Biology: Basic Components to the Scientific Process

1. **Problem Statement/ Objective:**
   - Formulate a cause and effect question
   - Usually stated as:
     - What is the effect of the manipulated variable on the responding variable?
     - Example: What is the effect of the amount of sunlight on the growth of a plant?

2. **Hypothesis/ Prediction:**
   - A prediction is simply answering the problem statement based on previous knowledge and experience (State what you think is going to happen).
   - A hypothesis not only answers the problem statement but also provides a explanation for the provided answer (State what you think is going to happen and why).
   - Hypothesis statements usually have the following format:
     - **If….then…..because…**
     - Example: If a plant is exposed to increased light, then it will experience more growth because plants use light in photosynthesis to make their own food

3. **Experimental Design:**
   - **A. Background Information –**Write a 2 to 3 sentence statement that summarizes how the experiment will be carried out (a brief overview of what is to be done). A diagram may be used to illustrate how the equipment is set up

   - **B. Variables –**
     - **Manipulated Variable** – A condition that is deliberately changed by the experimenter (the one factor that will be changed
     - **Responding variable** – a condition that changes in response to the to the change in the manipulated variable (the one factor that will be measured)
     - **Controlled Variables** – conditions that are kept the same by the experimenter (provide a **minimum of 3** controlled variables)

Note:

Variables in an experiment may also be *independent* or *dependent* variables. An independent variable is any variable that influences the effect being studied, but is not itself affected by the experimental conditions. Time is often an independent variable. The dependent variable is the same as the responding variable.

Along with variables, often an experiment will have two parts for comparison:

1. The **experimental group** or part that tests the condition
2. The **control group** (commonly called the control) – conditions remain unchanged/ constant or do not experience the manipulated variable.

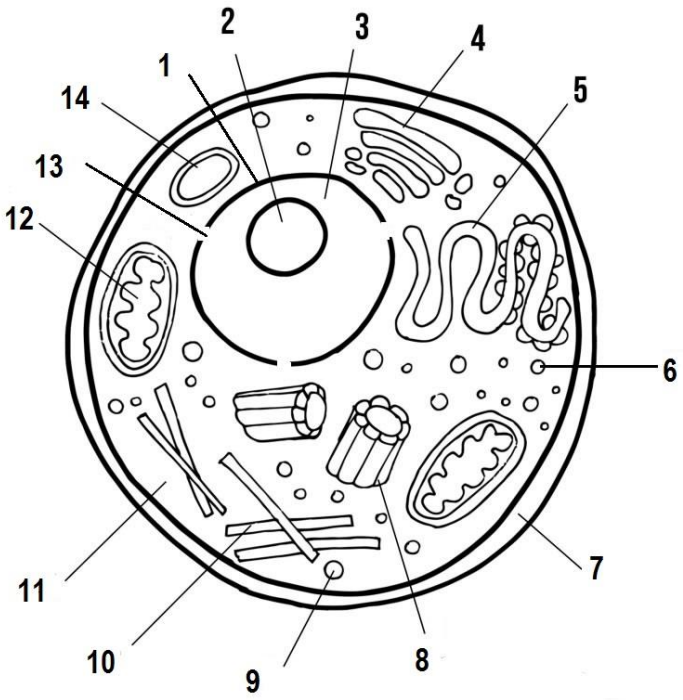
Example:
What is the effect of the amount of light on the growth of a tomato plant?

Control Group:	Experimental Group:
Plant grown in light	Plant grown in dark

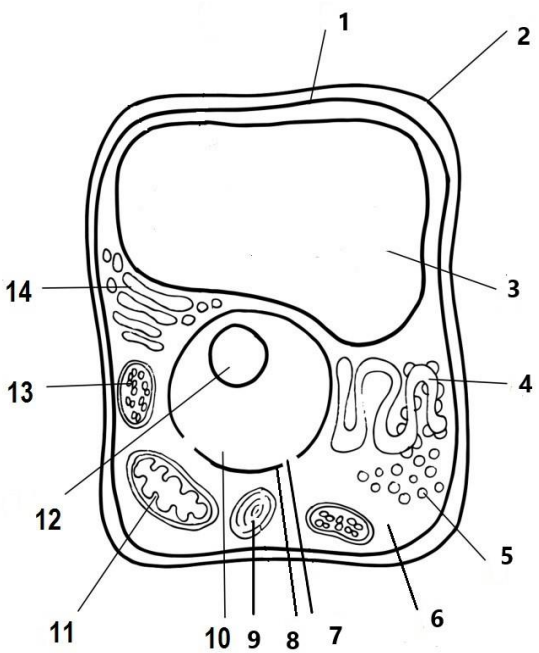
A quick exercise: For each of the following questions: identify the manipulated, responding, and controlled variables; provide a hypothesis; identify the control and experimental groups.

1. What is the effect of the consumption of Diet Coke on the frequency of urination?

2. What is the effect of carbon dioxide concentration in the blood on breathing rate?



1.	**Nuclear membrane**
2.	**Nucleolus**
3.	**Nucleus**
4.	**Golgi appartus**
5.	**Endoplasmic reticulum**
6.	**Ribosome**
7.	**Cell membrane**
8.	**Centrioles**
9.	**Vacuole**
10.	**Cytoskeleton**
11.	**Cytoplasm**
12.	**Mitochondria**
13.	**Nuclear pore**
14.	**Lysosomes**



1.	**Cell membrane**
2.	**Cell wall**
3.	**Vacuole**
4.	**Rough Endoplasmic Reticulum**
5.	**Ribosomes**
6.	**Cytoplasm**
7.	**Nuclear pores**
8.	**Nuclear membrane**
9.	**Plastid**
10.	**Nucleus**
11.	**Mitochondria**
12.	**Nucleolus**
13.	**Chloroplast**
14.	**Golgi apparatus**