Biology Must Knows!

Why do we need biology?

Biology is essential for…

Understanding the living world

Medical advancements

- **Medicines**
- **Vaccines**
- **Therapies**

Addressing global crises like pollution (via bioremediation) and disease

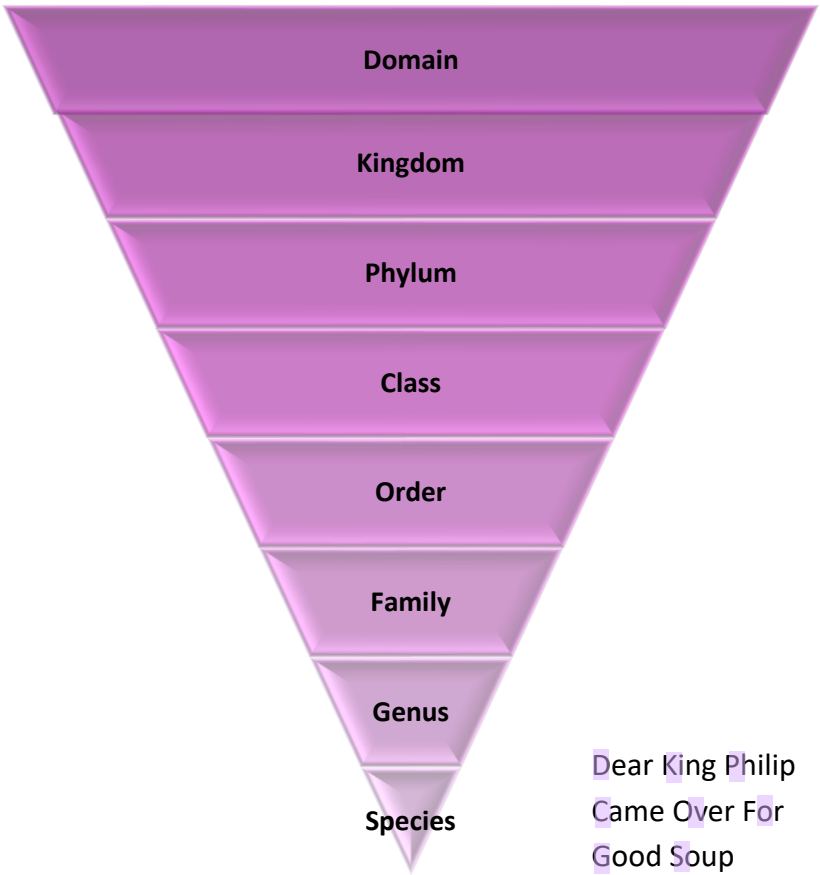
Food security and agriculture

- **Improve crop yields**
- **Manage pests**
- **Better farming practices**

Understanding ourselves

- **Our bodies, health, genetics & how to make informed lifestyle choices**

Taxonomic Hierarchy



Dear King Philip
Came Over For
Good Soup

BINOMIAL NOMENCLATURE

Genus species or *Genus species*

Ex. Homo sapiens

Organization of Living Systems

Cellular level

1. Atoms
2. Molecules
3. Organelles
4. Cells

 The cell is the basic unit of life

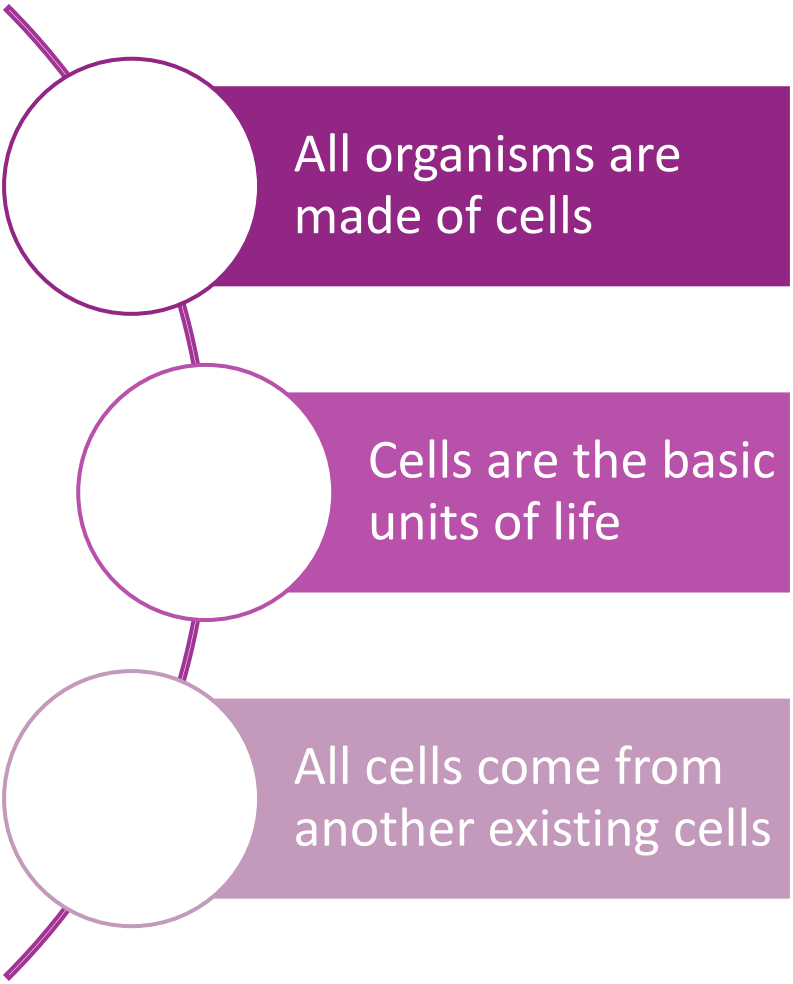
Organism level

5. Tissues
6. Organs
7. Organ systems
8. Organisms

Ecosystem level

9. Population – same place & species
10. Species – similar in appearance & able to interbreed
11. Community – different species in one place
12. Ecosystem – biological community & physical habitat
13. Biosphere – Earth

Cell Theory


All organisms are made of cells
Cells are the basic units of life
All cells come from another existing cells

The Scientific Method

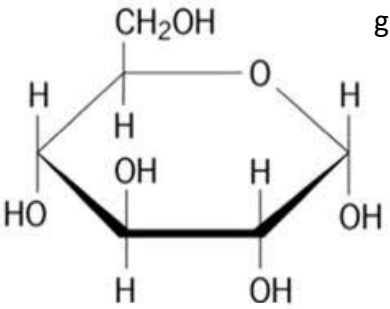
Number the steps of the scientific method.

- Hypothesis formation
- Observation
- Experimentation
- Conclusion
- Prediction

Macromolecules

Carbohydrates

- Provides energy
- 1:2:1 ratio (C:H:O)
- C–H covalent bonds hold energy
- Divided into 3 groups:
    - Monosaccharides
        - Sugars that cannot be broken down further aka. Simple sugars
        - Ex. glucose, fructose, galactose…
    - Disaccharides
        - “Double sugars” because they are formed from 2 monosaccharides
    - Polysaccharides
        - Large, complex molecules of hundreds to thousands of monosaccharides
        - Ex. starch, cellulose, glycogen…



Glucose

Proteins

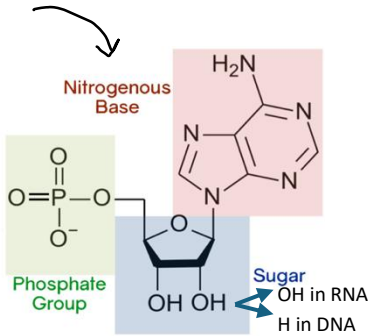
- THINGS that do STUFF
- Found in every part of a living cell
- Amino acids
  - Small units that make up proteins

Lipids

- Stores energy
- Hydrophobic (water fearing) molecules
- Nonpolar C–H bonds
- Ex. Fats, oils, waxes, and even some vitamins
  - Fats (triglycerides)
    - Made of glycerol and fatty acids ⇒ energy storage
  - Phospholipids ⇒ form membranes

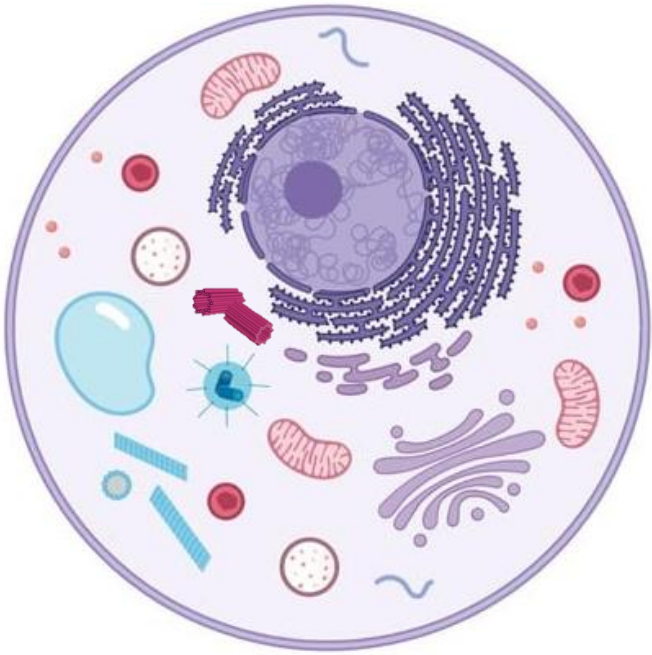
Nucleic Acids

- Information molecules
  - Ex. DNA & RNA
- Monomer: nucleotides
- Nitrogenous bases:
  - Adenine (A)
  - Cytosine (C)
  - Guanine (G)
  - Thymine (T)
  - Uracil (U) in RNA



Animal Cell

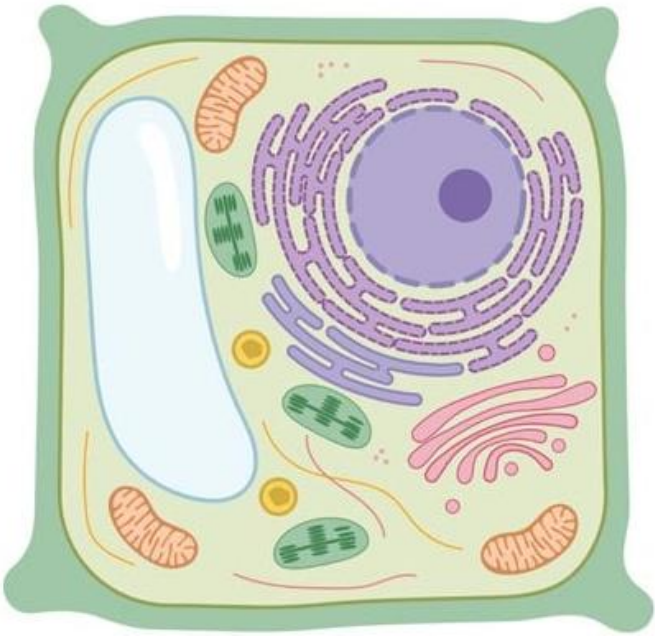
Label the animal cell.



Nuclear envelope	Golgi apparatus
Chromatin	Lysosome
Peroxisome	Nucleus
Nucleolus	Plasma membrane
Vacuole	Centrosomes
Mitochondria	Rough endoplasmic reticulum
Cytoplasm	Smooth endoplasmic reticulum
Ribosomes	

Plant Cell

Label the plant cell.



Cell wall	Golgi apparatus
Plasma membrane	Mitochondria
Cytoplasm	Nucleus
Central vacuole	Nuclear envelope
Chloroplast	Nucleolus
Ribosomes	Rough endoplasmic reticulum
Chromatin	Smooth endoplasmic reticulum

Organelles

A typical animal cell is made up of these organelles:

- **Cell membrane** – semipermeable phospholipid bilayer ⇒ controls what goes in and out of the cell
- **Cytoplasm** – all structures, organelles, and activities are contained in the cytoplasm
- **Ribosomes** – protein-making factories of the cell
- **Endoplasmic Reticulum (ER)** – works in the synthesis, storage and transport of proteins and other chemicals in the cell
    - **Rough** – ribosomes attached to it
    - **Smooth** – lacks attached ribosomes
- **Golgi apparatus** – Receives molecules made by the ER, chemically "processes" them, and then packages them in transport vesicles to their final destination
- **Mitochondria** – the powerhouse of the cell
    - Make ATP
- **Lysosomes** – the cell's garbage and recycling facility
    - Contain digestive enzymes that break down food, cell waste, and foreign particles that enter the cell
- **Peroxisomes** – similar to lysosomes but contain the enzyme catalase that allow cells to break down toxic hydrogen peroxide

- **Vacuole** – temporary storage bubbles
    - They store water, food and waste
    - The central vacuole in plant cells contains mostly water
- **Nucleus** – control center of the cell
    - **Nuclear envelope** – same function as the cell membrane
    - **Chromosomes/Chromatin**
        - The chromosomes are made of DNA and protein
        - In non-dividing cells they appear as thread-like strands called chromatin
    - **Nucleolus** – small structure that makes ribosomes and takes them to the cytoplasm
- **Centrosomes** – organize the microtubule proteins that make up the cytoskeleton of the cell

Plant cells have the same organelles that animal cells have (except centrosomes). But they have two additional organelles:

- **Cell wall** – Rigid structure outside the cell membrane that helps support and protect the cell
    - Made of cellulose in plants
- **Chloroplasts** – green organelles containing the green pigment chlorophyll that allows photosynthetic organism to absorb light energy and perform photosynthesis

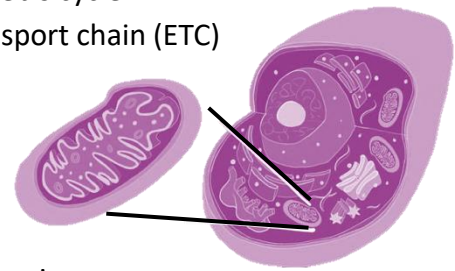
Metabolism

ALL of the chemical reactions that allow a cell to survive

Aerobic cellular respiration

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{ATP}$$

1. Glycolysis (splitting glucose)
2. Pyruvate oxidation
3. Citric acid/Kreb's cycle
4. Electron transport chain (ETC)



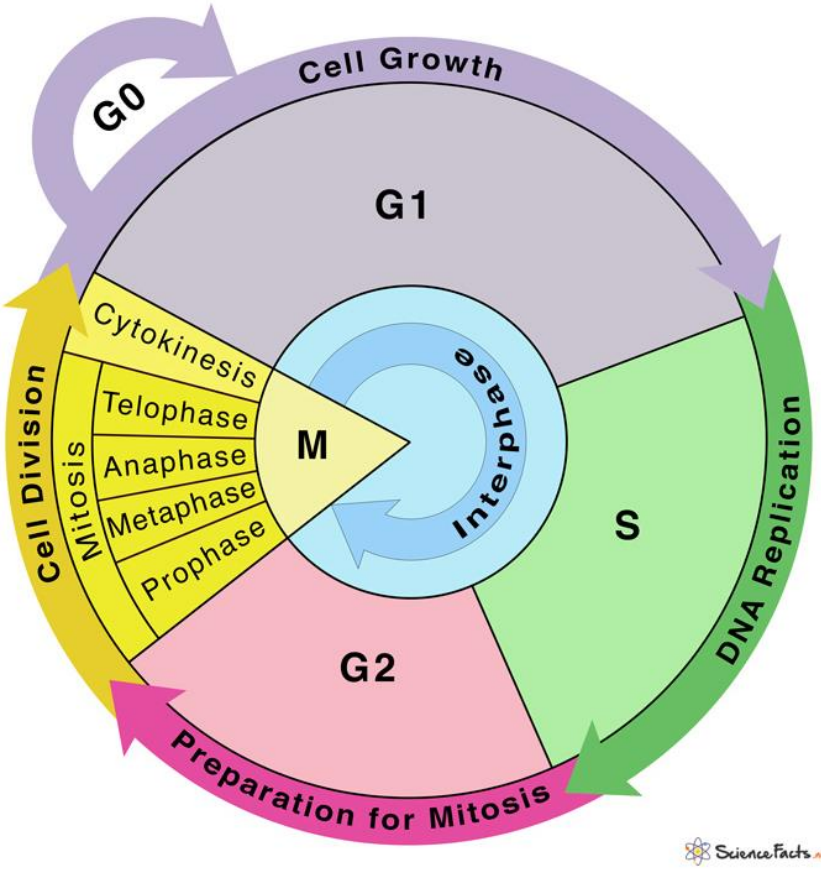
Fermentation

1. Glycolysis
2. Pyruvate reduction

Photosynthesis

$$6CO_2 + 12H_2O \xrightarrow{sunlight} C_6H_{12}O_6 + 6H_2O + 6O_2$$

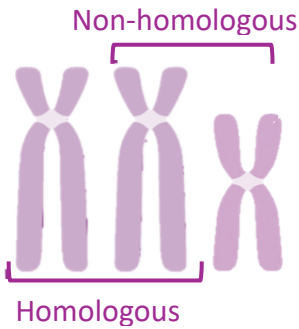
The Eukaryotic Cell Cycle



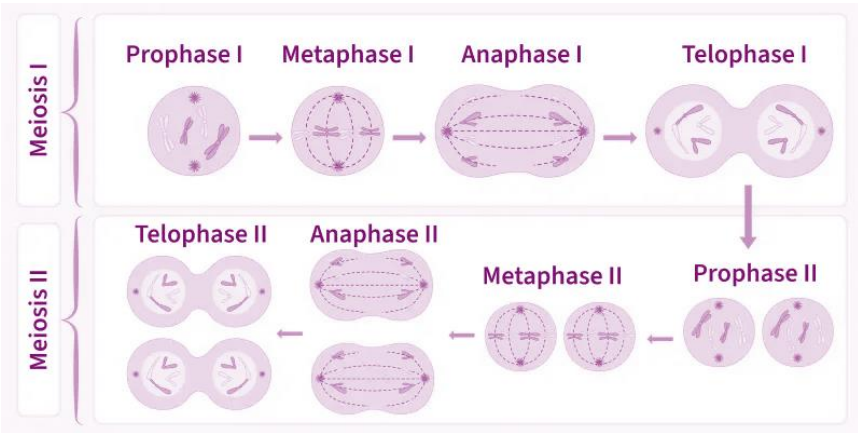
Meiosis

Two divisions with one round of DNA replication

- Meiosis I
  - "Reduction division"
    - Results in daughter cells that contain one homologue from each chromosome pair
  - 2n ⇒ 1n
  - No DNA replication between meiotic divisions
- Meiosis II
  - Just like mitosis
    - Separates the sister chromatids for each homologue
  - 1n ⇒ 1n



Each has a prophase, metaphase, anaphase and telophase



Heredity and Genetics

Phenotype: trait you see (blue eyes, brown hair, etc.)

Genotype: gene/alleles (TT, Tt, or tt)

Allele: alternative form of a gene

Homozygous: two of the same allele (TT, tt)

Heterozygous: different alleles (Tt)

Dominant allele: expressed (T)

Recessive allele: hidden by dominant allele (t)

Gene
Shirt
Allele
Type of shirt

Punnett Squares

	T	t
T	TT	Tt
t	Tt	tt

Notes