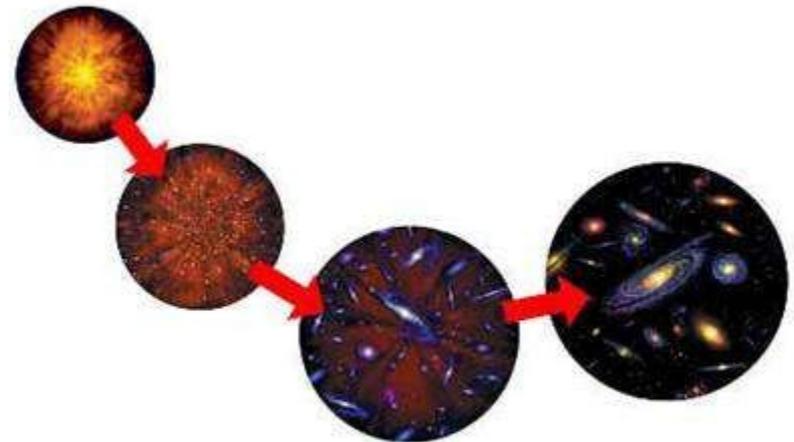


Introduction to **Biology**



Biology - The Study of Life

- Life arose more than **3.5 billion years ago**
- First organisms (living things) were **single celled**
- Only life on Earth for millions of years
- Organisms changed over time (**evolved**)



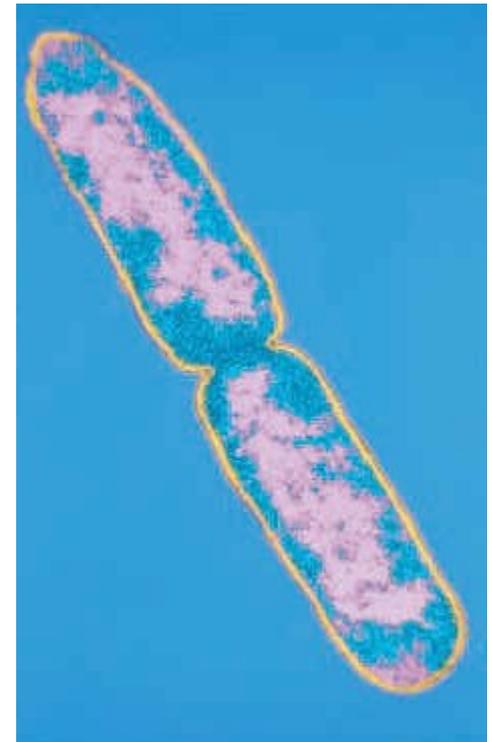
Big Bang Theory

- **New** organisms arose from older kinds
- Today there are **millions** of species
- They inhabit **almost every region** of Earth today



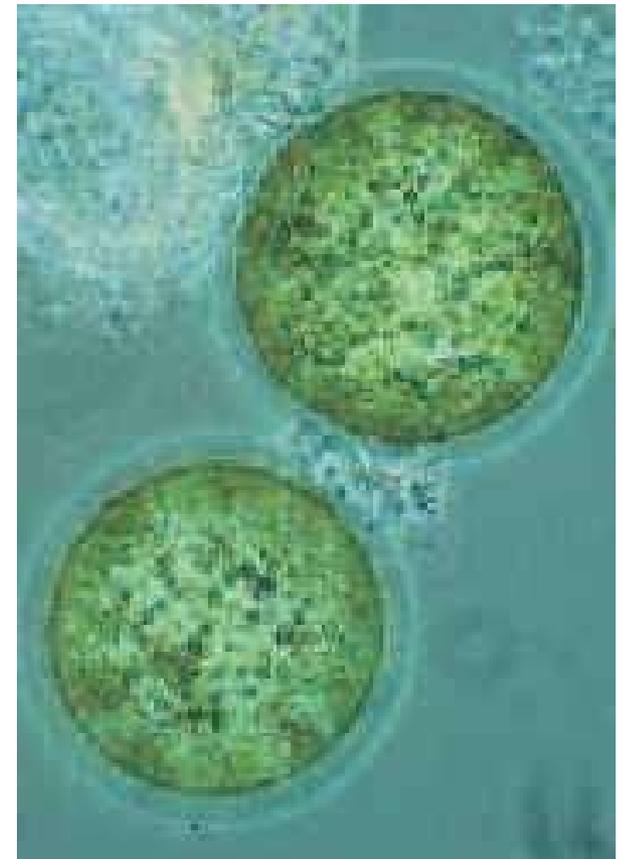
Themes of Biology

- **Cell** structure and function
- Stability and **homeostasis**
- Reproduction and **inheritance**
- **Evolution**
- **Interdependence** of organisms
- Matter, energy, and **organization**



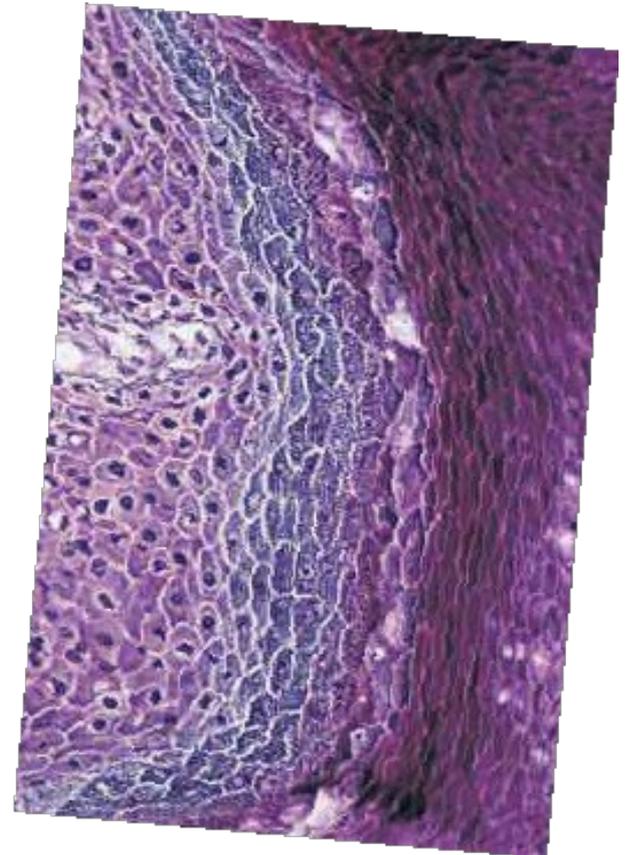
Cell Structure and Function

- **Cell** basic unit of life
- All organisms are **made of and develop from cells**
- Some composed of only a single cell (**unicellular**) which is usually **identical to**

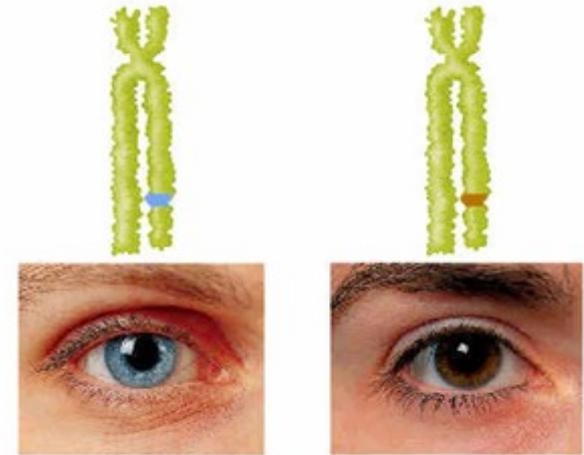


Cells

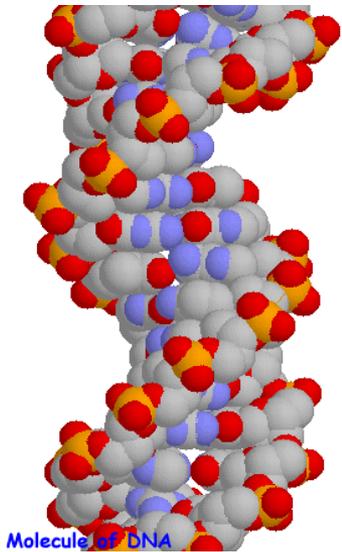
- Most organisms are composed of many cells (**multicellular**)
 - Cells are **different** (undergo differentiation)
- Cells are **small**
- Cells are **highly**



- Cells contain specialized structures (**organelles**) that carry out the cell's life processes



- Many **different kinds of cells** exist
- All cells surrounded by a **plasma membrane**
- Contain a set of instructions called **DNA**



©Rothamsted Experimental Station, 1997, 1998

Molecule of DNA

Stability and Homeostasis

- Organisms must Maintain very stable internal conditions -
HOMEOSTASIS
- **Temperature, water content, chemical content, etc. must be maintained**



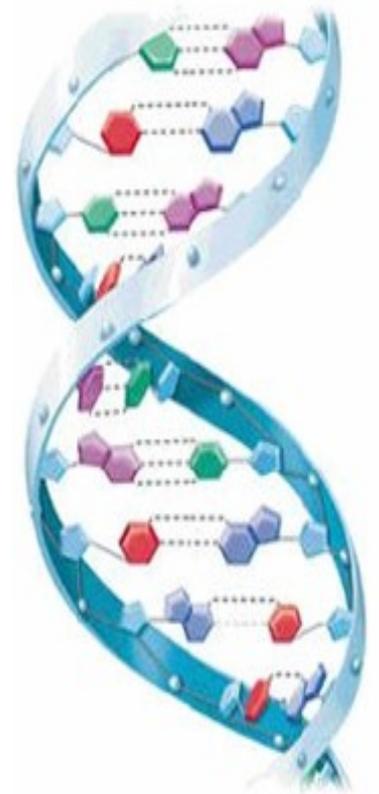
Reproduction and Inheritance

- All organisms produce new organisms like themselves **REPRODUCE**
- Organisms transmit hereditary information to their offspring **INHERITANCE**



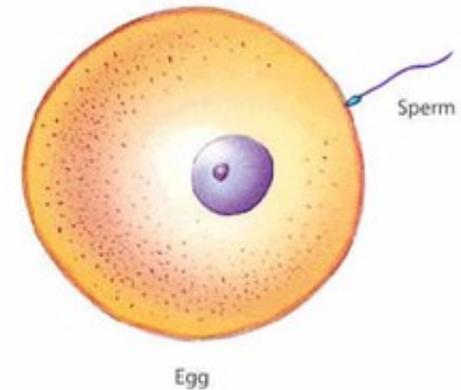
DNA

- Genetic Information in **all cells**
- **Deoxyribonucleic Acid**
- DNA contains instructions for traits **GENES**
- Make the structures and complex chemicals necessary for life **PROTEINS**
- DNA in every body cell **(SOMATIC CELLS)** is exactly



Sexual Reproduction

- Hereditary information from **two different organisms** of the same species are combined
- Egg and sperm → **zygote (fertilized egg)**
- Zygote contains hereditary information from **both parents**



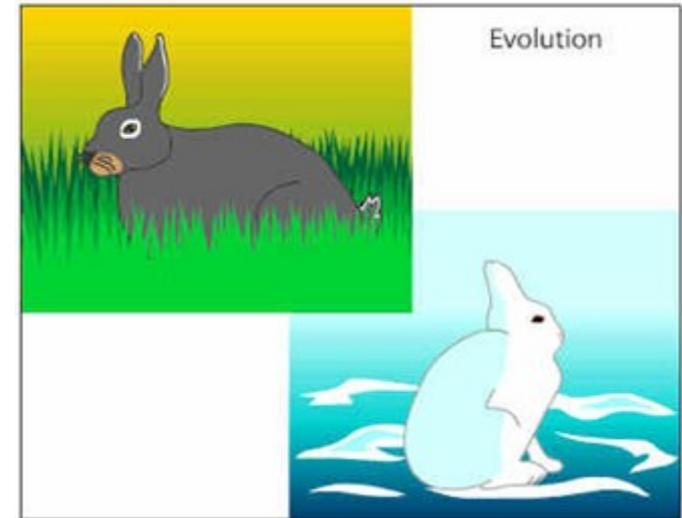
Asexual Reproduction

- Hereditary information from **one**, usually unicellular, **organism** that divides
- **Resulting cells** contain **identical hereditary information**
- Genetic information from **single parent**



Evolution

- Populations of organisms **change (evolve)** over generations (time)
 - Explains how many different kinds of organisms came into existence **SPECIES**
 - Explains how **modern** organisms are **related** to **past** organisms
- Copyright Cmassengale



- Explains why **organisms look and behave** the way they do
- Provides a basis for exploring the **relationships among** different groups of organisms



Natural Selection

- Natural selection is the **driving force in evolution**
- Organisms that have certain **favorable traits** are better able to **successfully reproduce** than organisms that lack these traits



Natural Selection

- Survival of organisms with favorable traits cause a **gradual change in populations over many generations**
- Also Called **"Survival of the Fittest"**

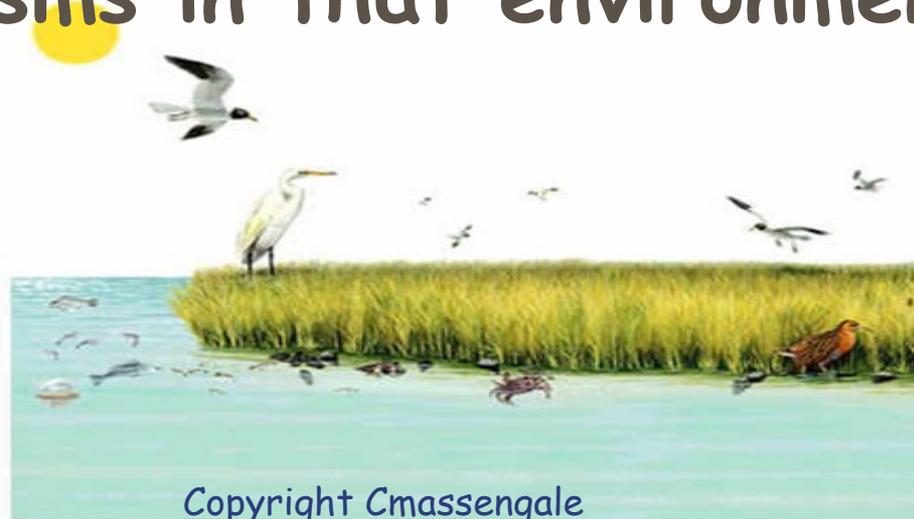


Interdependence of Organisms

- Interaction of organisms with one another and with their environment
ECOLOGY
- **Insects** depend and **flowers** **DEPEND** on each other for food & pollination
COEVOLUTION

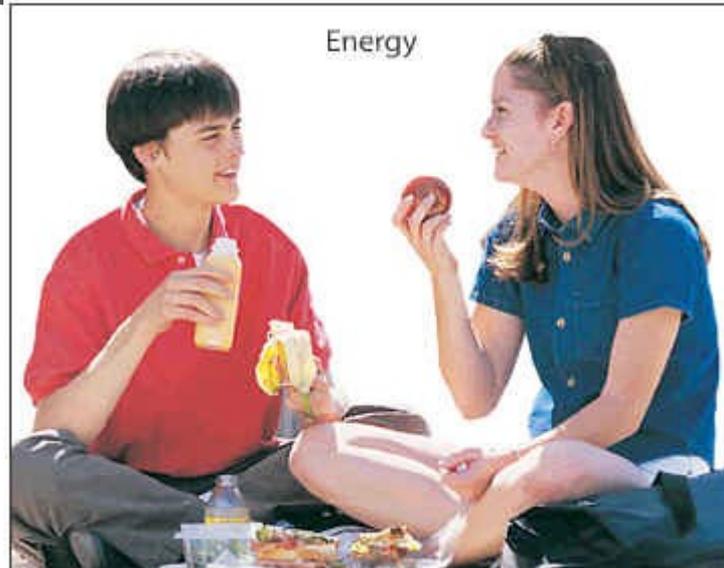


- All organisms need substances such as **nutrients, water, and gases** from the environment
- The **stability of the environment** depends on the healthy functioning of organisms in that environment



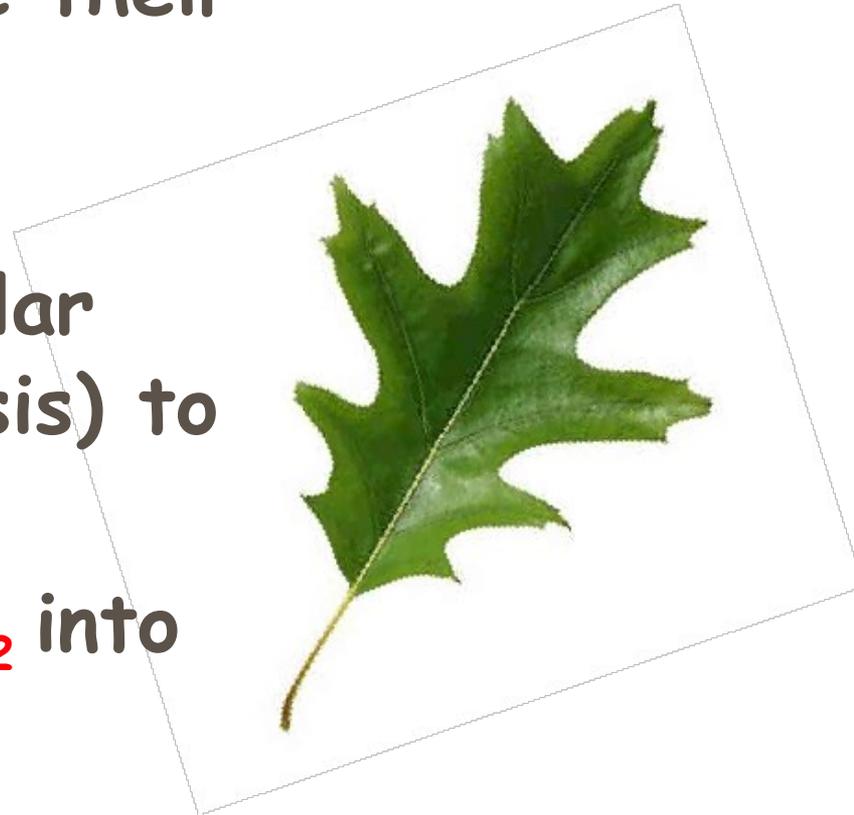
Matter, Energy and Organization

- Living things are **highly organized**
- Require a **constant supply of energy** to maintain their orderly state



Autotrophs

- Organisms that make their own food are called **autotrophs**
- **Phototrophs** - use solar energy (photosynthesis) to get energy
- Convert H_2O and CO_2 into **sugar and O_2**
- **Chemotrophs** - use different chemical processes to get energy



Heterotrophs

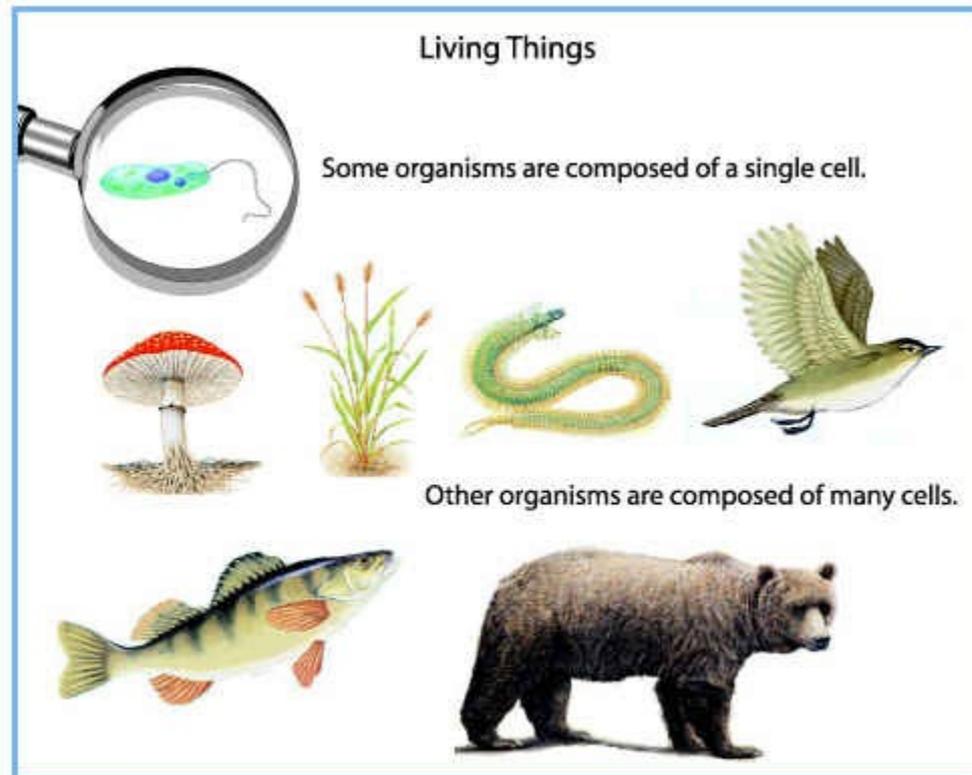
- Organisms that must take in food to meet their energy needs are called **heterotrophs**.
Consume autotrophs (**herbivores**), other heterotrophs (**carnivores**) or both (**omnivores**) for their energy needs



- Complex chemicals are broken down and **reassembled into chemicals** and structures

The World of Biology

Chapter 1.2

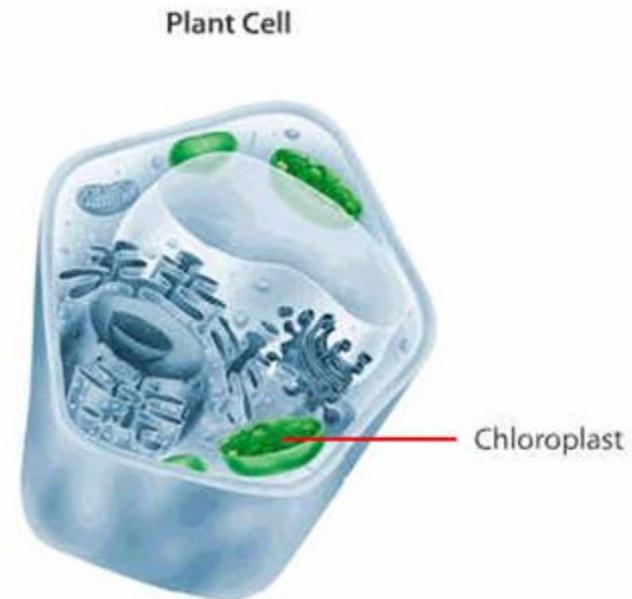


Characteristics of Life



Cells

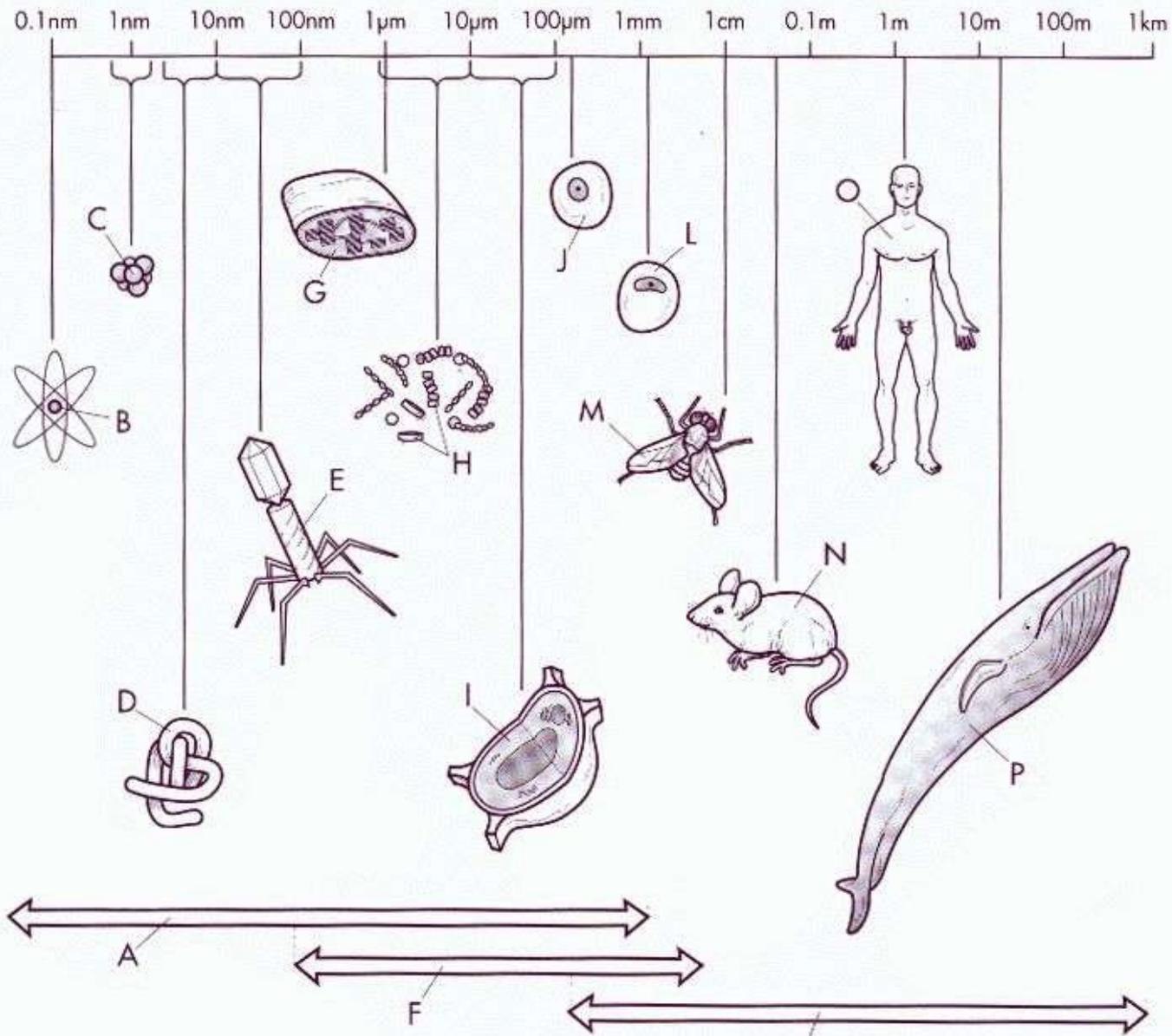
- All living things are composed of **cells**
- In multicellular organisms, many are **specialized** to perform specific functions
- Cells are always very **small**
- The size of multicelled organisms depends on **the number**



Organization

- Organized at both the **molecular and cellular levels**
- Take in substances from the environment and organize them in complex ways
- Specific cell structures (**organelles**) carry out particular





- In **multicellular organisms**, cells and groups of cells (tissues) are organized by their function

■ **Cells** → tissues

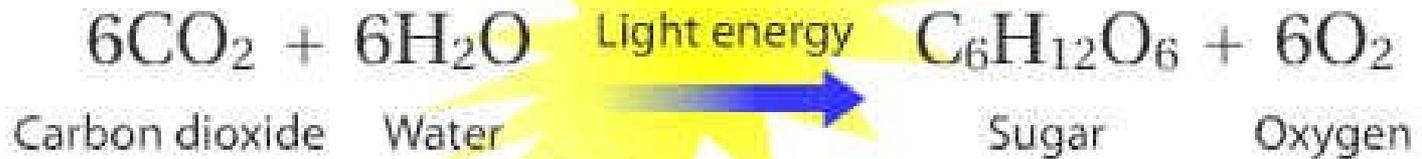
■ **Tissues** → organs

■ **Organs** → systems

Levels of Organization		
Biosphere	The part of Earth that contains all ecosystems	 Biosphere
Ecosystem	Community and its nonliving surroundings	 Ecosystem Landscape, water, trees, plants, dog, grass, stream, rocks, air
Community	Populations that live together in a defined area	 Community Hawk, stream, trees, plants, dog, grass
Population	Group of organisms of one type that live in the same area	 Population Deer
Organism	Individual living thing	 Organism Deer
System of Cells	Two or more organs and organ systems	 System of Cells Nervous tissue → Brain → Nervous system
Cells	Smallest functional unit of life	 Cells Neuron
Molecules	Groups containing smallest unit of most chemical compounds	 Molecules Water → DNA

Energy Use

- Use energy in a process called **metabolism**
 - *Sum of all chemical processes*
- Require energy to maintain their molecular and cellular organization, grow and reproduce



Homeostasis

- Maintain **stable internal conditions**
- **Temperature pH etc**



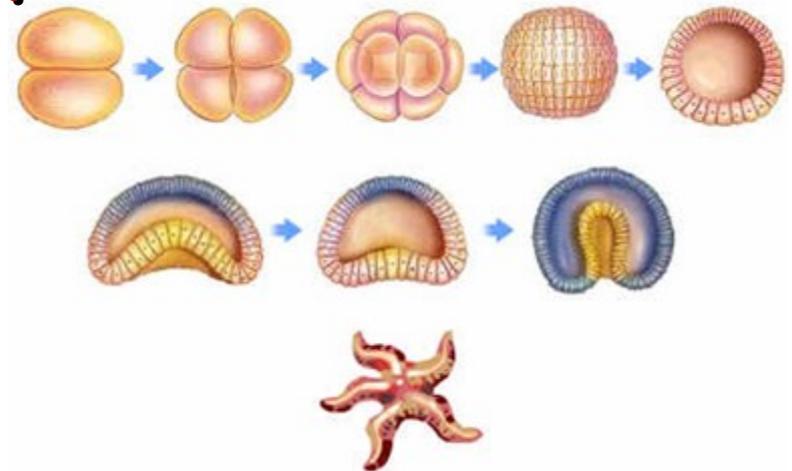


Growth

- Growth occurs as the result of **cell division and cell enlargement**
- **Cell division** is the formation of two cells from a **preexisting cell**
- New cells enlarge as they mature
- When a cell grows to a size where its **surface area isn't big enough for its volume**, the cell divides

Development

- The process by which an adult organism arise is called **development**
 - Repeated cell divisions and **cell differentiation**



Reproduction

- All species have the **ability to reproduce**
■ **Not essential to survival of individual**
but is essential for continuation of a
species



Responsiveness

- **Respond to stimuli** in the external environment
- Detect and respond to changes in **light, heat, sound and chemical and mechanical contact**
- Coordinates its responses



Evolve

- Ability to adapt to their environment through the process of **evolution**
- **Favorable characteristics** are selected for and passed on to offspring
- Called **adaptations**
- Driven by **natural selection** or "**survival of the fittest**"



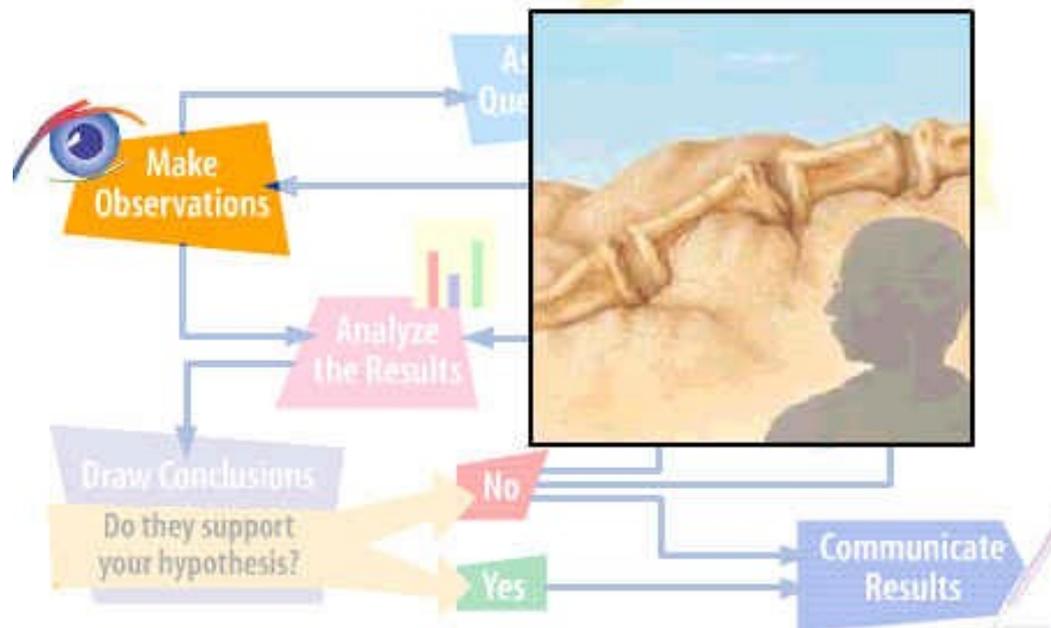
Scientific Method

Chapter 1.3



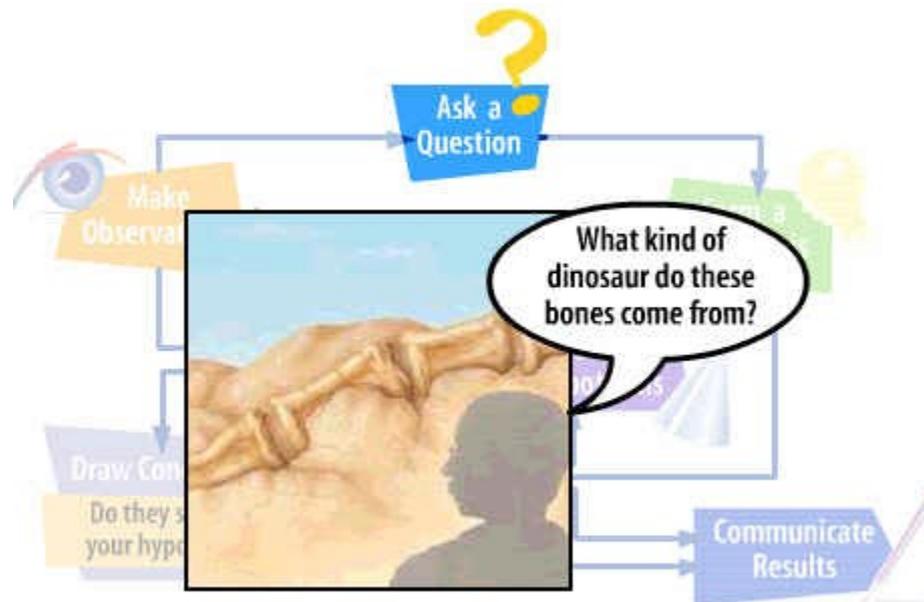
Observation - STEP 1

- Employing your **five senses** to perceive objects or events



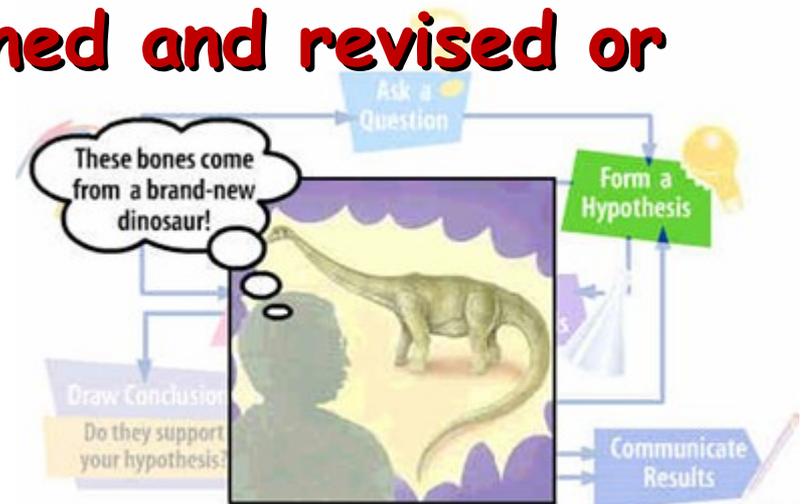
Asking a Question

- Based on observations; **one or more questions are generated**



Forming a Hypothesis - STEP 2

- A statement is **testable** if evidence can be collected that either does or doesn't support it
- It can never be proven beyond doubt
- Often must be **refined and revised or discarded**



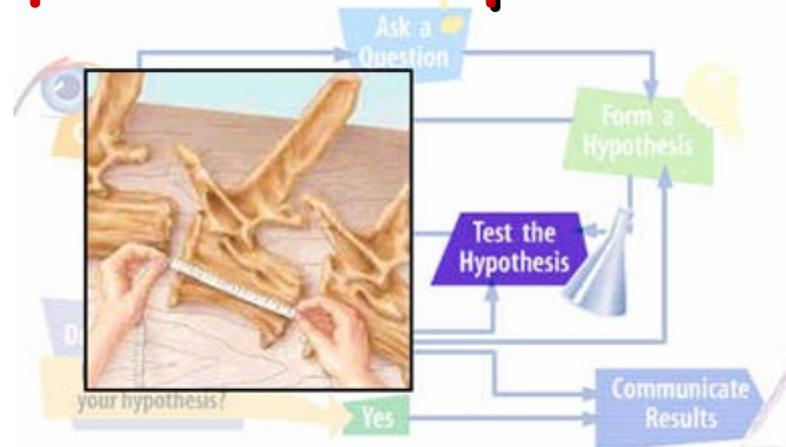


The Hypothesis ---

- **Is a statement made in advance that states the results that will be obtained from testing the hypothesis**
- Often written in the form of an **“if-then” statement**

Experimenting - STEP 3

- **Testing a hypothesis** or prediction by gathering data under **controlled conditions**
 - conducting a controlled experiment
- Based on a comparison of a **control group** with an **experimental group**



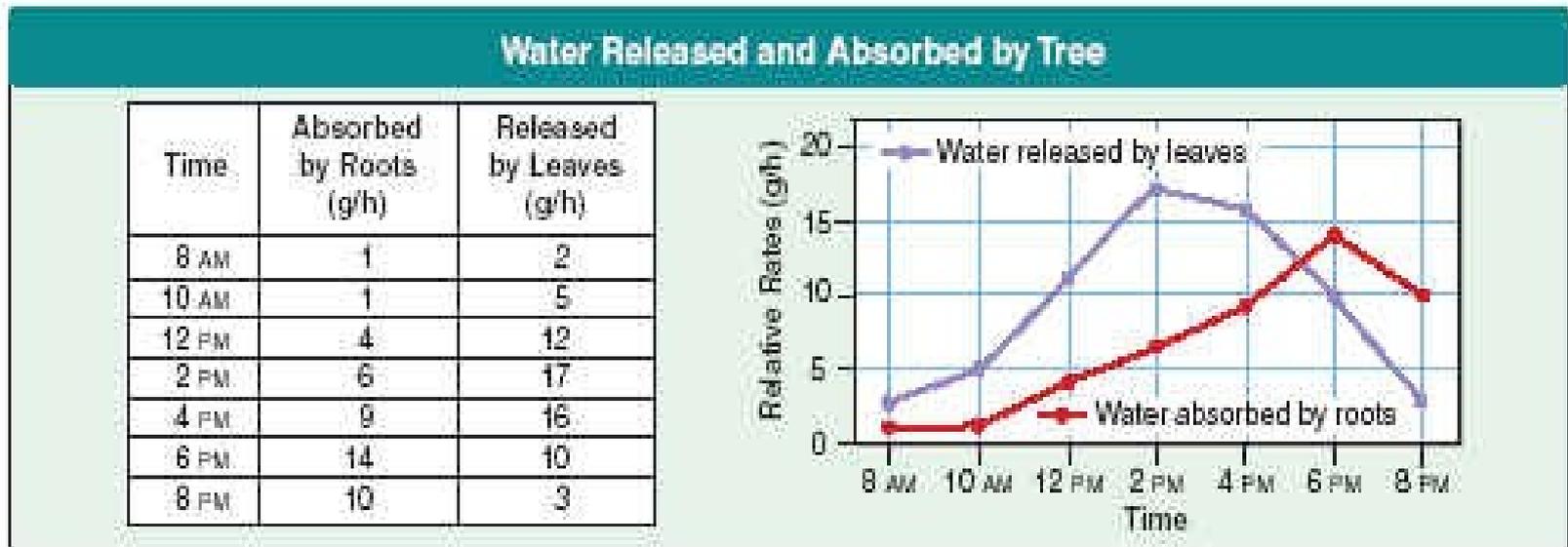
- Both groups are identical **except for one factor (independent variable)**
- Observations and measurements are taken for a particular factor (**dependent variable**) in both groups
 - Driven by or variable

Testing the Effect of UV Light on Frogs			
Factors	Groups		
	#1 Control	#2 Experimental	#3 Experimental
Type of frog	leopard frog	leopard frog	leopard frog
# of eggs	100	100	100
Temperature of water	25°C	25°C	25°C
Variable: UV light exposure	0 days	15 days	24 days

- 
- Measuring
 - Involves **quantitative data** that can be measured in **numbers** &/or **qualitative data** information that isn't numbers
 - Sampling
 - Technique of using a **sample** - a small part - to **represent the entire population**

Organizing Data - STEP 4

- Involves placing observations and measurement (data) in order
 - **Graphs, charts, tables, or maps**



Analyzing Data - STEP 4 cont)

- Collected and organized data must be analyzed
- Process of **determining whether data are reliable or whether they support or do not support a hypothesis or prediction**



Conclusion - STEP 5

- Conclusions are made on the basis of facts, not observations
 - Often **drawn from data** gathered from a study or experiment
 - Should **support the hypothesis**
 - Should be **re-testable**



Communication - STEP 6

- Scientists must **share the results of their studies** with other scientists (peers)
- **Publish** findings in **journals**
- Present their findings at **scientific meetings**
- Scientists must be **unbiased**
 - Should not tamper with their data
 - Only publish & report tested & proven

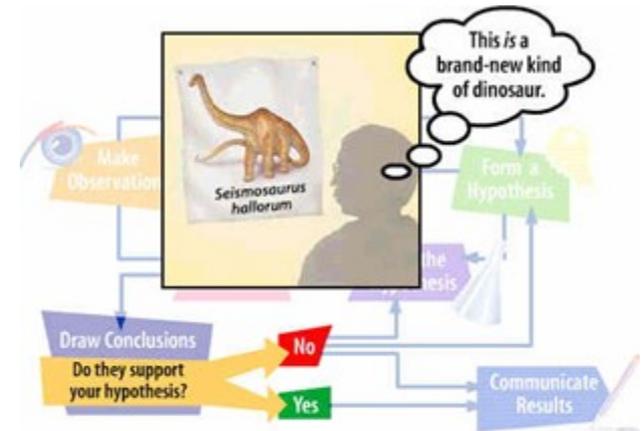


Communication

- **Sharing of information** is essential to scientific process
- Subject to examination and **verification** by other scientists
- Allows scientists to build on the work of others

Theories

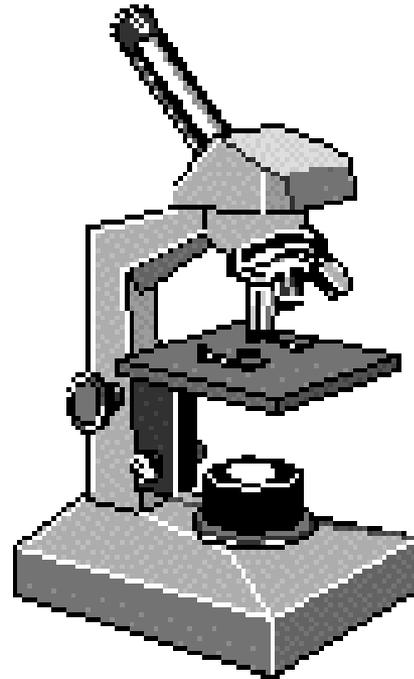
- A **theory** may be formed after many related hypotheses have been tested and supported with experimental evidence
- A **broad and comprehensive statement of what is thought to be true**
- Supported by **considerable evidence**
- Ties together related hypotheses



Laws

- A **Statement of fact** that concisely explains an action or group of actions
e.g. Law of Gravity
- **Accepted to be true**
- **Universal**
- May be expressed as a math equation

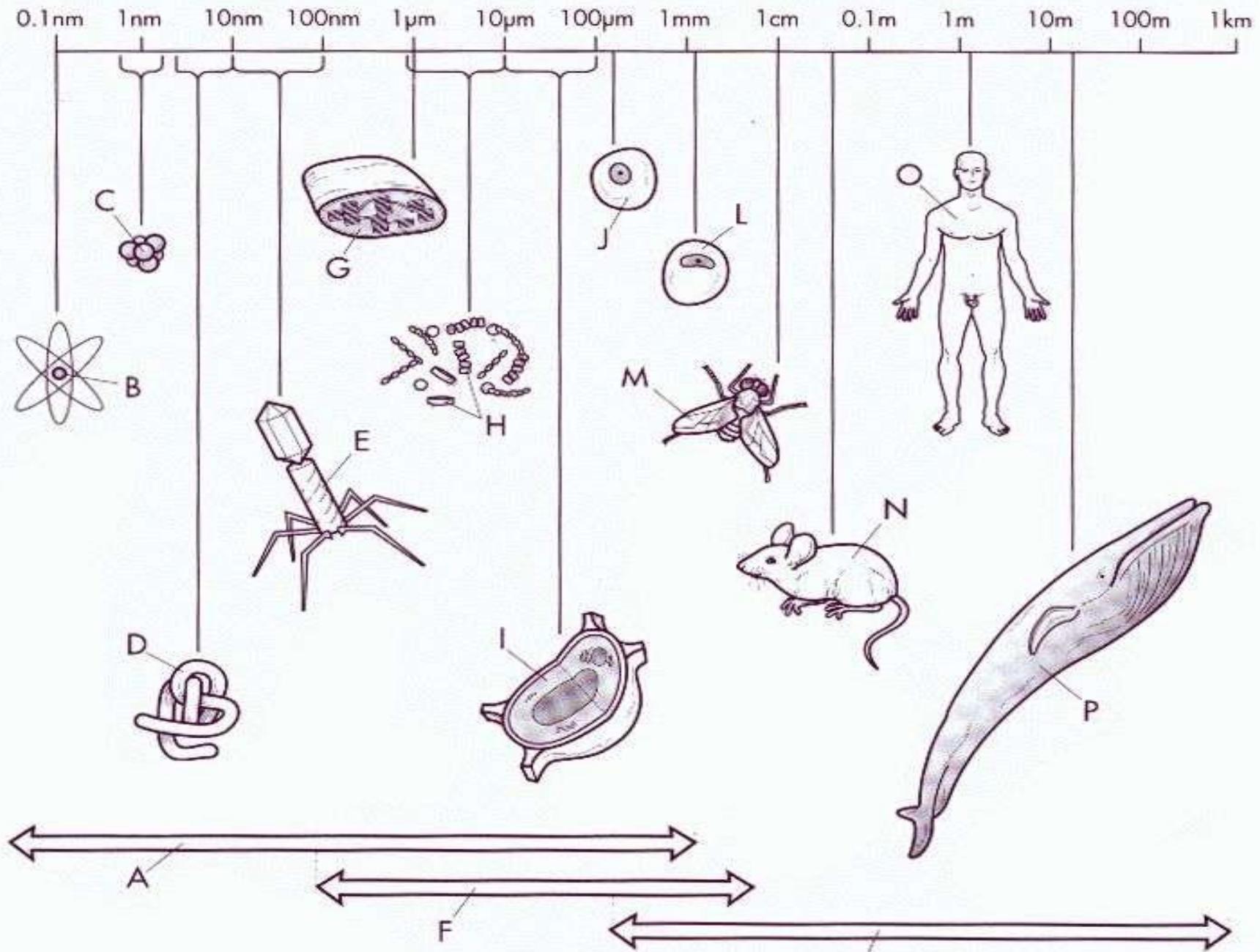
MICROSCOPES





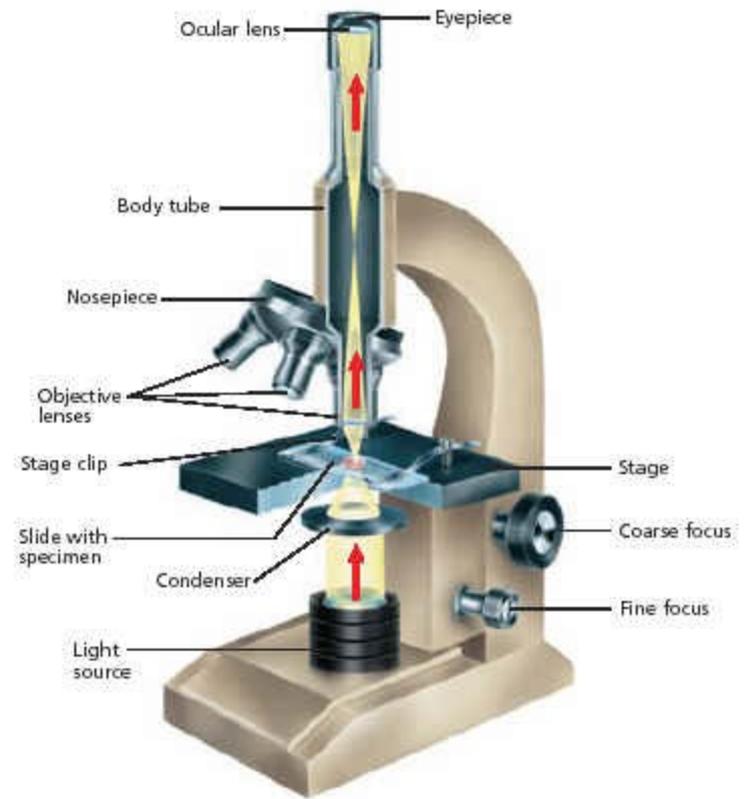
Microscopy and Measurement

- Microscopes - **produce an enlarged image of an object**
 - Used to study organisms, cells, and cell parts
 - Increase in apparent size is called **magnification**
 - The ability to show details clearly is called **resolution**
 - Microscopes vary in both magnification and resolution

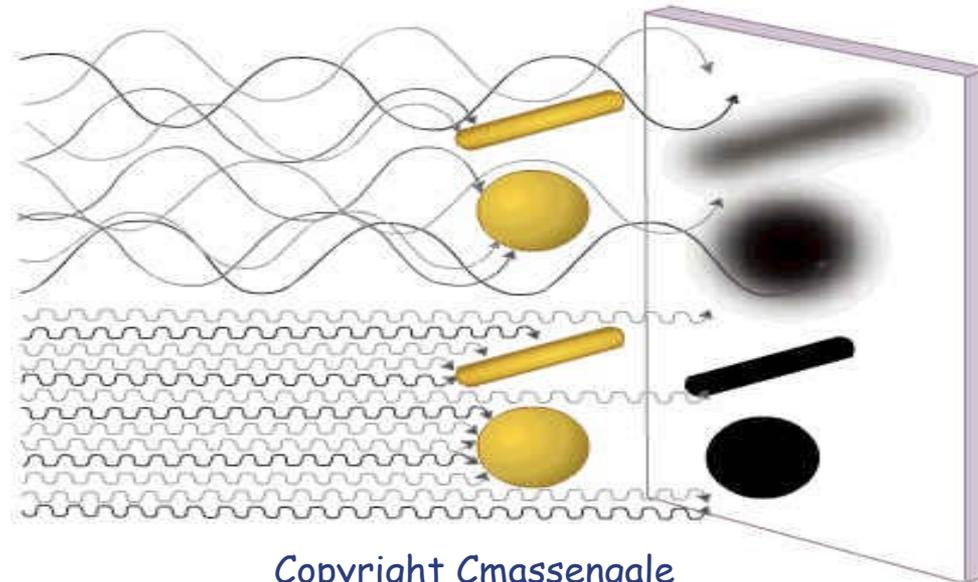


Compound Light Microscopes

- **Specimen** mounted on a **glass slide**
- Must be thinly sliced or very small
- Pair of **lenses**
 - **Ocular** lens (eye piece)
 - **Objective** lens (nose piece)
- Can be used to study **LIVE**



- **Magnification** determined by multiplying power of both lenses
- Eyepiece 10X times Objective power (20X, 40X...)
- **Highest** Maximum magnification is around **1000X**



Electron Microscope

- **Transmission EM (TEM)**
 - Uses a **beam of electrons** to produce an enlarged image of very thinly sliced specimen on screen or photographic plate
 - Image focused by **magnetic lenses**
 - 200,000X magnification
 - **Cannot be used to view**



■ Scanning EM (SEM)

- 3D image

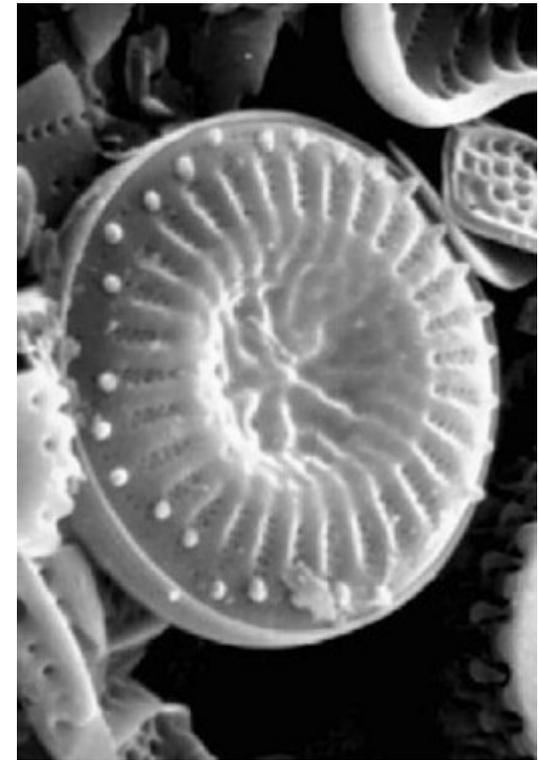
- Specimens **not sliced for viewing**

- Surface sprayed with fine metal coating

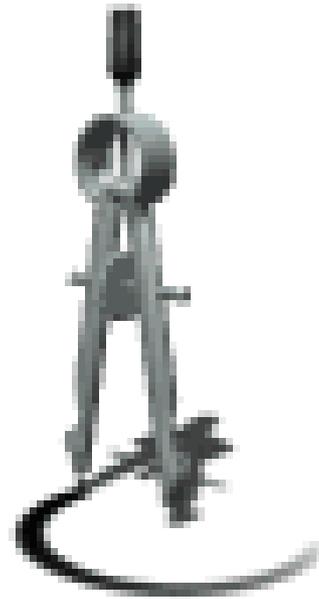
- Also uses electron beam and fluorescent screen or photographic plates

- **100,000X magnification**

- **Cannot be used to view**



MEASUREMENTS



Measurements

- We will be using **SI units or metric** system when possible --- the **WHOLE** world uses it except us (USA)

TABLE 1-4 Other Units Acceptable for Use with SI

<u>Name</u>	<u>Abbreviation</u>	<u>Value in SI units</u>
Minute	min	1 min = 60 s
Hour	h	1 h = 60 min = 3,600 s
Day	d	1 d = 24 h = 86,400 s
Liter	L	1 L = 1 dm ³ = 0.001 m ³
Metric ton	t	1 t = 1,000 kg

TABLE 1-2 *Some SI Prefixes*

Prefix	Abbreviation	Factor of base unit
giga	G	1,000,000,000
mega	M	1,000,000
kilo	k	1,000
hecto	h	100
deka	da	10
deci	d	0.1
centi	c	0.01
milli	m	0.001
micro	μ	0.000001
nano	n	0.000000001
pico	p	0.000000000001

TABLE 1-3 *SI Derived Units Often Used in Biology*

<u>Derived quantity</u>	<u>Name</u>	<u>Abbreviation</u>
Area	square meter	m ²
Volume	cubic meter	m ³
Mass density	kilogram per cubic meter	kg/m ³
Specific volume	cubic meter per kilogram	m ³ /kg
Celsius temperature	degree Celsius	°C

TABLE 1-4 *Other Units Acceptable for Use with SI*

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