

A Model of Matter: Part 1

My goal is simple. It is complete understanding of the universe, why it is as it is, and why it exists at all.

Stephen Hawking¹

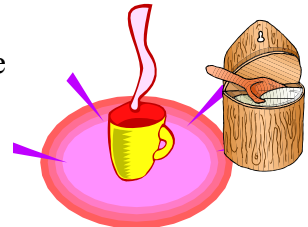
Matter is the “stuff” of the universe, and we make observations about matter all the time:



- Puddles disappear.
- Water disappears when it's boiled on a stove.
- Perfume feels cool on your skin



- Droplets of water appear on the bathroom mirror after a hot shower.
- Your tea tastes sweet even though you can't see any sugar in it.
- After you add hot cocoa to a mug, the outside of the mug gradually becomes hotter.



- Snow turns to water, drips, and turns into a solid that hangs down from the window.
- Metal tongs get hot when used to turn food that's cooked on a barbecue. (OK, well, you may not have noticed this lately, but think back...)

Water, ice, metals, glass, alcohol, water vapor, sugar...all are examples of matter we observe in our daily lives. We notice changes: water disappears from open containers; snow disappears; icicles form; drops of water appear as if by magic on the surfaces of cool objects; sugar disappears in hot tea, but its taste is still there. We observe that a metal spoon becomes hot when

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placed in hot food, but a plastic spoon does not. We know that liquids (e.g., perfume, water, sweat) make our skin feel cooler. We know that solids are different from liquids and gases but that all have mass and take up space.

Since the beginnings of recorded time, humans have made observations of the matter around them and tried to explain those observations. The age-old question is:

What model of matter can we develop that explains observed changes consistently?

Over 2,000 years ago, a Greek natural philosopher named Democritus (~ 460 BC - ~ 370 BC) wrote the following:

Matter is composed of tiny particles he called atomon, or “indivisible”

Democritus’ model of matter is described below. It is similar in significant ways to the model of matter that modern-day scientists propose:

Democritus asserted that space, or the Void, had an equal right with reality, or Being, to be considered existent. He conceived of the Void as a vacuum, an infinite space in which moved an infinite number of atoms that made up Being (i.e. the physical world). These atoms are eternal and invisible; absolutely small, so small that their size cannot be diminished (hence the name atomon, or “indivisible”); absolutely full and incompressible, as they are without pores and entirely fill the space they occupy; and homogeneous, differing only in shape, arrangement, position, and magnitude.²

Democritus argued that matter is composed of tiny particles. In addition to this, if our model of matter assumes that the “atomons” are in motion, can we use these ideas to explain our observations of the stuff of the universe (matter)?

This next series of emails will look at our model of matter: tiny particles in motion. These are important ideas; they turn up continually in the STC units. The ideas of tiny particles in motion can be used to explain the properties of solids, liquids, and gases; the expansion of matter when it is heated; evaporation, condensation, melting, and freezing; the water cycle; the rock cycle. We find these ideas in **STC units** including:

Balancing & Weighing
Chemical Tests
Electrical Circuits

Floating & Sinking
Rocks & Minerals
Soils

Solids & Liquids
Weather
Land & Water

Next week, we'll look at a change that we've all observed and see if we can explain it using our model of matter. Meanwhile, try this activity with your students:

Ask your students to draw a diagram and explain how water disappears from a puddle.

- What happens?
- Where does the water go?
- Why?

We'd love to see the answers they develop!

Please send your observations to us <mailto:crsep@schenectady.k12.ny.us>

or mail the drawings to:

CRSEP Office
Schenectady City School District Office
108 Education Drive
Schenectady, New York 12303

What do the New York State standards say?

In the Elementary and Intermediate Core Curricula, Standard 6, Interconnectedness: Common Themes,

Key Idea 2 states:

- *Models are simplified representations of objects, structures, or systems used in analysis, explanation, interpretation, or design.*

¹<http://www.famous-quotations.com/>

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²<http://www-gap.dcs.st-and.ac.uk/~history/Mathematicians/Democritus.html>

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