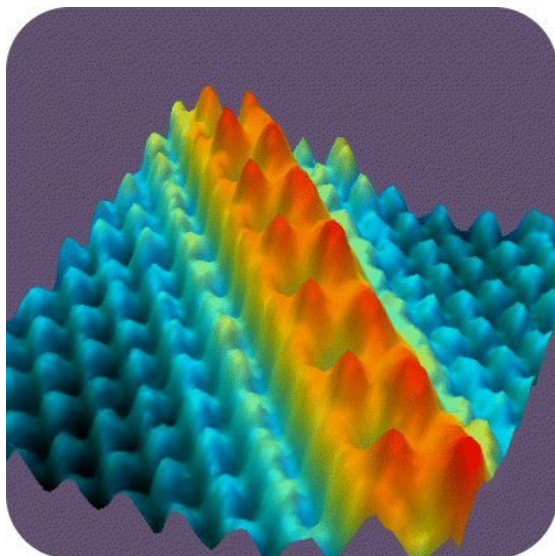


## Lesson Objectives

- Describe atoms and how they are related to elements.
- Identify the three main subatomic particles that make up atoms.

## Lesson Vocabulary

- Atom



[Figure 1]

What could this hilly surface be? Do you have any idea? The answer is row upon row of atoms. To be specific, they are nickel atoms. The picture was created using a scanning tunneling microscope. No other microscope can make images of things as small as atoms. How small are atoms?

## What Are Atoms?

Atoms are the building blocks of matter. Unlike blocks that we know, these building blocks are incredibly small. In fact, they are the smallest particles of an element. Atoms still have the same properties as the elements they make up. Elements are also pure substances. This means they are not mixed with anything else. Pure substances such as nickel, hydrogen, and helium make up all kinds of matter. All the atoms of a given element are identical. Atoms of different elements are not physically the same.

Think of something you might have made from LEGOs. You built some shape using the many different sized and shaped blocks. This is much like how atoms combine to become everything we know. If we took only one size and shape of block and put them together, we would make a pure substance. It would be an element. If you take apart anything that you have built, those individual parts are like the atoms. With those small parts, you build bigger things. Sometimes they are all the same type of block. Other times, they may be different kinds of blocks. We use these combinations of different blocks to make more complicated things.

## Size of Atoms

Unlike LEGO bricks, atoms are extremely small. The radius of an atom is well under 1 nanometer. That's one-billionth of a meter. Such a number is hard to imagine. Consider this: trillions of atoms would fit inside the period at the end of this sentence. In other words, atoms are way too small to be seen with the naked eye.

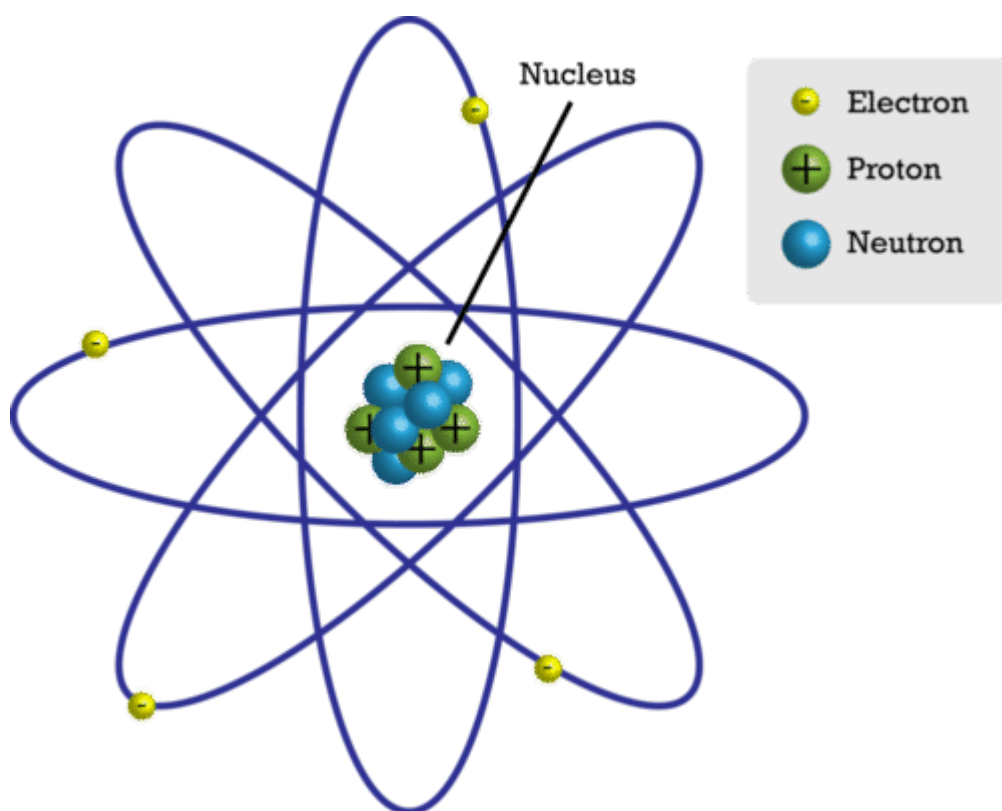
## Subatomic Particles

Although atoms are very tiny, they consist of even smaller particles. Atoms are made of protons, neutrons, and electrons:

- Protons have a positive charge.
- Electrons have a negative charge.
- Neutrons are neutral in charge.

### Parts of the Atom

**Figure below** represents a simple model of an atom. Models help scientists make sense of things. Perhaps they are either too big or too small. Maybe they are just too complicated to make sense of. This simple model helps scientists think about the atom. Is this how the atom really looks? Not exactly! Remember, a model helps us make sense of things. They may not be an exact copy of the object. You will learn about more complex models of atoms in the coming years, but this model is a good place to start.



[Figure 2]

This simple atomic model shows the particles inside the atom.

### The Nucleus

At the center of an atom is the **nucleus** (plural, nuclei). The nucleus contains most of the atom's mass. However, in size, it's just a tiny part of the atom. The model in **Figure above** is not to scale. If an atom were the size of a football stadium, the nucleus would be only about the size of a pea.

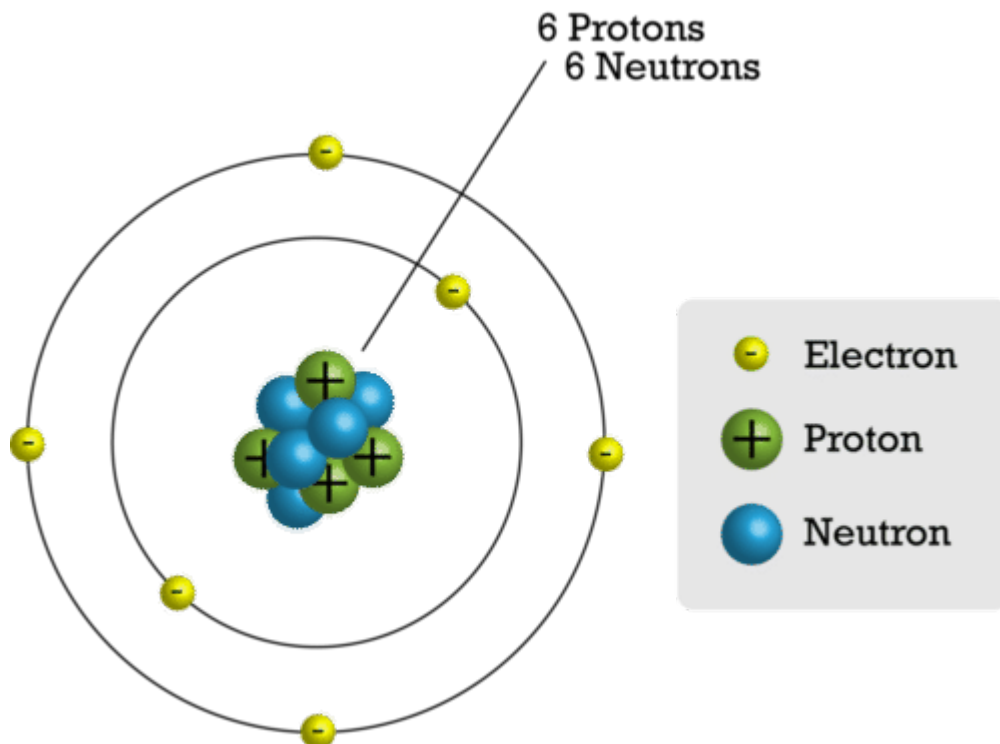
The nucleus, in turn, consists of two types of particles, called protons and neutrons. These particles are tightly packed inside the nucleus. Constantly moving about the nucleus are other particles called electrons.

### Protons

A **proton** is a particle inside the nucleus of an atom. It has a positive electric charge. All protons are identical. It is all about the number of protons in the atoms. The number of protons is what gives the atoms of different elements their unique properties. Atoms of each type of element have a characteristic number of protons. For example, each atom of carbon has six protons (see **Figure below**). No two elements have atoms with the same number of protons.

### Neutrons

A **neutron** is a particle inside the nucleus of an atom. It has no electric charge. Atoms of an element often have the same number of neutrons as protons. For example, most carbon atoms have six neutrons as well as six protons. This is also shown in **Figure below**.



[Figure 3]

This model shows the particles that make up a carbon atom.

### Electrons

An **electron** is a particle outside the nucleus of an atom. It has a negative electric charge. The charge of an electron is opposite but equal to the charge of a proton. Atoms have the same number of electrons as protons. As a result, the negative and positive charges "cancel out." This makes atoms electrically neutral. For example, a carbon atom has six electrons that "cancel out" its six protons.

### Lesson Summary

- Atoms are the building blocks of matter. They are the smallest particles of an element. They still have the element's properties.
- All atoms are very small. Atoms of different elements vary in size.
- Three main types of particles that make up all atoms are protons, neutrons, and electrons.

### Lesson Review Questions

1. What is an atom?
2. Which of the following statements is true about the atoms of any element:
  - a. They have the same number of protons as the atoms of all other elements.
  - b. They have protons that are identical to the protons of all other elements.
  - c. They have the same size as the atoms of all other elements.
  - d. They have the same number of protons as neutrons.