Rate Yourself: **1-I am unclear about** **2- I have the basics down**
3- I know it, but need a little practice **4-I am an expert, I can teach it**

- ☐ 1. Classify substances based on their physical properties, including:
  o thermal conductivity, electrical conductivity, solubility, magnetism, melting and boiling points, volume, and density
- ☐ 2. Investigate to explain how the physical properties of matter are independent of the amount sampled, such as: density and conductivity
- ☐ 3. Determine the physical property being analyzed given data from a table
- ☐ 4. Calculate the density of solids, liquids and gases using
  Density = mass ÷ volume
  o measure the mass and volume of solids, liquids and gases
- ☐ 5. Sequence various substances in order of increasing or decreasing density
- ☐ 6. Differentiate between mass and weight
- ☐ 7. Differentiate between solid, liquid, and gas based on their particle motion
- ☐ 8. Sequence the states of matter by increasing or decreasing kinetic energy
- ☐ 9. Explain how the state of matter of a substance is related to the average kinetic energy of its molecules
- ☐ 10. Predict what happens to the motion of particles during a phase change
- ☐ 11. Differentiate physical and chemical changes in matter
- ☐ 12. Cite examples of physical and chemical changes in matter
- ☐ 13. Investigate physical and chemical changes in matter
- ☐ 14. Explain how temperature influences chemical changes
- ☐ 15. Explain why mass is conserved when substances undergo physical and chemical changes according to the Law of Conservation of Mass
  o differentiate between a law and a theory
- ☐ 16. Investigate the law of conservation of mass using models, such as:
  o chemical equations, experiments, and demonstrations
  o Design an investigation to explore the Law of Conservation of Mass

☐ 1. Classify substances based on their physical properties, including:
o thermal conductivity, electrical conductivity, solubility, magnetism, melting and boiling points, volume, and density

Density is the amount of matter, mass (g), in a specific amount of something, volume (ml or cm^3). Density is a great way to identify an unknown substance because **every substance has its own unique density**, unlike physical properties like mass, volume, and color which can be shared amongst many different substances.

Metals are malleable, ductile, shiny, and are good conductors of both heat and electricity. The elements iron (Fe), copper (Cu), gold (Au), and silver (Ag) are classified as metals and share the same physical property of being good thermal and electrical conductors.

Boiling point, melting point, and freezing point are physical properties. They will remain the same no matter how big or small the sample size is.

Magnetism – The metals Iron, Nickel, and Cobalt are magnetic, regardless of the amount of Iron, Nickel, and Cobalt the pieces will all be magnetic.

Solubility – Certain substances are soluble (dissolve) in other substances. Regardless of how much you have, that material will always be soluble in certain substances as long as it is the exact same substance, the amount doesn't matter; it will still have the same properties.

Ex. Stephanie is given an unknown liquid to test in the laboratory. She thinks this liquid might be alcohol. One of the best physical properties that would be most helpful for Stephanie to determine the identity of the liquid would be boiling point because so many substances have the same physical properties of color, mass, and volume.

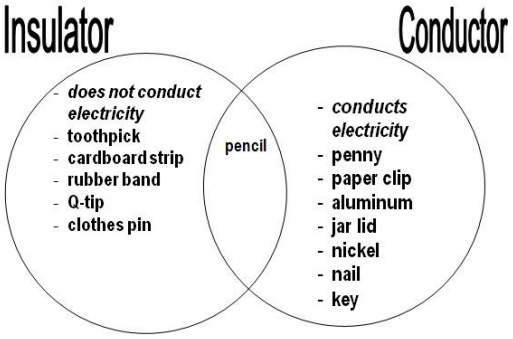
☐ 2. Investigate to explain how the physical properties of matter are independent of the amount sampled, such as: density and conductivity

Some characteristic physical properties of substances that allow them to be compared and classified are density; thermal or electrical conductivity; solubility; magnetic properties; melting and boiling points. **No matter the amount of the substance, or sample size, the properties remain the same** A small sample of a substance will have the same density, melting or boiling point, magnetism, or conductivity as a large sample.
Ex: A set of Legos are made up of 36 **identical** pieces. Because all pieces are made of the **same exact material**, the density of one piece is the same as the density of the whole set when connected together because it is the same type of material still.
Ex: If you have a swimming pool full of water, and were somehow able to heat the whole pool to 100 degrees, it would still boil at 100 degrees because water boils at 100 degrees regardless of how much water you have. The same goes for it freezing at 0°C….

☐ 3. Determine the physical property being analyzed given data from a table

PROPERTIES OF MATERIALS

Materials	Hard	Flexible	Conducts Electricity	Attracted by Magnets
Copper	No	Yes	Yes	No
Glass	Yes	No	No	No
Iron	Yes	No	Yes	Yes
Wood	Yes	No	No	No



Sample Data Table

Observations

Property	NaCl (Ionic)	Lauric acid (Molecular)	SiO_2 (Covalent)	Fe (Metallic)
Hardness	Brittle	Soft	Hard	Hard
Volatility/odor	None	Fatty	None	None
Melting	Barely	Easily	No	No
Water solubility	Soluble	No	No	No
Cyclohexane solubility	No	Soluble	No	No
Conductivity/solid	No	No	No	Yes
Conductivity/water solution	Yes	No	No	No
Conductivity/ cyclohexane solution	No	No	No	No

Element	Melting point (°C)	Boiling point (°C)	State at room temperature
Copper	1083	2567	Solid
Magnesium	650	1107	Solid
Oxygen	-218.4	-183	Gas
Carbon	3500	4827	Solid
Helium	-272	-268.6	Gas
Sulphur	112.8	444.6	Solid

☐ 4. Calculate the density of solids, liquids and gases using

Density = mass ÷ volume **(Density = $\frac{\text{Mass}}{\text{Volume}}$)**

o measure the mass and volume of solids, liquids and gases

Find the Mass of an item that has a Density of 6 g/ml and a volume of 2ml. Assume the item is regularly shaped item, like a cube.

6 g/ cm^3 = $\frac{\text{Mass}}{\mathbf{2}\ cm^3}$ **Look at the problem, what number divided by 2 is 6? 12 grams**

If a solid metal cube has a density of 5.0 g/cm3 and a mass of 10.0 grams, what is its volume?

5.0 g/ cm^3 = $\frac{\mathbf{10\ g}}{\mathbf{Volume\ (}cm^3\mathbf{)}}$ **Look at the problem, 10 divided by what # is 5? 2** cm^3

☐ 5. Sequence various substances in order of increasing or decreasing density

1. Use this data to answer the question.

Substance	Density
Oil	.8 g/mL
Water	1.0 g/mL
Plastic	.9 g/cm^3
Rock	4.2 g/cm^3
Aluminum	2.3 g/cm^3

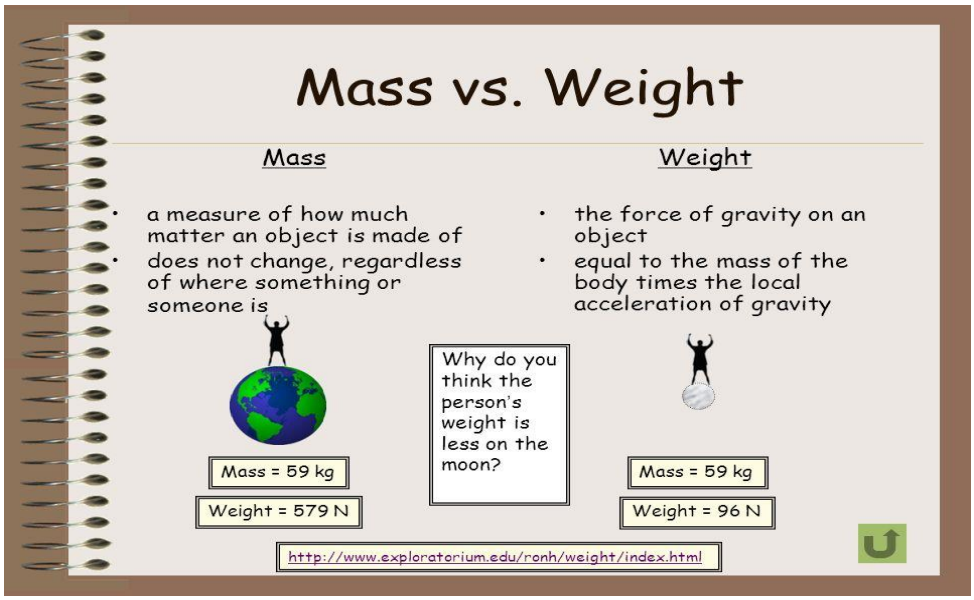
Where would a substance with a mass of 14 g and a volume of 20 mL float?

a. At the bottom
b. In the middle
c. At the top
d. Below the water

D=M/V D= 14g/20ml D= .7 g/ml
Answer – C – because the density is .7g/ml less than 1 and all other listed densities, so above the water

☐ 6. Differentiate between mass and weight

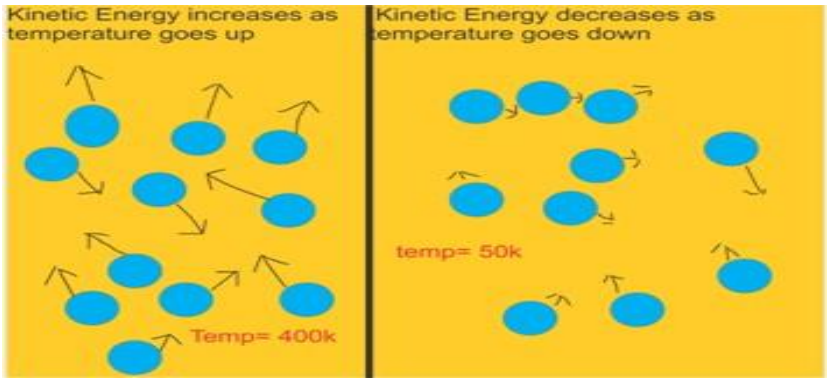
Mass is the amount of matter (or "stuff") in an object. Weight, on the other hand, is the measure of force of attraction (gravitational force) between an object and Earth.



☐ 7. Differentiate between solid, liquid, and gas based on their particle motion

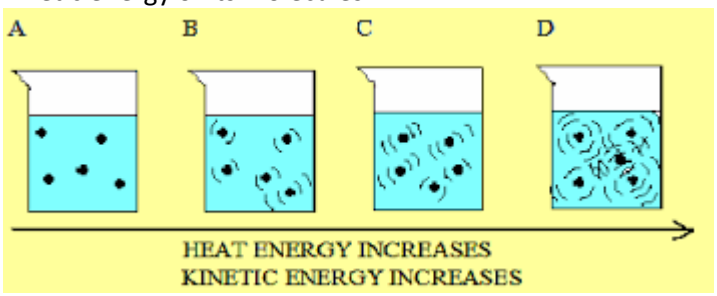
Solid – Has a definite shape and volume. The molecules, although still moving, are barely vibrating and packed closely together.
Liquid – Has a definite volume, but takes the shape of its container. The molecules move a little more freely although they are still fairly close together.
Gas – No definite volume or shape. The molecules are moving very fast and are spread far apart from one another.

☐ 8. Sequence the states of matter by increasing or decreasing kinetic energy



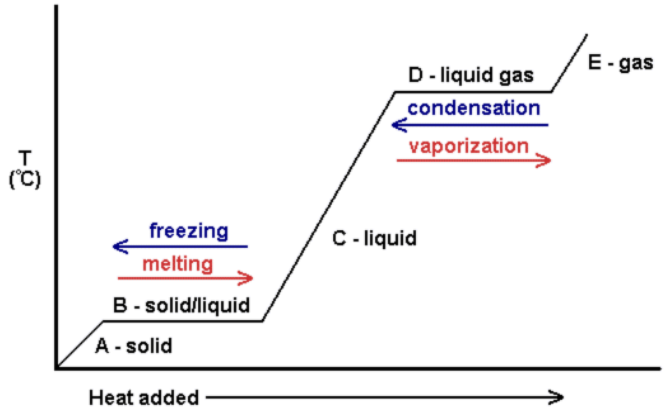
Temperature is the average kinetic energy of the particles of matter. The hotter something is the more kinetic energy it has. The cooler it is, the lower the kinetic energy.
Solid → Liquid →Gas -- Higher kinetic energy in the system from a solid to a gas
Gas → Liquid →Solid -- Less kinetic energy in the system from a gas to a solid

☐ 9. Explain how the state of matter of a substance is related to the average kinetic energy of its molecules



Adding energy (heating) atoms and molecules increases their motion, resulting in an increase in temperature.
Removing energy (cooling) atoms and molecules decreases their motion, resulting in a decrease in temperature.

☐ 10. Predict what happens to the motion of particles during a phase change



*As the temperature of a substance increases to the point of it melting, the molecules will begin to move faster and spread apart. As the temperature reaches the materials boiling point it will begin to turn into a gas, and the particles will move even faster.

*As the temperature of a gas decreases, the molecules will begin to slow down and get closer together, this can cause condensation to occur, and if it the temperature drops to the freezing point it will freeze and the molecules will just barely vibrate.

☐ 11. Differentiate physical and chemical changes in matter

Changes of state are **physical** changes. The substance does not change into something different as it changes from a solid to a liquid to a gas, but it can look different. *During a chemical change a **new material or substance** forms, BUT the amount of matter, mass, or number of atoms/molecules stays the SAME unless you have added something new.* When matter changes chemically, a rearrangement of bonds between the atoms occurs. This results in new substances with new properties.

☐ 12. Cite examples of physical and chemical changes in matter

A physical change is when the material changes form, but it is still the same material. (…such as a change of state; melting (solid to liquid), freezing (liquid to solid), evaporation (liquid to gas), also breaking, change shape or color, ripping, crumpling etc.)

Ex. Ryan boiled a liter of water and then stirred salt into it, adding more salt until no more would dissolve in the water, creating a saturated solution. It might look different, but Ryan's solution is an example of a physical change because NO NEW substance formed.

Ex. Melting a crayon – Physical change because NO new substance forms!

Ex. Rusting, tarnishing, burning, cooking an egg, and acid rain reacting w/ rocks and minerals, are examples of chemical changes because new substances have formed.

Ex. Combining 1/2 cup of vinegar with 1 gallon of milk causes the vinegar, which is an acid, to react with the milk. The milk sours and thickens, creating cottage cheese. This is a chemical change because a new substance forms.

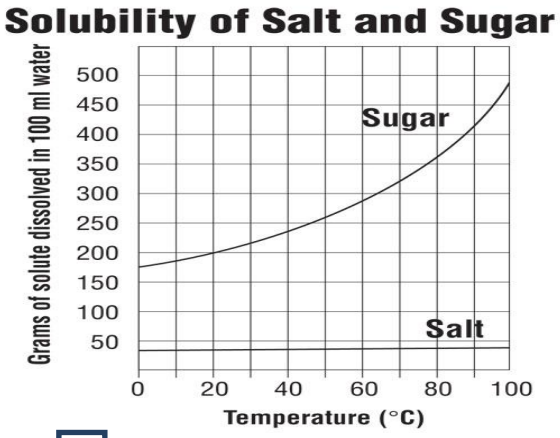
☐ 13. Investigate physical and chemical changes in matter

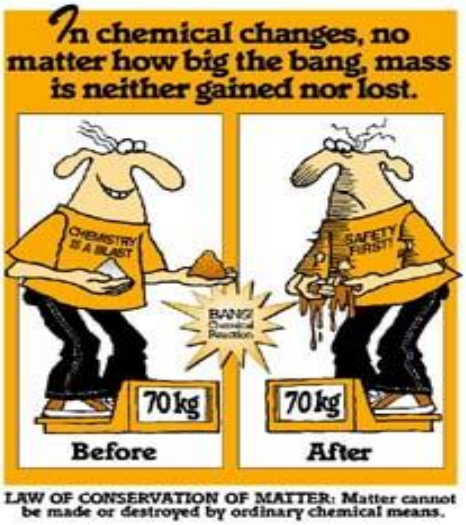
Physical Changes: If an ice cube with a mass of 15 grams melts, the liquid water will also have a mass of 15g. If the 15g of liquid water evaporates, the water vapor will also have a mass of 15g. Whether a substance undergoes a physical or chemical change, the Law of Conservation of Mass states the amount of matter (mass), or number of atoms, will not change even if a physical or chemical change takes place. Matter cannot be created or destroyed, only transformed.

☐ 14. Explain how temperature influences chemical changes

Heat speeds up a chemical reaction.

- Cookies bake faster at higher temperatures.
- Bread dough rises more quickly in a warm place than in a cool one.
- Low body temperatures slow down metabolism. In fact, warm-blooded animals regulate body temperature so that their biochemical reactions run at the correct rate.
- Lightsticks produce light via a chemical reaction. Dropping a lightstick into hot water makes it glow more intensely, demonstrating that the reaction runs faster at higher temperature.





☐ 15. Explain why mass is conserved when substances undergo physical and chemical changes according to the Law of Conservation of Mass
o differentiate between a law and a theory

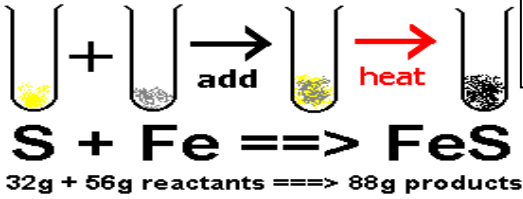
The Law of Conservation of Matter – Matter is not created or destroyed in any physical or chemical change.
In a chemical reaction two substances come together to form a new material, even though a new substance is formed the mass of the reactants is equal to the mass of the products.
The number of atoms in a given volume of water will remain the same whether it is solid ice, liquid water, or water vapor.

Theory vs Law

Theory: A well-substantiated **explanation** acquired through the scientific method and repeatedly tested and confirmed through observation and experimentation. Ex - Theory of Evolution
Law: A **statement** based on repeated experimental observations that describes some phenomenon of nature. Proof that something happens and how it happens, but not *why* it happens. Ex- Newton's Law of Universal Gravitation

☐ 16. Investigate the law of conservation of mass using models, such as:
o chemical equations, experiments, and demonstrations
o Design an investigation to explore the Law of Conservation of Mass

** The **law of conservation of mass** is observed in a balanced chemical **equation**, which is a chemical **equation** that shows all **mass** is conserved throughout the reaction. In a balanced chemical **equation**, the number and kinds of atoms on each side of the **equation** should be equal.



32g+56g=88g
Mass in=Mass out
Atoms in=Atoms out

Ex. If you measure the mass of some vinegar and the mass of some baking soda, and then you combine them, the mass of the products, including the carbon dioxide gas that forms, will be exactly the same because matter can't be created or destroyed. The number of atoms before the reaction is still the same as the number of atoms after the reaction, they just rearranged themselves.

Ex. Andy stirred 100 grams of salt (sodium chloride, NaCl) into a pot of water until he could no longer see any grains of salt. If he allows all the liquid to evaporate, how much salt will he find in the pot? 100 grams because that is what he started with. You can't create or destroy matter.

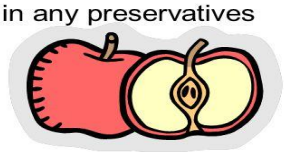
When conducting an experiment, only **ONE** variable should be tested at a time.
The **INDEPENDENT** (or test) VARIABLE is the one thing you **CHANGE**.
The **DEPENDENT** (or outcome) VARIABLE is the one thing you **MEASURE**.
The **CONTROL GROUP** is used to **COMPARE** the results to.

4. Design an Experiment

Answer:

I.V.- type of preservatives
D.V. -time it takes for the apple to get brown
Constants- type of apple, way the apple is cut, amount of preservatives, dipping time

Control Group- apples NOT dipped in any preservatives
Experimental Groups-
1) Apple in lemon juice
2) Apple in fruit freshener
3) Apple in lime soda



An **OBSERVATION** is something you detect using one or more of your 5 senses. OBSERVATIONS give us information about the world around us.
An **INFERENCE** is what you decide about an observation. INFERENCES attempt to explain or interpret observations based on the evidence and/or our experience.