Matter & Its Interactions

Chapter I
Properties & Changes

Name:	
Hour:	

Olenchek
Science 8

Properties & Changes

STANDARD MS-PS1: Matter and Its Interactions	
Performance Expectations: **MS.PS1-2**. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.	
Dimension	**Name**
Science and Engineering Practice	**Analyzing and Interpreting Data** Analyze and interpret data to determine the similarities and differences in findings
Disciplinary Core Idea	**PS1.A**: **Structure and Properties of Matter** Each pure substance has characteristic physical and chemical properties that can be used to identify it. **PS1.B: Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those reactants.
Crosscutting Concept	**Patterns** Macroscopic patterns are related to the nature of microscopic and atomic level structure.

STANDARD MS-PS1: Matter and Its Interactions	
Performance Expectations: **MS.PS1-5**. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.	
Dimension	**Name**
Science and Engineering Practice	**Developing and Using Models** Develop a model to describe unobservable mechanisms.
Disciplinary Core Idea	**PS1.B**: **Chemical Reactions** Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those reactants. The total number of each type of atom is conserved, and thus mass does not change.
Crosscutting Concept	**Energy and Matter** Matter is conserved because atoms are conserved in physical and chemical processes

Properties & Changes Vocabulary

1	Substance that has a mass and takes up space.
2	Principle stating that mass can neither be created nor destroyed
3	Chemical or physical property that helps identify and classify substances regardless of amount of the sample
4	Change that affects one or more physical properties of a substance
5	A measure of the amount of matter in an object. Usually measured in grams or kilograms
6	The ratio of the mass of a substance to the volume of the substance; often measured in grams per mL or grams per cm^3
7	Can be observed or measured without changing the matter's identity
8	An energy change from one state of matter to another without a change in chemical composition
9	A measure of the gravitational force exerted on an object; value changes depending on location in universe; measured in Newtons with a spring scale
10	Change that occurs when one or more substances change into entirely new substances
11	The amount of three-dimensional space occupied by a liquid, solid, or gas
12	The occupation by a submerged body or part of a body of a volume that would otherwise be occupied by a fluid
13	Property of matter that describes a substance's ability to participate in chemical reactions.

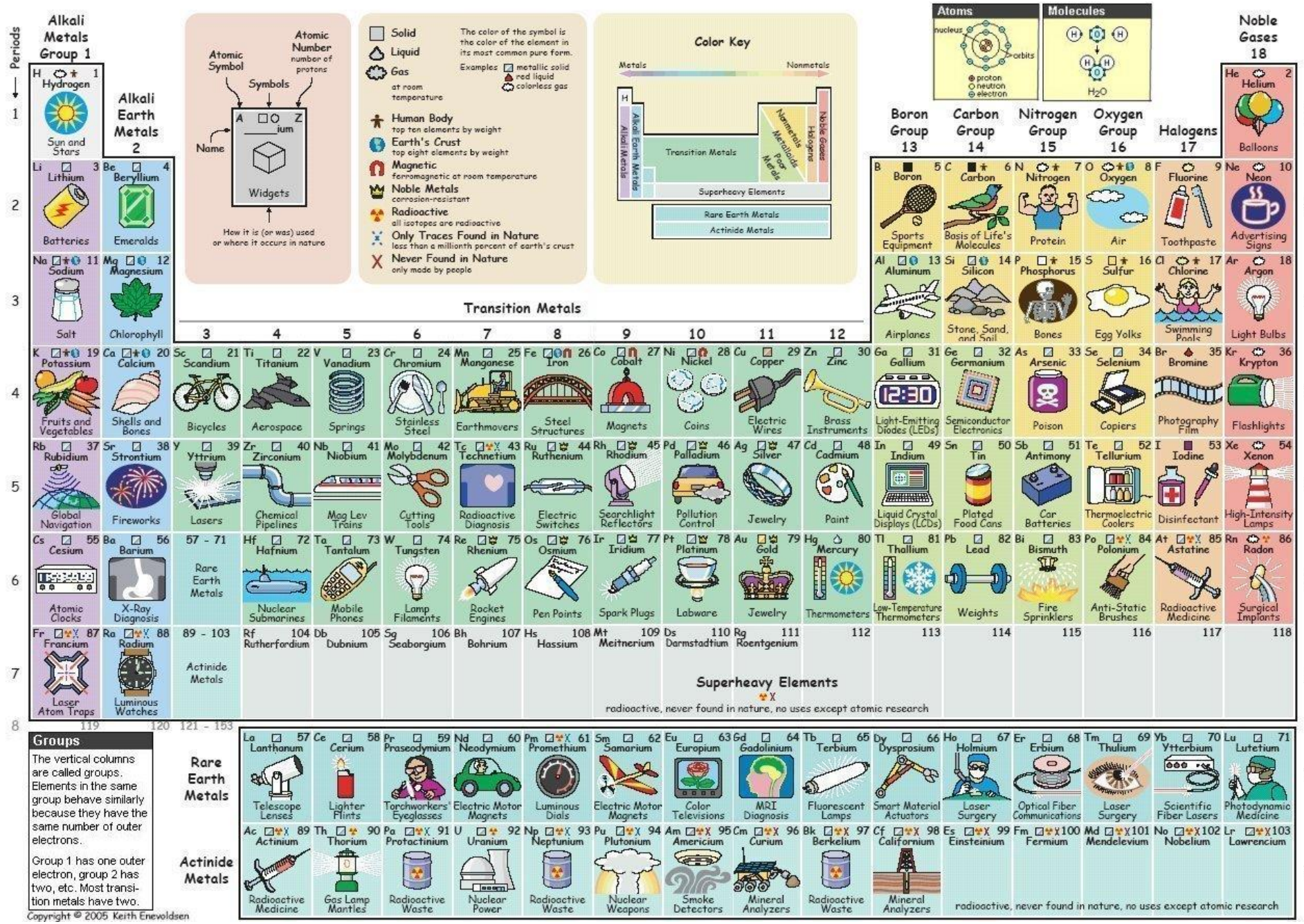
Element Symbols

1. Learn the **symbols** for the following elements.
2. Know how to **spell** each element's name.
3. **Pop Quiz** within the next week or two, start learning them now!

Quizlet Element Flashcards - **https://goo.gl/xoUKj5**

H		**Mg**		**Zn**	
He		**Al**		**Br**	
Li		**Si**		**Kr**	
Be		**P**		**Ag**	
B		**S**		**I**	
C		**Cl**		**Xe**	
N		**Ar**		**Au**	
O		**K**		**Hg**	
F		**Ca**		**Pb**	
Ne		**Fe**		**Rn**	
Na		**Cu**		**U**	

The Periodic Table of the Elements, in Pictures



Physical Properties

Additional information in your Matter Text or…
See olenchekclassroom.weebly.com > Matter > Properties & Changes; for helpful hints and extensions

Matter is anything that has mass and volume. It consists of various atoms and molecules, can be seen or not seen, living or nonliving. Plants, animals, rocks, water, salt, gold, air, oxygen are all examples of matter. They all consist of atoms and molecules and they all take up space. Yet, they are all different and have different characteristics or properties that can be used to identify them.

Physical properties can be observed or measured without changing the composition of matter. Physical properties are used to observe and describe matter.

Physical properties include: state of matter, mass, weight, volume, density, appearance, texture, color, odor, melting point, boiling point, solubility, magnetism, strength, flexibility, electrical conductivity, ductility, malleability and many others.

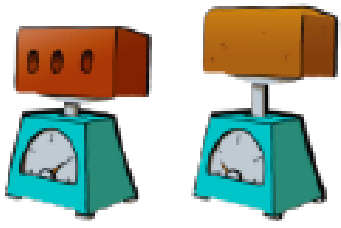
Mass – Mass is a general property of matter that is the amount of matter it an object. In other words, it is the amount of "stuff" there is. It is easy to confuse the terms "mass" with "weight" but they are different properties. The mass of an object does not change from place to place. You will measure mass using a balance and the units you will use are grams (g) and sometimes kilograms (kg).

Weight – Weight is not mass, but all objects have weight because they also have mass. The distinction is important because weight is determined by gravity, while mass is not. Since gravity is a force, weight is a force. Because weight is based on the force of gravity, an object's weight may change from place to place. If you weigh 120 lbs on Earth, your weight will be about 20 lbs on the moon, since the Earth's gravitational force is 6 times stronger than that of the moon. If your mass on earth is 60 kg however, you will still have a mass of 60 kg on the moon. To measure weight you use a spring scale and the standard unit for weight is a Newton (N).

***Optional Activity* – Go to https://www.exploratorium.edu/ronh/weight/**
Find out how much you would weigh on other planets!

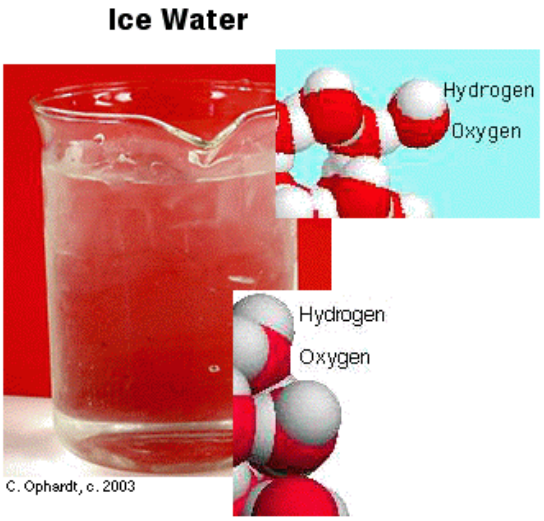
Volume – Volume describes how much space matter occupies. To measure the volume of a liquid, you will use a graduated cylinder. The standard units are milliliters (mL), liters (L) and cubic centimeters (cm 3 or cc). You will measure the volume of regular shaped objects using a metric ruler and calculating the length x width x height. The volume of irregular shaped objects is measured using water displacement.

What can you say about the mass, weight, and volume of a SPONGE and a BRICK that are the same size?



States of Matter

The three states of matter are: solid, liquid, and gas. The melting point and boiling point are related to changes of the state of matter. All matter may exist in any of three physical states of matter. What are the factors that determine the phase of matter in which a substance exists? The primary ones that we will experiment with include temperature and pressure. Phases of matter are technically "energy states of matter". Matter exists in a particular phase depending upon how fast the particles that make them up are moving and far apart they are from each other. In the graphic, two states of matter, the solid and liquid forms of water are shown.



Key Types of Physical Properties

Key Idea Statements - (summarize important thoughts here)

1.
2.
3.

Information Adapted by Mr. Olenchek & Courtesy of:
"Chemistry." *Annenberg Learner*, Harvard Smithsonian Center for Astrophysics, 10 Oct. 2017, https://goo.gl/3pY3Qv and
CK-12. "Matter, Mass, and Volume." *CK-12 Foundation*, CK-12 Foundation, 10 Oct. 2017, www.ck12.org/c/chemistry/matter-mass-and-volume/.

Physical Changes:

Additional information in your Matter Text or…
See olenchekclassroom.weebly.com > Matter > Properties & Changes; for helpful hints and extensions

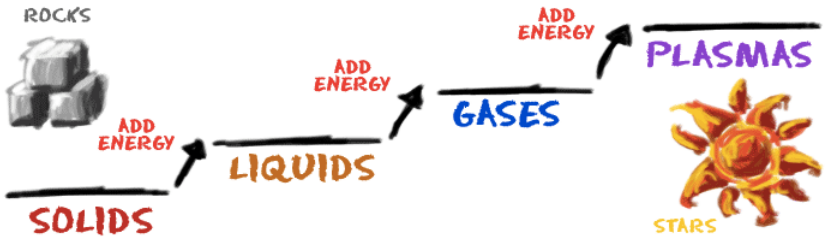
A **physical change** takes place without any changes in molecular composition. The same element or compound is present before and after the change. The same molecule is present throughout the changes. Physical changes are related to physical properties since some measurements require that changes be made. Molding clay and tearing your homework are examples of physical changes. Changes of state (phase) are also classic examples of physical changes.

Melting & Freezing – Melting and freezing refer to phase changes between liquids and solids. The melting of a solid occurs as the substance absorbs heat. The particles in the solid begin to break down and flow around each other. The temperature at which a solid melts is called the melting point, which is a physical characteristic that helps identify the substance. The melting point of ice is 0°C (32°F) and the melting point of table salt is 801°C, while that of a diamond is 3700°C.


PHYSICAL CHANGE OF WATER INTO ICE

The opposite phase change is called freezing. Freezing occurs as the substance loses energy and the particles slow down and begin to fall into a fixed position. The freezing point of a substance is the temperature at which this phase change occurs. It is the same temperature as the melting point. In other words, the melting point and the freezing point of water is 0°C. Whether water is freezing or ice is melting depends upon whether energy is absorbed (temperature increasing) or whether energy is taken away (temperature decreasing).

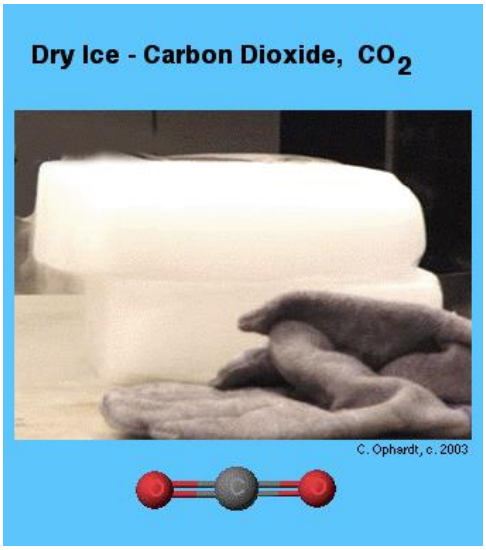
Boiling, Condensation, and Sublimation – Vaporization is the change of a substance from a liquid to a gas. Particles absorb enough energy to move fast enough to break away from each other. Two forms of vaporization are evaporation and boiling. Evaporation involves the vaporization of a liquid only on the surface. Evaporation is not totally temperature dependent. Boiling involves all of the liquids' particles changing into a gas phase, not just the surface particles. While a liquid boils, the energy absorbed causes all of the particles to move so fast that they need to break away from each other. The boiling point is the temperature at which as liquid changes from a liquid to a gas. Table salt's boiling point is 1413°C, while the boiling point of a diamond is 4200°C.



THE STATE OF MATTER CHANGES AS YOU ADD MORE ENERGY

The opposite phase change is called condensation. Gaseous water in the atmosphere condensing on objects is called dew.

Resources:
Rader, Andrew. "Matter Is the Stuff Around You." *Chemistry Basics*, Chem4Kids, 10 Oct. 2017, www.chem4kids.com/files/matter_intro.html.



Some substances skip the liquid phase and can change from a solid directly to a gas. These substances go through the process of sublimation. Dry ice is a substance that is sublime. Dry ice is a solid form of carbon dioxide that changes directly to a gaseous form of carbon dioxide as it absorbs energy. Dry ice is itself, very cold, and can be used to keep other items cold. Because dry ice goes through sublimation, it is considered sublime. Water in the solid form of snow (tiny ice crystals) also is sublime. Think of a snow bank in winter becoming smaller over time. Even without melting, a snow bank would carry out sublimation and eventually disappear.

Specific Examples of Physical Changes

What happens to the particles as a substance undergoes a phase change?

Summarizing Statement

Information Adapted by Mr. Olenchek & Courtesy of:

"Density: Applications with Gases." *Density of Gases*, Elmhurst College, 10 Oct. 2017, chemistry.elmhurst.edu/vchembook/123Adensitygas.html.

Chemical Properties:

Additional information in your Matter Text or…
See olenchekclassroom.weebly.com > Matter > Properties & Changes; for helpful hints and extensions

Chemical properties of matter describe its 'potential' or 'ability' to undergo some type of chemical change or reaction by virtue of its composition. This means which elements, electrons, and type of bonding are present to give the potential for chemical change.

It is quite difficult to define a chemical property without using the word "change." Eventually you should be able to look at the formula of a compound and state some chemical property. At this time this is very difficult to do and you are not expected to be able to do it.

For example hydrogen has the potential to ignite and explode given the right conditions. This is a chemical property based on flammability. If something will not burn, that is also considered a chemical property known as non-flammability. Metals in general have the chemical property of reacting with an acid. Zinc reacts with hydrochloric acid to produce hydrogen gas. This is a chemical property called reactivity.

Differences between Chemical and Physical Properties: It is tough to see a chemical property whereas you can use your five senses to determine physical properties. It is hard to look at a substance and determine if it is reactive for example.

Examples of Chemical Properties

Summarizing Statement

What is the difference between a chemical and physical property? Use your own words.

Information Adapted by Mr. Olenchek & Courtesy of:
"Density: Applications with Gases." *Density of Gases*, Elmhurst College, 10 Oct. 2017, chemistry.elmhurst.edu/vchembook/123Adensitygas.html.

Chemical Changes:

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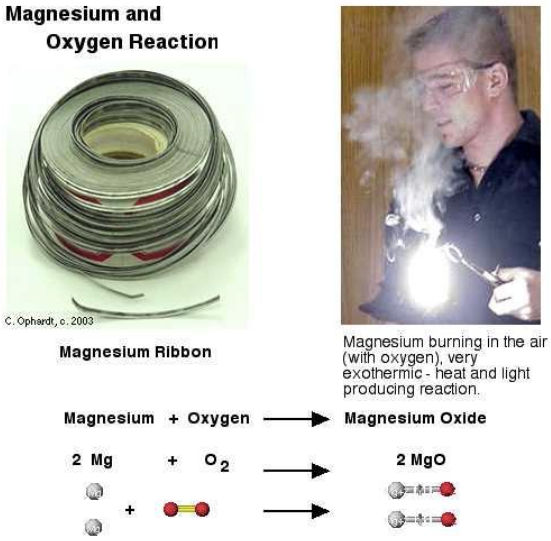


Chemical changes, or chemical reactions, result in one or more new substances, of entirely different composition from the originals, being created. The atoms and molecules at the start of the reaction are rearranged to form new compounds or elements. Rusting, cooking or baking, rotting, burning, and digesting are all common examples of chemical changes. In each example, the original substances rearrange to form new substances at the end and the process cannot be easily reversed.

A **CHEMICAL CHANGE** alters the composition of the original matter. Different elements or compounds are present at the end of the chemical change. The atoms in compounds are rearranged to make new and different compounds.

Magnesium reacts with oxygen from the air producing an extremely bright flame. This is a chemical change since magnesium oxide has completely different properties than magnesium metal shown on the left. Safety: Do not try this without supervision and DO NOT LOOK DIRECTLY AT THE LIGHT!

INDICATORS OF CHEMICAL CHANGE

There are several observations you can make that indicate a chemical change occurred. These include: change in color or odor, formation of gas bubbles, and/or change in temperature. These do not guarantee a chemical change is occurring. For example, you can color your paper with markers. The color of the paper changed, but this is not a chemical change. The paper is still paper – no new substance has been created. However, the presence of multiple indicators is a good sign that it is probably a chemical reaction.

Examples of Chemical Changes

Summarizing Statement

Information Adapted by Mr. Olenchek & Courtesy of:
CK-12. "Matter, Mass, and Volume." *CK-12 Foundation*, CK-12 Foundation, 10 Oct. 2017, www.ck12.org/c/chemistry/matter-mass-and-volume/

Investigate: Zinc & Hydrochloric Acid

	ZINC	HYDROCHLORIC ACID
Chemical Name		
Physical Properties		
Chemical Properties		
Evidence of Chemical Change when mixed together		

Mysterious Powders

MS-PS1-2	*Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.*

Challenge:

You are crime scene investigators. You have entered a scene and found an unknown white powder next to a dead body. It may be a clue to how this person died. You need to find out what it is by comparing its reactions with known powders. Good luck!

Essential Questions:

- How and why do scientists use physical and chemical changes and properties of known and unknown substances?
- How is the scientific process used to solve problems and questions?

Materials:

Baking Powder	Vinegar	Baking Soda
Corn Starch	Goggles	Water
Powdered Sugar	4 Spatulas	Stirring Rod
3 Eyedroppers	Iodine solution (no more than 1% iodine in water.)	

Background:
Remember, changing the state or shape of matter is an example of a **physical change**. Physical changes alter the form of a substance, but not its chemical composition or identity. Crushing a can and tearing paper are examples of physical changes.

In a **chemical change**, however, the molecules in a substance combine or break apart to form a new substance. Burning wood and rusting iron are examples of chemical changes.

Matter can also be described based on its **physical** and **chemical properties**. In this lab, students will describe four substances based on their properties and the changes they undergo.

Primary Question:

How can you identify an unknown powder using known information about physical and chemical properties of other powders?

<u>Hypothesis</u>: (your prediction)

Complete the table. Put a C in the box if you think a chemical change will occur. Put a P in the box if you believe a physical change will occur.

	Mixed with Water	**Mixed with Vinegar**	**Mixed with Iodine Solution**
Baking Powder			
Baking Soda			
Cornstarch			
Sugar			

Procedures:

1. Place a small amount of <u>each</u> powder into <u>the appropriate</u> square. Notice that the first column is the CONTROL column – these powders will not be mixed with any liquids. They are used for comparison purposes.

2. Add 5-10 drops of WATER to the second square of the baking powder. Stir the liquid into the powder. Make some observations and record in your data table. Use those observations to determine if it is a chemical or physical change. Record this information on your data table as well.

3. **Repeat this process using vinegar in the third square and iodine in the fourth square. Use a clean dropper for each powder and make sure you clean your stirring rod each time you use it! Continue to record your information in the page 16 data table.**

4. Repeat these steps with each of the known substances (baking soda, cornstarch, and sugar) and finally the unknown substance. **Remember to use a clean spatula (or spoon) for each substance**.
5. Clean up your lab area by throwing away your lab sheet with the powders/liquids **(make sure you've recorded all of your data before throwing away!)** and wiping down your lab area to remove any excess powders or liquids.

Data Table: Properties and Changes

Write P or C for physical or chemical change in the Change column. Support your answer by writing your observations that prove it was chemical or physical.

	Mixed with Water	Mixed with Water	Mixed with Vinegar	Mixed with Vinegar	Mixed with Iodine Solution	Mixed with Iodine Solution
Substance	*Phys or Chem Change?*	*Supporting Observations*	*Phys of Chem Change?*	*Supporting Observations*	*Phys or Chem Change?*	*Supporting Observations*
Baking Powder						
Baking Soda						
Cornstarch						
Sugar						
Unknown Powder						

Evaluation and Conclusion Questions:

1. What is the unknown powder? _____ What evidence supports your prediction?

2. What properties, clues, or observations did you use to decide if something was a *chemical change?*

3. Do you think the clues indicating a chemical change are always reliable? Why or why not? For example, could you identify some sort of clue that would indicate a chemical change when it actually isn't a chemical change?

4. When you cook food, is this an example of a chemical or physical change? Explain your reasoning.

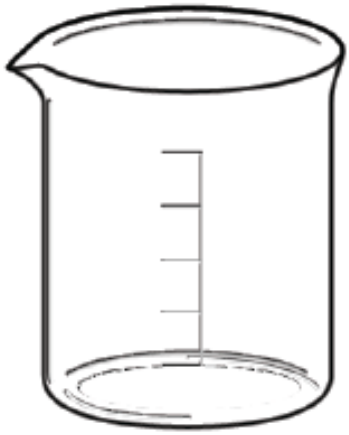
Physical Properties: States of Matter

In the beakers below, draw a model that shows the particles of a solid, liquid, and a gas. Explain your model in the text box below the beaker.

SOLID

LIQUID

GAS



SOLID	LIQUID	GAS
➢	➢	➢
➢	➢	➢
➢	➢	➢

Physical Properties: States of Matter

Additional information in your Matter Text or…
See olenchekclassroom.weebly.com > Matter > Properties & Changes; for helpful hints and extensions

Solids – An ice cube, a pencil, a shaker of salt, and a metal coin are all solids. They all share two important characteristics. Solids have a definite shape and a definite volume. The particles that make up a solid are packed tightly together and remain in a fixed position. They vibrate back and forth in their fixed places. This allows a solid to keep its shape since the particles cannot move from their places and flow around each other. Solids that form a regular, repeating pattern with their particles are called crystals. Draw and explain molecular model of a SOLID in the box to the right.

Particle Motion:	Particle Spacing:

Liquids – Particles in a liquid are close together but do not remain in a fixed position – they are free to move. The particles are moving much faster than those in a solid. As a result, they do not have a definite shape. Instead, liquids take the shape of its container. A liquid in a cube is square in shape, but the same liquid in a jar is round. Although liquids don't have a definite shape, they do have a definite volume. A 2-liter bottle of soda has the same volume if it is poured into a pitcher – same volume but different shape. Even though particles in a liquid are always close to each other (always touching) they flow around each other. Not all liquids flow as easily – try pouring water and then honey to see the difference. The measure of how easily a liquid flows is called viscosity.

Draw & explain a molecular model of a LIQUID in the box to the right.

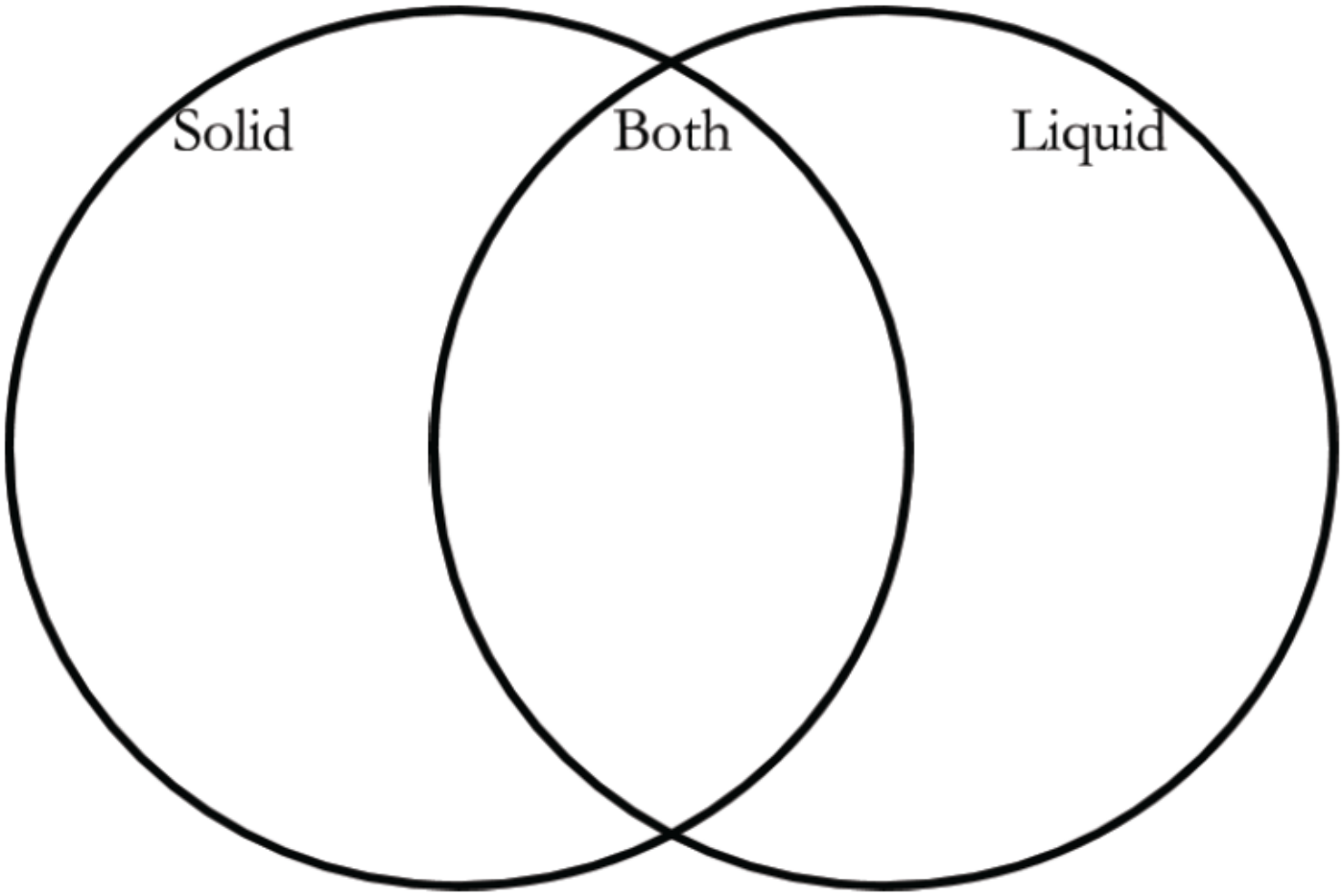
Particle Motion:	Particle Spacing:

Gases - Gases have neither a definite shape nor a definite volume. A gas fills all the available space in the container, regardless of all the size or shape of the container. This is

because the particles in a gas are moving very rapidly and are spread apart. There is a lot of empty space between these particles. Some move as fast as 500 m / second! These gas particles are constantly whizzing around and bumping into each other and the walls of the container – they may undergo 10 billion collisions each second! The volume and temperature of gases depend upon the pressure. The pressure of a gas is the measure of the number of collisions between particles. The temperature of the gas also determines the pressure, as particles move faster as temperature rises. Thus, there are more collision and a higher pressure. Draw and explain a molecular model of a GAS in the box to the right.

Particle Motion:	Particle Spacing:

Comparing Volume – Lesson #1



Comparing Volume – Lesson #2

Gallery Walk: Record at least three ideas from Venn Diagrams other than yours:

Idea	Quick Analysis of their Idea

Quick Take

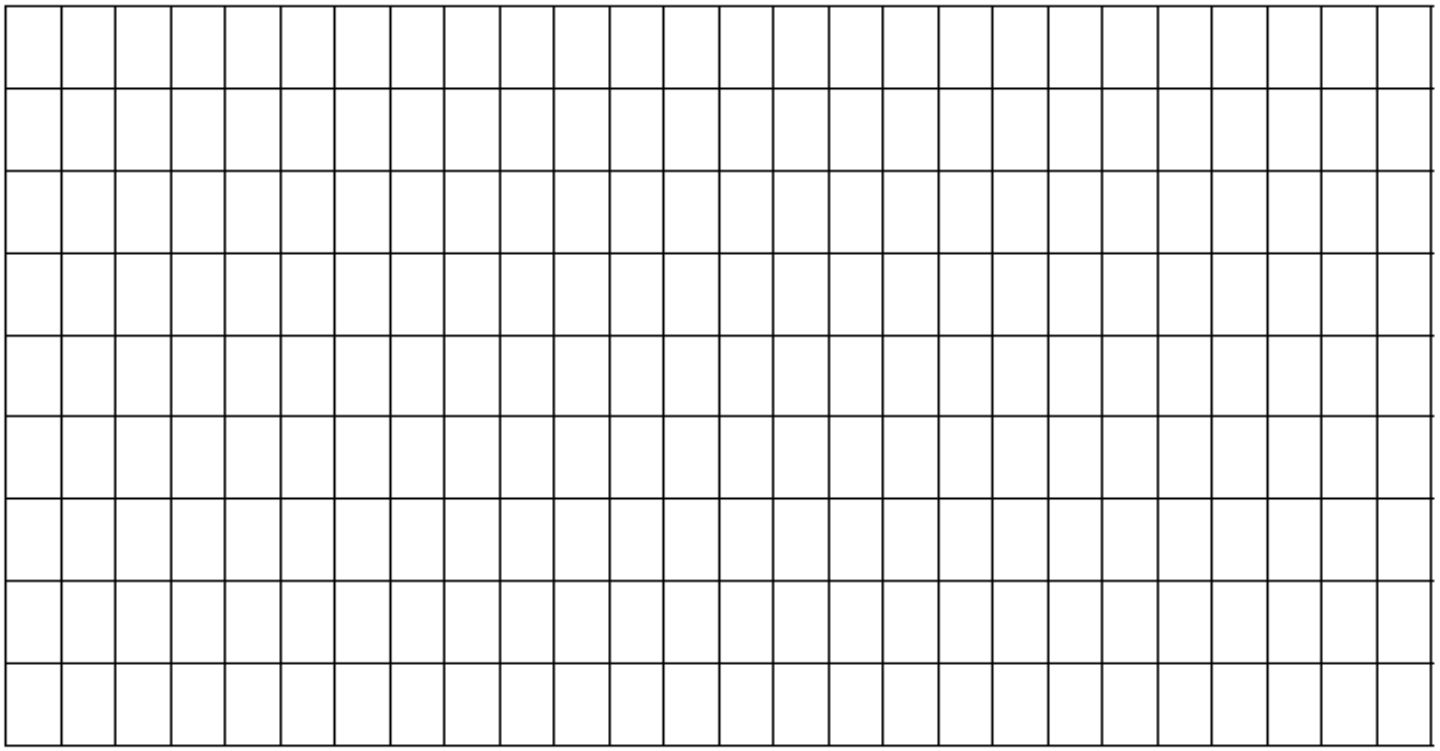
Design an experiment to compare cubic centimeters and milliliters.

Use these materials to design & conduct a short scientific experiment.

10 cubic cm blocks	Graduated Cylinders	Water	Eye dropper	Ruler

Graph Your Results

Title_____



Don't forget the following in your graph!

____Graph Title
____x-axis label
____y-axis label
____Data plotted

Comparing Volume – Lesson #3

You are a Gem!

Turns out you are a technician at a Gems R Us, a company using water displacement to measure the volume of irregularly shaped objects. Your company has a skeptical client who's not sure the procedure is accurate. You need to convince the client your procedure is honest and reliable.

Use what you know about **volume** and the **relationship** between milliliters and cubic centimeters to explain why water displacement correctly measures volume. Use evidence from your investigation to explain why the procedure can be effectively used. Explain or show your reasoning. Tell the client why your evidence supports your explanation.

You may use any or all of the following: sentences, labeled pictures, diagrams, a chart, math, a combo, and words from the word wall in your explanation…. Your choice, but you need to show a great understanding of the relationship between cm^3 and mL.

GEM!			
Advanced (4)	**Proficient (3)**	**Developing (2)**	**Beginning (1)**
Proficient; plus: Multiple forms of evidence are used / created to make convincing explanation You OWNED this scenario's point of view. Nice work.	Variables identified and relationship is analyzed to form evidence Cause for displacement is accurately stated and connected to evidence Point of view from scenario is actively taken throughout your explanation	Variables may be implied; data stated but may not be used as evidence Displacement is mentioned but not clearly defined Point of view is attempted but is not held throughout your entire explanation	Variables aren't mentioned or are confused; evidence is missing or inaccurate Displacement is missing or inaccurately defined Point of view is missing; this read like a straight explanatory paragraph

Physical Properties: Density

Additional information in your Matter Text or…
See olenchekclassroom.weebly.com > Matter > Properties & Changes; for helpful hints and extensions

Density – Matter is anything that has mass and volume. Scientists use those two properties to calculate the density of specific matter. Density is the mass per unit volume of an object and it allows you to compare different types of matter.

Which is "heavier" – lead or wood? If you had a flake of lead from a pencil and a baseball bat made of wood, the wood would be heavier. But if you had equal volumes of wood and lead, the lead would be heavier. The proper way to phrase that question is – Which has a higher density – lead or wood?

To answer that you need to know the volume of the object in addition to the mass. Since density is mass per unit volume you will need to measure both the mass and the volume of an object in order to calculate the density using the following formula:

Density Formula		
Version 1	**Version 2**	**Version 3**
Density = Mass / Volume		

The standard unit for mass is grams (g) and the standard unit for volume is milliliters (mL). So density is expressed as gram per milliliter (g / mL) or grams per cubic centimeter (g / cm^3).

Density of some Materials:

Material	**Density (g / cm^3)**	**Material**	**Density (g / cm^3)**
hydrogen	0.00009	aluminum	2.7
oxygen	0.0014	iron	7.9
water	1.0	gold	19.3

Characteristic Properties
Density is one example of a **characteristic property**. A characteristic property helps you identify a substance and applies regardless of the quantity. Out of all the elements, only copper melts at 1083 ^oC. Out of all common compounds, only H_2O has, at a specific temperature, a density of 0.98g/ml (usually rounded to 1). To say I have 215 g of a substance in my pocket will not help you guess what it is. It may be diamond, tangerine

peels, or a bunch of Kleenex, so mass is not characteristic. Other characteristic physical properties include melting or freezing point.

A non-characteristic property is a physical or chemical property that is not unique to one particular substance, including temperature, mass, shape, and color. These properties could describe MANY things and therefore, cannot help to identify the substance.

Summarizing Statement

Density Practice: D = m / v Show your work!

1. Rearrange the density equation to solve for the following:

Mass = Volume =

2. Calculate the density of a material that has a mass of 52.457 g and a volume of 13.5 cm^3.

3. A student finds a rock on the way to school. In the laboratory he determines that the volume of the rock is 22.7 mL, and the mass in 39.943 g. What is the density of the rock?

4. The density of silver is 10.49 g/cm^3. If a sample of pure silver has a volume of 12.993 cm^3, what is the mass?

5. What is the mass of a 350 cm^3 sample of pure silicon with a density of 2.336 g/cm^3?

6. Pure gold has a density of 19.32 g/cm^3 How large would a piece of gold be if it had a mass of 318.97 g?

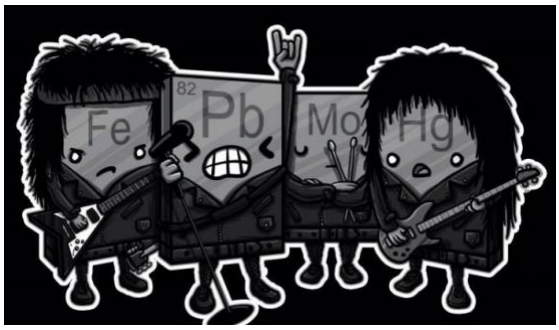
7. The density of lead is 11.342 g/mL. What would be the volume of a 200.0 g sample of this metal?

8. The mass of a toy spoon is 7.5 grams, and its volume is 3.2 mL. What is the density of the toy spoon?

9. A mechanical pencil has the density of 3 grams per cubic centimeter. The volume of the pencil is 15.8 cubic centimeters. What is the mass of the pencil?

10. A screwdriver has the density of 5.5 grams per cubic centimeter. It also has the mass of 2.3 grams. What is the screwdriver's volume?

HEAVY METAL



NGSS Standard: MS-PS1-2
Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

***Before analyzing properties of substances in chemical reactions, we will explore the property of density, how it can be calculated and used to identify substances – elements in particular.*

Metals, and other substances, come in many sizes and shapes. Each and every substance, regardless of size and shape, has a specific density calculated by dividing its mass by its volume. Since these densities are known values for elements, this property of matter can be used to determine unknown substances. This is the DILEMMA you face today!

Challenges:

- Select and properly use lab equipment
- Calculate densities of the metals.
- Determine the identity of the metals by comparing your calculations to online resources.
- Organize information into a neat table.
- Thoroughly answer evaluation questions.

Evaluation Questions

Record your group's best prediction for each of the 'Mystery Metals' and the 'Mystery Substance.'

	Metal 1	**Metal 2**	**Metal 3**	**Metal 4**	**Metal 5**	**Metal 6**	**Mystery Substance**
Density							
Element Symbol							
Element Name							

1. Based on your lab work, evaluate the technique your group used. Do you feel you were accurate? Explain why or what you might need to try to improve to get better density numbers.

2. You learned an object's mass, weight, and volume depend on the amount of the object. A bigger playground ball has more mass, more weight, and more volume. Is the same true for density? Why or why not?

3. If the object is made out of the same material, and you add more of that material (small playground ball vs. big playground ball), does that change its density? Why or why not? Use the definition and formula for density to support your answer.

4. Would the density of an object change on the moon? Why or why not? In your answer, be sure to use the following vocabulary words: MASS, WEIGHT, VOLUME, DENSITY, GRAVITY.

Floating Logs

A log was cut from a tree and put in water. The log floated on its side so half the log was above the water's surface. Another log was cut from the same tree. This log was twice as long and twice as wide. How does the larger log float compared to the smaller one? Circle the best answer:

A. More than half of the larger log floats above the water's surface.

B. Half of the larger log floats above the water's surface.

C. Less than half of the larger log floats above the water's surface.

Explain your thinking by creating a 'rule' you could use in determining your answer:

1. Complete the following table using the following website: https://goo.gl/CjY8TQ
2. Find the mass and volume of the objects by dragging the objects to the scale and the beaker for water displacement (note the "sophisticated thumb tack" that holds things under water)
3. Calculate the density of the objects (HINT: mass divided by volume).
4. Drag the object into the pail. Does it float? Write "YES" if the object floats and "NO" if the object does not float.
5. Rank: Number the objects from lowest density to highest density.

Description	**Mass (g)**	**Volume (mL)**	**Density (g / mL)**	**Rank (#1-10)**	**Sink or Float?**
Wood	13.30	15.60	0.85		Float
Aluminum					
Plastic					
Lead					
Cork					
Steel					
Clay					
Rubber					
Candle					

<u>Sink or Float Questions</u>:

1. Do you notice any correlation (pattern) between the density of an object and the ability of the object to sink or float? For example, what can you conclude about the densities of objects that float compared the densities of objects that sink? Look at the numbers! Be specific!

2. With your new knowledge about densities of objects that sink or float, make a prediction for the following scenario: You now have a **NEW** liquid in the pail, which has a density of 1.5 g/mL. Using this information, which objects do you think will sink or float in this new liquid? Please **CIRCLE** each object that will **SINK** and explain **WHY** these objects will sink while the others will float.

Wood	***Lead***	***Clay***
Aluminum	***Cork***	***Rubber***
Plastic	***Steel***	***Candle***

3. Why did you choose these objects?

4. Using the term density, write a universal rule that explains why ANY object would sink or float in ANY fluid. (Remember, universal means that the rule applies in any scenario.)

Matter Magic Square:

Directions

In a magic square the sum of each row, column, and diagonal is the same number, the so-called "magic constant." Match the letter with the correct number. Then add the numbers together in each row and column to see if you've found the magic constant!

A. _____ The curve at a liquid's

B. _____ Mass is the quantitative measure

C. _____ Grams / mL is a ratio of

D. _____ Balances the measure weight by

E. _____ Density is the ratio of the mass of

F. _____ A metric unit of capacity equal to

G. _____ A graduated

H. _____ Weight is the measure of the

I. _____ A unit used to measure weight

J. _____ Volume is the measure of the size

K. _____ A balance is a tool used to

L. _____ A metric unit of mass equal to

M. _____ One gram is approximately

N. _____ Mass is also known as a measure

O. _____ Inertia is the tendency of an

1. takes up space is known as matter.

2. of the amount of matter in an object.

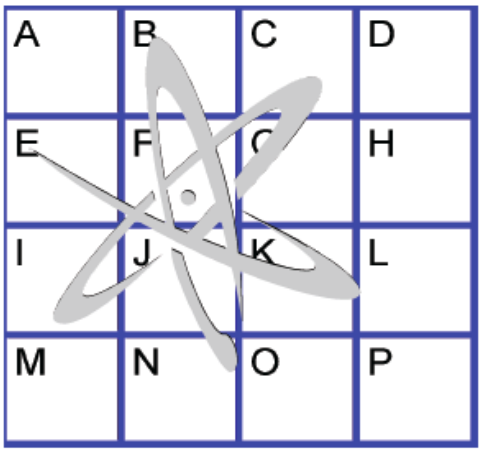
3. mass to volume used to calculate density

4. the mass of one paper clip.

5. a substance to its volume.

6. measure the mass of an object.

7. of a body or region in 3D space.



8. gravitational force exerted on an object.

9. on Earth is known as the 'Newton.'

10. cylinder is used to measure fluid volume.

11. 1000 mL is a 'liter.'

12. 1000th of a kilogram is a gram.

13. the tension on a spring are called 'spring scales.'

14. of inertia.

15. object to resist being moved.

16. surface by which one measures the volume of a liquid is called the meniscus.