Introduction to World Science
Chapter 1

Summary:
This chapter will introduce the world of life science, which includes plants, animals, bacteria, mushrooms, health, disease, and anything related to living organisms. Students will see that science is about asking questions and using scientific methods to find answers and build knowledge. Science is also about using models and tools to investigate questions and share answers with other scientist.

What You Will Learn (sec 1)

- Explain the importance of asking questions in life science.
- State examples of life scientists at work.
- List three ways life science is beneficial to living things.

I. Asking About Life

A. It all starts with a question

a). Life Science is the study of living organisms
Examples plants, animals and human beings

1. In your own backyard
   a). Why do animals have different structures and functions?
   b). Are plant cells different from animal's cells?
   C). We observe patterns of animal behavior?
   d). How does the energy flow within the ecosystem (food chains & food webs)

2. Touring the world
   a). Diversity is all around us
   b). Forest animals and plants, coral reefs, rain forest, deciduous forest (Plants that lose their leaves)

B. Life Science

1. Anyone: Men & Women can all become a life scientist
2. Anywhere: The laboratory can be anywhere, not just in a closed facility
3. Anything: Study what makes you curious. Animal behavior, reproductions genetics, evolution of different species, cells and how they differ to perform specific task

C. Why ask questions (Benefits of Life Science)

1. Fighting Diseases
   a). Life saving discoveries: vaccination to reduce pain/prevent illness
   - **Pathogens:** such as bacteria, viruses, or protists (single cell organism), cause infectious diseases.
   - **Infectious Diseases (shared): Influenza, chicken pox, strep throat, AIDS**
   - **AIDS: Acquired Immunodeficiency Syndrome (fatal)**
   - **HIV: Human immunodeficiency Virus**

2. Understanding Inherited Disease
   a). Scientists hope to find ways to prevent or cure these diseases.
   - Non infectious diseases: Cancer, heart disease, diabetes, cystic fibrosis, hemophilia

3. Protecting the environment
   a). Finding solutions to problems such as: air pollution, water pollution, destruction of forest,
   b). Solutions: using eco friendly materials, recycling, planting trees, disposing of chemicals properly

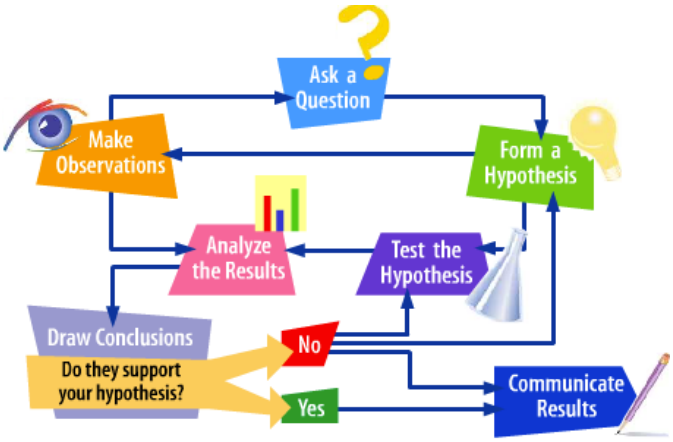
What You Will Learn (Sec 2)

- Describe scientific methods.
- Determine the appropriate design of a controlled experiment.
- Use information in tables and graphs to analyze experimental results.
- Explain how scientific knowledge can change.

II. Scientific Method

A. What are Scientific Methods?

a). Scientific Methods are the ways in which scientists answer questions and solve problems.



B. Asking a Question
   a). Helps focus the purpose of the investigation
   b). Scientist often asks questions based on observations
   Example Textbook: Deformed frogs

1. Make observations
   a). Pay close attention to the little details that you might think is not important

2. Accurate Observations
   a). Any and all information gathered through your senses
   b). Documented in a data table
   - Examples of information: measurements of volume, time, speed, sound, observing microorganisms using a microscope

C. Form a Hypothesis
   a). Possible explanation or answer to a question that is based on observation

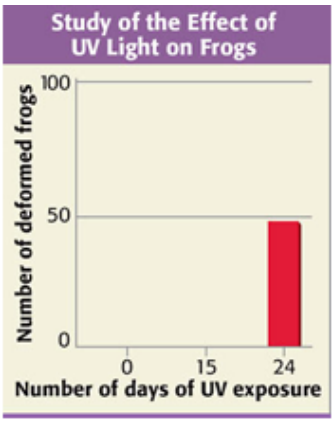
1. Predictions
   a). A statement of cause (if) and effect (then) that can be used to set up a test for a hypothesis

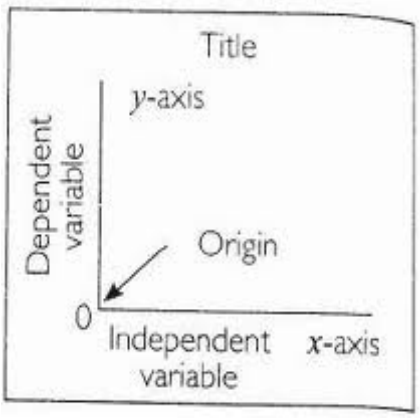
D. Test the Hypothesis
   a). Scientist have to design an experiment to clearly identify a particular factor caused by an observed outcome.

1. Under control (constant)
   a). Test one factor at a time; consist of a control group and one or more experimental groups
   b). Independent Variable: (What can I change) are controlled by the experimenter to determine its relationship to an observed

phenomenon

c). Dependent Variable: what do I observe, the outcome





2. Design an experiment

a). Requires planning and a consideration of all factors.

3. Collecting Data:

a). Keep clear, accurate, honest records of data so that other Scientists can repeat the experiment and verify the results.

E. Analyze the Results

a). Helps Scientists explain and stay focus on the effect of the variable.

F. Draw Conclusion

a). Must conclude if the results of the tests support the hypothesis. Proving that a hypothesis is not true can be as valuable as proving that it is true.

1. Is it the answer?

a). If your answer support the hypothesis, that does not mean the answer is the cause of the observed problem. It simply means that it is a possible explanation. Other factors need to be tested to rule out other causes.

G. Communicate Results

a). Sharing allows other scientists to repeat experiments to determine a consistent outcome.

b). Without bias for a publication of your work, if others can repeat and conclude the same results.

c). Sometimes, new data lead scientists to change their hypotheses.

Scientific Method: * Observation *Ask a Question *Form Hypothesis * Test the Hypothesis (experiment) * Analyze the Results *Draw Conclusions * Communicate results

What You Will Learn (Sec 3)

- Give examples of three types of models.
- Identify the benefits and limitations of models.
- Compare the ways that scientists use hypotheses, theories, and laws

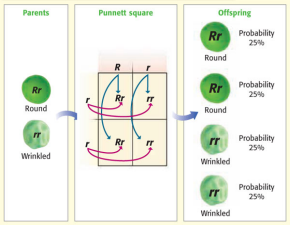
Something to think about

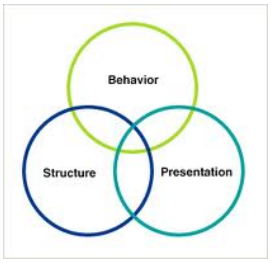
How do you learn about the parts of the cell if you don't have a microscope? You can look at a model of a cell. A model can help you visually understand parts of a cell.

III. Scientific Models

A. Types of Scientific Models

1. Physical Model: (Replica) such as miniature volcanoes and steam engines
2. Mathematical Models: may be made up of numbers, equations, and other forms of data. Examples: Charts and graphs
3. Conceptual Models: Conceptual models are systems of ideas or comparisons of unfamiliar things with familiar things to help explain unfamiliar ideas.





B. Benefits of Models

a). Models represent items that are very large/small and help explain complicated structures

C. Building Scientific Knowledge

a). Scientific knowledge is contently changing and growing. Scientist may draw the same conclusions or different conclusions from the same data that can lead to further research.

1. Scientific Theories

a). Ties many related fact and observations together (helps organize scientific thinking).

b). Used to explain observations and to predict future events
C). Example: Cell theory is an explanation of all living things made of cells

2. Scientific Laws: Newton's laws of motion states the actions
   a). State what will happen in specific situations, not why it will happen
3. Combining Scientific Ideas
   a). Every topic is linked together
   ex. Cells-tissues-organs-organ systems-organisms-eco system
4. Scientific Change
   a). If new evidence challenges an accepted idea, scientists must re-examine the old evidence and reevaluate the old idea

What You Will Learn sec 4

- Give examples of three types of models.
- Identify the benefits and limitations of models
- Compare the ways that scientist use hypothesis, theories, and laws.

IV. Tools, Measurements, and Safety

A. Computers and Technology
   a). Computers are used to create graphs, solve complex equations, analyze and communicate data.

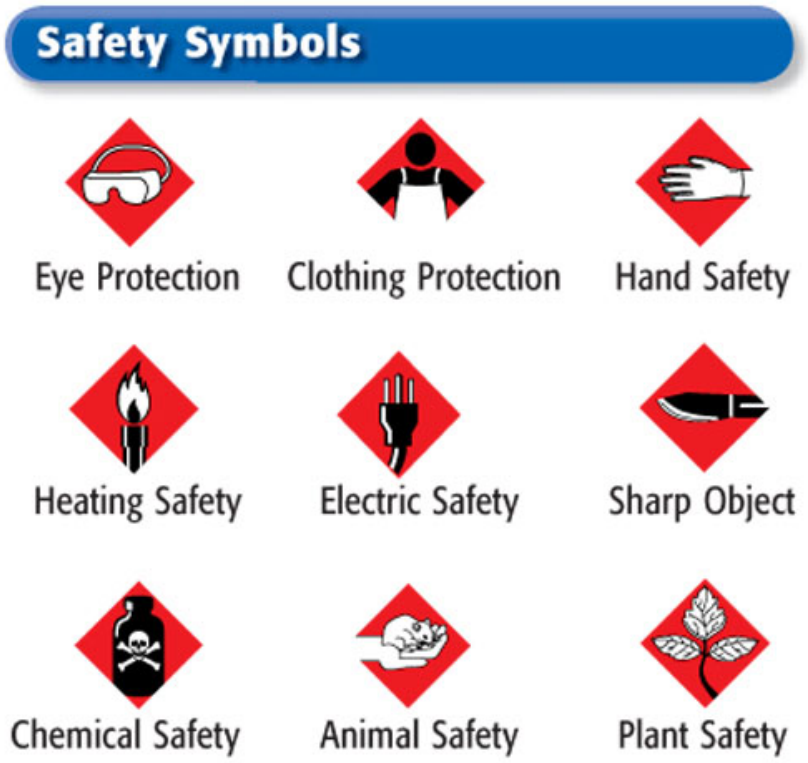
B. Tools for Seeing
   1. Compound Light Microscopes
      a). Is an instrument that uses two or more lenses to magnify small organisms.
   2. Electron Microscopes
      a). Focuses a beam of electrons to magnify objects.
      b). Although electron microscopes produce clearer and more detailed images than light microscope, they cannot be used to observe living things.

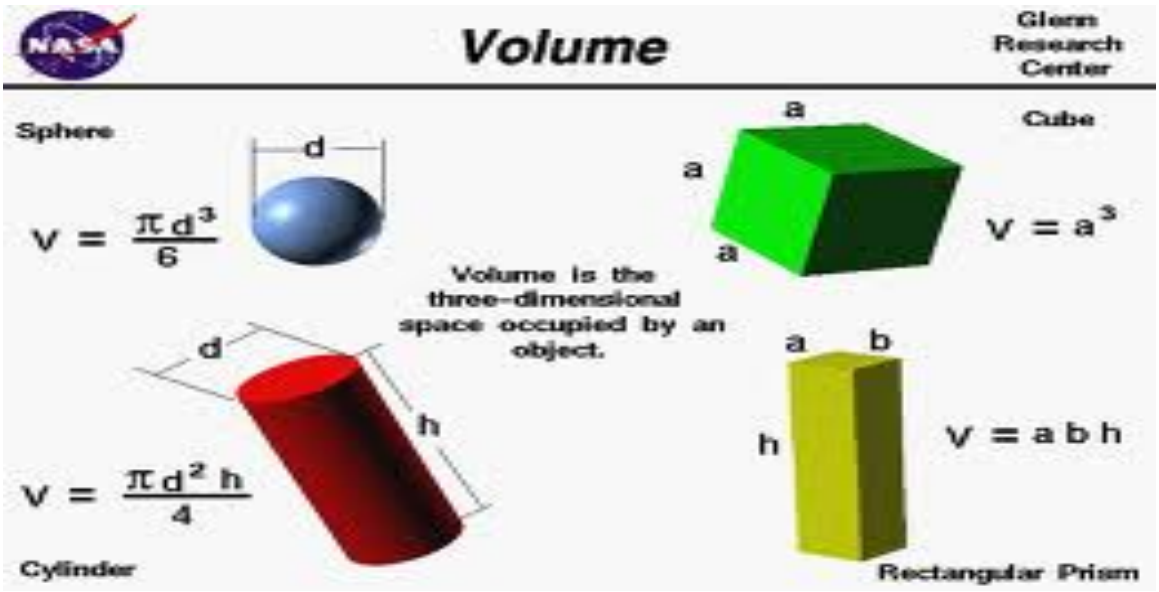
C. Measurements
   1. SI units: see weebly /class work SI unit worksheet hyperlink
      a). All SI units are based on the number 10, which makes conversion from one unit to another easily.
   2. Length: The basic unit of length in the SI is the meter.
   3. Area: The measure of how much surface an object has. Use the following equation:

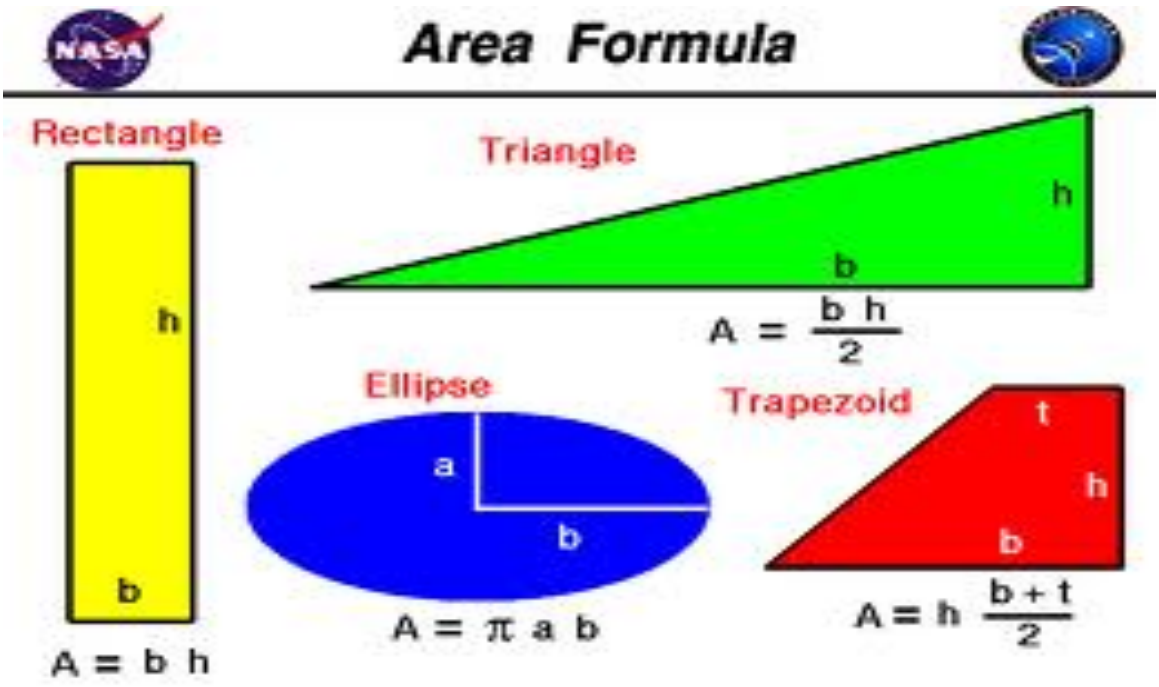
$$Area = length \times width$$

4. Volume: The measure of the size of a body or region in three dimensional space
5. Mass: A measure of the amount of matter
6. Temperature: The measure of how hot (or cold) something is

D. Safety Rules: Follow directions and always refer to safety manual when dealing with hazardous materials




Volume
Glenn Research Center
Sphere
d
$V = \frac{\pi d^3}{6}$
a
a
a
Cube
$V = a^3$
Volume is the three-dimensional space occupied by an object.
d
h
$V = \frac{\pi d^2 h}{4}$
Cylinder
a
b
h
$V = a\,b\,h$
Rectangular Prism


Area Formula
Rectangle
h
b
A = b h
Triangle
h
b
$A = \frac{b\,h}{2}$
Ellipse
a
b
A = π a b
Trapezoid
t
h
b
$A = h\,\frac{b+t}{2}$

Life Scientist

- An **agronomist** specializes in soil and crops.
- An **astronomer** studies stars, planets and galaxies.
- A **botanist** specializes in plants.
- A **cytologist** specializes in the study of cells.
- An **epidemiologist** studies the spread of diseases.
- An **ethologist** studies animal behavior.
- A **geneticist** studies how traits are inherited.
- A **geologist** specializes in the history of Earth.
- A **geographer** studies Earth's surface.
- A **marine biologist** studies ocean plants and animals.
- A **meteorologist** studies weather and climate.
- A **microbiologist** studies microscopic plants and animals.
- A **paleontologist** specializes in fossils.
- A **physicist** studies matter, energy, and how they are related.
- A **seismologist** studies earthquakes.
- **Anthropologists** study human beings.
- **Entomologists** study insects.
- **Herpetologists** study reptiles and amphibians.
- **Ichthyologists** specialize in fish.
- **Malacologists** study mollusks, like snails and clams.

- **Mammalogists** specialize in mammals.
- **Nematologists** study round worms.
- **Ornithologists** study birds.