

Summer Work Assignment: Understanding Variables and Hypotheses

Objective:

The goal of this assignment is to help you understand the concept of independent and dependent variables, as well as the roles of the negative control, null hypothesis, and alternative hypothesis in scientific research.

Definitions to Know:

1. Independent Variable:

The independent variable is the factor that you, the researcher, change or manipulate in an experiment. It is what you think might have an effect on the dependent variable.

Example: In a study on the effect of different amounts of sunlight on plant growth, the independent variable is the amount of sunlight (since you can control and change this factor).

2. Dependent Variable:

The dependent variable is the factor that you measure or observe in response to changes in the independent variable. It "depends" on the independent variable.

Example: In the same study on plant growth, the dependent variable is the growth of the plant (e.g., its height or number of leaves), as this will change based on the amount of sunlight it receives.

3. Negative Control:

A negative control is a group or condition that does not receive the experimental treatment or intervention. Its purpose is to provide a baseline that shows what happens when no treatment is applied, ensuring that any observed effects are due to the experimental treatment and not other factors.

Example: If you're testing the effect of sunlight on plant growth, the negative control group might be a plant kept in the dark, which should not grow well, showing that growth depends on sunlight.

4. Null Hypothesis (H_0):

The null hypothesis is a statement that suggests there is no effect or no difference as a result of the independent variable. It assumes that any observed changes are due to random chance or error.

Example: In the plant growth experiment, the null hypothesis could be: "The amount of sunlight has no effect on the growth of plants."

5. Alternative Hypothesis (H_1):

The alternative hypothesis is the statement that suggests there is an effect or a difference caused by the independent variable. It is what you aim to support or prove with your experiment.

Example: The alternative hypothesis could be: "The amount of sunlight affects the

growth of plants," meaning that plants exposed to more sunlight will grow better than those with less sunlight.

Instructions:

For each of the following scenarios, identify the independent and dependent variables, negative control, null hypothesis, and alternative hypothesis. Provide an explanation for each choice.

Scenario 1:

You want to study whether the type of fertilizer affects the growth of tomato plants. You decide to use three different types of fertilizer and measure how much the plants grow in height over a 4-week period.

1. **Identify the independent variable. Explain/justify your choice.**
 2. **Identify the dependent variable. Explain/justify your choice.**
 3. **Describe the negative control. Explain/justify your choice.**
 4. **State the null hypothesis (H_0).**
 5. **State the alternative hypothesis (H_1).**
-

Scenario 2:

You are testing whether listening to music while studying affects students' test scores. You compare the test scores of students who studied with music and those who studied in silence.

1. **Identify the independent variable. Explain/justify your choice.**
 2. **Identify the dependent variable. Explain/justify your choice.**
 3. **Describe the negative control. Explain/justify your choice.**
 4. **State the null hypothesis (H_0).**
 5. **State the alternative hypothesis (H_1).**
-

Scenario 3:

You are investigating the effect of water temperature on the rate at which sugar dissolves. You test water at three different temperatures: cold, room temperature, and hot, and measure the time it takes for sugar to completely dissolve.

1. **Identify the independent variable. Explain/justify your choice.**
2. **Identify the dependent variable. Explain/justify your choice.**
3. **Describe the negative control. Explain/justify your choice.**

4. **State the null hypothesis (H_0).**
 5. **State the alternative hypothesis (H_1).**
-

Scenario 4:

Scenario:

Recent studies have shown that ocean acidification—caused by increased carbon dioxide (CO_2) levels in the atmosphere—is negatively affecting marine ecosystems, particularly coral reefs. Scientists are investigating how varying levels of ocean acidity (pH levels) influence the growth of coral species. One such study involves exposing coral polyps to different pH levels in controlled lab environments, simulating current and future ocean acidification scenarios.

In this experiment, the researchers test three different pH levels: a control pH (similar to current ocean conditions), a slightly more acidic pH (representing moderate acidification), and a highly acidic pH (simulating future ocean acidification under climate change predictions). The researchers measure the growth rate of the coral polyps in terms of calcium carbonate deposition, which is critical for coral reef structure.

1. **Identify the independent variable. Explain/justify your choice.**
2. **Identify the dependent variable. Explain/justify your choice.**
3. **Describe the negative control. Explain/justify your choice.**
4. **State the null hypothesis (H_0).**
5. **State the alternative hypothesis (H_1).**

Extension Question:

Why is it important to have a negative control in an experiment? How does it help ensure the reliability of the results?

Submission Instructions:

- Complete your answers in a typed document.
- Provide detailed explanations for each of your choices.
- Write the definitions provided above in the Science Practices section of your notebook (see below)
- Submit your work by the second day of class.

Good luck, and have fun exploring the basics of scientific research!

Notebook Requirements:

1. Type of Notebook:

- **Size:** A standard notebook (8.5" x 11") is ideal for organizing your materials and keeping everything neatly in one place.
- **Binding:** Choose a sturdy, spiral-bound or 3-ring binder notebook. A 3-ring binder is preferable as it allows for easy addition or removal of pages, but spiral-bound works as well if you prefer that format.

2. Dividers:

- You will need **10 dividers** for organizing your work. These dividers will help you separate different sections of your notebook for easy access.
 - Each divider should be labeled according to the categories outlined below to keep your materials organized and easy to reference.
-

Notebook Sections:

Label your sections with the following titles, which correspond to different topics and practices you will learn in AP Biology:

1. Science Practices:

- This section will contain definitions for the various scientific terms that you will encounter, including independent and dependent variables, null hypotheses, controls, etc.
- You should also include notes on the different scientific methods and practices used in experiments.

2. Chemistry of Life

3. Cell Structure and Function

4. Cellular Energetics

5. Cell Communication & Cell Cycle

6. Heredity

7. Gene Expression & Regulation

8. Natural Selection

9. Ecology

10. Review/Study Materials:

- Keep any extra review sheets, practice questions, and summaries of key concepts in this section.
-

AP Review Book:

In addition to your notebook, it is highly recommended that you purchase an **AP Biology review book**. The review book will be an invaluable resource as you prepare for the exam and

will provide concise summaries, practice questions, and additional practice tests to help reinforce what you learn throughout the year.

- Look for a reputable AP review book (e.g., Barron's, Princeton Review, or Kaplan).
 - Make sure the book is specifically designed for **AP Biology** to ensure it aligns with the exam format and content.
-

Where to Purchase:

- **Local Stores:** Check your local office supply or big-box stores for notebooks and dividers.
 - **Online Stores:** Websites like Amazon, Walmart, or Staples usually have a variety of notebooks, dividers, and AP review books available.
 - **AP Review Book Purchase:** Visit online bookstores like Amazon, or in-person stores like Barnes & Noble.
-

Important Notes:

- Ensure that your notebook is large enough to hold all your materials for the year. If you choose a binder, make sure it can accommodate additional pages as the year progresses.
 - Keep your notebook organized and up-to-date by regularly adding new materials into the appropriate sections.
 - Be sure to bring your notebook to class daily, as it will be used for both in-class activities and homework (typically taking notes).
-

Good luck with your preparation for AP Biology! We look forward to a successful and engaging year.