## SECTION 1 (PP. 9-15): MATTER HAS MASS AND VOLUME.

**Georgia Standards: S8P1 - *Students will examine the scientific view of the nature of matter;***
**S8CS4b - *Use appropriate tools and units for measuring objects and/or substances.***

1. **All objects are made of matter.**
   Anything that has ***mass*** and takes up space is ***matter***. All the objects, liquids, gases, and living things in the universe are made of matter. Energy is not matter. However, under special circumstances, such as a nuclear reaction, energy can become matter and matter can become energy.

2. **Mass is a measure of the amount of matter.**
   Mass is measured by comparing the mass of an object with the mass of known units or standard units of mass. Units of mass are the kilogram and the gram. ***Weight*** is the downward pull of gravity on an object. An object's mass is invariable, but an object's weight varies, depending on the amount of gravity. Weight is measured in ***newtons (N)*.**

3. **Volume is a measure of the space matter occupies.**
   Units of ***volume*** are the cubic centimeter ($cm^3$ or cc) or milliliter. Thus, **1 mL = 1 $cm^3$**.
   The amount of space that matter takes up can be measured in two ways.
   - Use a formula to measure the volume of solids with a regular shape. For example, the volume of an object like a square or a rectangular box is length times width times height **(v = lwh*)***.
   - Use the ***displacement*** method to measure the volume of solids with an irregular shape. Submerge the object in a known amount of water. The increase in the volume of the water is the volume of the object. This technique will not work if the solid can dissolve.

## SECTION 2 (PP. 16-20): MATTER IS MADE OF ATOMS.

**Georgia Standards: S8P1a - *Distinguish between atoms and molecules;***
**S8CS4b - *Use appropriate tools and units for measuring objects and/or substances.***

1. **Atoms are extremely small.**
   All matter is made up of ***atoms***, which are so small that a teaspoon full of water has approximately $5 \times 10^{23}$ atoms. An atom has a radius of approximately $10^{-10}$ meters. Scientists have identified more than 100 kinds of atoms.

   Atoms combine to make ***molecules***. A molecule can be made from two or more of the same kind of atom or from two or more different kinds of atoms. For example, water molecules are made of 2 hydrogen atoms and 1 oxygen atom ($H_2O$). However, ozone molecules are made of oxygen atoms only ($O_3$).

2. **Atoms and molecules are always in motion.**
   Atoms and molecules are always moving. You can see evidence of moving air molecules as they collide with dust and other particles in the air. You can see liquids move when you add a drop of food coloring to water. Even the atoms and molecules in a solid constantly vibrate.

## SECTION 3 (PP. 21-26): MATTER COMBINES TO FORM DIFFERENT SUBSTANCES.

**Georgia Standards: S8P1b –** ***Describe the difference between pure substances (elements and compounds) and mixtures;*** **S8CS6c –** ***Organize scientific information in appropriate tables, charts, and graphs and identify the relationships they reveal.***

1. **Matter can be pure or mixed.**
   Matter that contains only one kind of atom or molecule is considered a pure substance. Matter often contains two or more substances mixed together. Substances can be composed of elements, compounds, or mixtures.
   - An ***element*** is a substance that contains only one type of atom. Examples of an element would include gold, silver, hydrogen, and oxygen.
   - A ***compound*** is a substance that consists of two or more different types of atoms that are chemically bonded together. Water molecules are compounds because they contain two kinds of atoms (hydrogen and oxygen) bonded together.
   - A ***mixture*** is a combination of different substances that retain their individual properties and can be separated by physical means (ex. – pepperoni pizza).

2. **Parts of mixtures can be the same or different throughout.**
   Mixtures can either be heterogeneous or homogeneous.
   - A ***heterogeneous mixture*** has different properties in different parts of the mixture because the substances in different parts of the mixture vary.
   - A ***homogeneous mixture*** has substances evenly spread out throughout the entire mixture.

## SECTION 4 (PP. 27-33): MATTER EXISTS IN DIFFERENT PHYSICAL STATES.

**Georgia Standards:** ***S8P1c – Describe the movement of particles in solids, liquids gases, and plasma states; S8CS2b – Demonstrate appropriate techniques in all laboratory situations.***

1. **Particle arrangement and motion determine the state of matter.**
   Solid, liquid, and gas are the three common ***states of matter***. When a substance changes from one state to another, the arrangement of its molecules change as well. The distance between molecules and the attraction they have for one another also changes.

2. **Solid, liquid, and gas are common states of matter.**
   - A ***solid*** has particles that are close together. The particles are attached to one another and can vibrate in place, but they cannot move from place to place.
   - A ***liquid*** has particles that are attracted to one another and are close together. The particles can slide over one another and move from one place to another.
   - A ***gas*** has particles that are not close to one another and can move about freely.

3. **Solids have a definite volume and shape.**
   A solid has a fixed volume and shape. The particles in some solids are in regular patterns and form crystals.

4. **Liquids have a definite volume but no definite shape.**
   A liquid has a definite volume because its particles are close enough together that they cannot move about freely, although they can slide past each other. A liquid takes the shape of its container.

5. **Gases have no definite volume or shape.**
   A gas has no definite volume or shape. The volume, pressure, and temperature of a gas are related to one another, and changing one can change the others.

6. **There are actually 5 states of matter.**
   In addition to solids, liquids, and gases, there are actually two other forms of matter. ***Plasma*** has super-fast particle movement and exists in forms such as fire and lighting, ***Bose-Einstein Condensate (BEC)*** has almost no particle movement at all and exists just above Absolute Zero.