

Read About the Particle Nature of Matter

PARTICLES OF MATTER DEFINITION

Matter is anything that has weight and takes up space. A *particle* is the smallest possible unit of matter. Understanding that matter is made of tiny particles too small to be seen can help us understand the behavior and properties of matter.

To better understand how the 3 states of matter work....

LET'S BREAK IT DOWN!

All matter is made of particles that are too small to be seen.

Everything you can see and touch is made of matter. It is all the “stuff” in the universe.

Things that are not made of matter include energy, and ideas like peace and love.

Matter is made up of small particles that are too small to be seen, even with a powerful microscope. They are so small that you would have to put about 100,000 particles in a line to equal the width of a human hair!

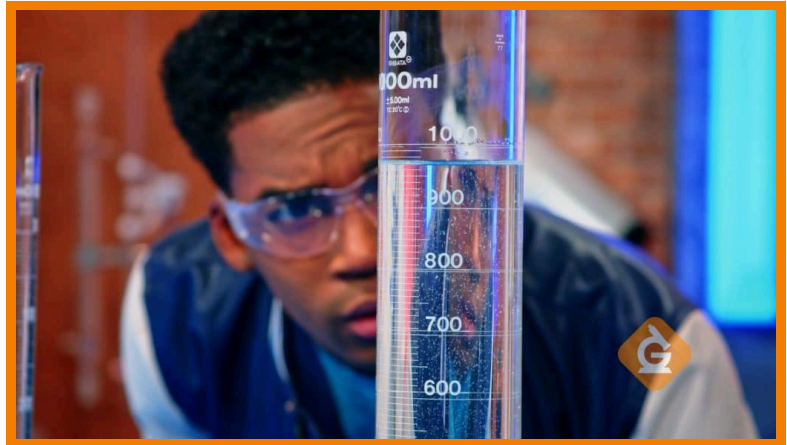


The arrangement of particles determines the state of matter.

Particles are arranged and move differently in each state of matter. Solids contain particles that are tightly packed, with very little space between particles. If an object can hold its own shape and is difficult to compress, it is a solid.

Liquids contain particles that are more loosely packed than solids, but still closely packed compared to gases. Particles in liquids are able to slide past each other, or flow, to take the shape of their container.

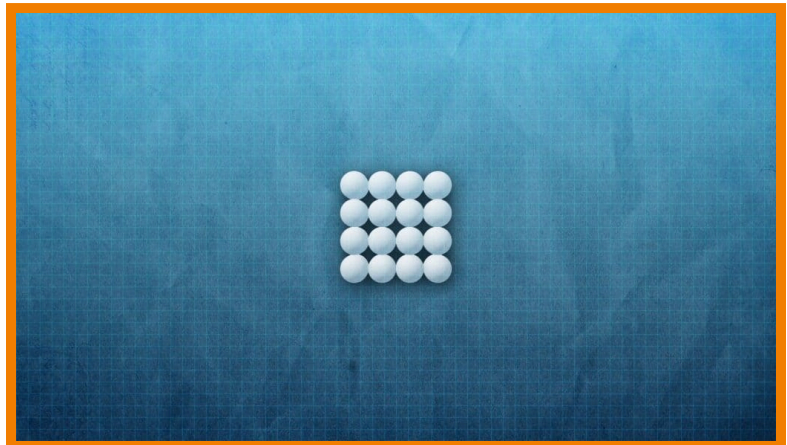
Particles are even more spread apart in gases. Gases will fill any container, but if they are not in a container, they will escape into the air. A lot of space exists between the particles in a gas, allowing gases to be compressed (pushed together) much more easily than solids and liquids.



Matter can change states.

Matter can change from one state to another. When solids change to liquids, the arrangement of the particles changes to become more loosely packed.

When liquids change to gases the particles become even more loosely packed.



It takes energy for matter to change from one state to another. To change liquid water to a gas, heat energy must be added. The opposite is also true. To change liquid water into a solid block of ice, energy must be removed.

The particle model explains the behavior of matter.

The particle model of matter states that all matter is made up of tiny, moving particles with spaces between them.

A neat science experiment can show us this: If we combine 50 mL of water and 50 mL of isopropyl alcohol, you would expect the total volume would

be 100 mL. In fact, the actual volume is 97 mL. It would seem that some of the liquid vanished. However, when the water and alcohol are mixed together, some of the particles of alcohol fit in between the particles of water.

An easier way to visualize this is to picture a beaker of ping-pong balls. If you pour tiny beads into the beaker with the ping-pong balls, the beads will fill in the spaces between the ping-pong balls.



EXAMPLES OF PARTICLES OF MATTER



When you inflate a soccer ball, it gets harder because of particles. Air particles are being compressed into the container and pushing on the inner walls of the ball. If the ball is placed in the freezer, the ball will deflate a little bit because the particles get closer together in the cooler temperatures.



Gas particles expand to fill their container. When air is removed from the vacuum chamber, the gases in the balloon will expand to fill the container.



Liquid nitrogen is cold enough to convert carbon dioxide gas particles to a solid. As the particles of carbon dioxide gas get colder, the space between the particles shrinks and the gas changes to a solid.

PARTICLES OF MATTER VOCABULARY

Matter

Anything that has weight and takes up space.

Particle

The smallest possible unit of matter.

Volume

The space occupied by a solid, liquid or gas.

Milliliters

A scientific measurement of volume, usually for liquids. A cup of water is 237 milliliters. Milliliters is usually abbreviated mL.

Graduated Cylinder

A scientific tool that is used to accurately measure out liquids.

Particle Model of Matter

The idea that all matter consists of many particles that are 100,000 times smaller than the width of a human hair. Knowing this allows us to explain a lot of interesting things in science.

PARTICLES OF MATTER DISCUSSION QUESTIONS

Why would a soccer ball that has been left out in the cold go flat?

A soccer ball that is filled with air can go flat when air particles in it take up less space. This can happen if you inflate the ball indoors but then play outside in cold weather.

What is the smallest possible unit of a type of matter called and about how big is it?

The smallest possible unit of matter is called a particle. Particles of matter are 100,000 times smaller than the width of a human hair. They cannot be seen, but we can detect them.

Why did 500 mL of water combined with 500 mL of alcohol add up to only 970 mL of total liquid? Use the particle model of matter to explain.

The liquid volume decreased because the water particles can fit into the spaces between the larger alcohol particles. This makes them take up less space (volume). To model this difficult concept, Dr. Jeff uses ping pong balls to represent large molecules and red beads to represent smaller particles that can fill the space between the ping pong balls.

What happens when Izzy and Zoe place the balloons filled with carbon dioxide into the bowl of liquid nitrogen?

Liquid nitrogen is extremely cold. When the carbon dioxide gas inside the balloon gets very cold it contracts, meaning the particles get closer together. In this case they got so close together it formed a solid.

What evidence for the particle model of matter does Dr. Jeff show during the liquid nitrogen demonstration?

When Dr. Jeff cuts open the balloon that Izzy placed in the liquid nitrogen, solid carbon dioxide falls out. The presence of solid carbon dioxide is evidence that the carbon dioxide gas is made up of particles. The solid carbon dioxide had to come from somewhere. (It is important to note that carbon dioxide is a unique material that can change directly from a solid to a gas without becoming a liquid first.)

Compare what happens to Zoe's soccer ball, which is left outside, to what you observed during the liquid nitrogen demonstration.

During the demonstration, carbon dioxide gas was cooled, causing the particles of carbon dioxide gas to come together and form solid carbon dioxide. This causes the balloon to deflate. Zoe's soccer ball was filled with air, which is also a gas. By leaving it outside, the cold air caused the air particles in the ball to move closer together. It didn't come together enough to form a solid, but it did make the ball deflate a little.
