

The Methods of Biology

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What **motivates** biologists to try to answer simple questions about everyday observations?

Curiosity

- 💡 The knowledge obtained when scientists answer one question often generates other questions in solving problems.
- 💡 They are **common** steps
- 💡 Do **NOT** always follow a **FIXED** order

The Methods of Biology

 Define *scientific methods*.

 The common steps that biologists and other scientists use to gather information and answer questions.



Step #1 of Scientific Method



Scientific methods usually begin with scientists **identifying a problem** to solve by **observing** the world around them.



Observations are always made through your **senses**.

Step #2 of Scientific Method

 Define *hypothesis*.

💡 A hypothesis is an explanation for a question or a problem that can be formally tested.

💡 Scientists that form a hypothesis **MUST** be certain that it can be tested.

Testable Hypothesis

💡 What does *testable hypothesis* mean?

→ Something that can be **measured**.

- ❖ pH
 - ❖ time
 - ❖ color change
 - ❖ production of gas
- mL
temperature



Step #3 of Scientific Method

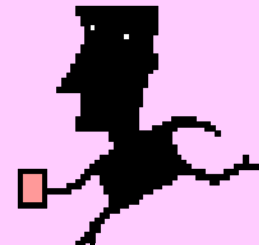
🧠 Gathering Information (Research)

🧠 How?

- ❖ Personal observations
- ❖ Extensive readings
- ❖ Previous investigations


🧠 Why?

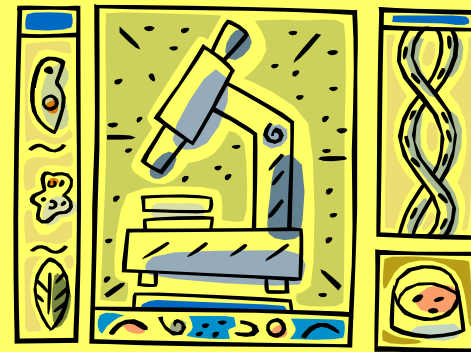
- ❖ Not wasting your time




Step #4 of Scientific Method

 Define *conducting an experiment*.

 An experiment is an **investigation** that **tests a hypothesis** by the process of collecting information under **controlled conditions**.




Step #4 of Scientific Method

 How many groups are usually involved in an experiment?

2

 Define each group

 A *control group* is the part of the experiment that is the **standard** against which results are **compared**

 In other words control group receives **NO** experimental treatment.

Step #4 of Scientific Method



The *experimental group* is the test group that receives experimental treatment.



In an **controlled** experiment, how many conditions are changed at a time?



One variable, which is the **factor** being tested.

Designing An Experiment

📖 Define *independent variable*.

💡 The independent variable is the condition in an experiment that is being **tested**.

- ❖ factor that **affects the outcome** of the experiment
- ❖ **can control it**
- ❖ **x-axis**



Designing An Experiment

📖 Define *dependent variable*.

💡 The dependent variable is the **results** from the change of the independent variable.

❖ cannot control it

❖ y-axis



Step #5 of Scientific Method

 Define *data*.

💡 Data is information obtained from investigations

💡 Scientists need to **record, organize, and analyze** the data collected.

Types of Data

💡 How can a testable hypothesis be measured?

1.) Quantitative -

→ *quantity*

→ numerical data

→ Organized by charts and graphs

❖ Examples: pH, volume (mL), time, temperature, mass (g), length (meters)

Types of Data

2.) Qualitative-


→ *quality*


→ observational data

→ analyzed through your senses

❖ **Examples:** color change, precipitation, odor, behavioral response, etc.

Step #6 of Scientific Method

-  After careful review of the results, the scientist must come to a **conclusion**.

-  What 3 questions should a scientist ask when developing a conclusion?
 - 1.) Was the hypothesis supported by the data?
 - 2.) Was it not supported?
 - 3.) Are more data needed?




Step #6 of Scientific Method

 Name the **publication** where most scientists report the **results** and **conclusions** of investigations.

Scientific Journals



Step #7 of Scientific Method

-  After results have been published, other scientists can try to verify results by **repeating** the procedure.
-  Explain when a hypothesis is considered **valid** and accepted by the scientific community?
-  When the hypothesis is **supported** by data from **additional** investigations yielding **similar** results.

Theories versus Laws

Define *theory*

- 💡 A theory is an explanation of a natural phenomenon that is **supported** by a **large** body of **scientific evidence** obtained from **many different investigations** and **observations**.
- 💡 In other words, a theory results from **continual verification** and **refinement** of a hypothesis.

Theories versus Laws

 Define *laws*

💡 A **law** is a well established theory regarding facts of nature.

❖ Examples: The Law of Gravity

: The Law of Conservation