science: the study of nature to explain what one observes

Consider the following: On the first day of school, you get in your car and turn the key on the ignition, but nothing happens. What could be the problem?

1.4 THE SCIENTIFIC METHOD

Applying the Scientific Method

1. Propose a hypothesis to explain what is observed (the system).

2. Test the validity of the hypothesis by carrying out experiments, controlled observations designed specifically to verify or disprove a hypothesis.
   - Record observations, which can be qualitative (water is a liquid) and/or quantitative (water boils at 100°C in Seattle).
   - Analyze the data.
     → It's important to keep good records, so others can reproduce the work.

3. Conduct additional experiments to test the hypothesis under various conditions.
   - If all or part of the hypothesis does not hold up to testing, then it is adjusted or a new hypothesis is proposed to explain the observations.
   - If the hypothesis holds up to extensive testing, it can lead to the development of a scientific (or natural) law and/or a scientific theory.

scientific (or natural) law: a simple statement or equation that summarizes past observations and predicts future ones

scientific theory: a tested broader and deeper explanation of observed natural phenomena

Thus, a scientific law summarizes what happens; a scientific theory explains why it happens.

Example: Many news reports and articles claim that global warming is “just a theory”. How does this illustrate the media and the general public’s lack of understanding regarding scientific theories?
1.5 Learning Chemistry

Ex. 1: What is your major and why are you taking this class? Why do you think knowledge in chemistry is needed in so many different fields?

Ex. 2: What comes to mind first when you hear the word “chemical”?

Ex. 3: Are there chemicals in a cup of coffee? Give some examples.

Thus, chemicals are not necessarily hazardous. In fact, almost *everything consists of chemicals* since any substance consisting of more than one type of atom is a chemical.

For example, the glass of soda above contains water (H\textsubscript{2}O) molecules and carbon dioxide (CO\textsubscript{2}) molecules; the “lead” in a pencil is actually graphite which consists of carbon atoms; and we are made of DNA and various other biological molecules or chemicals.
**chemistry:** the science that studies how matter behaves by understanding the properties and behavior of atoms and molecules that make up the matter

Consider the water and carbon dioxide molecules:

The atoms making up these molecules and their structure at the atomic or molecular level determine their properties and behavior at the macroscopic level (i.e. what we can observe with the naked eye).

**The Structure and Properties of Ice**

Ice floats on water because ice is less dense than liquid water.

- The strong attraction and repulsion between two different water molecules in ice results in "holes" or empty space in the ice crystal.
- When ice melts, the water molecules fill in the holes, so liquid water is more dense than ice.
- Note the holes in the molecular-level structure or ice have a hexagonal (six-sided) shape.
  → Snowflakes have hexagonal symmetry because of the hexagonal holes in the molecular-level arrangement of H₂O molecules in ice!