

Name: \_\_\_\_\_

Date: \_\_\_\_\_

# What are atoms?



## Vocabulary Words:

Atoms: smallest part of an element that is still that element

**Everything is made of atoms.** Atoms are teeny, tiny bits of matter. Atoms are the smallest part of an element that is still that element. The smallest part of hydrogen is an atom of hydrogen. Each element found on the periodic table of elements is made up of a different kind of atom. There are more than 109 different types of atoms. When atoms join together, they form molecules. Each molecule is made up of atoms. Atoms can combine to form different substances. The 109 different kinds of atoms can combine to form millions of different molecules.

What is an atom?

**How big is an atom?** Atoms are small. Atoms are really, really small. Atoms are smaller than anything you can imagine. An atom is so small that a million atoms can fit into the period at the end of this sentence. It is hard to believe, but scientists are able to study atoms despite their size. Atoms cannot be seen, even with the most powerful microscope, but they have other tools that they use to study them. These tools are new to science. Before these tools, scientists had to make guesses about atoms. Democritus was a Greek teacher who was around about 2,000 years ago. Democritus studied matter. He was able to guess that matter was made up of tiny particles. At first, he called these particles, particles atoms. He thought that atoms were solid particles that could not be broken apart. After much research, scientists no longer believe this theory. Even though his ideas may not have been true, they were helpful to scientists who later studied atoms.

How did Democritus describe an atom?

Theories of atoms. After Democritus, not much was studied about atoms until about 150 years ago when an English chemist named John Dalton came up with his own theory about atoms. Dalton studied atoms and came up with four ideas about them.

- ✓ All elements are made of tiny particles called atoms.
- ✓ All atoms of the same element weigh the same amount. Atoms of different elements have different weights.
- ✓ Atoms are solid particles that cannot be split apart.
- ✓ Atoms can combine with other atoms to form compounds.

As scientists continue to study atoms, they disagree with some of Dalton's ideas however, much of his ideas have helped to form present day ideas about atoms. How are Democritus and Dalton's theories alike?

How does a chemical change effect an atom? When a chemical reaction occurs, atoms will combine to form molecules or they might break down to form atoms. No matter what happens, the atom itself will never change in a chemical reaction.

For example, two atoms of hydrogen and one atom of oxygen will combine to form water. The atoms of hydrogen and oxygen do not change. The molecule of water can be broken down into the same atoms of hydrogen and oxygen. Chemical reactions create new substances, but they do not produce new atoms. The new substance will contain the same kind and number of atoms as the old substance.

What happens in a chemical reaction?



### You Learned:

- ✓ An atom is the smallest part of an element that is still an element.
- ✓ Atoms are so small that millions fit into the period of a sentence.
- ✓ Theories about atoms change as we learn more about them.
- ✓ Chemical reactions do not change the atom.

### Questions:

1. \_\_\_\_\_ was the first person to study atoms.
2. Democritus first called atoms \_\_\_\_\_.
3. There are more than \_\_\_\_\_ different types of atoms.
4. The 109 different atoms can combine to form \_\_\_\_\_ of different molecules.
5. The smallest bit of iron is an \_\_\_\_\_ of iron.
6. \_\_\_\_\_ took Democritus' theories a bit farther as he learned more about atoms.
7. According to Dalton, atoms of the same element have the same \_\_\_\_\_ and atoms of different elements have a different \_\_\_\_\_.
8. Atoms can combine with other atoms to form \_\_\_\_\_.
9. Chemical reactions \_\_\_\_\_ change atoms.
10. Why did Dalton know more about atoms than Democritus?

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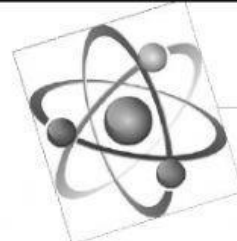
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# Atomic Theories Over Time



## Vocabulary Words:

Theory: smallest part of an element that is still that element

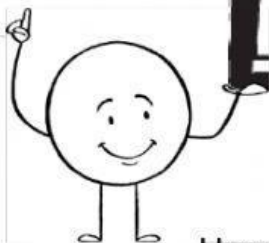
**Democritus.** Democritus was a Greek philosopher in 430 B.C. who first came up with the theory that atoms were small pieces of matter that could not be cut into smaller parts. Democritus first named atoms, atomos, this is a Greek word that means uncuttable. Today, we call them atoms. Atoms are the smallest particle that can still be considered part of an element.

The word atom came from the Greek word, atomos, what is the meaning of this word?

**Dalton.** John Dalton was interested in atoms and used evidence from past theories to build upon his own. Through his findings, Dalton determined a few things about atoms and began to build upon their characteristics. Dalton visualized atoms as smooth, hard spheres that could not be broken down into smaller pieces. Some of his other theories include:

### Dalton's Atomic Theory

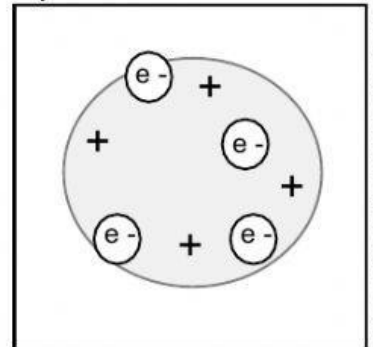
- All elements consist of atoms that cannot be divided.
- All atoms of the same element are exactly alike and have the same mass. Atoms of different elements are different, so they have different masses.
- Chemical reactions do not change atoms.
- Compounds are formed by combining different atoms.



How did John Dalton build upon Democritus' atomic theory?



**Thomson.** In 1897, J.J. Thomson founded an important discovery as he was studying atoms. Thomson realized that atoms contain negatively charged particles called electrons. This was interesting because scientists knew that atoms did not have an electrical charge. Knowing this information made them dig deeper. If part of the atom had a negative charge, then there must be a positive charge somewhere to balance it out. Thomson developed a visual for his model to look like the one to the right. The large circle represents the positive part with smaller parts representing the electrons.



An important change in this finding is that an atom contains smaller parts, like the negatively charged electron.

What important finding did Thomson discover?

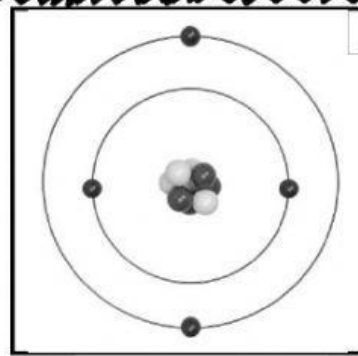
**Rutherford.** In 1911, Ernest Rutherford, a former student of Thomson, made a discovery that challenged his teacher's findings. The discovery came about when they were experimenting with a piece of gold. An experiment was conducted that had positively charged particles aimed at a piece of gold foil. When these particles were aimed at the piece of gold, many of the pieces of gold were deflected at large angles.

Based on these findings, Rutherford was able to determine that an atom is made up of mostly empty space but has a positive charge in the center. He determined this because he knew that like charges would repel one another sending them flying away. Based on how the particles deflected, Rutherford inferred that the atom has a nucleus in which there are positive particles inside that deflected the other positive particles.

Rutherford named these positive particles, protons. He updated what an atom looks like. According to Rutherford, an atom has a nucleus that holds protons with electrons moving all around it. He felt it looked similar to the inside of a cherry. The protons were in the nucleus like a pit and the electrons were around it.



Bohr. Niels Bohr was Ernest Rutherford's student. After further studying, the model of the atom was revised again. Bohr's findings led him to believe that electrons travel in orbits, specific paths around the nucleus of the atom. His visual resembled planets orbiting the sun. According to Bohr, each orbit contains a specific energy level.



How did Bohr build upon Thomson's findings?

Cloud Model. Yet another change came in the 1920s. This time, scientists felt that instead of the electrons orbiting around the nucleus, it was determined that the electrons move around the nucleus quickly in a cloud. This means they are constantly moving in all different directions. They move so quickly that you cannot really see where it is at any given point, so it resembles a cloud. The rate at which electrons move depends upon its energy level. An energy level is the specific amount of energy it has.

How is the cloud model different from Bohr's model?

Today's Model. How the atom looks has changed a lot since it was first discovered. It may continue to change as scientists continue to learn more about it and the parts that make it up. What led to the latest change happened in 1932 when James Chadwick came to the realization that another particle was found within the atom. Chadwick discovered neutrons. A neutron was the last part of the atom to be found. It was the hardest part to find because it has no electrical charge.

Today, scientists know that protons and neutrons are found within the nucleus of an atom. Surrounding the nucleus is the electron. Most of an atom's volume is the space in which the electron takes up.

Why has the visual of an atom changed so many times throughout history? Is it possible it will continue to change?



### You Learned:

- ✓ The look of the atom has changed over time because of new information that the scientists have found.
- ✓ Democritus was the first scientist to theorize that atoms are small bits of matter that cannot be cut into smaller parts.
- ✓ John Dalton found that atoms cannot be divided, atoms of the same element are exactly alike, atoms of different elements are different, chemical reactions do not change atoms, and atoms can combine to form different things.
- ✓ J.J. Thomson discovered that atoms have negatively charged particles called electrons.
- ✓ Ernest Rutherford discovered that atoms have a nucleus that contain positively charged particles called protons.
- ✓ Niels Bohr suggested that electrons orbit the nucleus in paths like a planet orbits the sun.
- ✓ Cloud model found that electrons do not actually orbit the nucleus but move rapidly in a cloudlike area.
- ✓ Modern model was founded by James Chadwick who discovered that the nucleus also contains neutrons and that most of the volume is the space in which the electrons move.

### Questions:

1. Why does the look of an atom keep changing?

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2. Is it possible that the look of the atom will continue to change? Explain.

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## Atomic Theory



Directions: Read through each theory and illustrate what the atom looked like.

The look of atoms have changed over time. As scientists learn more about atoms, they have changed their ideas of what it looks like. Read through their findings and illustrate their version of the atom in the box.



Democritus:

John Dalton:

J.J. Thomson:

Ernest Rutherford:

Niels Bohr:

Cloud Model:

Today's Model: