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TEACHER GUIDE

PARTICLE NATURE OF MATTER
GRADES 3-5

NOTE: This lesson will be better understood if students have already learned about the conservation of matter so that they understand that matter cannot vanish. If you haven't already done so, WATCH THE GENERATION GENIUS CONSERVATION OF MATTER VIDEO with the class.

COMMON MISCONCEPTIONS

- **Students have difficulty with immensely large or small scale.**
  In the video, the size of particles is compared to the width of a human hair, which is something relevant that students can use for reference. However, since the particles are said to be 100,000 times smaller than the width of a human hair, this scale is still difficult to visualize. Interactive simulations can be found online that help students make comparisons at various scales.

- **Matter disappears (when dissolving or evaporating).**
  Matter may seem to disappear when it dissolves or evaporates, but in fact matter is just changing forms.

- **Gases are weightless.**
  Gases have weight and take up space (that's the definition of matter). If you weigh a balloon that is inflated with air and one that is not, you can find evidence that the balloon with air weighs more.

MATTER

Matter is anything that has weight and takes up space. Matter can exist in solid, liquid, and gas form, and each of these forms have weight and take up space, even if they appear to be invisible. As matter changes form, the amount of matter stays constant. For example, if an ice cube (solid water) melts into liquid, the liquid will weigh as much as the ice did. If that liquid water then evaporates in a contained space, the water vapor (gas) captured from the evaporating liquid will also weigh the same as the liquid and solid. This is called the conservation of matter. If the water vapor is not contained, matter is still conserved but the gas will become part of the surrounding air.

PARTICLES

All matter is made up of pieces of whatever type of matter it is. If you break apart any type of matter, it is still the same type of matter, just a smaller piece. For example, an ice shard from an ice cube is still solid water, and a droplet next to a glass of water is also still water, just less of it. If you could divide matter into the smallest possible pieces they would be extremely tiny—too small to see with your eyes. Particles of matter are much, much smaller than the width of a human hair—approximately 100,000 times smaller. That means about 100,000 particles could fit across a human hair! Because they are so small, we can't see particles. But we know they are there because they explain the properties of solids, liquids and gases.

In solid materials, particles are packed tightly together. They don't move much, if at all. Conversely, gas particles spread far apart and move freely. Gas particles spread to fill the shape of the container they are inside. Particles in a liquid are somewhere in between - they aren't spread as far and free as gas, but they aren't as tightly packed and stationary as particles in solids. Remember, for any type of matter, these are the same particles—they come together as solids and spread apart as liquids and even further as gases!

MODELING IN SCIENCE

When scientists want to explain something, they often develop models. These can be especially useful in explaining things that can't be seen. In everyday life, we tend to think of models like model airplanes, or styrofoam balls modeling the solar system. While creating a smaller version of something to scale is part of modeling, models can also be very useful for showing how processes work. For example, we often draw models to show how water cycles or how rocks cycle. In this lesson the focus is on particles of matter. Models are created and refined based on new knowledge to explain materials and interactions that can't be seen. We don't have a way to see for sure whether our model is correct, but a model becomes more and more accepted if it provides a way to explain various phenomena. Scientists sometimes find evidence that doesn't support a model and they have to figure out what changes need to be made to their understanding. The model might need to be changed a little bit.

Models don't have to be three-dimensional. They might be drawings, computer simulations, mathematical equations, or even people representing other things. Also, models aren't perfect. It is important for students to be clear about what each part of a model represents in a real system, and also to define the system it represents—what is included and what is not. Models can then be a clear way to communicate ideas with others.

PARTICLE MODEL OF MATTER

The Particle Model of Matter simply shows that all matter is made up as particles, and that these particles exhibit different qualities when the matter is solid, liquid or gas. We can use this model to explain phenomena that we observe with solids, liquids and gases. Other ideas or models about what matter is made of may exist, but the Particle Model of Matter is accepted in science because it has worked to explain our observations of matter so far.