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# The Properties of Matter

## Definition of Matter:

Everything around us is made up of very tiny bits called matter. Living things like people and animals are matter. Rocks, dirt, and water are also made of matter too. Even really small things we can't see with just our eyes are matter. Atoms join together to make molecules. Different molecules make up all the different materials. Matter comes in solids, liquids, and gases. It can be thin or thick. Understanding matter helps explain what the world is built from.



## Mass:

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## Volume:

Volume is a property that tells us how much space something takes up. We measure volume in units like liters and cubic centimeters. Volume is like mass in that it stays the same, no matter what. A cup of water has the same volume whether the cup is big or small. Volume also doesn't change if you squish something down or stretch it out. A ball of clay keeps its volume even when rolled flat as a pancake. Gases are special because their volume can be very large and change a lot with temperature or number of molecules. Measuring volume along with mass gives valuable info about densities too.



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## Physical Changes:



Changes between solid, liquid and gas states are physical, not chemical changes. This means the identities stay the same. During melting, a solid like ice becomes a liquid water when enough heat is added. Freezing is the opposite of melting. Evaporation occurs as a liquid turns to a gas, such as water boiling to make steam. The gas can condense back to liquid by cooling. Sublimation skips the liquid phase as something like dry ice transforms straight from solid to gas. Deposition goes the reverse way. Temperature or pressure alterations can cause a physical change with no new material made.

## Properties in Different States:

The arrangement of molecules affects properties in each state of matter. Solids are densely packed, so they hold their shape and volume no matter what. Their particles only vibrate in place. Liquids flow because

molecules slide over each other but stay close. Gases expand to fill any container since molecules spread apart with busy random motion. Density is an important property too. Solids have the highest density while gases have the lowest density. Increased vibrations or temperatures make solids melt to less dense liquids then vaporize to even less dense gases. Understanding how states differ helps predict how matter will act in different environments.

#### Applications:



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#### Factors Affecting State Changes:

Temperature and pressure control matter changes. On charts showing states in conditions, you can see melting/boiling points. Water freezes below  $0^{\circ}\text{C}$  and boils over  $100^{\circ}\text{C}$  at normal air pressure. Adjusting temperature allows matter to physically change between solid, liquid and gas phases. Pressure also impacts states - more squishes molecules closer together like in deep oceans while less lets the molecules spread out. Scientists manipulate temperature and pressure to perform experiments and understand the world around us.



#### Practical Applications



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##### Engineering and Construction

One major area is engineering and construction. Knowing densities helps evaluate the load-bearing strength of materials like steel beams and concrete foundations. Manipulating melting points permits joining metals through welding or casting. Insulation relies on low thermal conductivity of gases trapped in solids.

In manufacturing, property knowledge guides processing methods. Crystallization controls product textures. Films are spun or sprayed using vaporization properties. Material properties determine the viability of 3D printers or injection molding plastics.



##### Cooking

Cooks rely on phase transitions to perfect baked goods and frozen treats. Monitoring dough rising and cake layers falling involves water's unusual gas behavior. Boiling aids even heat distribution while searing seals moisture in meat.

### Reading Comprehension Questions:

1. What makes up all matter?
2. What
3. What
4. What units are used to measure mass?
5. Does the mass
6. What property tells us how much space something takes up?
7. What
8. How do
9. What
10. What two factors can cause matter to change between solid, liquid and gas phases?

### Extension questions:

1. An object is made of plastic with a
2. Provide an example of how engineers might use knowledge of phase diagrams in construction.
3. Explain how scientists



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