

CHE 107 Lecture Outline

Chapter 1: Matter, Measurement, and Problem Solving

Chapter 2: Atoms and Elements

Chapter 3: Molecules and Compounds

Chapter 4: Chemical Reactions and Quantities

Chapter 5: Intro. to Solutions and Aqueous Reactions

Chapter 6: Gases

Chapter 7: Thermochemistry

Chapter 9: Periodic Properties of the Elements

Chapter 10: Chemical Bonding I

Chapter 11: Chemical Bonding II

How to Do Well in This Course (Lecture)

- 1) Attend class and **take notes**.
- 2) Study lecture PowerPoints and read the textbook.
- 3) **Work on problems:** Homework; Online Quizzes (take twice, study feedback and explanations); textbook; in-class.
- 4) Use the Study Guide.
- 5) Study review PowerPoints.
- 6) Extra-help sessions and tutoring, if needed.
- 7) Ask your instructor to explain anything from lecture or the problem sets that doesn't make sense to you.

Chapter 1 (Tro Textbook)

Matter, Measurement, and Problem Solving

1.1: Atoms and Molecules

1.2: The Scientific Approach to Knowledge

1.3: The Classification of Matter

1.4: Physical and Chemical Changes and Properties

1.5: Energy: A Fundamental Part of Physical and Chemical Change

1.6: The Units of Measurement

1.7: The Reliability of a Measurement

1.8: Solving Chemical Problems

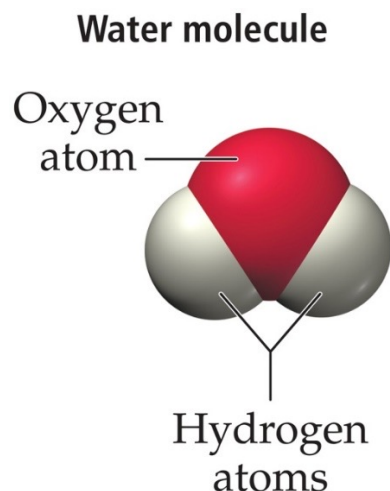
1.1: Atoms and Molecules (1 of 4)

- The properties of matter are determined by the properties of atoms and molecules.
 - The properties of water molecules determine how water behaves; the properties of sugar molecules determine how sugar behaves.
- The understanding of matter at the molecular level gives us unprecedented control over that matter.

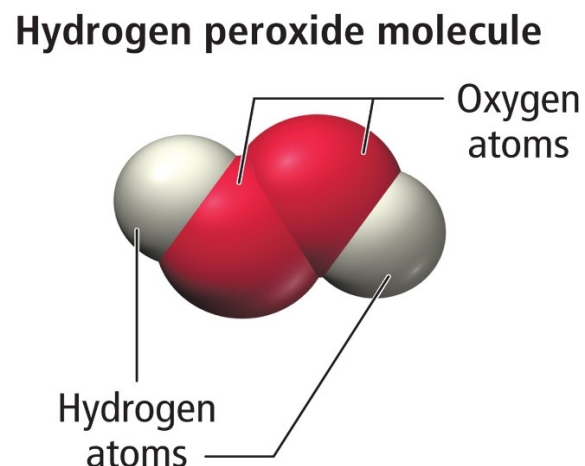
Atoms and Molecules (2 of 4)

- **Atoms** are the submicroscopic particles that constitute the fundamental building blocks of ordinary matter.
- Free atoms are rare in nature; instead, they bind together in specific geometrical arrangements to form **molecules**.

Atoms and Molecules (3 of 4)



- Water is composed of water **molecules**.
- Each molecule contains two hydrogen **atoms** and an oxygen **atom** held together by chemical bonds.



- Hydrogen peroxide is composed hydrogen peroxide **molecules**.
- Each molecule contains two hydrogen **atoms** and two oxygen **atoms** held together by chemical bonds.

Atoms and Molecules (4 of 4)

- If we want to understand the substances around us, we must understand the atoms and molecules that compose them—this is the central goal of chemistry.
 - **Chemistry is the science that seeks to understand the behavior of matter by studying the behavior of atoms and molecules.**

1.2: The Scientific Approach to Knowledge

(section 1.1 of OpenStax Chemistry 2e)

1. The approach to scientific knowledge is empirical—it is based on **observation** and **experiment**.
2. The **scientific method** is a process for understanding nature by **observing** nature and its behavior, and by conducting experiments to test our ideas.
3. Key characteristics of the scientific method include **observation**, formulation of **hypotheses**, **experimentation**, and formulation of **laws and theories**.

Observations

- Observations are also known as **data**.
- They are the descriptions about the characteristics or behavior of nature.
 - Antoine Lavoisier (1743–1794) noticed that there was no change in the total mass of material within a container during combustion.
- Observations often lead scientists to formulate a **hypothesis**.

Hypothesis

- A **hypothesis** is a tentative interpretation or explanation of the observations.
 - For example, Lavoisier explained his observations on combustion by hypothesizing that when a substance burns, it combines with a component of air.
- A good hypothesis is *falsifiable*.
 - The results of an experiment may support a hypothesis or prove it wrong, in which case the scientist must **modify** or **discard** the hypothesis.

A Scientific Law

- A brief statement that summarizes past observations and predicts future ones.
 - **Law of conservation of mass**—“In a chemical reaction, matter is neither created nor destroyed.”
- Allows you to predict future observations.
 - So you can test the law with experiments
- A law does NOT provide an explanation for the observations.

Theory (1 of 2)

- One or more well-established hypotheses may form the basis for a scientific **theory**.
- A **scientific theory** is a model for the way nature is and tries to explain not merely what nature does, but why.
- **Theories** are **validated** by experiments.
- **Theories** can never be conclusively proven because some new observation or experiment always has the potential to reveal a flaw.

Theory (2 of 2)

- General explanation for the characteristics and behavior of nature
- Models of nature

An example: Dalton's Atomic Theory (Chapter 2)

- 1) All matter is made of atoms. Atoms are indivisible and indestructible.
 - 2) All atoms of a given element are identical in mass and properties
 - 3) Compounds are formed by a combination of two or more different kinds of atoms.
 - 4) A chemical reaction is a ***rearrangement*** of atoms.
- Can be used to predict future observations
 - So they can be tested by experiments

The Scientific Approach to Knowledge (Summary)

