

BIOLOGY NOTE-TAKING HANDOUT THE SCIENCE OF BIOLOGY

What Science Is and Is Not

1. If we examine something *scientifically*, what exactly are we doing? What does it mean to say that an approach to a problem is scientific?

Science has several features that make it different from other ways of looking at our world:

a.

b.

c.

So this means that *science* is an _____

2. Scientific thinking usually begins with an _____, which is the process of gathering information in an _____ way.

This information is called _____.

Quantitative data

Qualitative data

Scientists will use their data to make _____, which are logical _____

For example:

3. After making many observations and inferences, scientists may propose one or more _____.

A *hypothesis* is _____

Scientific hypotheses must be _____. There are two ways to test a hypothesis:

1.

2.

What if there is no way to show that a hypothesis is wrong?

4. **Conducting an Experiment** (see Appendix A on page 1062)

A gardener collects seeds from a favorite plant, stores them indoors over winter, and plants them the following spring. None of the stored seeds develop into plants, yet uncollected seeds from the original plant germinated in the normal way. The gardener wonders: *Why didn't the collected seeds germinate?*

This question is too broad to be tested by an experiment and needs to be narrowed. To narrow the topic more specific questions need to be asked, such as

As researchers design an experiment, they identify **variables**, _____

Some common variables include _____

An experiment involves **three** categories of variables:

(1) the **manipulated variable**

(2) the **responding variable**

(3) the **controlled variables**

What is a "Control Group"?

For the gardener, the manipulated variable will be _____

The responding variable will be _____

and the variables that need to be controlled include _____

Forming Operational Definitions

In an experiment it is often necessary to _____

An operational definition describes _____

What is the gardener's operational definition for "cold"?

Interpreting Data

The observations and measurements made during an experiment are called _____.
Data must be collected in an _____ way. When an experiment is finished the data is _____ for _____ or _____ by doing _____ or making _____.

The gardener's data:

To be sure the results of an experiment are "valid" (_____) scientists look at their results "critically" (_____)

Sources of "experimental error" include _____

Drawing Conclusions

If researchers are confident that their data are _____ they make a final statement summarizing their results:

Communicating Scientific Results

5. Science does deal with a lot of facts but science is _____ a set of truths that never change.

Science is a _____ that is constantly _____, _____, and _____.

New _____, better _____ means scientific understanding is always _____.

The best scientists are *skeptics*. Skeptics _____

How Scientists Work

1. What happens when food is left outside for several days in the summer?

Hundreds of years ago these creatures were believed to have come from _____

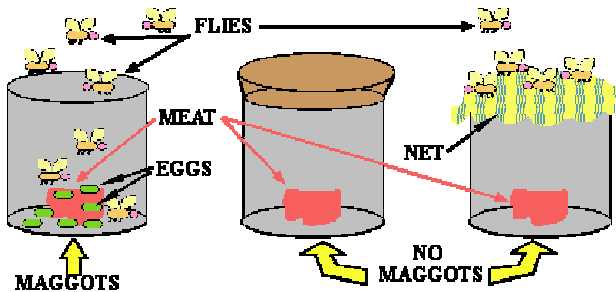
The process was known as _____.

2. About 350 years ago, Francesco Redi proposed a different hypothesis.

3. A *controlled experiment* was performed to test his idea.

Redi's hypothesis:

The factors in an experiment that can change are called _____. Whenever possible a hypothesis should be tested by changing only _____ at a time. The other variables are kept unchanged or _____. In a controlled experiment the variable that is changed is called the _____ or _____ variable. The variable that is observed and changes in response to the manipulated variable is called the _____ or the _____ variable.



Redi's conclusion:

5. Over the next 100 years _____

6. Needham's test of Redi's conclusions:

Needham's conclusions:

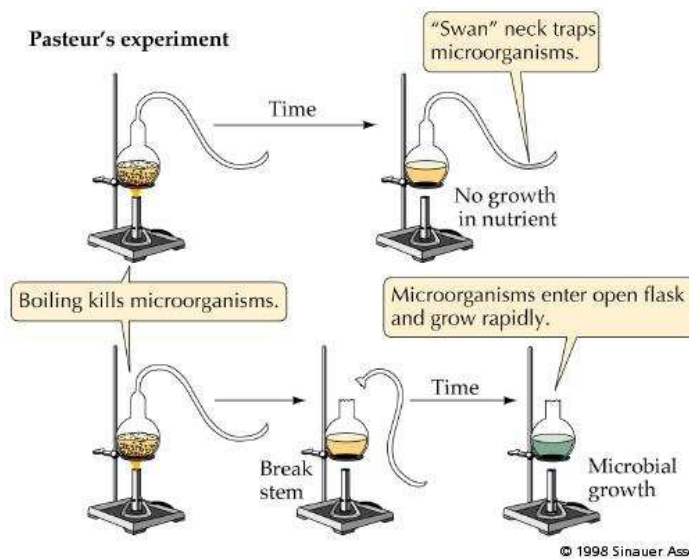
7. An Italian, Lazzaro Spallanzani, read about Needham's and decided to improve Needham's experiment.

Spallanzani's experiment:

Spallanzani's conclusion:

How did Spallanzani improve Needham's experimental set-up?

8. Louis Pasteur



How did Pasteur improve Spallanzani's experimental set-up?

9. It is not always possible to do an experiment to test a hypothesis.
The behavior of wild animals

Suspected human carcinogens

10. When an overwhelming amount of evidence supports a hypothesis it may become a _____ . In science, the word “theory” means something quite different from the same word used in everyday speech (“oh, that’s just a theory...”). A scientific theory is _____

There are not many theories in science. Some well-known scientific theories include _____

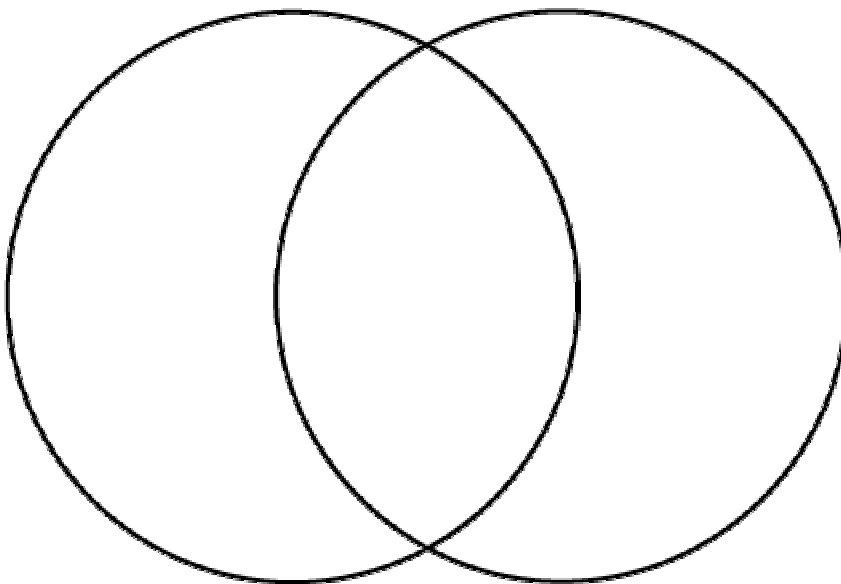
Theories are _____ absolute truths and as new _____ is uncovered theories are _____.

Studying Life

Nonliving things may sometimes seem like they’re alive, so what does it mean to be alive? Compare the following two things; one alive one not alive.

Fire

Firefly



Characteristics of Living Things

We will see that one characteristic is not enough and often nonliving things show some of these too. Describing what makes something alive is not easy.

1. Living things are made up of units called cells.
2. Living things can reproduce.
3. Living things are based on a universal genetic code.
4. Living things grow and develop.
5. Living things use materials and energy.
6. Living things respond to their environment.
7. Living things maintain a stable internal environment.
8. Taken as a group, living things change over time.

All biological sciences are tied together by _____ or “big ideas”. Each of these themes will be a part of every unit we cover this year. These “big ideas” include:

Interdependence in Nature

Matter and Energy

Cellular Basis of Life

Information and Heredity

Unity and Diversity of Life

Evolution

Structure and Function

Homeostasis

Science, Technology, and Society

Branches of Biology

Biology is divided up into many different fields; zoology studies _____, botany studies _____, entomology studies _____, paleontologists study _____. This list could get quite long! Living things may be studied on many different levels as well. Population biologists and ecologists study some of the _____ while cell biologists study some of the _____.

We could list the various levels of organization in biology starting with the largest and most complex level: the biosphere.

Biosphere

Ecosystem

Community

Population

Organism

Groups of cells

Cells

Molecules