UNIT 1

Introduction to Biology

Essential Question: What role does science play in the study of life?

1. What is science?

A. The goal of science is to investigate and understand the natural world, to explain events in the natural world, and to use those explanations to make useful predictions.

B. Science:
1. Science deals only with the natural world.
2. Scientists _____
_____
_____
3. Scientists propose _____ that can be _____ by examining evidence.
4. Science is an organized way of using evidence to learn about the natural world.

C. How is science done?
1. Science begins with an _____. This is the process of gathering information about events or processes in a careful, orderly way.
2. _____ is the information gathered from making observations.
3. There are two types of data:
   a) Quantitative data are _____.
   b) Qualitative data are _____.
4. Hypothesis
   a) A hypothesis is a _____.
   b) A hypothesis must be stated in a way that makes it "testable." The hypothesis is a possible answer to a question, and it must be thoroughly tested.

2. What are the central themes of biology?

A. Biology is the _____.

B. This study of life ranges from the very simple one-celled organisms to the very complex multicellular organisms.

C. Biology is unified by certain themes no matter what kind of organism is being studied.

D. The themes of biology are:
1. Cell structure and function
2. Stability and homeostasis
3. Reproduction and Inheritance
4. Evolution

5. Interdependence of organisms
6. Matter, energy and organization

E. Cell Structure and Function

1. The cell is the _____. All living organisms are composed of cells.
2. Different levels of cell structure and organization include:
   a) Unicellular Organisms
      1. _____
      2. Examples: _____
   b) Colonial Organisms
      1. _____
      2. _____
      3. _____
   c) Multicellular Organisms
      1. _____
      2. _____
      3. Cell Specialization: _____
      4. Tissue: _____
      5. Organ: _____
      6. Organs work together to form _____.
      7. Various systems compose a multicellular organism.
      8. Advantage of having cell specialization: _____

_____

_____

9. Disadvantage of cell specialization: _____

_____

_____

3. There are many different types of cells, but they are alike in several ways:
   a) They are surrounded by a _____.
   b) They contain _____

_____

_____

F. Stability and Homeostasis

1. Cells must be able to maintain very stable _____

_____.

2. All cell processes must be very carefully regulated.
3. _____ is the internal balance that a cell must maintain.

G. Reproduction and Inheritance

1. Reproduction: All organisms produce new organisms like themselves.
2. All organisms pass their genetic information to their offspring in the form of _____.
3. Gene: _____

_____

4. Sexual reproduction: _____

_____

_____

5. Asexual reproduction: _____
_____
_____

H. Evolution

1. To evolve means to _____.
2. Scientists study evolution in order to understand how all the different organisms that live on Earth today came to be.
3. Evolution is the result of Natural Selection

a) Organisms with _____ characteristics are more likely to _____ and reach reproductive age.

b) Favorable characteristics might include: the ability to catch food, the ability to be well camouflaged, or the ability to withstand harsh environmental conditions.

c) When these organisms reproduce _____
_____
_____

d) If an organism is not well suited to its environment, it is unlikely that it will live and reproduce.

e) Since different genes are being passed on to offspring, organisms slowly change over time.

I. Interdependence of Organisms

1. The study of an individual organism is very important, but in order to understand our biological world, scientists must study the interaction of organisms with one another and with their environment.
2. This branch of biology is called _____.
3. No single organism can survive on its own. Animals depend on _____ as a source of food. Plants make their own food, but require the _____ released into the environment by animals. All of the organisms on Earth are interconnected.

J. Matter, Energy, and Organization

1. Life on Earth depends upon _____
_____.
2. Through the process of _____, plants are able to harness the energy of the sun to make their own food in the form of _____.
3. Autotrophs are _____.
   These organisms include _____
_____.
4. Heterotrophs are _____.
   These organisms include _____
_____.
   Heterotrophs must take in food by consuming _____
_____.

3. What procedures are the core of scientific methodology?

A. The scientific method is _____
_____
_____

B. The Steps to the Scientific Method

Step 1: Observation / Asking a Question

1. A problem or a question must first be identified.
2. Examples: How much water can a root hair absorb? Why does a plant stem bend toward the light? What effect does temperature have on heart rate?

Step 2: Form a Hypothesis

1. Hypothesis: _____
_____
It is simply a prediction and has not yet been _____
_____.
2. It must be stated in a way that is testable. A statement is considered "testable" if evidence can be collected that either does or does not support it.

Step 3: Designing a Controlled Experiment

1. The factors in an experiment that can be changed are called _____. Some examples of variables would be: changing the temperature, the amount of light present, time, concentration of solutions used.
2. A controlled experiment works with _____
_____. If several variables are changed at the same time, the scientist would not know which variable is responsible for the observed results.
3. In a _____ only one variable is changed at a time. All other variables should be unchanged or "controlled".
4. An experiment is based on the comparison between a _____ with an _____.

a) These two groups are identical except for one factor.

b) The control group serves as the comparison. It is the same as the experiment group, except that the one variable that is being tested is removed.

c) The experimental group shows the effect of the variable that is being tested.

5. Example: In order to test the effectiveness of a new vaccine, 50 volunteers are selected and divided into two groups. One group will be the control group and the other will be the experimental group. Both groups were given a pill to take that was identical in size, shape, color and texture.

Describe the control group:
_____
_____
_____

Describe the experimental group: _____
_____

What variables are kept constant? _____
_____
_____

What variable is being changed? _____
_____

6. There are two variables in an experiment:
a) The independent variable is the variable that is _____
_____
_____

b) The dependent variable is the one _____
_____
_____.

The dependent variable is the data we collect during the experiment. This data is collected as a result of changing the independent variable.

c) In the above example, what is the independent variable?
_____
_____

d) In the above example, what is the dependent variable?
_____
_____

Step 4: Recording and Analyzing Results

1. The data that has been collected must be organized and analyzed to determine whether the data are reliable.
2. Does the data support or not support the hypothesis?

Step 5: Drawing Conclusions

1. The evidence from the experiment is used to determine if the hypothesis is _____.
2. Experiments must be repeated over and over. When repeated, the results should always be the same before a valid conclusion can be reached.

C. Forming a Theory

1. A theory may be formed after the hypothesis has been tested many times and is supported by much evidence.
2. Theory: _____
_____
3. A theory is supported by considerable evidence.

4. How is data analyzed effectively?

A. Making a Table

As scientists collect data, it must be recorded in an organized fashion. Any time data is collected in an experiment, it is most often presented in a table. The data table must have a title, rows, columns, and heads. The title should be placed at the top and tells the observer what information is contained in the table. At the top of each column should be a "head" that tells you what information is in the column.

Example 1: Make a data table for the following information
The following data were collected for the growth of a plant.
On day 0, there was 0 growth. On day 1, there was 2.0 cm of growth.
On day 2, there was 5.3 cm of growth.
On day 3, there was 6.1 cm of growth. On day 4, there was 8.4 cm of growth. On day 5, there was 11 cm of growth.

1) In the top row, place the title of your data table.

2) In the next row, place the two column heads.

3) In the remaining rows, fill in the data.

Example 2: Make a data table for the following information
The number of cricket chirps was recorded on two different nights at various temperatures (Celsius). On night 1, the following data was obtained: Temp 16, cricket chirps 33; Temp 18, cricket chirps 38; Temp 20, cricket chirps 42; Temp 22, cricket chirps 46; Temp 24, cricket chirps 50.

On night 2, the following data was obtained:
Temp 16, cricket chirps 32; Temp 18, cricket chirps 36; Temp 20, cricket chirps 41; Temp 22, cricket chirps 43; Temp 24, cricket chirps 51.

1) In the top row, place the title of your data table.
2) In the next row, place the two column heads. Since data were collected on two different nights, you will need four columns.
3) In the remaining rows, fill in the data.

B. Making a Line Graph

Line graphs show data plotted as points that are connected by a line. Line graphs are often used to show change over time and can be used to compare two or more sets of data.

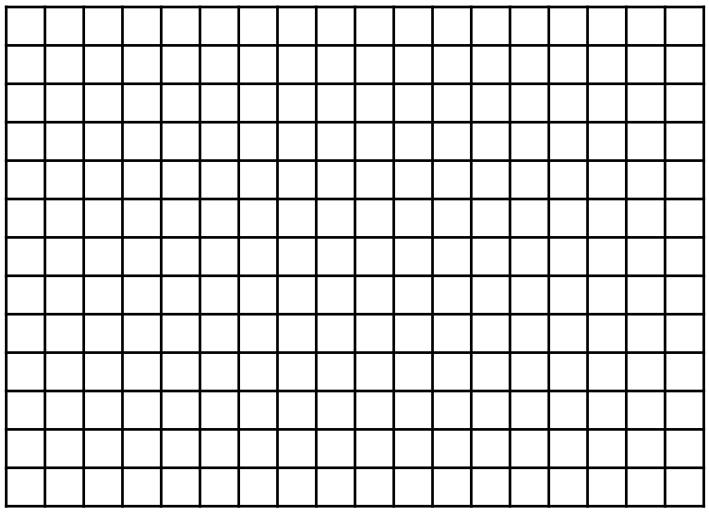
Before a line graph can be constructed, you must identify the two variables that will serve as x and y coordinates on the graph. These are called the _____ and the _____.

The independent variable is the one being _____ _____ during the experiment. It is always placed on the _____.

The dependent variable is the observed result of the independent variable being changed. The dependent variable is always placed on the _____. An easy way to remember this is to ask yourself the questions, “What did I know before I did the experiment?” (independent variable) and “What did I learn by doing the experiment?” (dependent variable)

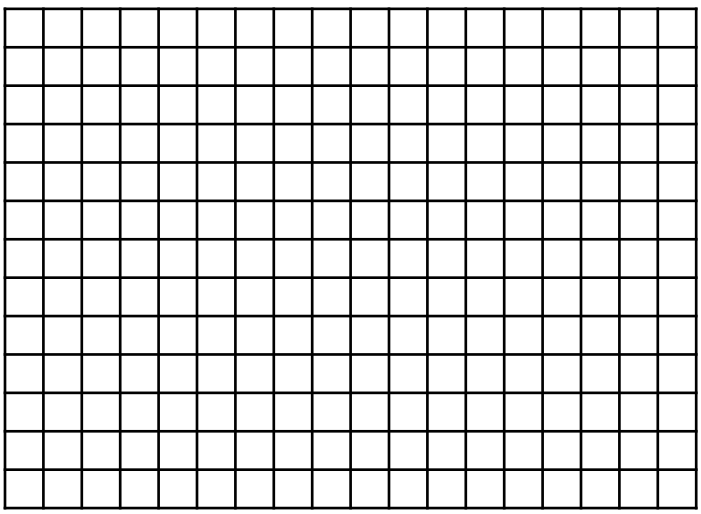
Using the grid below, make a line graph using the information in example 1 from above.

Be sure to: (1) First determine which variable to place on the horizontal (x) axis and which variable to place on the vertical (y) axis. (2) Label each axis appropriately. (3) Scale each axis appropriately. (4) Title your graph.



Using the grid below, make a line graph using the information in example 2 from above.

Be sure to: (1) First determine which variable to place on the horizontal (x) axis and which variable to place on the vertical (y) axis. (2) Label each axis appropriately. (3) Scale each axis appropriately. (4) Title your graph. (5) Since this graph will have two different lines, be sure to label each line.

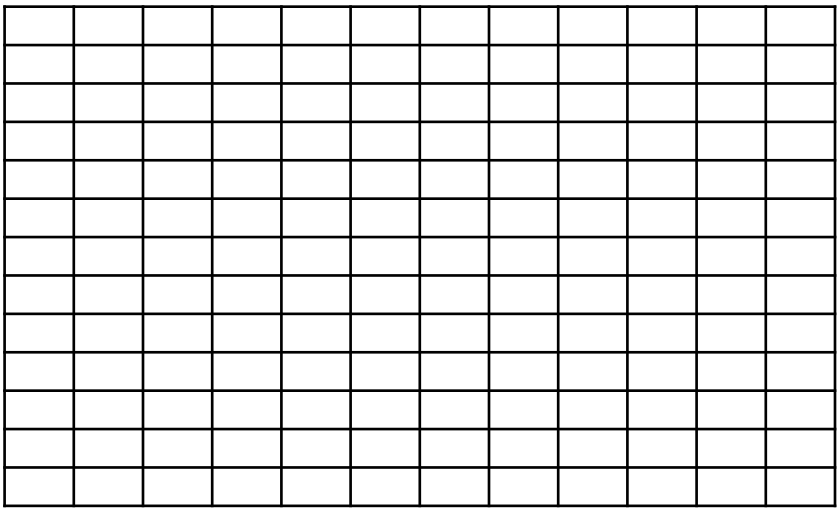


C. Making a Bar Graph

Bar graphs are useful for showing comparisons of data collected by counting. A bar graph has two axes, a horizontal axis and a vertical axis. Generally the horizontal axis is _____ and the vertical axis is _____.

In the space below, make a bar graph of the following information. In an orchard the following kilograms of peaches were picked during a 6 year period

Year	Kilograms	Year	Kilograms
1995	54	1998	57
1996	42	1999	48
1997	35	2000	62



5. What were ideas held by early biologists?

A. The principle of "biogenesis" states that: _____
_____
_____

B. Prior to the 17th century, scientists believed in the idea of _____ or abiogenesis.

1.This was the idea that _____
_____.

2.Examples:

- Maggots arise from dead, rotted meat.
- Mice arise from grain stored in a barn.
- Beetles arise from cow dung.

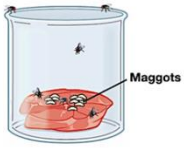
C. Francesco Redi – 1668

1.Redi did not believe in spontaneous generation and conducted an experiment to _____ it.

2.It was believed at the time that _____ arose from _____.

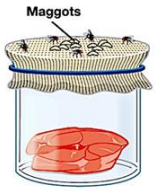
Redi wanted to _____ the idea that flies were produced _____ from rotted meat.

3.Redi's experiment consisted of _____ _____.



Experimental Group

_____
_____
_____
_____



Control Group

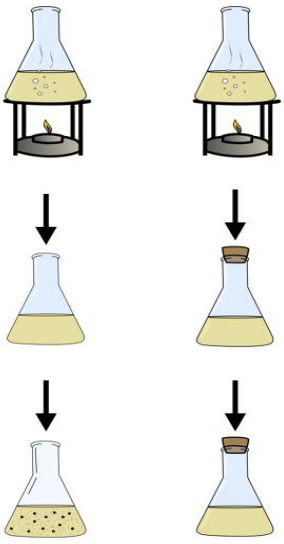
_____
_____
_____
_____
_____
_____
_____

4.Results: The cloth allowed air to enter the jar, but prevented the flies from landing on the meat. Therefore, no maggots appeared in the covered jars. This _____ Redi's hypothesis that _____, and that maggots _____ from rotting meat.

D. Lazzaro Spallanzani (mid 1700's)

1. At the time that Redi was conducting his experiment, the _____ was invented, revealing that the world is teeming with _____. Many scientists believed that microorganisms appeared by _____.
2. Spallanzani designed an experiment to test a hypothesis about the spontaneous generation of microorganisms.

His hypothesis: _____
_____



_____
_____
_____
_____

_____
_____
_____
_____

_____
_____
_____
_____

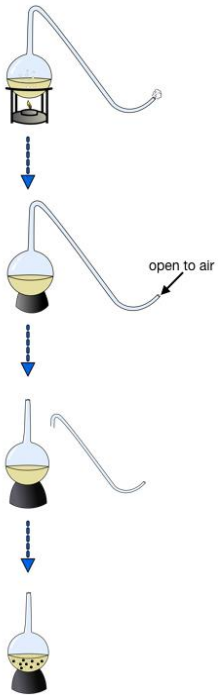
3.Spallanzani concluded that the boiled broth in the open flask became contaminated with microorganisms from the _____. Since no microorganisms appeared in the closed flask, microorganisms were not produced by _____.

4.Many scientists at the time, who still believed in spontaneous generation, objected to his experiment. These scientists claimed that Spallanzani had heated the flasks for too long and had destroyed the "_____" in the air. Since the flask was sealed, new air containing this "_____" could not enter and spontaneous generation was not allowed to occur.

5.The idea of spontaneous generation was kept alive for another _____.

E. Louis Pasteur (mid 1800's)

1. Pasteur finally disproves spontaneous generation once and for all.



_____
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_____
_____

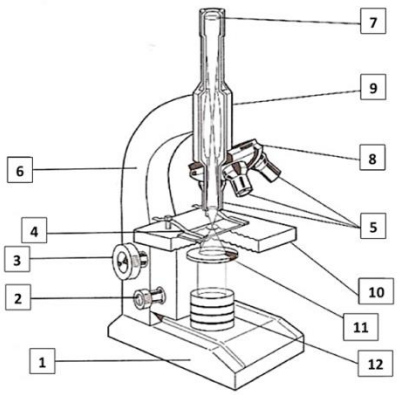
2. Scientists who believed in spontaneous generation could not _____ since the "_____" air was still allowed to enter the flask. The curved neck was open to the air, but the curved neck _____ solid particles containing microorganisms from _____ the flask. Once the neck was taken off, _____ entered the flask and the broth immediately became _____ with microorganisms.

6. What characteristics do all living things share?

All living things, no matter how different from each other they may be, share a set of common characteristics:

A. Living things: _____
_____
B. Living things: _____
_____
C. Living things: _____
_____
D. Living things: _____
_____
E. Living things: _____
_____
F. Living things: _____
_____
G. Living things: _____
_____
H. Living things: _____
_____

7. How is a microscope used to study biology?



A. Parts of the microscope

1. _____
2. _____
_____
3. _____
_____
4. _____
5. _____
_____
6. _____
7. _____
_____
8. _____
_____
9. _____
_____
10. _____
11. _____
_____
12. _____

B. Compound (Light) Microscope

1. This microscope allows light to pass through the specimen and uses two lenses to form an image.
2. The modern compound microscope is capable of two things:
   a) Magnification is a measure of how much the image is enlarged.

NOTE: Many oculars have a magnification of 10x, but it is possible for a microscope to have an ocular that magnifies differently.

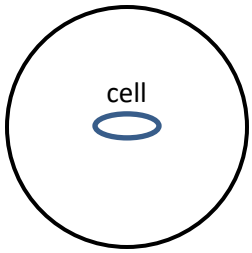
b) Resolution: _____
_____
_____

C. How to Measure Under the Microscope

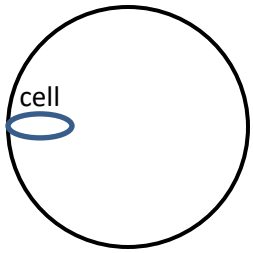
1. The unit of measurement used to measure things under the microscope is the micron (μ).

One micron = .000001 meters or 1/25,000 inch.

2. How to measure under the microscope:



10x objective has a field of view with a diameter of _____
Estimated size of cell: _____



40x objective has a field of view with a diameter of _____
Estimated size of cell: _____

D. The Electron Microscope

1. Does not use light.
2. It uses a stream of electrons. Magnets guide the stream of electrons toward the specimen, and the image is projected on a photographic plate.

3.Advantage: _____
_____

4.Disadvantage: _____
_____
_____