

# Atomic Theory

Textbook pages 28–37

## Before You Read

What do you remember about atoms from earlier studies? Record your ideas below.

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### Mark the Text

#### Identify Details

As you read the section, use one colour to highlight the text that explains how the atomic theory was developed. Use another colour to highlight facts about the parts of an atom.

### Reading Check

- List three subatomic particles.

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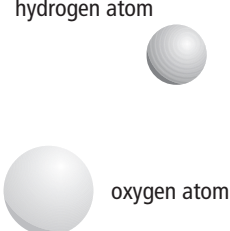
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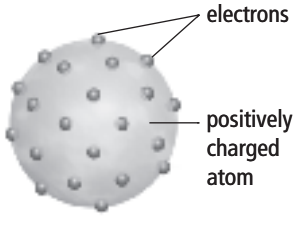
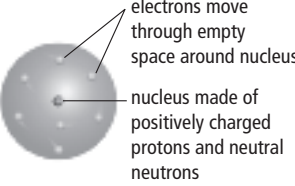
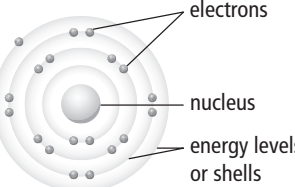
### What are atoms and how do we know they exist?

An **atom** is the smallest particle of an element that still has the identity and properties of the element. Atoms are made up of **subatomic particles** (particles that are smaller than atoms). These particles are protons, neutrons, and electrons. **Protons** are positively charged subatomic particles. Protons cluster with uncharged subatomic particles called **neutrons**. Protons and neutrons form the central positively charged core, or **nucleus**, of an atom. Fast-moving, negatively charged **electrons** occupy the space that surrounds the nucleus. ✓

### How did atomic theory develop?

Our understanding of the atom has come from the work of many men and women in different countries. The following chart mentions some of their most important discoveries.

The theory of the atom	Who developed the theory	The features of the theory	The experimental evidence for the theory
	John Dalton (1766–1844)	<ul style="list-style-type: none"> <li>All matter is made of small particles called atoms.</li> <li>Atoms cannot be created, destroyed, or divided into smaller particles.</li> <li>All atoms of the same element are identical, but they are different from the atoms of other elements.</li> <li>Compounds are created when atoms of different elements link together in specific ways.</li> </ul>	Dalton used the idea of atoms to help him explain the results of his experiments with compounds such as carbon dioxide, water, and nitrogen oxide.

	<p>John Joseph (J. J.) Thomson (1856–1940)</p>	<ul style="list-style-type: none"> <li>• Atoms contain negatively charged particles (later called electrons).</li> <li>• The negatively charged particles are embedded in the atom, which is positively charged.</li> </ul>	<p>Thomson observed streams of negatively charged particles while studying electric currents in gas discharge tubes. He inferred that all atoms contained these tiny particles.</p>
	<p>Ernest Rutherford (1871–1937)</p>	<ul style="list-style-type: none"> <li>• Most of the atom is empty space. Electrons move in this space.</li> <li>• Most of the mass of the atom is concentrated in a tiny, dense, positively charged central core: the nucleus.</li> <li>• The nucleus contains positively charged particles called protons and particles with no electric charge called neutrons.</li> </ul>	<p>Rutherford exposed gold foil to streams of high-speed, positively charged particles called alpha particles. Most of the alpha particles passed through the thin foil, but a small number of alpha particles were deflected as if they had struck something solid. This “something solid” was the atomic nucleus.</p>
	<p>Niels Bohr (1885–1962)</p>	<ul style="list-style-type: none"> <li>• Electrons surround the nucleus of the atom in specific energy levels or shells.</li> </ul>	<p>Bohr made hydrogen gas glow by passing an electric current through it. He studied the light given off as electrons gain energy and as they give off energy. Bohr proposed that electrons can only exist in specific energy levels or shells around the nucleus.</p>

 **Reading Check**

2. What caused some alpha particles to be deflected in Rutherford's gold foil experiment?

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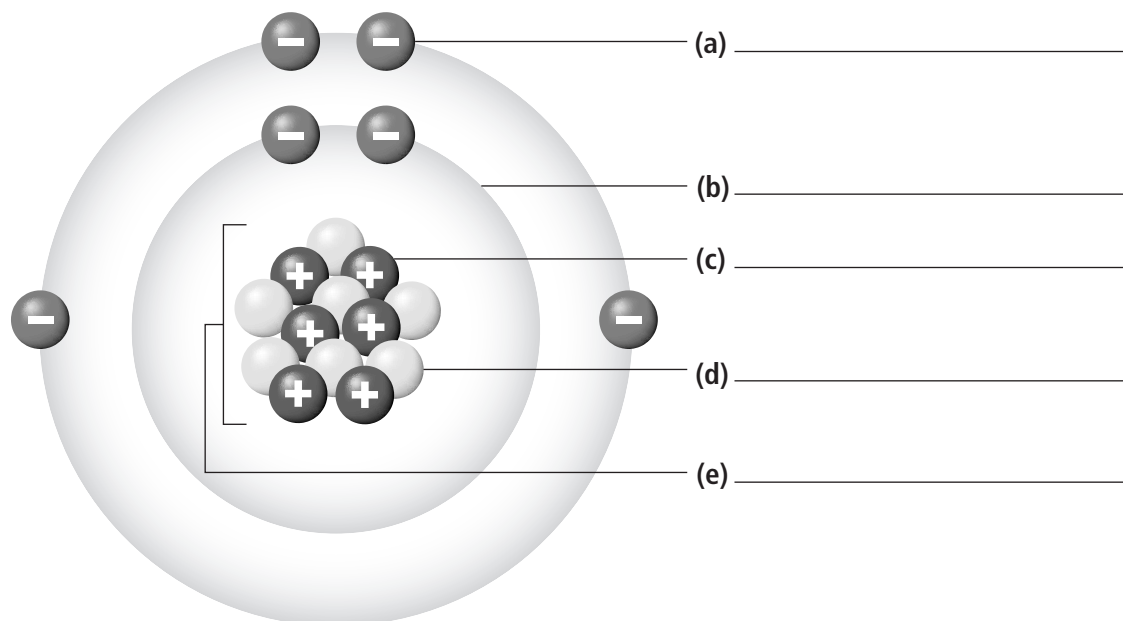
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Use with textbook pages 28–33.

## Atomic structure

1. Use the vocabulary terms that follow to label the parts of an atom. Place the correct term on the line next to each part of the atom. You will not need to use all the terms.

- atom
- proton
- nucleus
- neutron
- electron
- shell



2. Complete the following table describing the three subatomic particles.

	Proton	Neutron	Electron
<b>electric charge</b>			
<b>location in the atom</b>			

Use with textbook pages 28–33.

## The atom

### Vocabulary

Bohr	neutrons
Dalton	positive
electrons	protons
energy	shells
mass	subatomic particles
negative	Rutherford
neutral	Thomson

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

- \_\_\_\_\_ suggested that matter is made up of atoms.
- \_\_\_\_\_ proposed that atoms contain negatively charged particles later called \_\_\_\_\_.
- \_\_\_\_\_ discovered the nucleus and its subatomic particles. He suggested that the nucleus was made up of positively charged particles called \_\_\_\_\_ and particles with no charge called \_\_\_\_\_.
- \_\_\_\_\_ proposed that electrons are located in \_\_\_\_\_ around the nucleus.
- Electrons have different amounts of \_\_\_\_\_ and can jump back and forth between the energy levels.
- All atoms are made up of three \_\_\_\_\_: protons, electrons, and neutrons.
- Protons have a \_\_\_\_\_ charge, electrons have a \_\_\_\_\_ charge, and \_\_\_\_\_ have no electric charge.
- \_\_\_\_\_ and \_\_\_\_\_ cluster together to form the nucleus of an atom.

Use with textbook pages 28–33.

## Contributions to atomic theory

Scientist
Bohr
Dalton
Rutherford
Thomson

**Match each scientist to the statements describing his contribution to the atomic theory. Identify who was the first to propose these ideas. Each scientist may be used more than once.**

1. Atoms cannot be created, destroyed, or divided into smaller particles.

\_\_\_\_\_

2. Electrons occupy specific energy levels or shells.

\_\_\_\_\_

3. Most of the mass of the atom is in the tiny, dense, positively charged nucleus.

\_\_\_\_\_

4. Most of the atom is empty space.

\_\_\_\_\_

5. All matter is made of small particles called atoms.

\_\_\_\_\_

6. All atoms of the same element are identical.

\_\_\_\_\_

7. Atoms contain negatively charged particles.

\_\_\_\_\_

8. The nucleus contains positively charged particles called protons and particles with no electric charge called neutrons.

\_\_\_\_\_

9. Different elements combine together to form compounds.

\_\_\_\_\_

10. Electrons move around a central nucleus.

\_\_\_\_\_

Use with textbook pages 28–33.

## Atomic theory

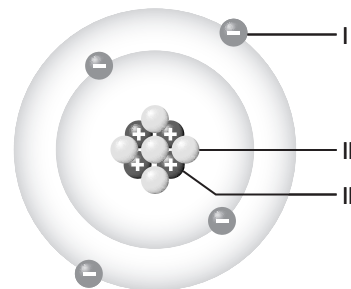
Match each Descriptor on the left with the corresponding Scientist on the right. Each Scientist may be used more than once.

Descriptor	Scientist
1. _____ discovered the nucleus	<b>A.</b> Bohr <b>B.</b> Dalton <b>C.</b> Rutherford <b>D.</b> Thomson
2. _____ suggested that all matter is made of atoms	
3. _____ proposed the “raisin bun” model of the atom	
4. _____ observed streams of negatively charged particles in gas discharge tubes	
5. _____ proposed that electrons exist in energy levels	

Circle the letter of the best answer.

6. Which of the following was not part of Dalton’s atomic theory?
- A.** All matter is made of small particles called atoms.  
**B.** Atoms can be created or destroyed.  
**C.** Atoms of the same element are identical.  
**D.** Atoms of one element are different from the atoms of other elements.
7. Which of the following was not part of Rutherford’s atomic theory?
- A.** Most of the mass of the atom is concentrated in electrons.  
**B.** Most of the atom is empty space.  
**C.** The nucleus is the tiny, dense, central core of the atom.  
**D.** The nucleus contains protons and neutrons.

Use the following diagram of an atom to answer questions 8 and 9.



8. Which of the following is the structure labelled II in the diagram?
- A.** atom  
**B.** proton  
**C.** neutron  
**D.** electron
9. Which of the following exists in energy levels?
- A.** I only  
**B.** II only  
**C.** III only  
**D.** II and III only
10. What is the electrical charge of the nucleus of an atom?
- A.** neutral charge  
**B.** positive charge  
**C.** negative charge  
**D.** It depends on the element
11. The nucleus of the atom contains which of the following subatomic particles?
- A.** electron  
**B.** proton and neutron  
**C.** proton and electron  
**D.** proton, neutron, and electron