

STATES OF MATTER

BIG IDEA 8: PROPERTIES OF MATTER

BENCHMARKS AND TASK ANALYSES

SC.2.P.8.1 Observe and measure objects in terms of their properties, including size, shape, color, temperature, weight, texture, sinking or floating in water, and attraction and repulsion of magnets.

SC.2.P.8.2 Identify objects and materials as solid, liquid, or gas.

SC.2.P.8.3 Recognize that solids have a definite shape and that liquids and gases take the shape of their container.

The student:

- uses various containers to investigate the shapes of solids, liquids, and gases.

SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

- raises questions about the natural world.
- investigates them in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

SC.2.N.1.3 Ask “how do you know?” in appropriate situations and attempt reasonable answers when asked the same question by others.

The student:

- asks “how do you know?” in appropriate situations.
- attempts reasonable answers when asked the same question by others.

SC.2.N.1.5 Distinguish between empirical observation (what you see, hear, feel, smell, or taste) and ideas or inferences (what you think).

KEY QUESTION

Into what three groups can we sort almost every kind of material on Earth?

TEACHER BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or removing heat causes matter to change from one state to another. A solid is something that maintains its shape, and its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid. A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate). A gas has no fixed volume. The atoms of a gas are spaced apart. When heat is lost, matter changes from gas to liquid to solid states.

MATERIALS

Teacher/Class

food coloring (optional)
empty container with
various solids, liquids, gases
4 resealable sandwich baggies
1 rock
1 pencil
water

Per group

3 resealable sandwich baggies (one
containing water, one with solid objects,
and one filled with air)
1 tray
1 pencil
various graduated cylinders
various plastic cups

clipart/magazines for pictures of matter
paper towels for spills/clean-up

SAFETY

At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting. Instruct students not to touch materials without specific instructions. Ask students to report all accidents immediately. Have paper towels nearby in case of spills. Always follow OCPS science safety guidelines.

TEACHING TIPS

Prepare a set of three baggies for each group and for yourself. Place a mix of solid objects, such as rocks, cotton balls, crayons, etc. in the first bag (mix hard and soft objects). Put a small amount of water in the second bag. (Adding food coloring to the water makes it easier to see.) Blow air into the third bag and seal it.

In the Explore and Explain sections, group observations and conclusions about the solids, liquids, and gases can also be individually recorded in student science notebooks.

ENGAGE

1. Bring out the first bag containing the rock or other solid object. Ask the students what they think is inside the bag. When students respond that they see a rock, ask students if they know what we call objects such as rocks? Explain that scientists call objects like rocks, "solids."
2. Focus on the second bag containing water. Ask students what they think is in the bag. Students will usually answer that the bag contains water. Ask students if they know what we call objects such as water. Explain that scientists call materials like water, "liquids."
3. Hold up the third bag containing air. Ask students what they think is in the bag. Many of them will report that the bag is empty and that they see nothing. Show them a fourth bag that is flat so they can compare it with the full bag of air. Tell students that such materials are called, "gases."
4. Explain to the students that nearly everything on Earth may be classified as a solid, a liquid, or a gas. Have students think of non-examples of matter (energy, time, imagination, ideas, etc.).

EXPLORE

1. Tell students, "A minute ago, I asked you what you thought was in the baggies. Now, I want you to use your senses to observe the items in the baggies."
2. Ask: Is there a difference between observations when you use your senses and ideas based only on what you think? (yes, observations are based in evidence gathered from observations)
3. Ask: Which do you think scientists rely on more: observations based on their senses or ideas based on what they think? (they use both but science is generally based on observable data)
4. Organize the students into groups. Distribute the bags containing solid objects to each group.
5. Encourage students to explore the objects using their senses.
6. Ask them to discuss within their group how the objects look, feel, smell, etc.
7. Remind students that they should be using their senses to make observations.
8. Have students put the first bag aside. Distribute the bags containing water. (Have students keep the bag on a tray in case of spills.)
9. Encourage the students to explore the water just as they did the solid objects.
10. After students have moved the bag of water aside, distribute the bags containing air. Again,

encourage students to explore the properties of the contents of the bag.

EXPLAIN

1. Create a class chart with two columns and the headings: *Changes shape easily* and *Solids pass through it easily*. List the objects to be tested: rock, water, air. Have students vote thumbs up or thumbs down as to whether or not they observed each of the listed properties when exploring the rock, water, and air. Label the chart *yes* or *no*, according to their votes.

	Changes shape easily	Solids pass through it easily
Rock (solid)		
Water (liquid)		
Air (gas)		

2. Guide the students to recognize the differences and similarities of liquids, solids, and gases by further exploring the contents of the bags using graduated cylinders and plastic cups in addition to the baggies.
 - Ask the students if the shape of the solid object can be changed easily.
 - Ask: How do you know? What observations, using your senses, did you make to support your statement?
 - “Pour” the solid objects on the table and show that the shape cannot be changed easily.
 - Ask the students if they think a pencil can be moved easily through the solids. Demonstrate that it cannot.
 - Allow time to explore.
 - Discuss the properties of a solid:
 - Doesn't change shape easily
 - Another solid cannot be passed through it easily
3. Pick up the bag of water and move the water around by tipping the bag.
 - Ask the students if its shape can be changed easily.
 - Ask: How do you know? What observations, using your senses, did you make to support your statement?
 - Pour the water into another container and demonstrate that the shape is now different from the shape of the water when it was in the baggie.
 - Ask the students if they think a pencil can be moved easily through the liquid. Demonstrate that it can.
 - Allow the groups time to try this.
 - Discuss the properties of a liquid:
 - Changes shape easily
 - A solid passes through it easily
4. Pick up the bag of air (gas).
 - Ask the students if its shape can be changed easily.
 - Ask: How do you know? What observations, using your senses, did you make to support your statement?
 - Open the bag and release the air.

- Then ask the students if a solid can be passed through the air easily. Demonstrate by moving your finger or a pencil easily through the air.
- Allow the groups time to try this.
- Discuss the properties of a gas:
 - Changes shape easily
 - A solid passes through it easily

EXTEND AND APPLY

Students will identify objects as solid, liquid, or gas and justify their responses by giving the correct properties.

- Prepare three large sheets of construction paper with the labels *solid*, *liquid*, and *gas*.
- Instruct students to sort the items by placing them on the construction paper and then ask a classmate to check their work.
- Remind them to use your strategy of asking their classmates, “How do you know” so that they are using verifiable observations and not just what they think.

Choose 3 items from each of the following lists (9 total):

Remind students that we’re thinking of what is *inside* the inflated objects.

Solids

block of wood
computer disk
ball of clay
empty glass
pencil

Liquids

water
food coloring
cooking oil
syrup
juice

Gases

inflated balloon
inflated bicycle tire
inflated playground ball
inflated swimming wings
inflated water float

ASSESSMENT

Ask students to look around at home for things or for pictures in magazines that represent each of the three states of matter. They should draw or cut out pictures of the objects to share with the class. Have students place the pictures on a class bulletin board under the headings: *Solid*, *Liquid*, and *Gas*. Discuss the placement of the pictures as they are put on the bulletin board. The following rubric may be applied:

3 points: Correctly identifies the state of matter for all objects. Correctly gives a property for each state of matter.

2 points: Correctly identifies the state of matter for most of items. Correctly gives a property with the state of matter for most of items.

1 point: Incorrectly identifies the state of matter. Does not give a correct property with the state of matter.

COMPARING SOLIDS

BIG IDEA 8: PROPERTIES OF MATTER

BENCHMARKS AND TASK ANALYSES

SC.2.P.8.1 Observe and measure objects in terms of their properties, including size, shape, color, temperature, weight, texture, sinking or floating in water, and attraction and repulsion of magnets.

SC.2.P.8.2 Identify objects and materials as solid, liquid, or gas.

SC.2.P.8.3 Recognize that solids have a definite shape and that liquids and gases take the shape of their container.

The student:

- uses various containers to investigate the shapes of solids, liquids, and gases.

SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

The student:

- raises questions about the natural world.
- investigates questions in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

SC.2.N.1.3 Ask “how do you know?” in appropriate situations and attempt reasonable answers when asked the same question by others.

The student:

- asks “how do you know?” in appropriate situations.
- attempts reasonable answers when asked the same question by others.

SC.2.N.1.5 Distinguish between empirical observation (what you see, hear, feel, smell, or taste) and ideas or inferences (what you think).

KEY QUESTION

Are all solids the same?

TEACHER BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or removing heat causes matter to change from one state to another. A solid is something that maintains its shape, and its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid. A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate). A gas has no fixed volume. The atoms of a gas are spaced apart. When heat is lost, the matter changes from gas to liquid to solid states.

Solids can be sorted according to their properties, including size, color, shape, texture, weight, attraction/repulsion of magnets, and ability to sink/float.

MATERIALS

Per student

science notebooks

Per group

baggies of solids
small tub of water
magnet

various graduated cylinders
various plastic cups

Teacher

paper towels for spills/clean-up

SAFETY

At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting. Instruct students not to touch materials without specific instructions. Ask students to report all accidents immediately. Have paper towels nearby in case of spills.

Always follow OCPS science safety guidelines.

TEACHING TIPS

You may want to begin a Class Vocabulary Chart to use throughout the lessons or you may make individual vocabulary charts to display. When students are giving definitions, be sure to accept what they say. Later, after working with the solid materials during the following lessons, you can ask questions that may lead them to come back and correct or add more to their definitions.

Baggies of solids are used for this lab and may be saved for the next year. Students will use the items to compare properties of solids. Be sure to include objects made of all different materials. All baggies of solids need to contain the same 10 items. Choose any 10 solids of your choice, or from the following examples to put into your baggies:

plastic solids - bottle top, math token, unifix cube, button, spoon, clear cup; metal solids - paper clip, nail, tin foil, small pipe cleaner, bobby pin, penny; wooden solids - q-tip, popsicle stick, small block, pencil; other solids - cloth square, paper square, cork, crayon; transparent solids - Lucite, magnifying glass, clear beads, clear plastic cup, piece of transparency paper, etc.

ENGAGE

Ask:

- *What's the matter?*
- *Does anyone know what matter is? (Anything that takes up space and has mass/weight.)* Use a class vocabulary chart to develop a child friendly definition.
- *When you define matter, did you use observations based on your senses or just what you think?*
- *Which should we use- observations based on our senses or our thoughts? (observations)*
- *In what forms does matter exist? (solids, liquids, and gases)*
- *How do you know?*

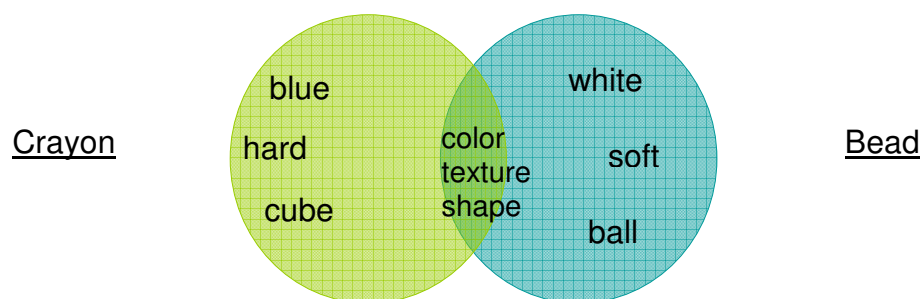
Ask students to list all kinds of different matter for examples. Help them sort their examples into the different states of matter.

EXPLORE

1. Tell students, "Today we will work with solid matter."
2. Distribute the materials and provide students some free exploration time.
3. Ask students to explore the solids using the different containers (graduated cylinders, plastic cups, the baggie) and to notice what happens when the materials are placed in these different containers.
4. Remind students to ask their partner, "How do you know?" like they did in the lab, *States of Matter*.
5. After they have had a chance to explore the solid objects, choose the same two solids from

each baggie and have students observe to compare and contrast. Make a list or a Venn diagram of the comparisons.

Venn Diagram Example:



“Properties of Solids” Chart Example:

All solids have:	color	ability to sink or float
	shape	weight
	texture	movement

EXPLAIN

1. From the comparisons, come up with a list of properties of solids. For example, if students say the crayon is blue and the bead is white, write this on the diagram and then add the word “color” to the “Properties of Solids” chart. Accept any properties that are characteristic of solids, such as weight, size, ability to be used, ability to be magnetic or non-magnetic, ability to move, ability to sink/float, etc. Students may add to this chart at later times as they think of others.
2. Ask students for a definition of a solid.
3. Ask: *Does it keep its shape? How do you know?* (when they put it in the various containers, it did not change shape)
4. *What are its characteristics?* (texture, shape, color, ability to sink or float, etc.) Example: A solid is matter that keeps its shape. You may add this to the Class Vocabulary Chart. (Students may recognize that a solid such as paper can change its shape when you fold or cut it. You may want to clarify your definition by saying that a solid keeps its shape when it is

sitting on a table.)

EXTEND AND APPLY

- Compare/contrast additional examples of solids using a Venn diagram.
- Students create the vocabulary chart in their science notebooks with the word(s) matter/solid and put in their own examples.
- Have students divide into cooperative groups to see who can come up with the longest list of solids. Encourage them to use examples from other areas of science: weather, food, human body, plants.

ASSESSMENT

Assess student learning through class discussions and science notebook entries. The following three-point rubric may be adapted to evaluate students' work during these lessons:

3 points: Students are highly engaged in class discussions; were able to demonstrate a clear understanding of the vocabulary; give correct examples appropriate to the lesson.

2 points: Students participate in class discussions; were able to demonstrate a basic understanding of the vocabulary; give mostly correct examples; drew pictures that were somewhat appropriate to the lesson.

1 point: Students participate minimally in class discussions; unable to demonstrate a basic understanding of the vocabulary; could not give examples of the lesson. Pictures were incomplete and/or did not clearly identify lesson objectives.

LOOKING AT LIQUIDS

BIG IDEA 8: PROPERTIES OF MATTER

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The student:

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The student:

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SC.2.N.1.5 Distinguish between empirical observation (what you see, hear, feel, smell, or taste) and ideas or inferences (what you think).

KEY QUESTION

Are all liquids the same?

TEACHER BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or removing heat causes matter to change from one state to another. A solid is something that maintains its shape, and its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid. A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate). A gas has no fixed volume. The atoms of a gas are spaced apart. When heat is lost, matter changes from gas to liquid to solid states.

Liquids can be sorted according to their properties, including color, volume, viscosity (ability to flow), solubility (ability to mix with water), and density (ability to sink/float in water). Liquids take the shape of their container. But they also have a tendency to flow and will spread out on a surface if not in a container.

MATERIALS

Teacher

Food coloring (optional)

Paper towels for spills/clean-up

Various shaped/sized clear containers (plastic jars, cups, test tubes, graduated cylinders, detergent scoops, etc.)

Water

Per student

science notebooks

Per group

4 cups, each with a different liquid
(water, glue, oil, syrup, etc.)

1 tray

4 pipettes/droppers/straws

various sizes graduated cylinders and cups

SAFETY

At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting. Instruct students not to touch materials without specific instructions. Ask students to report all accidents immediately. Have paper towels nearby in case of spills. It is unsafe to touch their faces, mouths, eyes, and other parts of their body when working with different chemicals or liquids, until they have washed their hands. Never mix chemicals or liquids just to see what happens.

Always follow OCPS science safety guidelines.

TEACHING TIPS

- The number of liquids for students to explore can be increased or decreased depending on level of challenge desired. Adding food coloring to the water makes it easier to see.
- You may want to continue with your Class Vocabulary Chart created in the lab, *States of Matter*.

ENGAGE

1. How many different liquids can you name? Create a list and discuss similarities/ differences.
2. Say, "Today, we are going to come up with a definition of a liquid by observing different liquids in different containers."
3. Pour colored water into different shaped containers and ask students to tell you the shape of the water in each container.
4. Ask: *What shape is the water? What shape is the container?* (The liquid always takes the shape of the container it is in.)
5. Ask: *How do you know? Did you use your senses to make observations or did you just say what you are thinking?*
6. Ask: *Which would be preferable for a science investigation?* (observations using the senses)
7. Ask: *What observations can be made about liquids?*
8. Use this information to create a definition of a liquid for the Class Vocabulary Chart or on a vocabulary chart like the one below.

Word

Liquid

Definition

A form of matter that takes the shape of its container.

Examples: milk, rain, blood, juice, sap

Non-examples: rock, wood, spoon, balloon

EXPLORE

1. Tell students they will now compare and contrast four different liquids.
 - Give each small group a set of cups with the different liquids. Ask them to observe, feel, and carefully tilt their cups to find likenesses and differences of the liquids. Examples: Glue has a smell and water doesn't. Glue feels sticky and water feels wet. Glue sticks to the side of the cup and water doesn't.
 - They may list their comparisons in their science notebooks or share them orally in their groups.
 - Remind students to use their senses to make observations and to challenge their partner's observations by asking, "How do you know?"
2. Ask students to pour the liquids into different containers and make observations. Remind them to challenge their partner's observations by asking, "How do you know?"
3. Ask students to set the water cup on the table and carefully pour some of the glue into the water. Say, "Watch what happens *without disturbing the container*. Be careful not to touch or shake the cup or table as you observe for about two minutes."
 - Let them draw what they see in their science notebooks. (The glue will look like long strings hanging down in the water as it first begins to sink.)
 - Ask: *Does the glue sink or float in water?* (Sinks after a few minutes.)
 - Have students shake or stir their mixture after several minutes.
 - Ask: *Does the glue mix with the water?* (Yes.) *Can you separate them?* (No.)
 - Tell students to repeat the above process with other liquids in clean water.

EXPLAIN

Bring students together and make a list of their comparisons. Accept any true observation, such as texture, weight, thickness, smell. Use their findings to create a chart of "Properties of Liquids."

Example:

Observation: The liquid always poured into different containers.

Property: Liquids take the shape of their container.

Observation: The water is transparent and the glue is white.

Property: Liquids may have color.

Observation: Water moves quickly when you tilt the cup and glue moves slowly.

Property: Liquids have a tendency to flow.

Observation: The glue sinks in water. The oil floats in water.

Property: Some liquids can sink and some can float.

Observation: The glue mixes with water. The oil does not mix with water.

Property: Some liquids mix with water and some do not.

EXTEND AND APPLY

Based on previous observations of the various liquids, have students predict which liquids would win or lose in a "race." Test students' ideas by making one drop of each liquid at the end of a tray. Carefully tilt the end of the tray up, so that the liquids can flow down to the opposite end. Discuss/record results.

ASSESSMENT

Assess student learning through class discussions and science notebook entries. The following three-point rubric may be adapted to evaluate students' work during these lessons:

3 points: Students are highly engaged in class discussions; were able to demonstrate a clear understanding of the vocabulary; give correct examples appropriate to the lesson.

2 points: Students participate in class discussions; were able to demonstrate a basic understanding of the vocabulary; give mostly correct examples; drew pictures that were somewhat appropriate to the lesson.

1 point: Students participate minimally in class discussions; unable to demonstrate a basic understanding of the vocabulary; could not give examples of the lesson. Pictures were incomplete and/or did not clearly identify lesson objectives.

EXPLORING AIR

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KEY QUESTION

How do we know air is made of matter?

TEACHER BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or removing heat causes matter to change from one state to another. A solid is something that maintains its shape, and its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid. A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate). A gas has no fixed volume. The atoms of a gas are spaced apart. When heat is lost, matter changes from gas to liquid to solid states.

Air is a form of matter called a gas. Although it is not seen unless something moves, it is real and is everywhere. It is made up of molecules which are tiny particles that make up every form of matter. Air takes up space, moves things, changes speeds, changes directions, interacts with objects, can be compressed, and can be measured.

Mass is defined as the measure of the amount of matter in a solid, liquid, or gas. All solids, liquids, and gases have mass because they are all made of matter. Mass is recorded in units such as kilograms or grams. A balance is used to measure the mass of an object.

MATERIALS

Per group

- 1 resealable sandwich baggie
- 1 2L drink bottle or empty dish soap bottle
- 1 cup
- 1 dry paper towel
- 1 pan/bucket of water

Teacher/Class

- paper towels for spills/clean-up
- 2 balloons (different colors)
- two-pan balance OR meter stick
- tape
- string

SAFETY

At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting. Make sure students do not share balloons, etc., to prevent the spread of germs. Instruct students not to touch materials without specific instructions. Ask students to report all accidents immediately. Have paper towels nearby in case of spills. Always follow OCPS science safety guidelines.

TEACHING TIPS

- During the ENGAGE section, to compare the mass/weight of the balloons, you can use a two-pan balance OR make your own by attaching each balloon to opposite ends of a meter stick and suspending the meter stick by attaching a string to the middle of the stick.
- You may want to continue with your Class Vocabulary Chart created in the lab, *States of Matter*.

ENGAGE

1. Say, "Matter comes in the form of a solid, a liquid, and a gas. We have already explored solids and liquids. Here is our chance to explore a gas: air. Air is all around us, but because we can't see it, many people think it's not made of anything. But we can prove that air IS something.
2. Ask: *As scientists, what do we use to make observations?* (our senses)
3. Ask: *Is it preferable to use our senses to make observations or just make inferences (say what we think)?* (observations)
4. Show students the balance.
 - Ask, *what is this? Have you ever seen something like this?*
 - Ask: *What does it do? How do you know?*
 - Ask: *What is it used for?*
 - Ask inquiring questions that will help children realize that the balance is perfectly level when nothing is in it. Ask why that is and why it is important before you measure something in it.
5. Use the balance to compare the mass/weight of two empty balloons. Ask students to observe and explain what happens.
 - Blow up one of the balloons and use the balance to compare the mass/weight of an empty balloon and one filled with air.
 - Ask students to observe and explain. Ask: *How do you know?*
 - This demonstration shows that air takes up space and has weight. When the balloon is inflated, it make the balance go down because it is heavier with the addition of air.

EXPLORE

1. Hold up a baggie filled with air and allow students to explore in their groups.
 - Ask: *Why can't your hands press the sides of the bag together?* (There is air in the bag.)

- Ask: *Can you see air?* (No) *Can you feel air?* (Yes)
 - “Poof” the air out of the bag on someone.
 - Ask: *Did you feel it?*
 - Use an empty drink bottle or a dishwashing liquid bottle to squeeze air out for students to feel.
2. Have students wad up a dry paper towel and stuff in the bottom of a cup.
 - Ask them what will happen to the paper towel if you push the cup (upside down) to the bottom of a pan of water. (Most will think the paper towel will get wet.)
 - Push the upside down cup straight down to the bottom of a basin of water.
 - Pull it straight up and show the students the dry paper towel in the bottom of the cup.

EXPLAIN

1. Have students brainstorm other examples of feeling air and keep a class chart or write them in their science notebooks.
2. *Why did the towel not get wet?* (There was air in the cup between the paper towel and the water. The air took up space so the water could not get into the cup.)
3. Air is all around us. Ask: *How do we know this?* (We can't see air but we can feel it.)
4. We use air to dry things and to breathe.
5. Give students an opportunity to write about what happened in their science notebooks.

EXTEND AND APPLY

Take students outdoors to look for evidence of air (a/c units, trees moving, clouds moving, leaves blowing, sand blowing, birds flying, flags waving, etc.).

ASSESSMENT

Assess student learning through class discussions and science notebook entries. The following three-point rubric may be adapted to evaluate students' work during these lessons:

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THE CHANGING STATES OF WATER

BIG IDEA 8: PROPERTIES OF MATTER

BENCHMARKS AND TASK ANALYSES

SC.2.P.8.4 Observe and describe water in its solid, liquid, and gaseous states.

SC.2.N.1.1 Raise questions about the natural world, investigate them in teams through free exploration and systematic observations, and generate appropriate explanations based on those explorations.

The student:

- raises questions about the natural world.
- investigates questions in teams through free exploration and systematic observations.
- generates appropriate explanations based on those explorations.

KEY QUESTION

How does water change states?

TEACHER BACKGROUND INFORMATION

Matter is anything that takes up space and has mass. Matter on earth may exist in three states: solid, liquid, and gas. Adding or reducing heat causes matter to change from one state to another. A solid is something that maintains its shape. Its atoms vibrate in a fixed place. When heated to the melting point, the atoms vibrate out of their fixed space and become liquid. A liquid maintains its volume but takes the shape of its container. When heat is applied, some atoms on the surface of the liquid vibrate enough to break away (evaporate). A gas has no fixed volume. The atoms of a gas are spaced apart. When heat is lost, matter changes from gas to liquid to solid states.

MATERIALS

Teacher

electric skillet with lid
cooler for storing ice
chalk
paper towels for spills/clean-up

Student

plastic zipper-type bag with ice cube
ice cube in a cup
Changing States of Water worksheet
ScienceSaurus (book), GreatSource Education Group

SAFETY

- Only an adult should operate the electric skillet.
- Caution students not to touch the hot skillet.
- At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting unless directed otherwise (in this case, ice).
- Instruct students not to touch materials without specific instructions.
- Ask students to report all accidents immediately.
- Have paper towels nearby in case of spills.
- Always follow OCPS science safety guidelines.

TEACHING TIPS

- Use ice cubes small enough for students to place on their tongue.
- You may want to continue with your Class Vocabulary Chart created in the lab, *States of Matter*.

ENGAGE

Give each student a cup with one ice cube. Tell the students to put the pieces of ice on their tongues but not to chew them. Ask:

- *What is happening? How do you know?*
- *What is causing the ice to melt?*
- *What are some other ways we could melt the ice?*

EXPLORE Part 1

Give each student an ice cube in a plastic zipper-type bag. Challenge students to see if they can melt the ice cube without taking it out of the bag.

EXPLAIN Part 1

1. Ask the students to describe how they melted their ice cubes.
2. Record the responses on the board.
3. Help students to realize that they were applying a heat source by holding the ice bag in their hands, sitting on the bag, wrapping it up in their jacket, etc.
4. Tell students, "Frozen water is called ice. Ice is water in its solid state. Ice is made when heat is removed from water, or frozen. When heat is added again, the solid ice will melt, or turn back into a liquid."

EXPLORE Part 2

1. Explain that students are now going to observe ice being melted at a higher temperature than they could produce themselves.
2. Place an ice cube in an electric skillet. *Caution students not to touch the electric skillet.*
3. Ask students to observe the melting ice.
4. Continue heating until most of the water has changed to a gas.
5. Ask:
 - *What is the difference between melting the ice cube in a bag and melting it in a skillet?*
 - *Do you observe anything forming above the skillet?*
 - *What would you call this smoke-like substance forming above the skillet?*
 - *What do you think is going to happen next?*
6. Explain to students that the increased heat not only caused the ice to melt quickly but that it also changed the liquid to a gas. The liquid water evaporated, or turned into water vapor.
7. Ask students if they think we could reverse the process (change the gas back to liquid).
8. Ask: *If we added heat to change the ice to water and the water to steam, what do we now need to take away to reverse the change?*
9. Have the students feel the lid of the skillet.
10. Ask: *How does the lid feel?* (Since the lid has not been used on the skillet, it should feel cool to the touch.)
11. Put the lid on the skillet to collect the condensation.
12. After a few moments, remove the lid to show the students the water droplets.
13. Ask: *How did these water droplets form?* (When the steam came in contact with the cool skillet lid, the gas particles condensed into liquid particles. This is called condensation, or when water vapor turns back into liquid.)

EXPLAIN Part 2

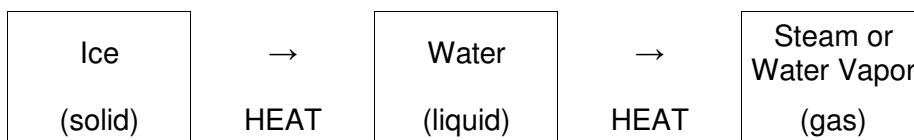
1. On an outside paved area, have the students stand as close to each other as they can while you draw a chalk circle around them.
2. Tell them to move or vibrate without getting out of the circle.
 - Tell them that they are behaving as the parts of a solid.
 - They stay in one spot and cannot move freely.
3. Now have the students step away from each other so there is at least an arm's length between them and they can no longer touch one another.
4. Draw another chalk circle around the outside of the group.
5. Tell them to move around within the circle again.
 - Point out that they are now behaving as the parts of a liquid.
 - They can move a little more freely but still tend to stay together.
6. Finally, have the students spread out in the entire area of a large given space (an area still has to be designated for the students).
7. Tell them to move around the space.
 - Tell them that they are behaving as the parts of a gas.
 - They can move very freely and do not have to stay in one place.
 - They can spread out.
8. Guide students to draw how the parts are arranged in a solid, a liquid, and a gas on the *Changing States of Water* worksheet. Have students list some examples of solids, liquids, and gases on the worksheet. An excellent reference is p. 253 of *ScienceSaurus*, from Great Source Education Group.

EXTEND AND APPLY

- Discuss how we see water change states in our daily routines.
- Ask students to estimate how long it would take the ice cube to melt at room temperature, in the sunlight, in a cooler, or in a refrigerator.
- Invite other suggestions and explore as time allows.




ASSESSMENT

Assess student learning through class discussions and worksheet completion. Direct students to create a Flow Map to show the process of water changing states. Example:



Student Scientist: _____

THE CHANGING STATES OF WATER

SOLID 	LIQUID 	GAS 
<p>Draw a picture to show how the parts of water look in each state.</p>		
<p>List other examples of each state of matter.</p>		

LIQUID MEASUREMENT

BIG IDEA 8: PROPERTIES OF MATTER

BENCHMARKS AND TASK ANALYSES

SC.2.P.8.6 Measure and compare the volume of liquids using containers of various shapes and sizes.

SC.2.N.1.2 Compare the observations made by different groups using the same tools.

The student:

- uses same materials in an investigation and reports and compares results with other groups.

SC.2.N.1.4 Explain how particular scientific investigations should yield similar conclusions when repeated.

KEY QUESTION

How do we measure liquids?

TEACHER BACKGROUND INFORMATION

Mass is defined as the measure of the amount of matter in a solid, liquid, or gas. All solids, liquids, and gases have mass because they are all made of matter. Mass is recorded in units such as kilograms or grams. A balance is used to measure the mass of an object. The amount of space that an object or substance takes up is defined as volume. Volume is measured in units such as liters. A liter box is one tool used to measure the volume of liquids. The mass and volume of water are equal (e.g., 1 mL = 1 g).

Answer Key

Estimations will vary. Actual measurements should be close to the following:

2 Cups = 1 Pint

16 Cups = 1 Gallon

8 Pints = 1 Gallon

40 Pints = 5 Gallons

Mystery container #1 = dependent on what you use

Mystery container #2 = dependent on what you use

MATERIALS

Per group

1 one-pint measuring container
(16 oz. cup or water bottle)

1 one-gallon measuring container
(empty milk jug)

2 mystery containers

1 large bucket or basin of water to use a water source

Per student

1 one-cup measuring container
(8 oz. cup)

Liquid Measurement worksheet

1 sheet of construction paper

Teacher/Class

measuring cups

1 5-gallon bucket

permanent marker

food coloring (optional)

paper towels for spills/clean-up

water



SAFETY

At the start of each activity, remind students that a good scientist always thinks about safety. Instruct students never to taste or place in their mouths any substances used in the science laboratory setting. Instruct students not to touch materials without specific instructions. Ask students to report all accidents immediately. Have paper towels nearby in case of spills. It is unsafe to touch their faces, mouths, eyes, and other parts of their body when working with different chemicals or liquids, until they have washed their hands. Never mix chemicals or liquids just to see what happens. Always follow OCPS science safety guidelines.

TEACHING TIPS

1. Prepare one-cup measuring containers by measuring one cup of water and pouring it into the 8 oz. cups. Draw a line on the cup to indicate the one-cup level. Prepare a one-cup measuring container for every student in the class.
2. Prepare one-pint containers by measuring two cups of water and pouring them into the 16 oz. cups, or small, clear plastic water bottles. Draw a line on the cup to indicate the one-pint level.
3. Prepare a one-pint measuring container for each group. (If you use plastic water bottles, removing the narrow opening on the bottles may help minimize spills during this activity.)
4. Pre-measure the mystery containers so that you know the volume of liquid they can hold. Try to select containers with differing heights and lengths so the volumes might be surprising, such as a very tall skinny vase.
5. Adding food coloring to the water makes it easier to see.

ENGAGE

1. Divide students into groups. Give each student a copy of the worksheet and a one-cup measuring container. Distribute to each group a one-pint measuring container and a one-gallon container.
2. Discuss the different sized measuring containers with the class. Show students how you made their measuring containers and direct their attention to the various containers set out for this activity.
3. Inform students that they will be estimating how many pints or cups of liquid fit into each container. Have students fill in the group work estimation section of the worksheet prior to doing the activity.

EXPLORE

1. When students have made all of their estimates, allow them to begin testing their estimates by making real measurements.
2. Have students attempt to answer each question by using either their cup or pint measuring containers to see just how much liquid each container will hold.
3. Instruct students to record their actual measurements on the worksheet.
4. When all students have completed their measurements, have the students share and discuss their results.
5. Ask: *Did everyone get the same results? Why or why not?* (they should have in this situation because they were measuring the same amounts of something)
6. Ask: *In what situations might scientists get different results when doing the same investigation?*
7. Ask: *If we did this same activity again, should we get the same results?* (yes)
8. Have students then look at the five-gallon bucket and make an estimate of how many pints will fit into it. Record on worksheet. Discuss how to solve.
9. Have students gather as a class to measure how many pints are needed to fill the five-gallon



container. Record on worksheet.

EXPLAIN

Ask:

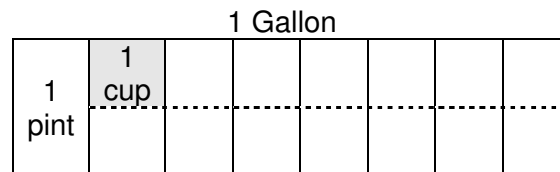
- *How did your estimates compare to your actual measurements?*
- *Which container held the most liquid? How do you know?*
- *Which container held the least liquid? How do you know?*
- *How can we determine the amount of space taken up by a liquid?* Explain that this is a measurement of volume.
- *What units of measurement did you use to measure the volume of liquids?*

EXTEND AND APPLY

Have students investigate the relationship between other units of volume, such as quarts and liters.

ASSESSMENT

Assess student learning through class discussions and worksheet completion. Using a sheet of construction paper, have students fold into eighths. Ask: *If this piece of paper represents one gallon, how much does each section we folded represent?* (1 pint. There are 8 pints in 1 gallon.) Shade in half of one of the folded sections. Ask: *How much does the shaded portion represent?* (1 cup. 2 cups = 1 pint) Continue asking questions in this manner to explore the relationships of the different measurements



Student Scientist: _____

LIQUID MEASUREMENT



Directions: Fill in the estimation section of the chart before you start to take measurements. After you have estimated each section, work with your group to figure out the actual measurements and record your data in the chart.

	ESTIMATE	MEASUREMENT
How many cups are in 1 pint?	cups	cups
How many cups are in 1 gallon?	cups	cups
How many pints are in 1 gallon?	pints	pints
How many cups are in mystery container #1?	cups	cups
How many pints are in mystery container #1?	pints	pints
How many cups are in mystery container #2?	cups	cups
How many pints are in mystery container #2?	pints	pints
How many pints will it take to fill the five-gallon bucket?	pints	pints



How many cups will it take to fill the five-gallon bucket?

cups

cups