar completely with cold water and add a drop of different colored food coloring. Place a piece of an index card (cut to slightly larger than the opening of the jar) on top of the jar with the hot water and tap it into place. (It should stay in place when you invert the jar, if not, use your hand to hold it in place.) Quickly, invert the jar and set it on top of the jar with the cold water. Line up the lips of both jars and gently slide out the piece of index card. (Note: The hot water will stay on top and the cold water will stay on bottom, they

will not mix.) Discuss the results of this experiment with the class. If time permits, conduct the experiment again with the hot water on the bottom and the cold water on the top and discuss the results.
4) Relate the ideas of heat and water changing state to real-world examples. Put the "Water Changing States" overhead back on the board. Discuss sweating with the class. How does sweat help humans cool off? (Evaporating water absorbs heat from our bodies). What happens to a drink with ice in it? Why does the drink get warmer as the ice melts? (Water as a solid (ice) releases heat as it turns into a liquid). If your coat (or scarf) is covering your mouth, why does it get wet? (Water vapor (gas) in your breath condenses to liquid water because body temperature is warmer than air temperature and water vapor loses heat energy.) Move on to the closure questions relating water and weather.

Closure: Discuss the following questions with the class: What makes water change from one state to another? How is water the same and how is water different when it is in the three states?

Assessment: Science notebook responses, predictions, results and conclusions from the experiments in class, participation in class discussions

Lesson Eight Introducing Physical and Chemical Changes

Objectives
Cognitive : Students will define terms, and predict outcomes.

Psychomotor: Students will test their predictions, create sections of paper for the experiment.
Materials

Item	Amount
Science notebooks	
Play-Doh	2 containers (in bin)

Paper (not provided)	(in classroom)
Salt	1 container (in bin)
Sugar	1 container (in bin)
Plastic bowl	1 (in bin)
Flashlights	2 (in bin)
Beakers	2 (in bin)
Water (not provided)	(in classroom)
Flour	1 container (in bin)
Spoons	20 (in bin)
Corn oil	1-2 (in bin)
Food coloring	5 boxes (in bin)
Glass or plastic jar	1 (in bin)
Lighter	1 (in bin)
Candle	1 (in bin)
Clay	1 box (in bin)
Aluminum foil	1 (in bin)
Baking soda	1 box (in bin)
Vinegar	1 bottle (in bin)
Balloons	2 bags (in bin)
Glass flasks	3 (in bin)
5 x 8 index cards	200 (in bin)

Procedure:

Focus Activity: Give each of the students a piece of Play-Doh. Ask the students to make something using the Play-Doh. Then ask the students to answer the following question in their science notebooks: Is the Play-Doh still made of the same kind of matter or did it change after you made something with it?

Introduction: Introduce the idea of physical changes. Explain that matter can be mixed, separated, or be in a different state but if it is still the same type of matter then this is a physical change. All types of matter (solids, liquids, and gases) can undergo physical changes. Relate this water changing states (i.e. ice, liquid water, and water vapor are all the same type of matter).

Activity:

1) Rip a piece of paper. Ask the students: has the type of matter in the paper changed? Or is it the same? Mix some sugar and salt in a bowl. What is in the container? Are the types of matter the same or different? Show a melting piece of ice. Review that this is a physical change because both ice and liquid water and made of the same type of matter – water.

2) Many examples of physical changes involve mixtures – mixing two or more types of matter together. All mixtures can be separated. Many types of matter are mixed with water. Get two beakers with water. Add some salt to one beaker and some flour to the other beaker. Ask student helpers to stir each beaker so that they are both well mixed. Darken the room and use a flashlight to illuminate the contents of each beaker. Ask students to share their observations and discuss as a class. (Extension: You can ask students to think about how these mixtures could be separated.)

3) Write the words solution and suspension of the board. Tell the class that the salt and water represents a solution and the flour and the water represents a suspension. Get ideas from the students about how to define each term. Write the definitions on the board.

Solution: a mixture, one type of matter is dissolved in another type of matter

Suspension: a mixture, one type of matter is finely spread out in another type of matter

4) Give each student a 5x8 note card and ask them to fold it in half both ways (creating 4 sections). Instruct them to complete a vocabulary card for physical change by doing the following in each section (post these instructions on the board):

a. Write the idea: Physical change

b. Define physical change: a change occurs but the kind of matter stays the same (mixtures, solutions, suspensions, phase changes)

c. Draw a picture of a physical change.

d. List 2 examples of physical changes.

5) Do a demonstration for the class showing physical changes. Pour about 3 inches of water into the large glass jar. Pour a layer of oil on top of the water and allow the layers to settle. Review density of liquids as necessary. Discuss the water and oil as a mixture (physical change). Add one drop of food coloring and observe the results. Then, add salt to the top. Stop, and observe the effects. Add more salt (of different amounts) to repeat the effects. Discuss the following questions with the class. What happens when we pour the salt on the oil? Does the salt dissolve in the oil? Does the salt dissolve in the water? Does this demonstrate a solution? A suspension? Explain.

6) Explain that physical changes are one type of change but there are also chemical changes. Show the class several demonstrations showing chemical changes.

a. Light a lighter. Discuss the flame. Is the matter changing? (Discuss light and heat (or cold) as signs of chemical changes)

b. Mix baking soda with vinegar in a flask and put a balloon on top. Discuss the production of a gas. Is the matter changing? (Discuss gas production as a sign of a chemical change)

c. Baking is a good example of a chemical change. If time permits, you can bake something with the class. At the very least, discuss baking. Can the ingredients be separated back out after baking?

7) Give each student a 5x8 note card and ask them to fold it in half both ways (creating 4 sections). Instruct them to complete a vocabulary card for chemical change by doing the following in each section (post these instructions on the board):

a. Write the idea: Chemical change (reaction)

b. Define chemical change: two or more kinds of matter react to form different kinds of matter (this can be related to bonding)

c. Draw a picture of a chemical change.

d. List 2 examples of chemical changes.

8) Attach the candle to the table using the clay. Cut out a small piece of aluminum foil (approximately 1 inch by 4 inches) and fold it in half. Place a tiny amount of sugar at one end. Hold the sugar (in the foil) a little bit above the tip of the flame of the candle. Ask students to observe and describe the results. Discuss this demonstration as a chemical reaction. What was produced? What happened to the sugar?

Closure: Read off examples from the list below of physical and chemical changes. Ask students to identify the type of change in each example using active participation: Students should hold up one finger to indicate a physical change and two fingers to indicate a chemical change. Read an example, give all the students time to think, and then ask the students to reveal their hands. Discuss any examples that cause confusion with the class. If time permits, you can also get ideas for other examples of physical and chemical changes from the students.

- Cars rusting
- Adding water to orange juice
- Eating and digesting a piece of chocolate
- Burning wood in a fire
- Making salad dressing
- Baking bread
- Running a car engine
- Taking a shower
- Making Kool-aid (or other powdered drink)

Assessment: Science notebook responses, definitions of physical and chemical changes, participation in class observations and discussions, active participation in differentiating between physical and chemical changes

Lesson Nine Investigating Physical and Chemical Changes

Objectives:

Cognitive: Students will think about what the differences are between physical and chemical changes.

Psychomotor: Students will conduct experiments at each station. They will record their findings and discuss it with the class.

Materials:

Item	Amount
Science notebooks	
Physical and chemical changes chart student copies	50-100 (in bin)
Student instructions for each station	1 per station (in bin)
Beakers	30 (in bin)
Spoons	20 (in bin)

Graduated cylinders	10 (in bin)
Thermometers	15-20 (in bin)
Flashlights	2 (in bin)
Iron filings	1 container (in bin)
Sand	1 bag (in bin)
Magnets	3 (in bin)
Corn starch	1 container (in bin)
Vinegar in a squeeze bottle	1 bottle, 1 squeeze bottle (in bin)
Alka-seltzer tablets	15 (in bin)
Baking soda	1 box (in bin)
Lemon juice	5-6 bottles (in bin)
Glass plate	1 (in bin)
Alcohol	2 bottles (in bin)
Sugar	1 container (in bin)
Bubbles	1-2 bottles (in bin)
Metal pan	1 (in bin)
Steel wool	1 bag (in bin)
Aluminum foil	1 box (in bin)
Salt	1 container (in bin)
Dull pennies	20-30 (in bin)
Paper towels (not provided)	(in classroom)
Water (not provided)	(in classroom)
Milk (not provided)	

Procedure:
Focus Activity: Ask students to explain the differences between physical and chemical changes in their science notebooks. They can use their definition note cards from the last lesson as necessary. Discuss the differences as a class.

Introduction: Talk about physical and chemical changes. Are physical changes reversible? Are chemical changes reversible? How can you tell that a chemical change has occurred? (Heat, cold, light, color, gas or solid production) Tell the students that they will observe and describe different types of changes in class today and classify them as either physical or chemical changes.

Activity:
1) Pass out a copy of the physical and chemical changes chart to each student. Allow the students to work individually or in pairs. Set up the different stations around the room (with the materials and instructions) before class using the instructions provided below. Instruct students to follow the instructions at each station, record their observations and results, and explain if the change is a physical or chemical change. Assist students individually as necessary as they go to the different stations around the room.
2) Physical and Chemical Changes Stations:
a. Materials: Iron filings, sand, spoons, beaker, magnet
   - Students will mix the sand and iron filings and then use the magnet to separate the mixture (Physical change)
b. Materials: Corn starch, spoon, beakers with water, flashlight
   - Students will mix some corn starch into the water, stir well, and use the flashlight to observe the mixture (Physical change, suspension)
c. Materials: Milk in beakers, vinegar in a squeeze bottle, spoon
   - Students will mix the milk and vinegar and stir, observing what forms (Chemical change, solid forms)
d. Materials: Alka-seltzer tablet, beakers with water
   - Students will add a half (or quarter) of an Alka-seltzer tablet to water and observe (Chemical change, gas forms)
e. Materials: Baking soda, 25 mL of lemon juice in beakers, spoon, thermometer
   - Students will mix the baking soda and lemon juice and then record the temperate with a thermometer every minute (Chemical change, temperature drops)
f. Materials: Alcohol, glass plate

- Students will pour a small amount of alcohol on a plate and observe (Physical change, evaporation)

g. Materials: Sugar, spoon, beakers with water, flashlight
- Students will mix some sugar into the water, stir well, and use the flashlight to observe the mixture (Physical change, solution)

h. Materials: Bubbles and a metal pan
- Students will blow bubbles onto a metal pan and observe (Physical change)

i. Materials: Vinegar in a beaker, steel wool, thermometer, beakers, aluminum foil
- Students will soak some steel wool in vinegar, wring out the steel wool, wrap it around a thermometer, place it in a beaker, cover the beaker with aluminum foil, and record the temperature every minute (Chemical change, temperature rises, color changes)

j. Materials: Vinegar and salt solution in beakers (60 ml vinegar mixed with 1 spoon of salt), pennies (dull), paper towels
- Students will hold pennies in the solution and observe the results (Chemical change, color changes)

3) Ask the students to share their results and conclusions with the class. Discuss each station and ask if it demonstrated a chemical or a physical change. Get different groups or individuals to share their ideas with the class and discuss any differences in opinion. Reinforce the concepts of physical change and chemical change through this discussion.

Closure: Review the major concepts of this unit with the class. What is matter? What are three states of matter? How is the energy of each state different? Explain how water changes states. What type of change is this? What other types of changes can happen to matter?

Assessment: Science notebook responses, physical and chemical changes chart including observations and conclusions, participation in class discussions

Physical and Chemical Changes

Station	Observations	Conclusion: Please circle and explain.

Station #1	What happens?	Physical Chemical
Station #2	Solution or suspension? Explain.	Physical Chemical
Station #3	What happens?	Physical Chemical
Station #4	What happens?	Physical Chemical
Station #5	Temperature: What happens? Start: _____	Physical Chemical

	1 minute: _____ 2 minutes: _____ 3 minutes: _____ 4 minutes: _____ 5 minutes: _____	
Station #6	What happens?	Physical Chemical
Station #7	Solution or suspension? Explain.	Physical Chemical
Station #8	What happens?	Physical Chemical
Station #9	Temperature What happens? Start: _____ 1 minute: _____	Physical Chemical

	2 minutes: _____ 3 minutes: _____ 4 minutes: _____ 5 minutes: _____	
Station #10	What happens?	Physical Chemical