


Chapter 1
Introduction to Chemistry

1.1 The Scope of Chemistry

- 1.2 Chemistry and You
- 1.3 Thinking Like a Scientist
- 1.4 Problem Solving in Chemistry




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1.1 The Scope of Chemistry > What Is Chemistry?

Matter is anything that has mass and occupies space.

The trees, the water, and the buildings in the figure are all examples of matter.



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1.1 The Scope of Chemistry > What Is Chemistry?


Chemistry answers many questions you may have about the world you live in.

- **Chemistry** is the study of the composition of matter and the changes that matter undergoes.

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1.1 The Scope of Chemistry > What Is Chemistry?

 **Chemistry affects all aspects of life and most natural events because all living and nonliving things are made of matter.**

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1.1 The Scope of Chemistry >



What is wrong with an advertisement for juice drinks that claims the juice is all-natural and free of chemicals?

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1.1 The Scope of Chemistry >



What is wrong with an advertisement for juice drinks that claims the juice is all-natural and free of chemicals?

Everything is made up of matter; therefore, everything contains chemicals. Even all-natural products are made of chemicals.

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1.1 The Scope of Chemistry > Areas of Study

Areas of Study

 **What are five traditional areas of study in chemistry?**

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1.1 The Scope of Chemistry > Areas of Study

 **Five traditional areas of study are:**

- organic chemistry
- inorganic chemistry
- biochemistry
- analytical chemistry
- physical chemistry

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1.1 The Scope of Chemistry > Areas of Study

Most chemicals found in organisms contain carbon.

- **Organic chemistry** is defined as the study of all chemicals containing carbon.

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1.1 The Scope of Chemistry > Areas of Study

An organic chemist might develop new lightweight plastics for flying disks.



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1.1 The Scope of Chemistry > Areas of Study

The study of chemicals that, in general, do not contain carbon is called **inorganic chemistry**.

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1.1 The Scope of Chemistry > Areas of Study

The study of chemicals that, in general, do not contain carbon is called **inorganic chemistry**.

- Many inorganic chemicals are found in nonliving things, such as rocks.

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1.1 The Scope of Chemistry > Areas of Study

An inorganic chemist might develop metal materials that provide strong structural parts for buildings.



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1.1 The Scope of Chemistry > Areas of Study

The study of processes that take place in living organisms is **biochemistry**.

- These processes include muscle contraction and digestion.

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1.1 The Scope of Chemistry > Areas of Study

A biochemist might study how the energy used for the contraction of muscles is produced and stored.



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1.1 The Scope of Chemistry > Areas of Study

The area of study that focuses on the composition of matter is **analytical chemistry**.

- A task that would fall into this area of chemistry is measuring the level of carbon dioxide in the atmosphere.

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1.1 The Scope of Chemistry > Areas of Study

An analytical chemist might test the air for the presence of pollutants.



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1.1 The Scope of Chemistry > Areas of Study

Physical chemistry is the area that deals with the mechanism, rate, and energy transfer that occurs when matter undergoes a change.

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1.1 The Scope of Chemistry > Areas of Study

A physical chemist might study factors that affect the rate of photosynthesis in trees.



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1.1 The Scope of Chemistry > Areas of Study

The boundaries between the five areas are not firm.

- A chemist is likely to be working in more than one area of chemistry at any given time.
- For example, an organic chemist uses analytical chemistry to determine the composition of an organic chemical.

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1.1 The Scope of Chemistry > Areas of Study

Pure chemistry is the pursuit of chemical knowledge for its own sake.

- The chemist doesn't expect that there will be any immediate practical use for the knowledge.

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1.1 The Scope of Chemistry > Areas of Study

Applied chemistry is research that is directed toward a practical goal or application.

- In practice, pure chemistry and applied chemistry are often linked.

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1.1 The Scope of Chemistry > CHEMISTRY & YOU

Why would you study a puffer fish if you were a biochemist? If you were an organic chemist?



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1.1 The Scope of Chemistry > CHEMISTRY & YOU

Why would you study a puffer fish if you were a biochemist? If you were an organic chemist?

- Biochemists might study the puffer fish to determine how its toxin acts on the human body.
- Organic chemists might study the composition of the puffer fish toxin.



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1.1 The Scope of Chemistry > Big Ideas in Chemistry

Big Ideas in Chemistry

 **What are the central themes of chemistry?**

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1.1 The Scope of Chemistry > Big Ideas in Chemistry

 **Some of chemistry's big ideas are as follows:**

- chemistry as the central science
- electrons and the structure of atoms
- bonding and interactions
- reactions
- kinetic theory
- the mole and quantifying matter
- matter and energy
- carbon chemistry

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1.1 The Scope of Chemistry > **BIG IDEA**

Chemistry as the Central Science

- Chemistry overlaps with all of the other sciences.
- Many physicists, biologists, astronomers, geologists, environmental scientists, and others use chemistry in their work.

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1.1 The Scope of Chemistry > **BIG IDEA**

Electrons and the Structure of Atoms

- Carbon, oxygen, and copper are all examples of elements.
- Elements are composed of particles called atoms, and every atom contains a nucleus and one or more electrons.
- The type of products obtained in a chemical reaction is largely determined by the electrons in the reacting chemicals.

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1.1 The Scope of Chemistry > **BIG IDEA**

Bonding and Interactions

- Most elements exist in chemical compounds, which are collections of two or more elements held together by relatively strong attractive forces.
- These forces, called chemical bonds, greatly influence the properties of compounds.
 - Weak bonds between the particles of an element or compound can also contribute to the properties of the material.

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1.1 The Scope of Chemistry > **BIG IDEA**

Reactions

- Chemical reactions involve processes in which reactants produce products.
 - When you strike a match, the compounds in the head of the match combine with oxygen in the air to produce a flame.
 - New compounds, along with light and heat, are formed.
 - The compounds in the match head and oxygen are the reactants, and the new compounds are the products.

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1.1 The Scope of Chemistry > **BIG IDEA**

Kinetic Theory

- The particles of matter are in constant motion.
 - The ways in which these motions vary with changes in temperature and pressure determine whether a substance will be a solid, liquid, or gas.

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1.1 The Scope of Chemistry > **BIG IDEA**

The Mole and Quantifying Matter

- In conducting a chemical reaction, you would want to use just the right amount of the reacting material so none is wasted.
- This precise measurement is possible using the mole, the chemist's invaluable unit for specifying the amount of material.

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1.1 The Scope of Chemistry > **BIG IDEA**

Matter and Energy

- Every chemical process uses or produces energy, often in the form of heat.
 - The heat changes that occur in chemical reactions are easy to measure.
- Changes in a quantity called free energy allow you to predict whether a chemical reaction will actually occur under the given conditions.

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1.1 The Scope of Chemistry > **BIG IDEA**




Carbon Chemistry

- There are about 10 million carbon-containing compounds, with new ones being prepared each day.
 - Many of these compounds, including plastics and synthetic fibers, are produced from petroleum.
- Carbon compounds are the basis of life in all living organisms.

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1.1 The Scope of Chemistry > Key Concepts

-  Chemistry affects all aspects of life and most natural events because all living and nonliving things are made of matter.
-  Five traditional areas of study are organic chemistry, inorganic chemistry, biochemistry, analytical chemistry, and physical chemistry.
-  Some of chemistry's big ideas are chemistry as the central science, electrons and the structure of atoms, bonding and interactions, reactions, kinetic theory, the mole and quantifying matter, matter and energy, and carbon chemistry.


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1.1 The Scope of Chemistry > Glossary Terms

- **matter**: anything that has mass and occupies space
- **chemistry**: the study of the composition of matter and the changes that matter undergoes
- **organic chemistry**: the study of compounds containing carbon
- **inorganic chemistry**: the study of substances that, in general, do not contain carbon
- **biochemistry**: the area of chemistry that focuses on processes that take place in organisms

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1.1 The Scope of Chemistry > Glossary Terms

- **analytical chemistry**: the area of chemistry that focuses on the composition of matter
- **physical chemistry**: the area of chemistry that deals with the mechanism, the rate, and the energy transfer that occurs when matter undergoes a change
- **pure chemistry**: the pursuit of chemical knowledge for its own sake
- **applied chemistry**: research that is directed toward a practical goal or application