

BIOLOGY EOC REVIEW

REVIEW WHAT WE LEARN, REPEAT
OUR REVIEW, AND ADD MORE
INFORMATION

**MIAMI-DADE COUNTY PUBLIC SCHOOLS
DISTRICT PACING GUIDE**

YEAR-AT-A-GLANCE

| BIOLOGY I | | COURSE CODE: 200031001 | |
|--|---|---|---|
| 1st Nine Weeks | 2nd Nine Weeks | 3rd Nine Weeks | 4th Nine Weeks |
| <p>I. Introduction to Biology/Nature of Life</p> <p>A. The Process of Science</p> <p>B. Introduction to Biology</p> <p>II. Building Blocks of Life (Carbon, Hydrogen, Oxygen, Nitrogen)</p> <p>A. Survey of the Periodic Table</p> <p>B. Chemical Bonds</p> <p>C. Chemical Reactions</p> <p>D. Biogeochemical Compounds</p> <p>E. Enzymes</p> <p>III. Biogeochemical Cycles</p> <p>A. Types of Biogeochemical Cycles</p> <p>B. Processes Related to Cycles</p> <p>C. Human Impact on the Cycles</p> <p>IV. Ecosystems and Energy Flow</p> <p>A. Conservation of Matter and Energy</p> <p>B. Food Chains and Food Webs</p> <p>C. Types of Pyramids</p> <p>D. Organism Interactions</p> <p>V. Introduction to Biomes and Succession in an Ecosystem</p> <p>A. Biomes</p> <p>B. Succession</p> <p>VI. Population Ecology</p> <p>A. Population Growth Curves</p> <p>B. Human Population Dynamics</p> <p>C. Human Environmental Impacts</p> <p>VII. Cell Structure and Function</p> <p>A. Levels of Organization</p> <p>B. The Cell Theory</p> <p>C. Cell Structures and Function</p> <p>D. Discussion of Division of Labor and Specialized Cells</p> <p>E. Comparison of Plant and Animal Cells</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS <i>From 1st nine weeks</i></p> | <p>VIII. Photosynthesis</p> <p>A. Plant Structures and Function</p> <p>B. ATP Formation</p> <p>C. General Equation for Photosynthesis</p> <p>D. Light-dependent Reactions</p> <p>E. Light-independent Reactions</p> <p>F. Factors Affecting Photosynthesis</p> <p>IX. Cellular Respiration</p> <p>A. General Equation for Cellular Respiration</p> <p>B. Stages</p> <p>X. Cell Cycle and Mitosis</p> <p>A. Cell Cycle</p> <p>B. Mitosis (Nuclear Division)</p> <p>C. Cytokinesis (Cytoplasmic Division)</p> <p>D. Comparison of Plant and Animal Mitosis</p> <p>XI. Meiosis</p> <p>A. Meiosis</p> <p>B. Genetic Variation Resulting From Meiosis</p> <p>C. Comparison of Mitosis and Meiosis</p> <p>XII. Heredity - Mendelian Genetics</p> <p>A. Mendel's Experiments</p> <p>B. Probability and Punnett Squares</p> <p>C. Chromosome Theory of Inheritance</p> <p>D. Patterns of Inheritance</p> <p>E. Linked Genes and Crossing Over</p> <p>XIII. Genetic Diseases and Human Genetics</p> <p>A. DNA and the Human Genome Project</p> <p>B. Causes of Genetic Diseases</p> <p>C. Chromosomal Disorders</p> <p>D. Sex-Linked Genes</p> <p>E. Examining Human Chromosomes & Traits</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS <i>From 2nd nine weeks</i></p> | <p>XIV. DNA, Replication and Transcription</p> <p>A. Experiments and History</p> <p>B. Structure of DNA & Chromosomes</p> <p>C. DNA Replication</p> <p>D. Transcription</p> <p>XV. RNA and Protein Synthesis</p> <p>A. RNA Structure and Review of Transcription</p> <p>B. Types of RNA (Structure & Function)</p> <p>C. Translation</p> <p>D. "One Gene – One Enzyme"</p> <p>E. Mutations</p> <p>XVI. Genetic Engineering</p> <p>A. Experiments/Contributions</p> <p>B. Forms of Biotechnology</p> <p>C. Regulation of Genes (Prokaryotes)</p> <p>D. Bio Ethical Issues</p> <p>E. Careers in Genetic Engineering</p> <p>XVII. Theory of Evolution</p> <p>A. Theories on the Origins of Life</p> <p>B. First Organic Molecules</p> <p>C. Ideas That Shaped Darwin's Thinking</p> <p>D. Darwin's Theory of Evolution by Natural Selection</p> <p>E. Evolution of Populations (Microevolution)</p> <p>XVIII. Evidence of the Theory of Evolution and Taxonomy</p> <p>A. Evidence for the Theory of Evolution</p> <p>B. Macroevolution</p> <p>C. Hominid Evolution</p> <p>D. Taxonomy</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS <i>From 3rd nine weeks</i></p> | <p>XIX. Human Body Systems</p> <p>A. Integumentary System</p> <p>B. Skeletal System</p> <p>C. Muscular System</p> <p>D. Circulatory and Respiratory Systems</p> <p>E. Digestive and Excretory Systems</p> <p>F. Nervous Systems</p> <p>G. Survey of Endocrine and Reproductive Systems</p> <p>H. Immune System</p> <p align="center">XX. BIOLOGY EOC AA BENCHMARKS <i>CRUNCH TIME (2 weeks)</i></p> <p>XXI. Prokaryotes , Viruses, Protists and Fungi</p> <p>A. Prokaryotes</p> <p>B. Viruses</p> <p>C. Protists</p> <p>D. Fungi</p> <p>XXII. Study of Animal Diversity and Adaptations of the Invertebrate Phylum</p> <p>A. Invertebrate Diversity</p> <p>B. Integration of Human Body Systems with Invertebrates and Chordates</p> <p>XXIII. Study of Animal Diversity and Adaptations of the Chordate Phylum</p> <p>A. Chordate Diversity</p> <p>B. Integration of Human Body Systems with Invertebrates and Chordates</p> <p>XXIV. Survey of Plant Diversity</p> <p>A. Non-vascular Plants (Diversity and Reproduction)</p> <p>B. Vascular Plants (Diversity and Modes of Reproduction)</p> <p>C. Importance of Plants</p> |

Important Learning Tools

- Prokaryote (“PR”) Primitive: Simple bacterial cells with no clearly defined organelles
- Eukaryotes (“E”) Evolved: Modern highly evolved cells with organelles and a clearly defined nucleus
- “IPMAT” “C” Interphase (live of cell), **Prophase, Metaphase Anaphase, Telophase,(takes place in nucleus)**, Cytokinesis (cell division)
- Heterotroph(Consumer) Autotroph (producer)

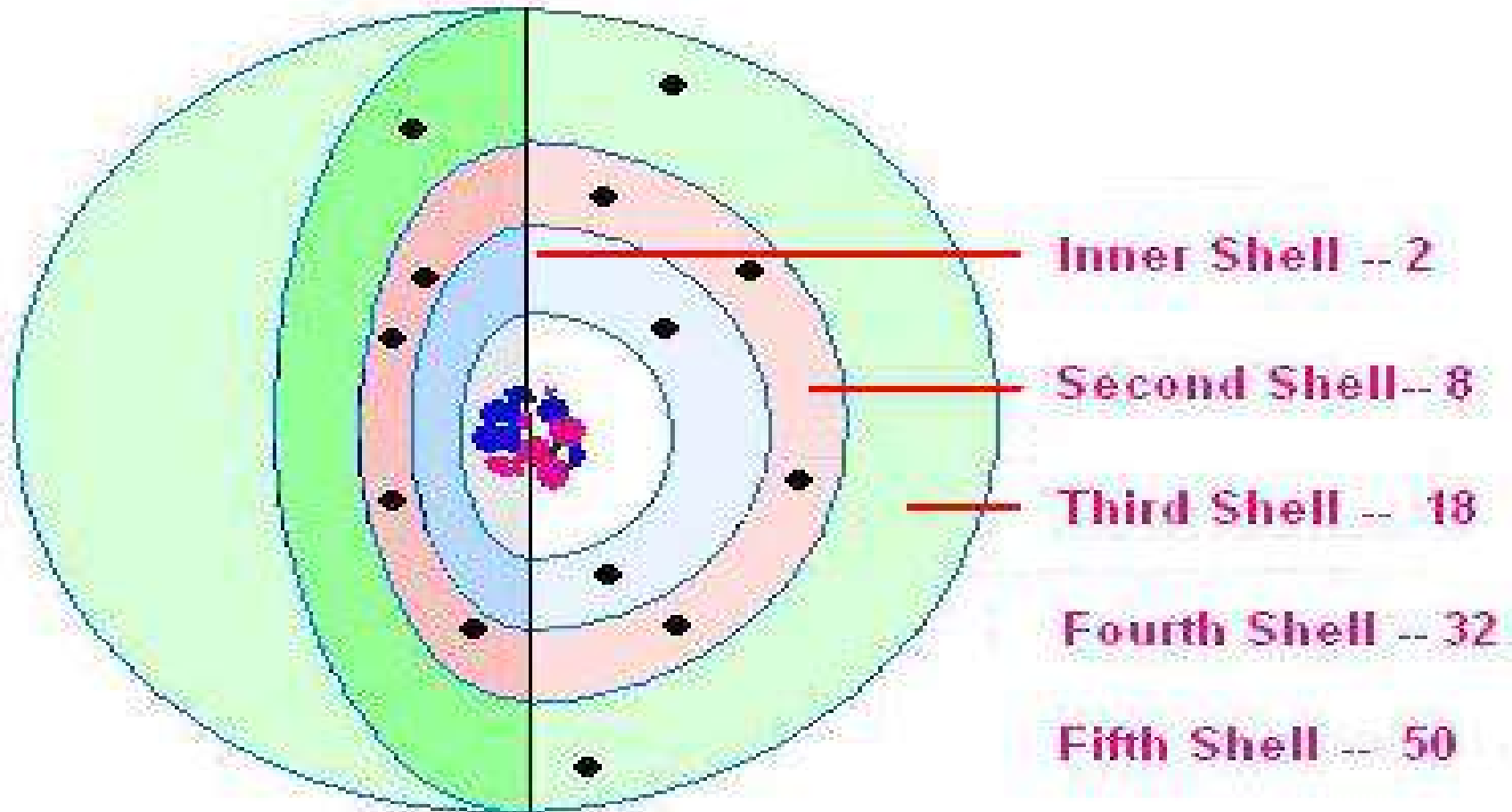
ORIGIN OF LIFE

- Origin of Life: Spontaneous Generation / biogenesis
- Franseco Redi: Meat in jars experiment, jars open, jars with lids, jars with mesh, lots of flies
- Life Properties: use of energy, reproduction, response to environment, growth and development, production of waste
- Organization: Molecules, cells, tissue, organs, organ systems, organism, population, communities, ecosystems, biomes, biosphere
- Adaptation / Interdependence: predator-prey Symbiotic Relationships: mutualism, commensalism, and parasitism
- Louis Pasteur: S-shaped flask to keep out bacteria, Preservation of food, disproved spontaneous generation
- Doing the Work of Biology: Scientific Method, observation, define the problem, hypothesis, experiment, data collection, data analysis, conclusions

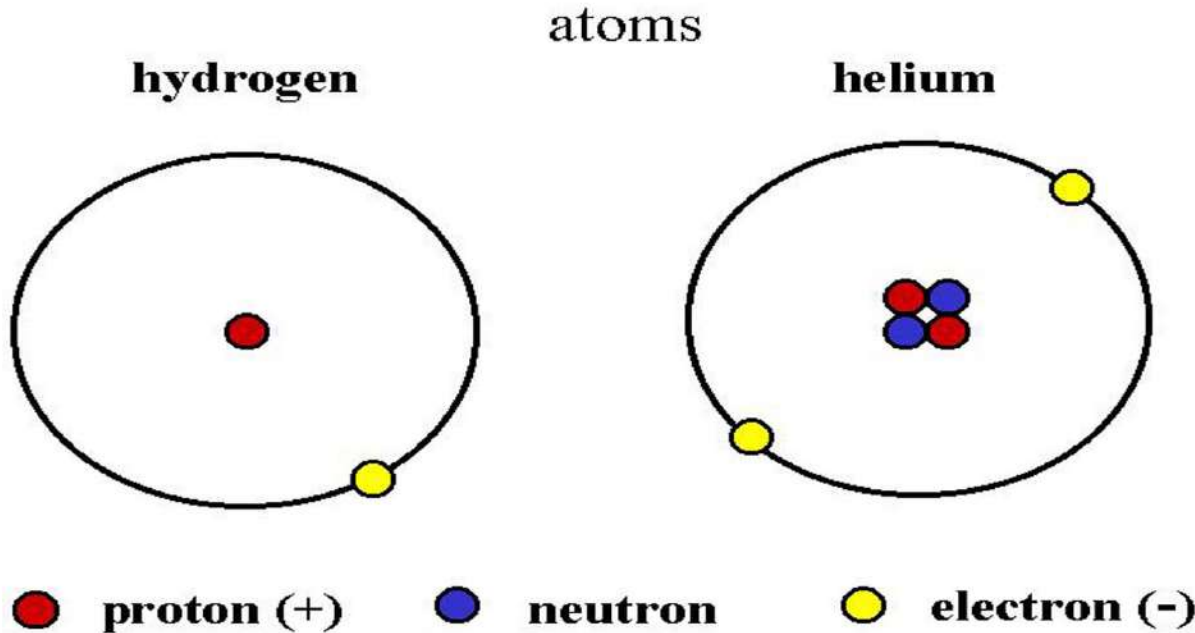
BUILDING BLOCKS OF LIFE

- Building blocks of life: carbon, nitrogen, oxygen, hydrogen
- Subatomic Particles: electron (-), proton (+), neutron (neutral)
- Proton and neutron in nucleus, electrons orbit outside. The atomic mass is the number of protons plus the number of neutrons. Electrons are negligible.
- Two type of Bonds: Covalent (shared electrons) Ionic (electrons traded)
- Organic Molecules contain carbon, Organic Chemistry is the study of carbon.

Electron Shells



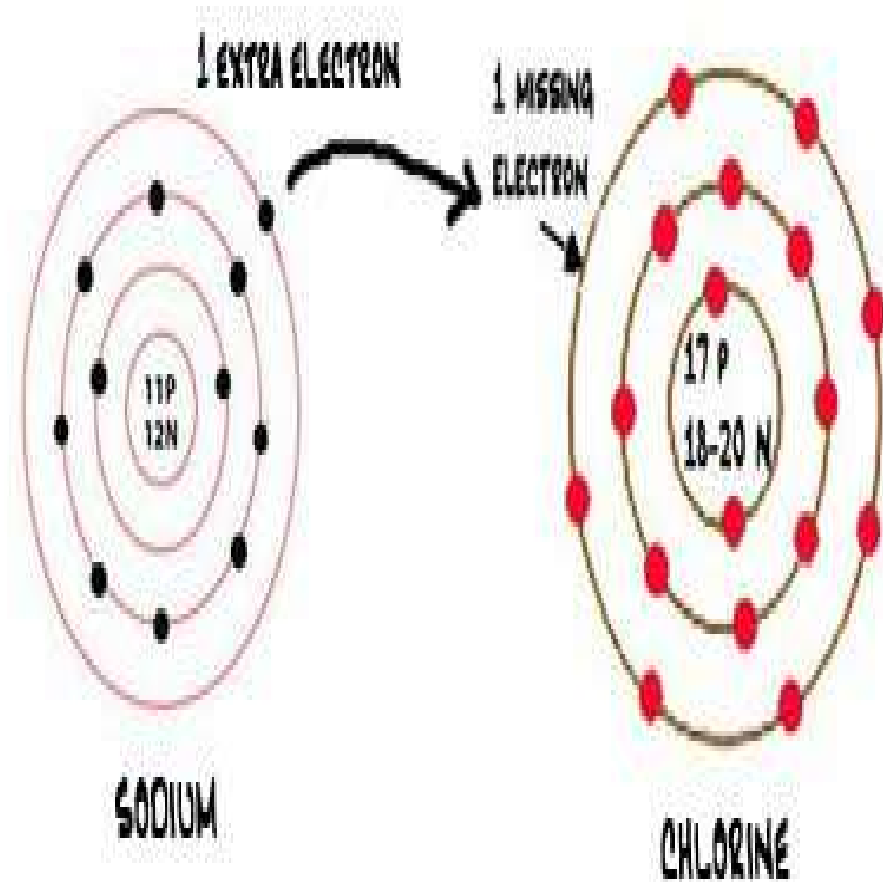
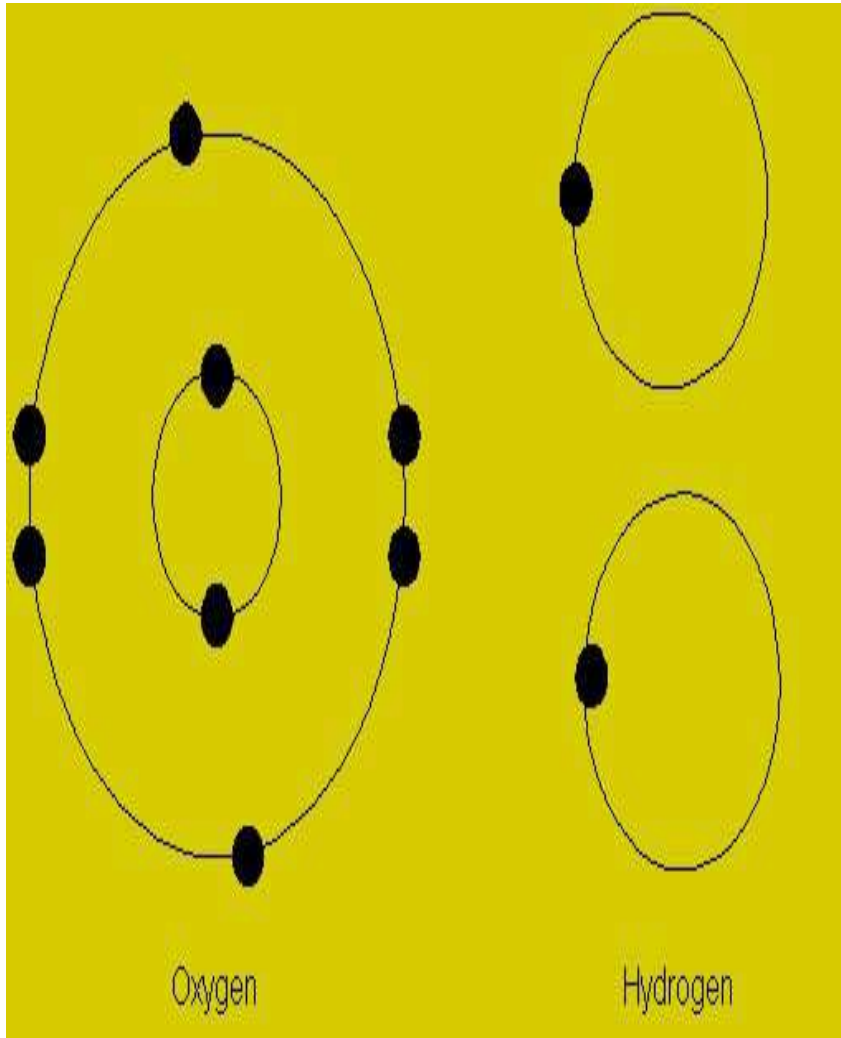
Atomic Structure



Neutrons and protons are held together in the nucleus by the “strong” force, which has to overcome the electrical repulsion of the two positively charged protons in helium (and in more complex atoms too). Electrons are held around the atom by the electrical attraction between their negative charge and the positive charge of the protons in the nucleus.

Covalent Bond of Water H₂O (polar)

Ionic Bond of Salt NaCl



Chemicals at Work

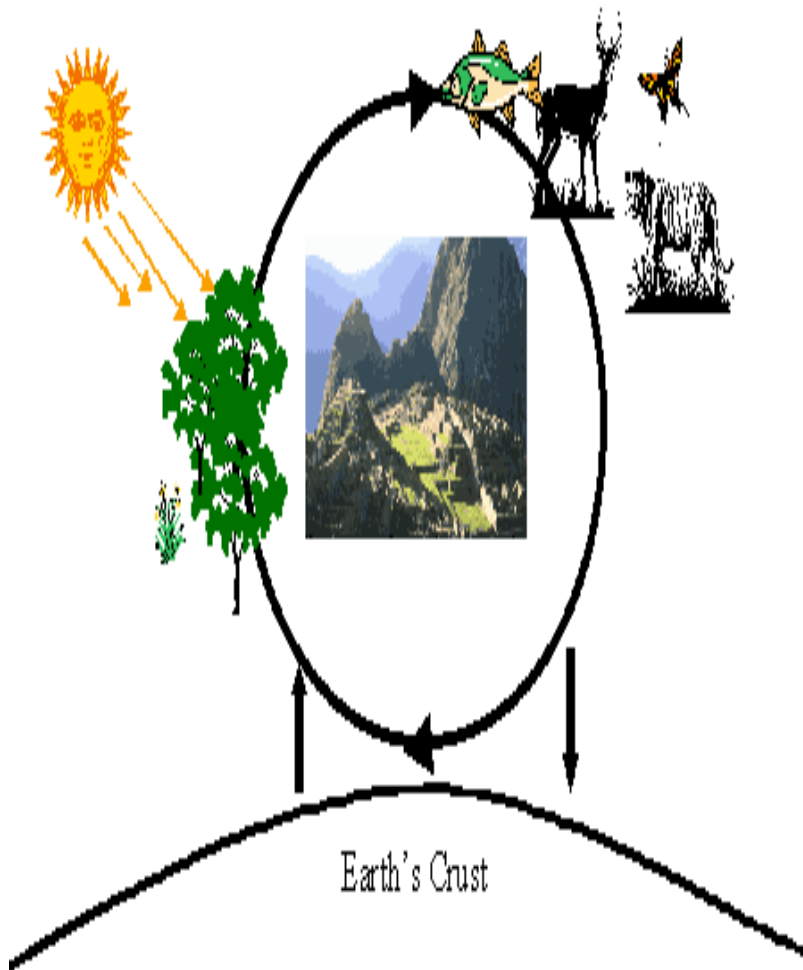
- Chemicals equations represent chemical reactions. During a chemical reaction, bonds are broken and new bonds are formed. Energy is absorbed or released.
- Conservation of Matter and Energy.
- Most enzymes of protein catalysts that speed up and slow down reactions that occur, including reactions in living things.

BIOCHEMICAL CYCLES

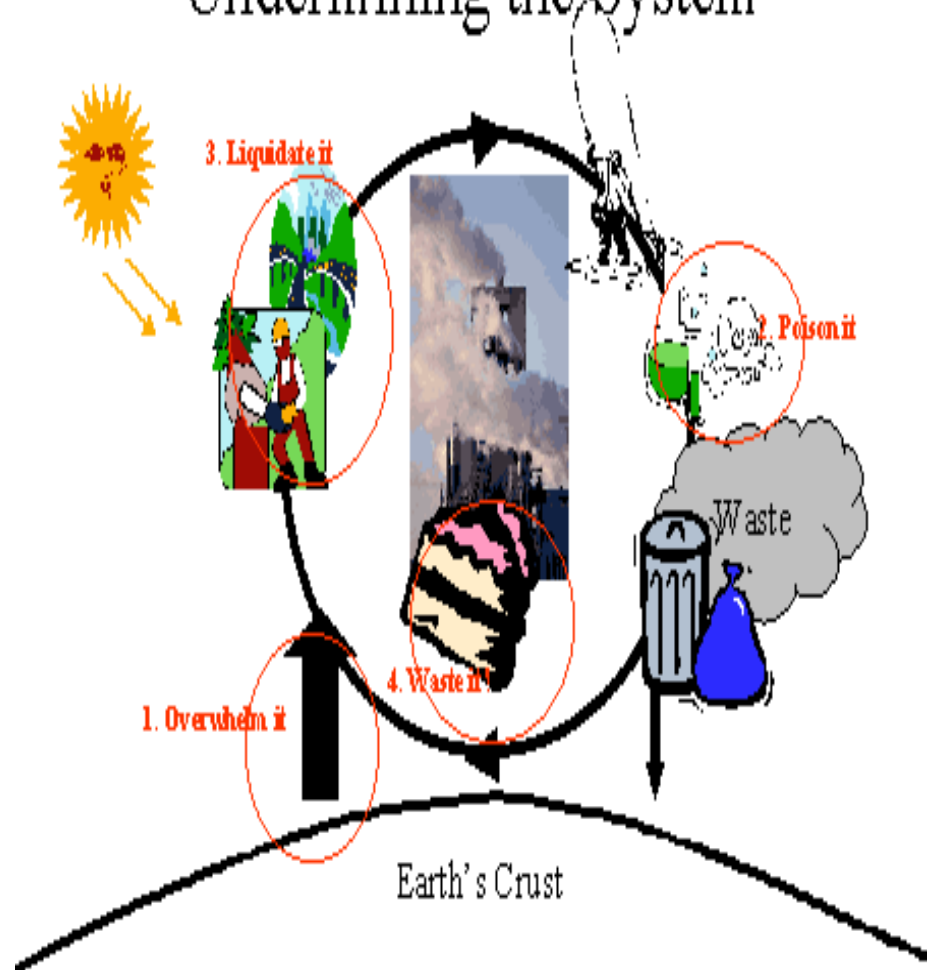
- Types of Biochemical Cycles: Hydrologic Cycle (water), Carbon Cycle, and Nitrogen Cycle
- Process related to cycles: Sun, Bacteria, and Interdependent Relationships (plant and animal)
- Human Impact: In the past human impact has been negative. Today humans are learning to conserve natural resources, curb pollution, and restore damages to the environment.
- Concerns: carbon footprint and global warming.

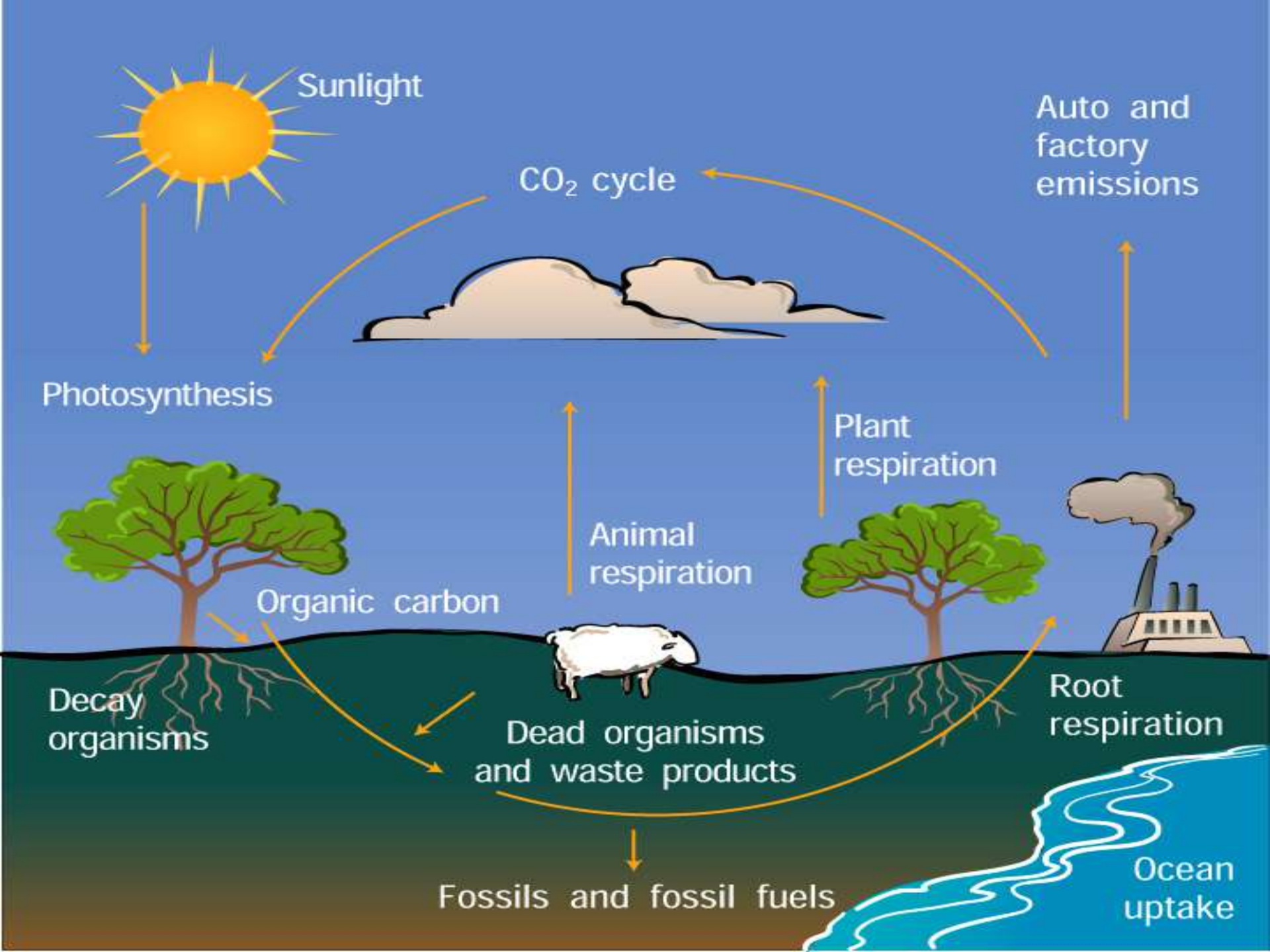
Human Impact and Global Warming

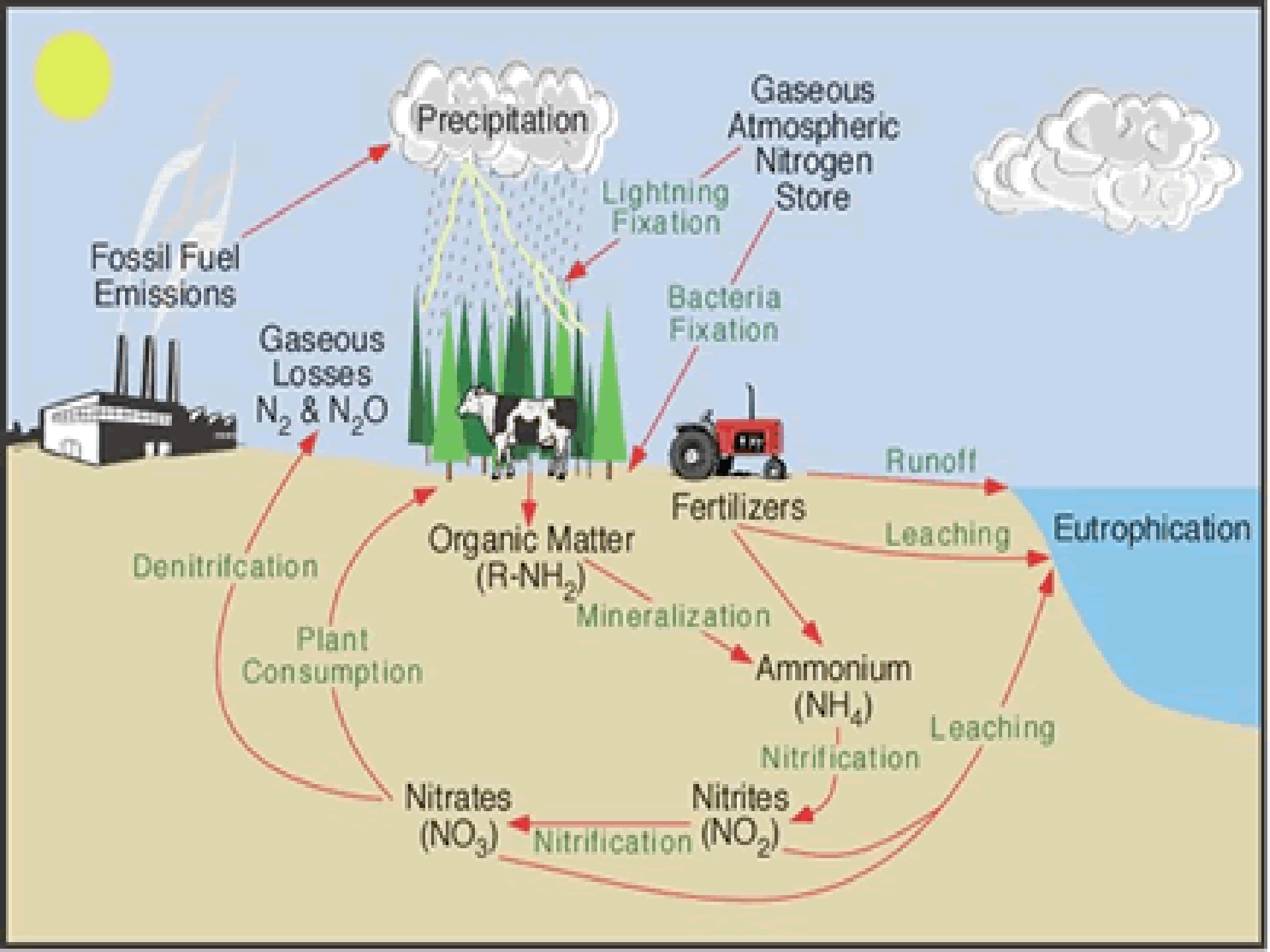
The Natural Cycle



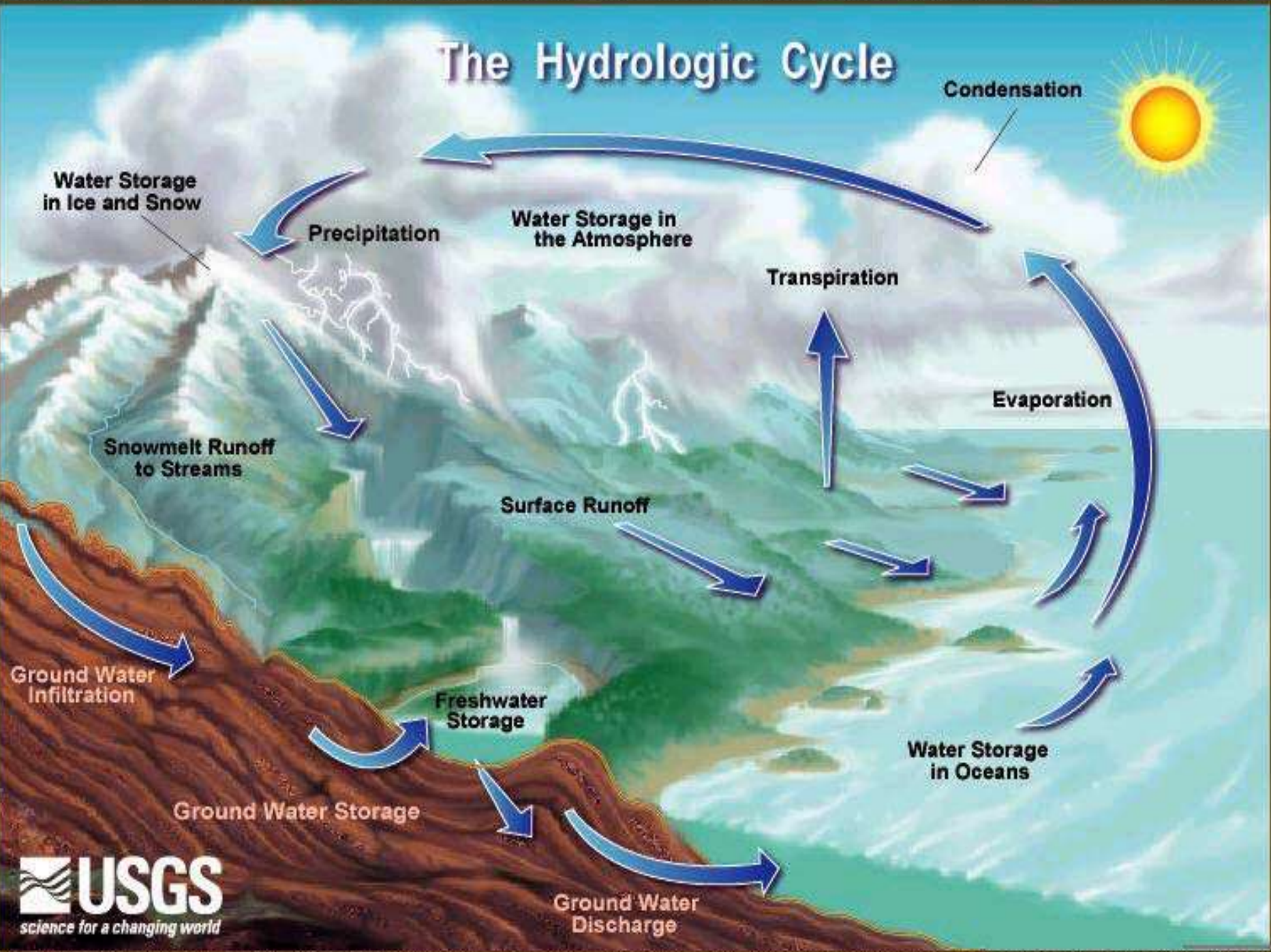
Undermining the System







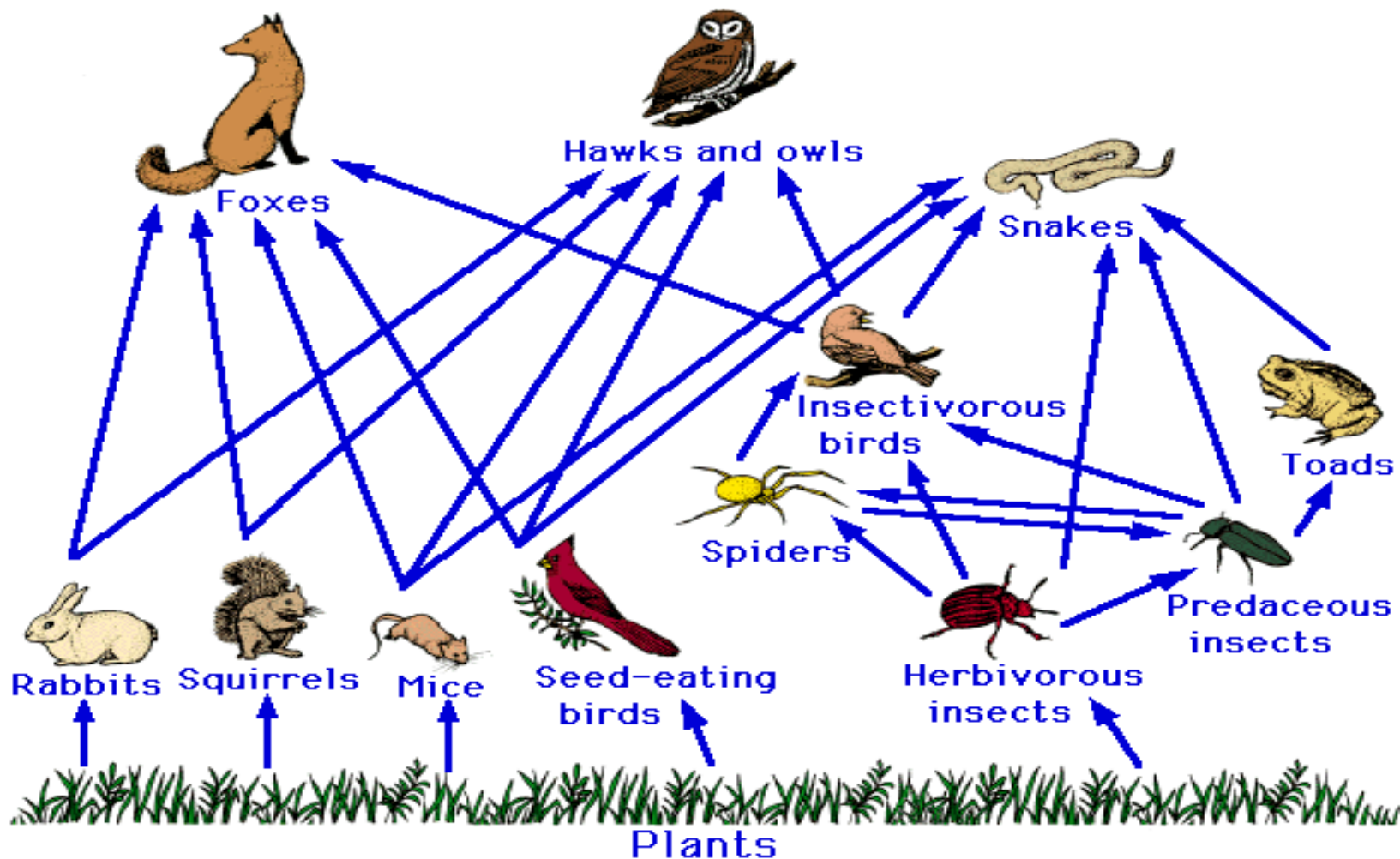
The Hydrologic Cycle



ECOSYSTEMS AND ENERGY FLOW

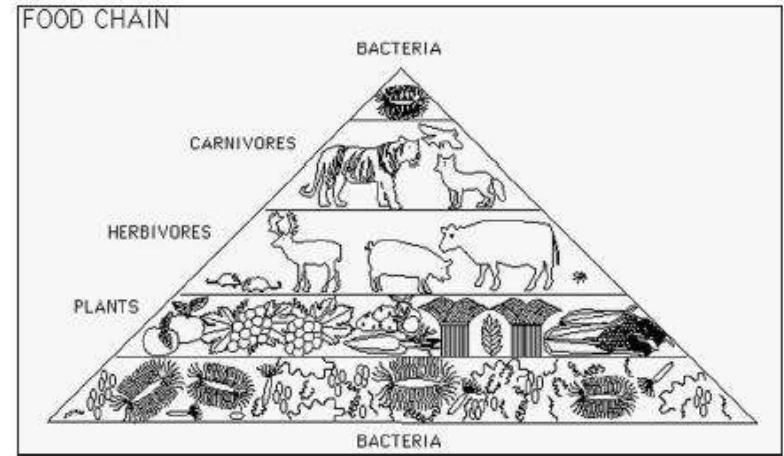
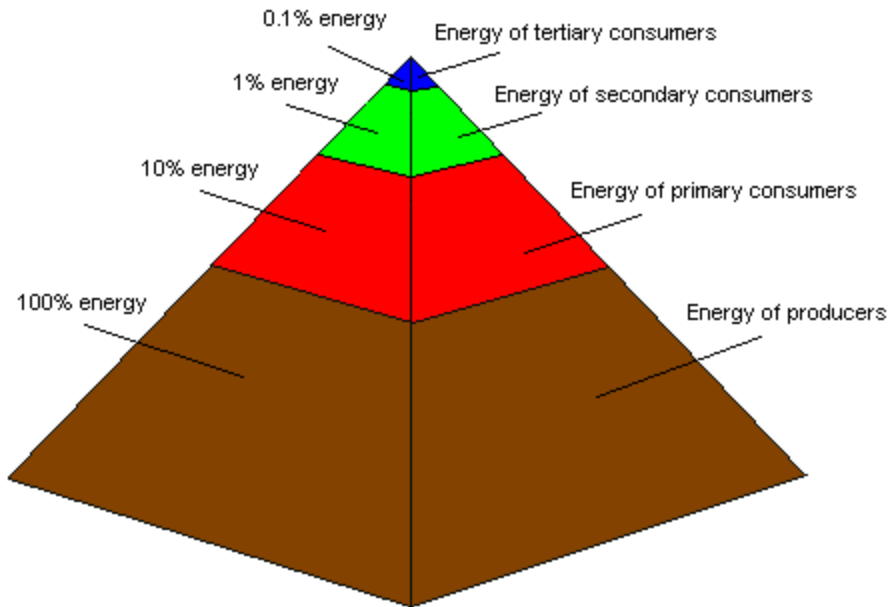
- Conservations of matter and energy
- Food chains and Food Webs
- Types of Pyramids: Pyramid of Numbers, Pyramid of Biomass, and Pyramid of Energy Flow
- Organism Interaction: Interdependent Relationship (Predator/Prey) Symbiotic Relationships: (mutualism, parasitism, and commensalism)

Food Chains and Food Webs

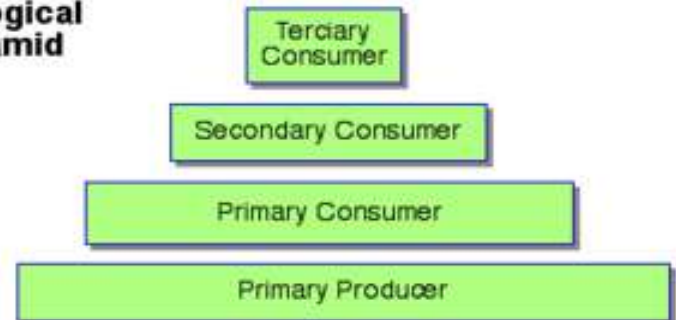


ECOLOGICAL PYRAMIDS

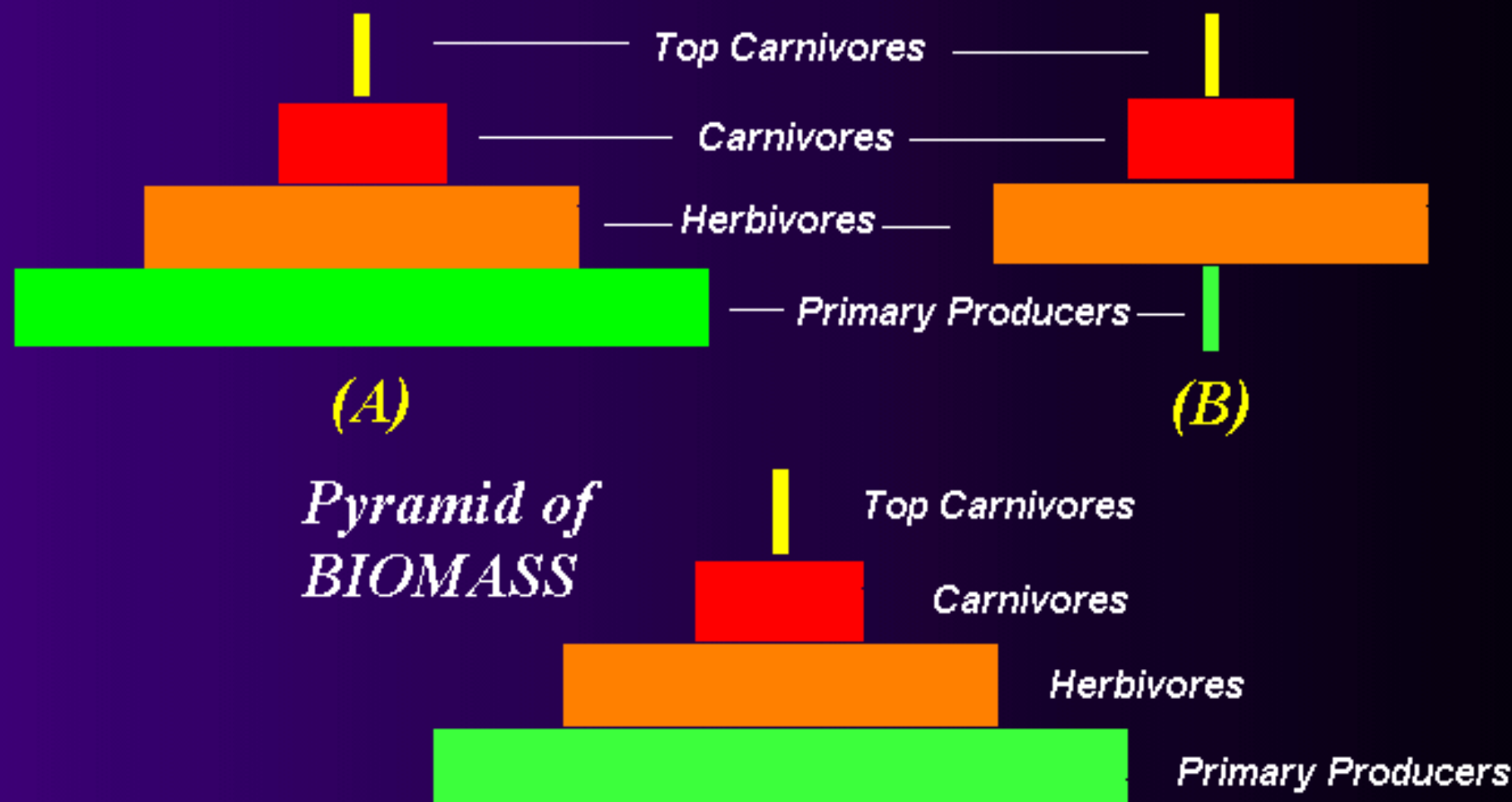
Ecological Pyramid



Ecological Pyramid



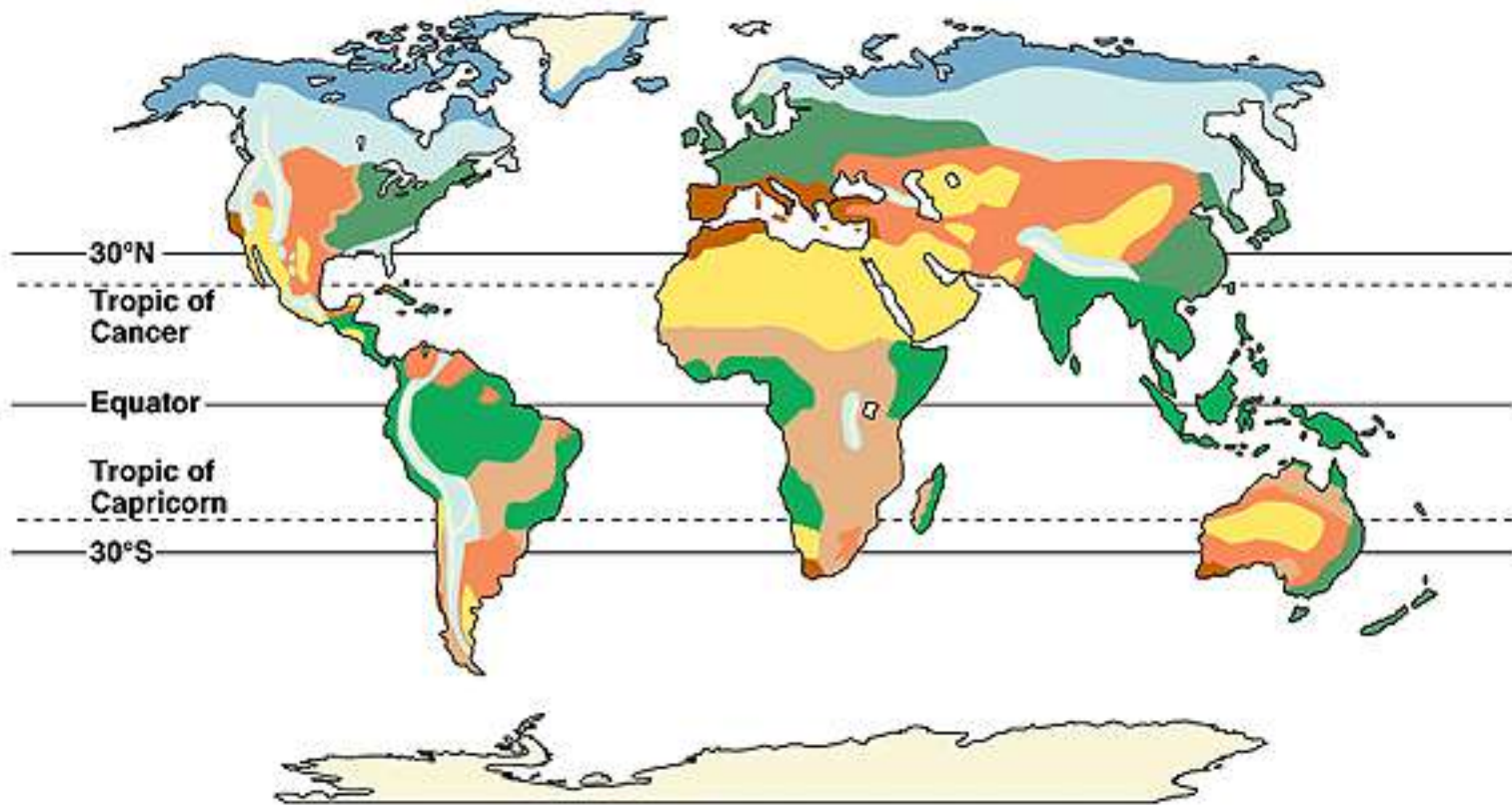
Pyramids of NUMBERS












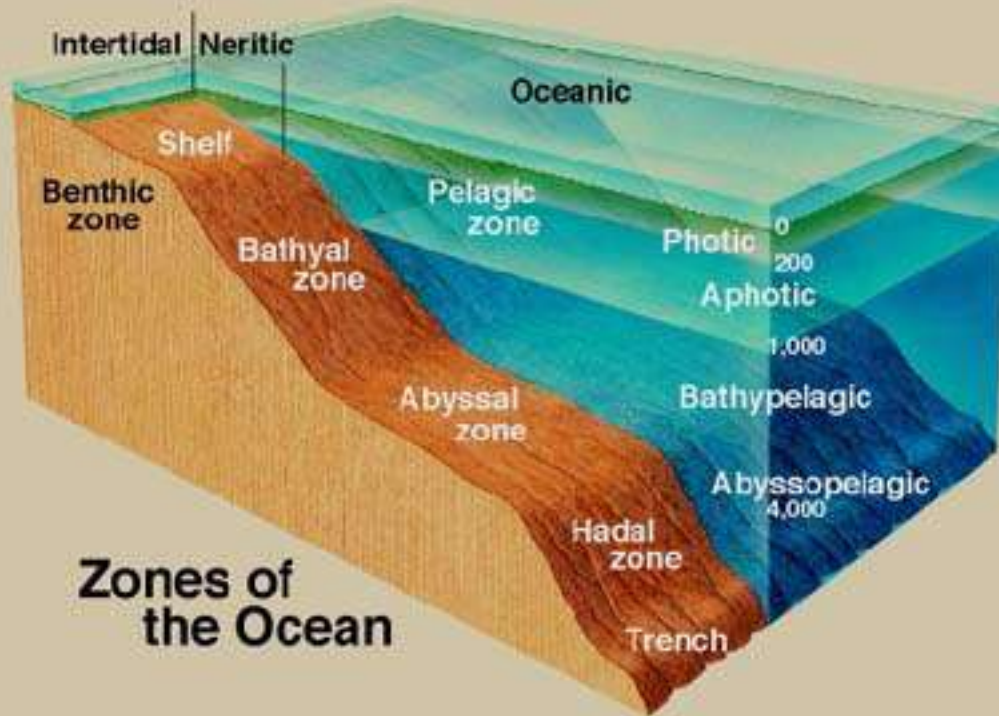
Quantification of Trophic Level Hierarchy in terms of Numbers (after Charles Elton) and Biomass.

INTRODUCTION TO BIOMES AND SUCCESSION IN AN ECOSYSTEM

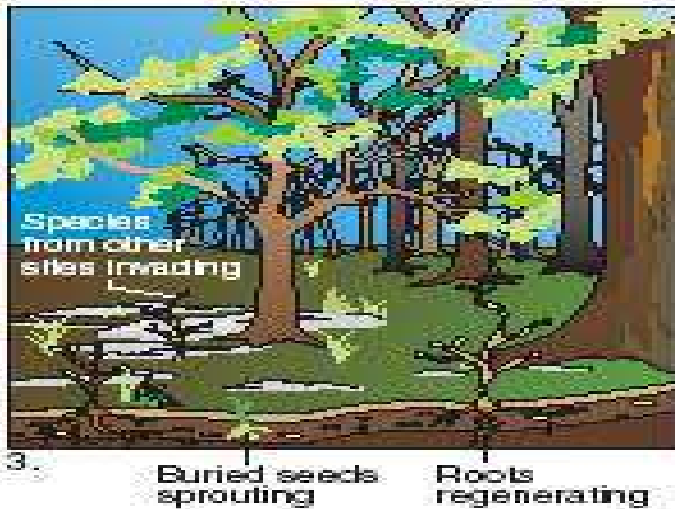
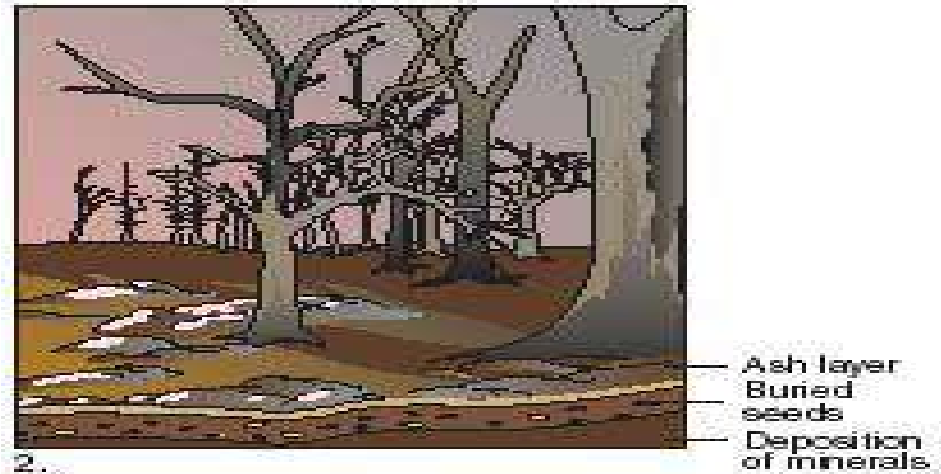
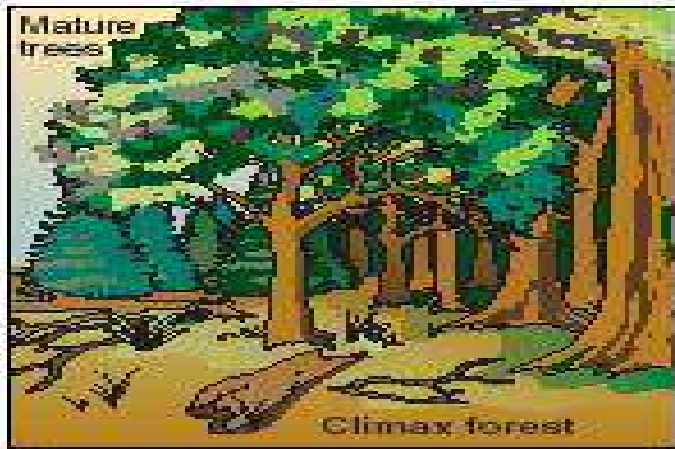
- Climate: Arctic Zone, Temperate Zone, Tropical Zone
- Earth tilted on axis, Northern Hemisphere, Southern Hemisphere, and Equator
- Types of Biomes: Tundra, Taiga, Deciduous Forest, Temperate Forest, Tropical Rain Forest, Chaparral, Grassland, Desert
- Water Biomes: Inland Wetlands, Coastal Wetlands, and Marine Zones
- Succession: when new communities of organisms gradually replace existing ones



- | | | |
|---|---|--|
|  Tropical forest |  Polar and high-mountain ice |  Temperate deciduous forest |
|  Savanna |  Chaparral |  Coniferous forest |
|  Desert |  Temperate grassland |  Tundra (arctic and alpine) |



Ecological Succession in a Forest After a Volcanic Eruption

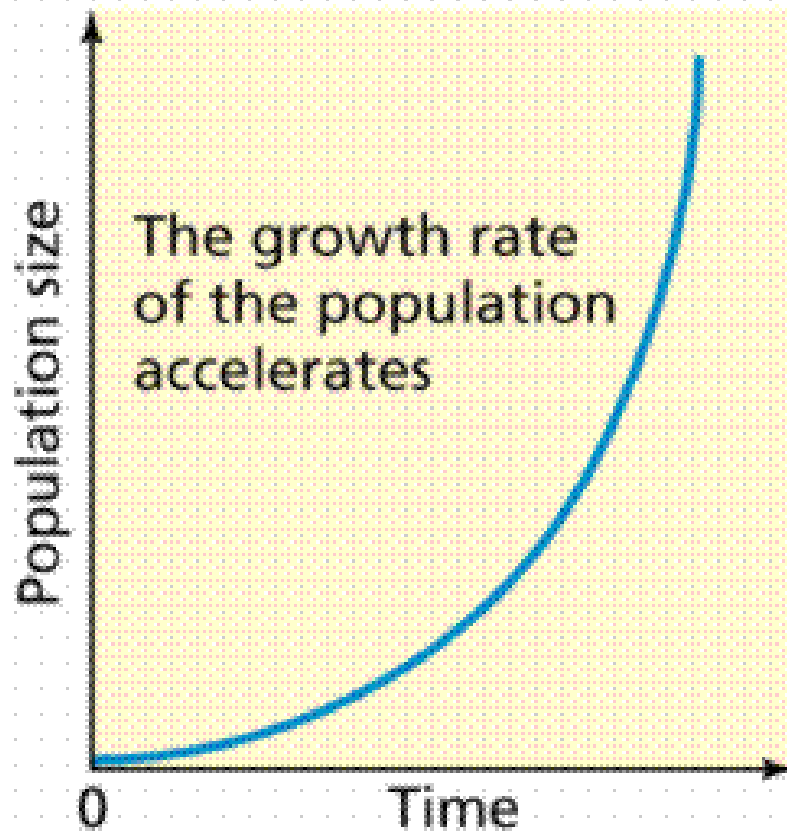


POPULATION ECOLOGY

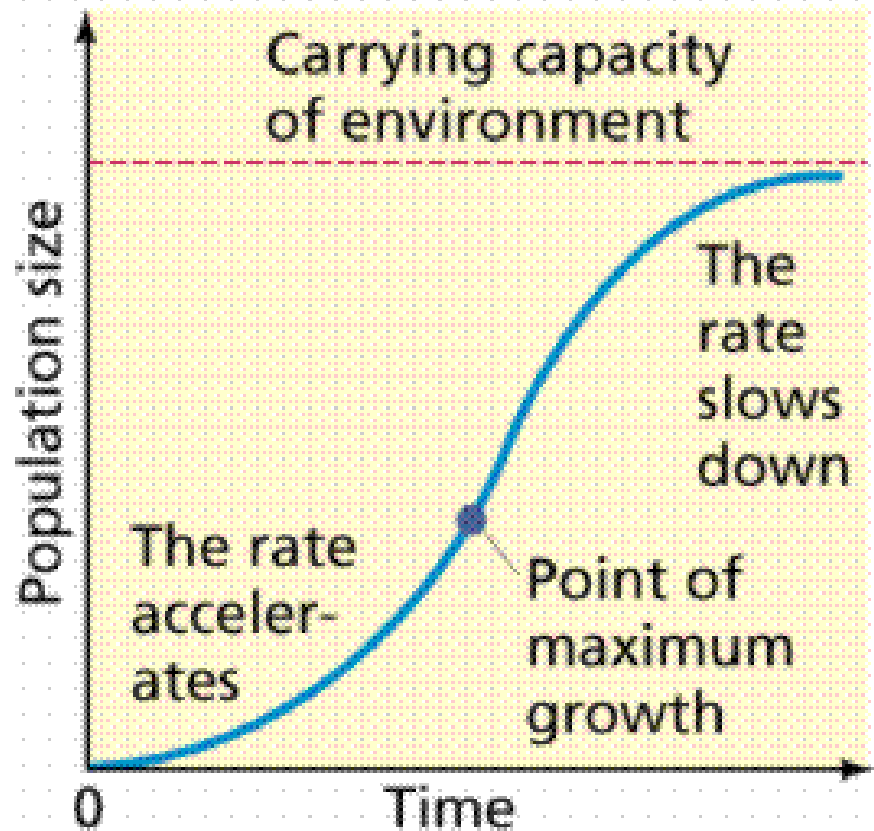
- Population and Growth Curves: J Curve (exponential growth) S Curve (population carrying capacity) Spike Curve (boom and bust)
- Human Population Dynamics
- Four factors that affect growth rate are birth rate, death rate, immigration and emigration.
- A population's carrying capacity is determined by limiting factors.
- Human Environmental Impacts: Air and Water Pollution, Global Warming

Population Growth Curves

(a) Exponential (unrestricted) growth



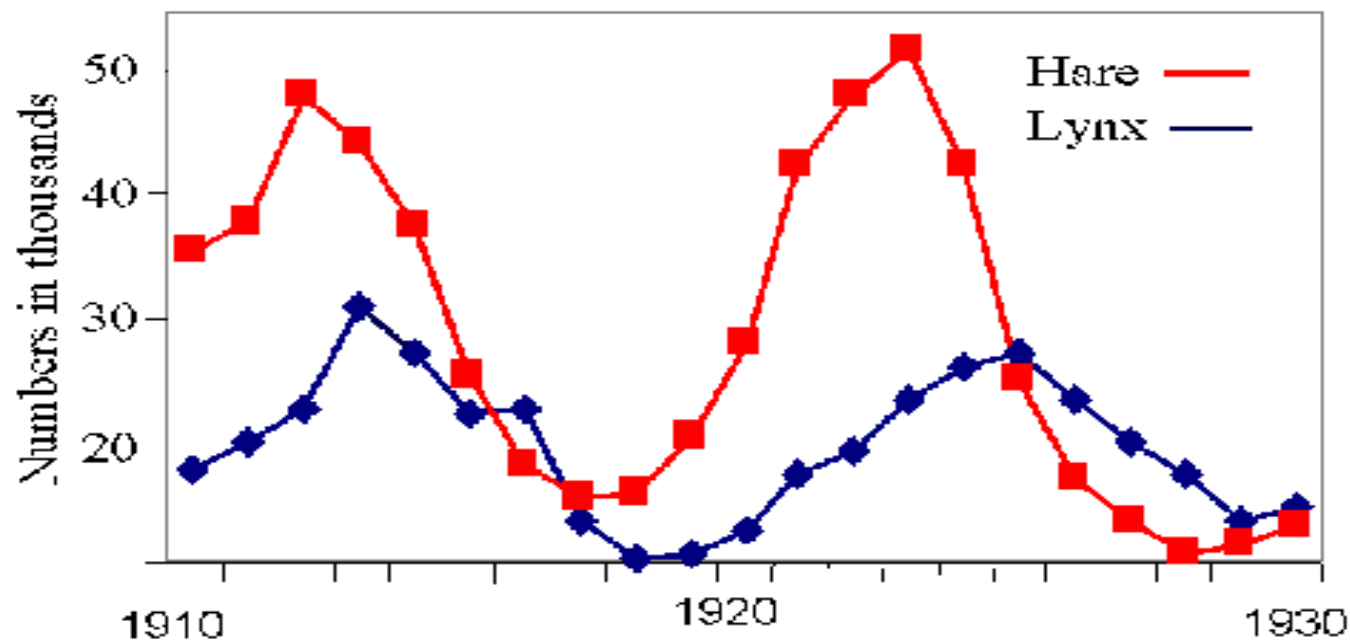
(b) Logistic (restricted) growth



Lynx and Hare

Predator Prey Relationships

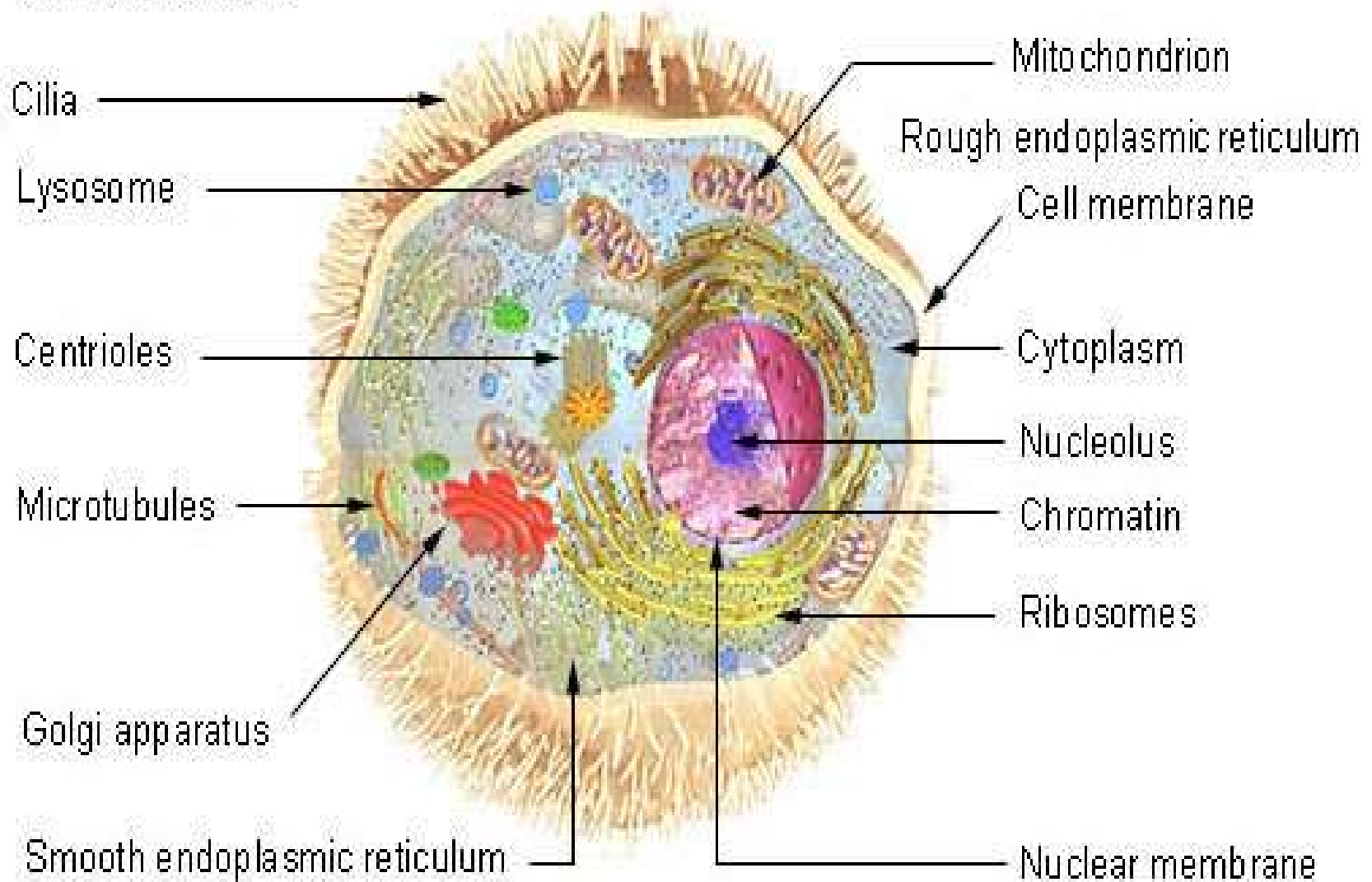
Cycles in the population dynamics of the snowshoe hare and its predator the Canadian lynx (redrawn from MacLulich 1937). Note that percent mortality is an elusive measure, it may, or may not, be useful since mortality varies with environment and time.



Cell Structure and Function

- Levels of Organization: cell, tissue, organ, organ system, organism, population...
- The Cell Theory: The cell is the basic unit of structure and function of all living things. All living things are made of cells. All cells come from other cells.
- Discuss the Division of Labor and Specialized Cells. What is cell differentiation?
- Comparison of Plant and Animal Cells

Cell Structure



Anatomy of the Plant Cell

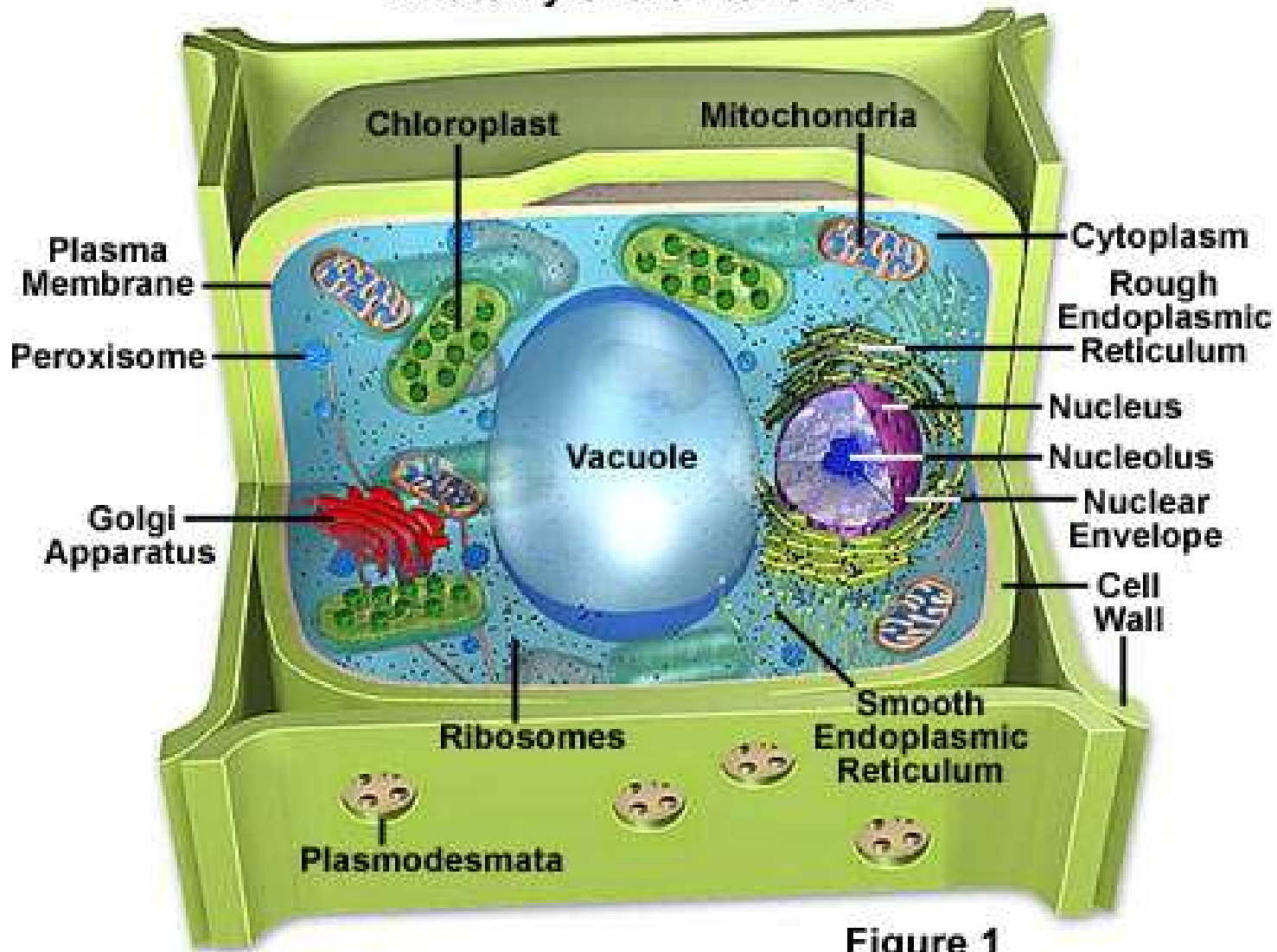
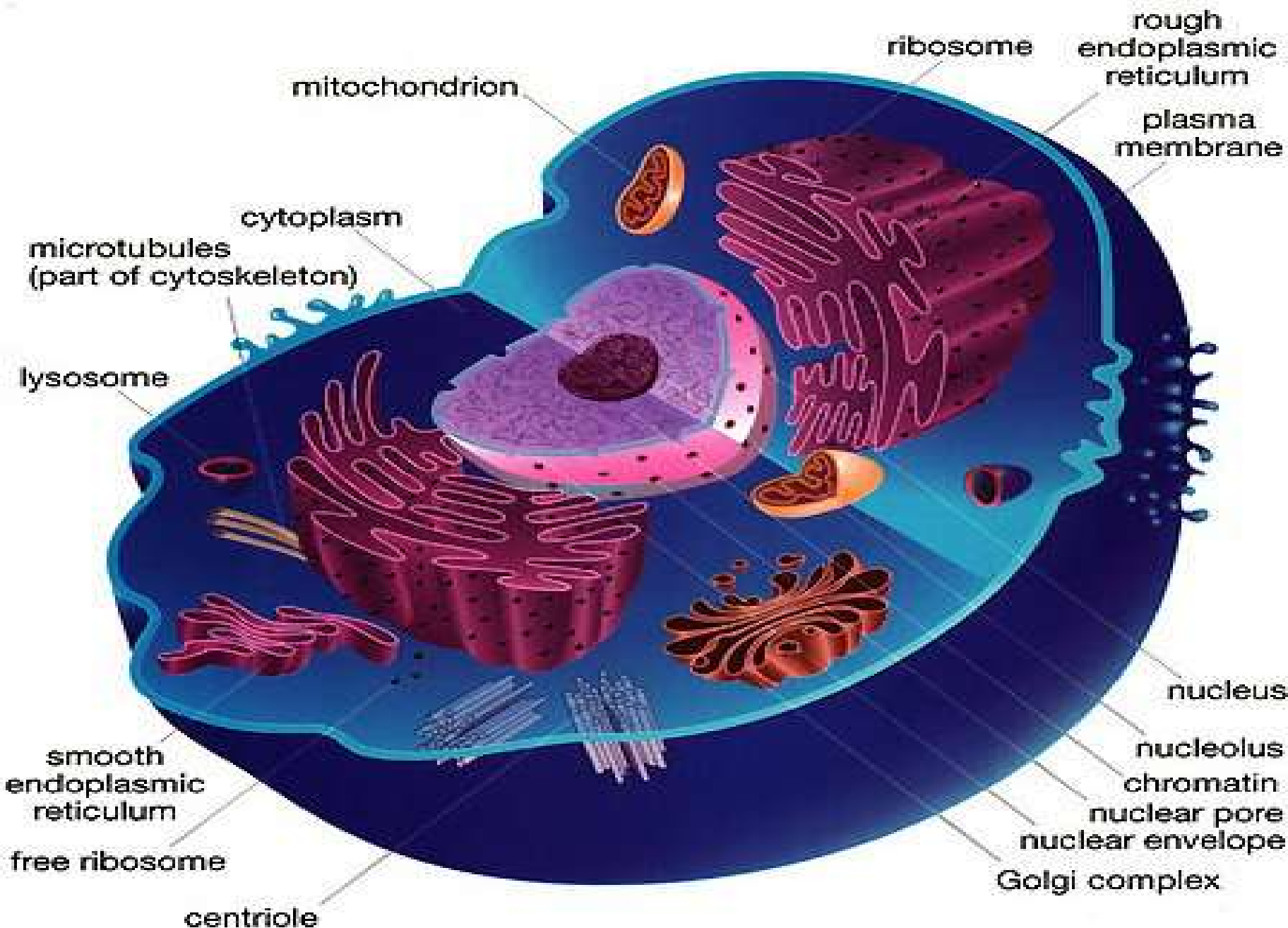


Figure 1



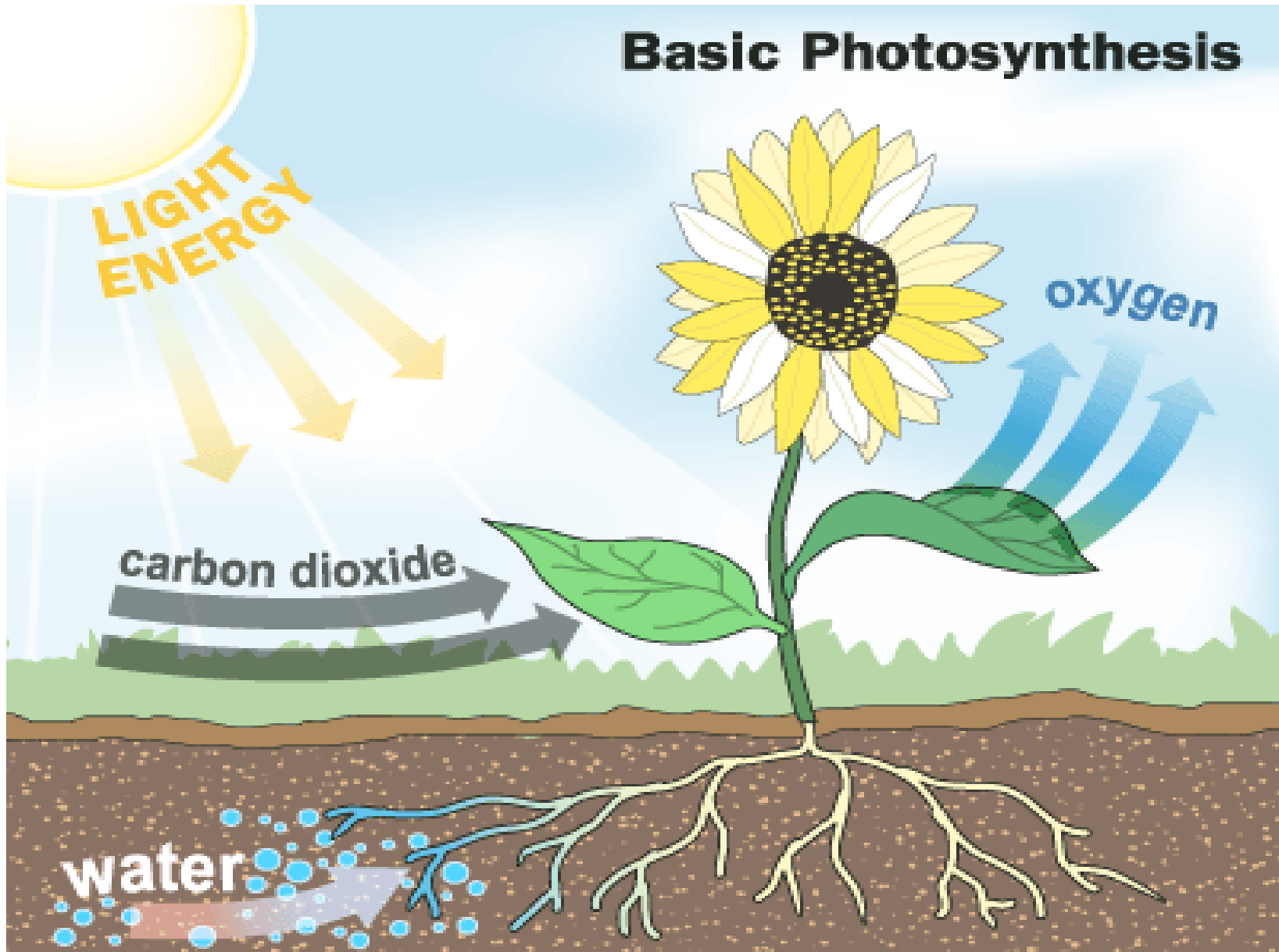
Cell Structure and Function

- In sexual reproduction the sperm and egg unite to form a zygote. As the zygote divides all the stem cells are exactly the same. As the zygote develops into an embryo the cells begin to differentiate into their specialized functions of an advanced multi-cellular eukaryotic organism.
- The main parts of a cell are the cell membrane (bi-phospholipid layer), nucleus(contains DNA), and cytoplasm (Clear jelly-like substance aqueous).
- Plants cells differ from animal cells because they have a cell wall made of cellulose, chloroplasts, and a large vacuole.

PHOTOSYNTHESIS

- Plant Structures: root, stem, trunk, leaves
- ATP Adenosine Tri-phosphate the energy molecule of the cell, a rechargeable battery.
- carbon dioxide + water → glucose + oxygen + energy
$$6\text{CO}_2 + 6\text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2 + \text{energy}$$

Basic Photosynthesis

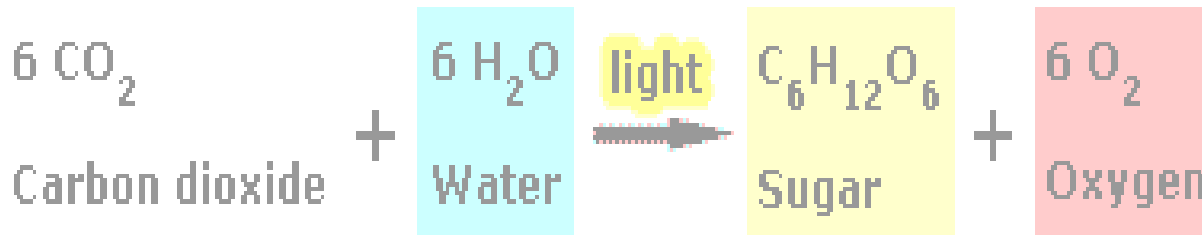


Photosynthesis

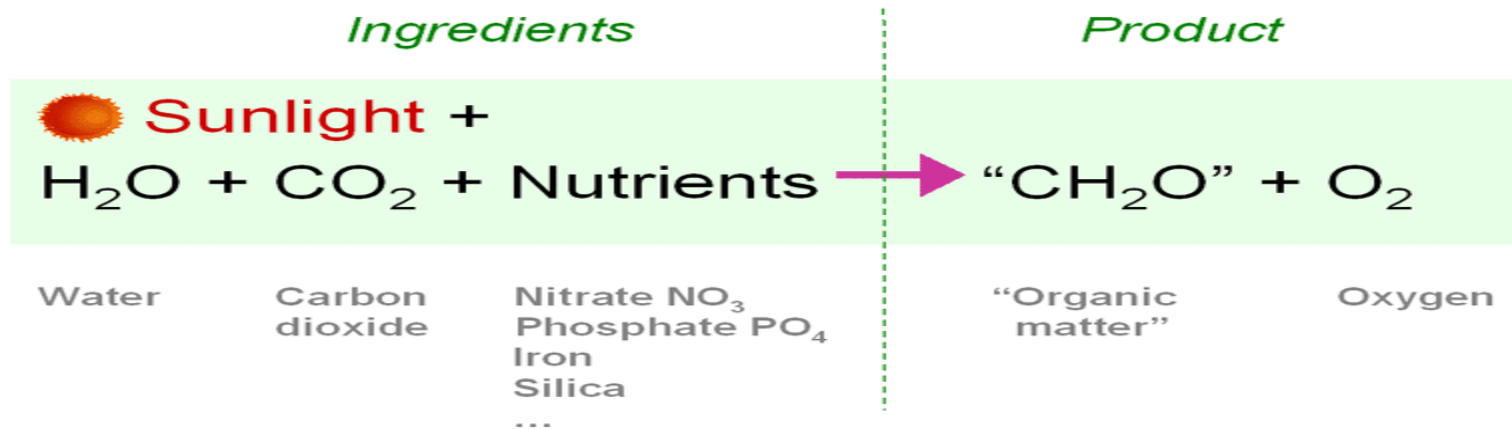
sunlight

Carbondioxide + Water ----->> Glucose + Oxygen.

Chlorophyll



Photosynthesis



Same rule applies to marine life that applies to terrestrial life.

Photosynthesis: Light Dependent and Light Independent Reactions.

- The '*light-dependent reactions*', or *photosynthesis*, is the first stage of photosynthesis, the process by which plants capture and store energy from sunlight. In this process, light energy is converted into chemical energy, in the form of the energy-carrying molecules ATP and NADPH. In the '*light-independent reactions*' (The Calvin Cycle), the formed NADPH and ATP drive the reduction of CO₂ to more useful organic compounds, such as glucose.

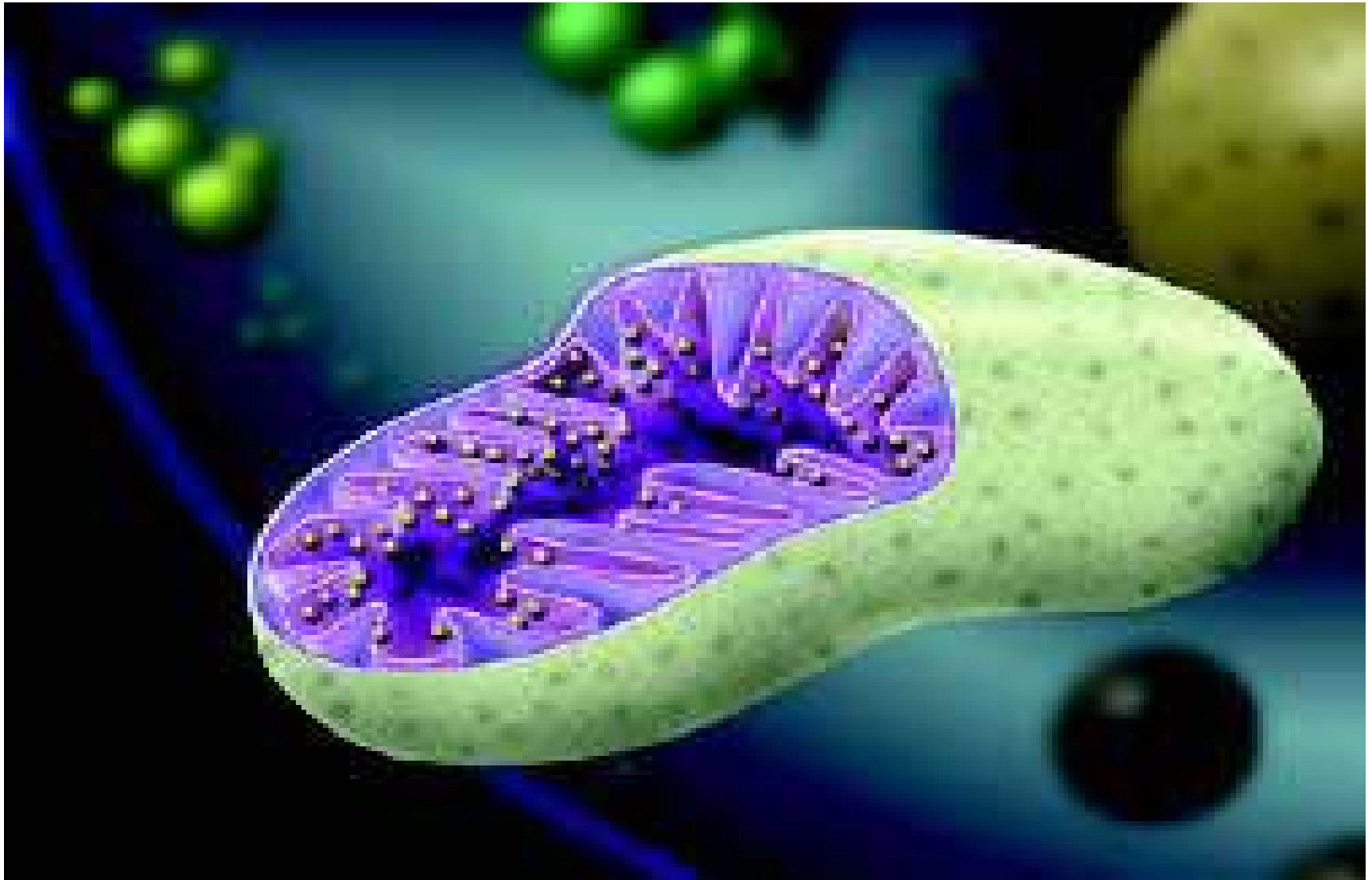
Factors affecting Photosynthesis

- Temperature affects photosynthesis.
- Water affects photosynthesis.
- Carbon dioxide affects photosynthesis.
- Sunlight affects photosynthesis.
- Too much or too little of all of these factors can inhibit photosynthesis.

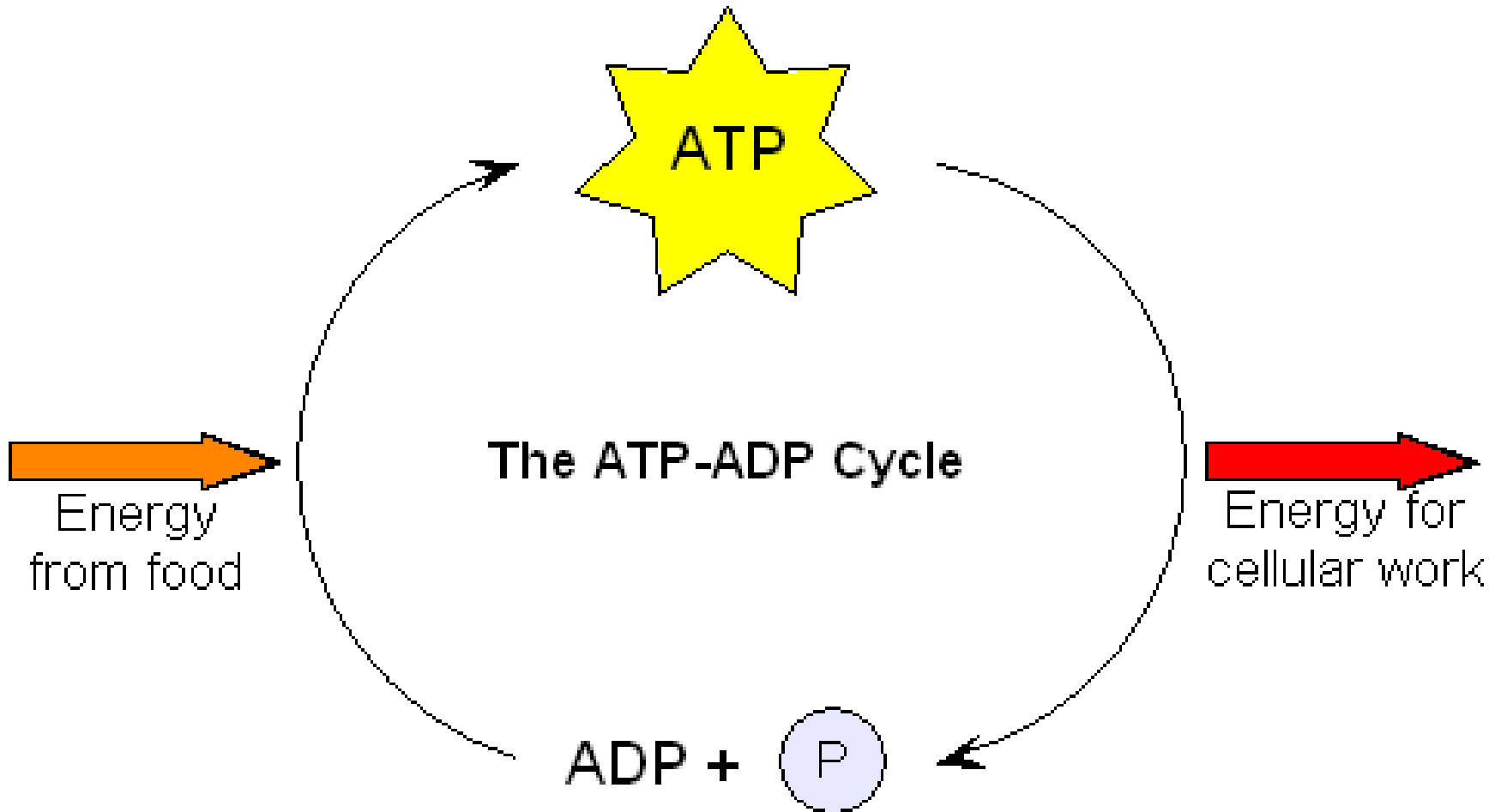
AEROBIC RESPIRATION

- During Cellular respiration energy is released from food molecules. The energy fuels the ATP – ADP energy cycle in the cell. Anaerobic respiration takes place in the mitochondrion.
- Aerobic respiration, which requires oxygen, has three phases: glycolysis, the Krebs Cycle, and electron transport.
- Anaerobic respiration, which takes place without oxygen, involves only glycolysis and fermentation.
- Anaerobic is inefficient compared to Aerobic. Anaerobic Respiration always leaves a high energy molecule as waste. Anaerobic respiration in your body leaves lactic acid which causes pain after strenuous exercise.

Aerobic Respiration starts in the Cytoplasm and
Ends in the “Mitochondria”



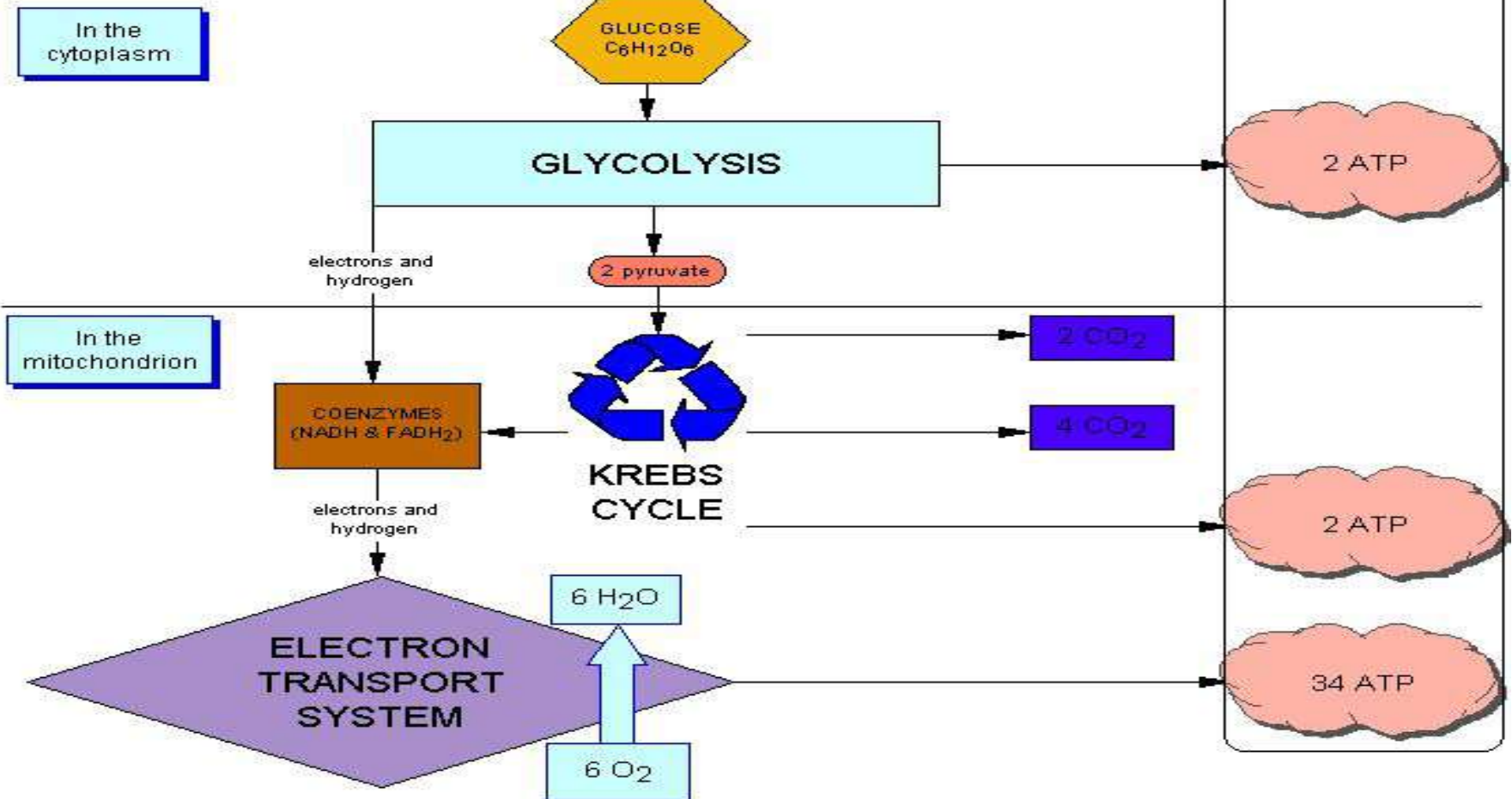
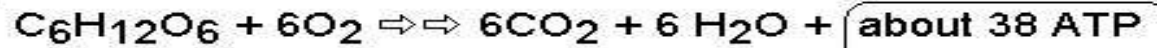
ATP – ADP ENERGY CYCLE



Cellular Respiration

cell food + oxygen \rightarrow energy + carbon dioxide

Cellular Respiration: An Overview



Comparison of Respiration and Photosynthesis.

They are exactly equal and opposite of one another.

- Photosynthesis

- Two Stages
- Light Dependant Reactions
- Calvin Cycle
- 1 Glucose Molecule

- Respiration

- Three Stages
- Hydrolysis
- Krebs Cycle
- Electron Transport
- Approximately 38 ATP

Cellular Respiration

cell food + oxygen → energy + carbon dioxide

Photosynthesis

carbon dioxide + water $\xrightarrow{\text{light}}$ cell food + oxygen

Photosynthesis and Aerobic Respiration Equal and Opposite

- carbon dioxide + water (sunlight) → glucose + oxygen + energy absorbed
- $6\text{CO}_2 + 6\text{H}_2\text{O}$ (sunlight) → $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ + energy absorbed
- Glucose + Oxygen → Carbon dioxide + water + 38ATP energy released
- $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$ → $6\text{CO}_2 + 6\text{H}_2\text{O} + 38\text{ATP}$ energy released

When and why do Cells divide?

- The ratio of cell membrane surface area to cell volume is a factor that limits cell size. When a cell reaches its optimum size, the nucleus initiates cell division.
- Cell division is the mechanism for growth and differentiation in multi-cellular organisms; for the replacement of old cells and the regeneration of injured cells; and for asexual reproduction. (Asexual reproduction is how unicellular organisms reproduce. Genetic information is rarely ever exchanged.)

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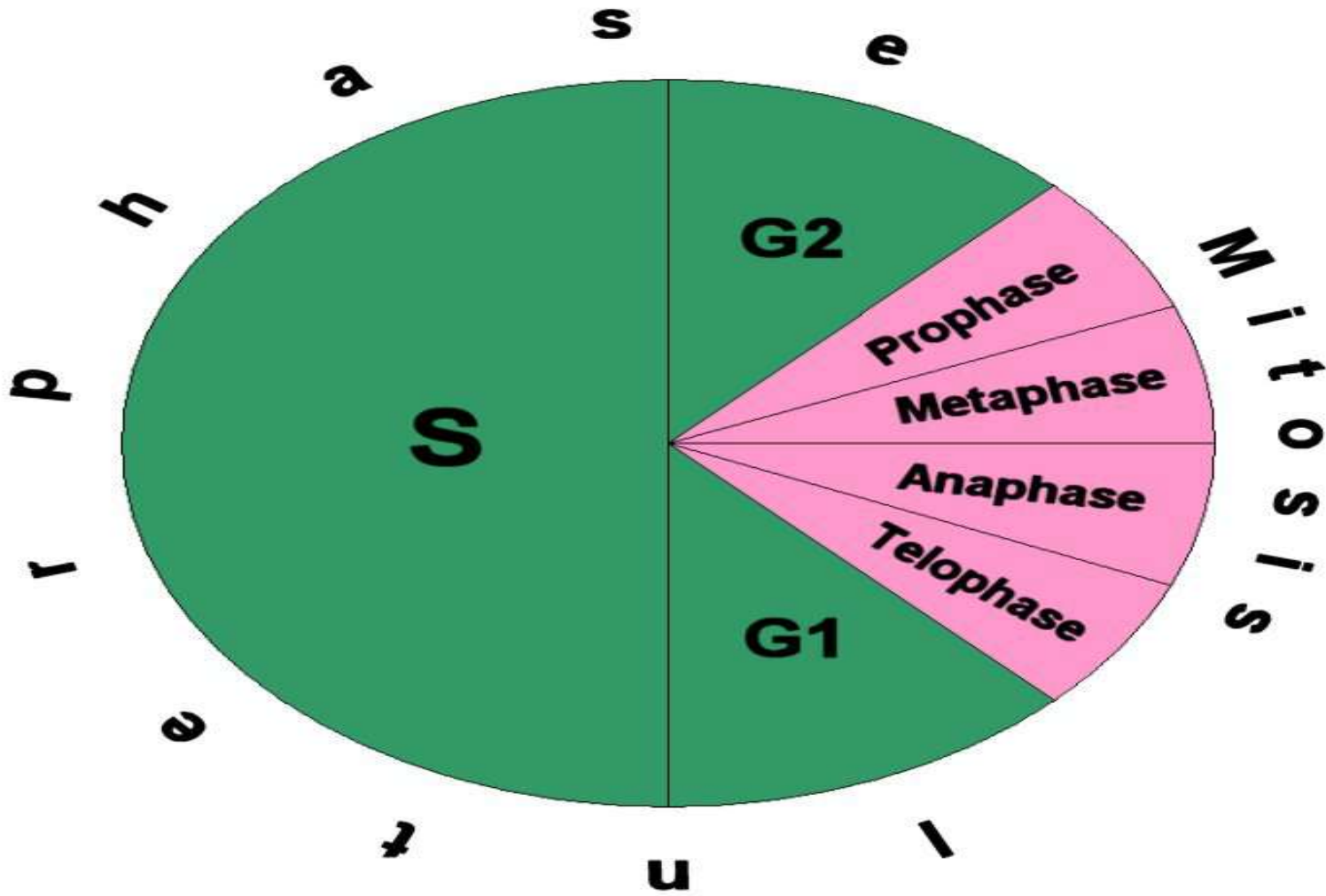
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|---|---|---|--|
| 1st Nine Weeks | 2nd Nine Weeks | 3rd Nine Weeks | 4th Nine Weeks |
| <p>I. Introduction to Biology/Nature of Life A. The Process of Science B. Introduction to Biology</p> <p>II. Building Blocks of Life (Carbon, Hydrogen, Oxygen, Nitrogen) A. Survey of the Periodic Table B. Chemical Bonds C. Chemical Reactions D. Biogeochemical Compounds E. Enzymes</p> <p>III. Biogeochemical Cycles A. Types of Biogeochemical Cycles B. Processes Related to Cycles C. Human Impact on the Cycles</p> <p>IV. Ecosystems and Energy Flow A. Conservation of Matter and Energy B. Food Chains and Food Webs C. Types of Pyramids D. Organism Interactions</p> <p>V. Introduction to Biomes and Succession in an Ecosystem A. Biomes B. Succession</p> <p>VI. Population Ecology A. Population Growth Curves B. Human Population Dynamics C. Human Environmental Impacts</p> <p>VII. Cell Structure and Function A. Levels of Organization B. The Cell Theory C. Cell Structures and Function D. Discussion of Division of Labor and Specialized Cells E. Comparison of Plant and Animal Cells</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS From 1st nine weeks</p> | <p>VIII. Photosynthesis A. Plant Structures and Function B. ATP Formation C. General Equation for Photosynthesis D. Light-dependent Reactions E. Light-independent Reactions F. Factors Affecting Photosynthesis</p> <p>IX. Cellular Respiration A. General Equation for Cellular Respiration B. Stages</p> <p>X. Cell Cycle and Mitosis A. Cell Cycle B. Mitosis (Nuclear Division) C. Cytokinesis (Cytoplasmic Division) D. Comparison of Plant and Animal Mitosis</p> <p>XI. Meiosis A. Meiosis B. Genetic Variation Resulting From Meiosis C. Comparison of Mitosis and Meiosis</p> <p>XII. Heredity - Mendelian Genetics A. Mendel's Experiments B. Probability and Punnett Squares C. Chromosome Theory of Inheritance D. Patterns of Inheritance E. Linked Genes and Crossing Over</p> <p>XIII. Genetic Diseases and Human Genetics A. DNA and the Human Genome Project B. Causes of Genetic Diseases C. Chromosomal Disorders D. Sex-Linked Genes E. Examining Human Chromosomes & Traits</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS From 2nd nine weeks</p> | <p>XIV. DNA, Replication and Transcription A. Experiments and History B. Structure of DNA & Chromosomes C. DNA Replication D. Transcription</p> <p>XV. RNA and Protein Synthesis A. RNA Structure and Review of Transcription B. Types of RNA (Structure & Function) C. Translation D. "One Gene – One Enzyme" E. Mutations</p> <p>XVI. Genetic Engineering A. Experiments/Contributions B. Forms of Biotechnology C. Regulation of Genes (Prokaryotes) D. Bio Ethical Issues E. Careers in Genetic Engineering</p> <p>XVII. Theory of Evolution A. Theories on the Origins of Life B. First Organic Molecules C. Ideas That Shaped Darwin's Thinking D. Darwin's Theory of Evolution by Natural Selection E. Evolution of Populations (Microevolution)</p> <p>XVIII. Evidence of the Theory of Evolution and Taxonomy A. Evidence for the Theory of Evolution B. Macroevolution C. Hominid Evolution D. Taxonomy</p> <p align="center">REVIEW OF BIOLOGY EOC AA BENCHMARKS From 3rd nine weeks</p> | <p>XIX. Human Body Systems A. Integumentary System B. Skeletal System C. Muscular System D. Circulatory and Respiratory Systems E. Digestive and Excretory Systems F. Nervous Systems G. Survey of Endocrine and Reproductive Systems H. Immune System</p> <p align="center">XX. BIOLOGY EOC AA BENCHMARKS CRUNCH TIME (2 weeks)</p> <p>XXI. Prokaryotes, Viruses, Protists and Fungi A. Prokaryotes B. Viruses C. Protists D. Fungi</p> <p>XXII. Study of Animal Diversity and Adaptations of the Invertebrate Phylum A. Invertebrate Diversity B. Integration of Human Body Systems with Invertebrates and Chordates</p> <p>XXIII. Study of Animal Diversity and Adaptations of the Chordate Phylum A. Chordate Diversity B. Integration of Human Body Systems with Invertebrates and Chordates</p> <p>XXIV. Survey of Plant Diversity A. Non-vascular Plants (Diversity and Reproduction) B. Vascular Plants (Diversity and Modes of Reproduction) C. Importance of Plants</p> |

HOW CELLS DIVIDE

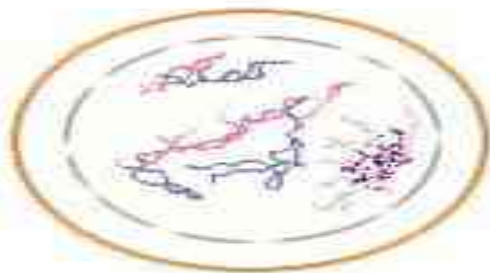
- The two parts of a cell's cycle are interphase and cell division. Cell division involves mitosis and cytokinesis.
- During interphase, cells grow, chromosomes replicate, and cells prepare for cell division.
- You should know that mitosis describes the division of the nucleus in four stages. PMAT prophase, metaphase and telophase. Once thought to be a resting period, Interphase which has 3 stages the G1 or gap 1, the S stage, and the G2 or gap 2 stage; is now known to be an important preparatory phase.
- During mitosis, the nucleus divides into daughter nuclei containing identical sets of chromosomes. For most cells, the final stage of cell division is the division of the cytoplasm during cytokinesis.

Phases of the Cell “IPMAT”

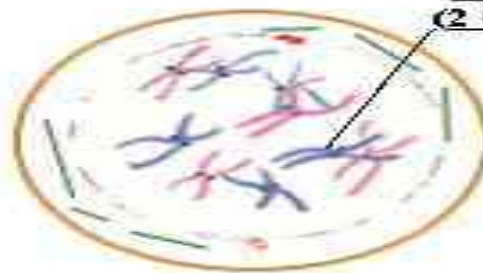


MITOSIS AND CYTOKINESIS

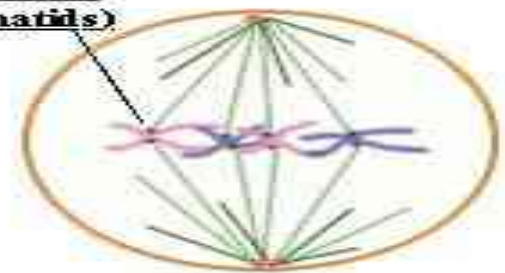
Mitosis



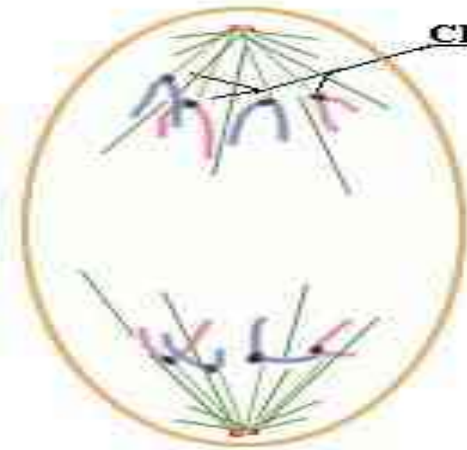
Prophase



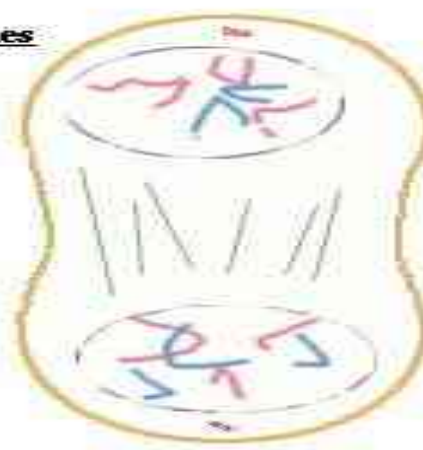
Prometaphase



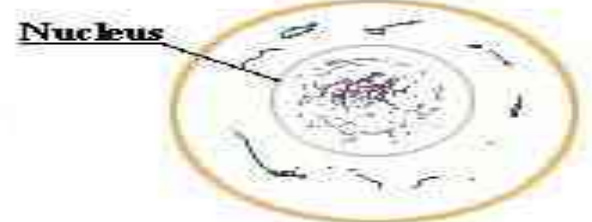
Metaphase



Anaphase



Telophase



Interphase



**Chromosome
(2 Chromatids)**

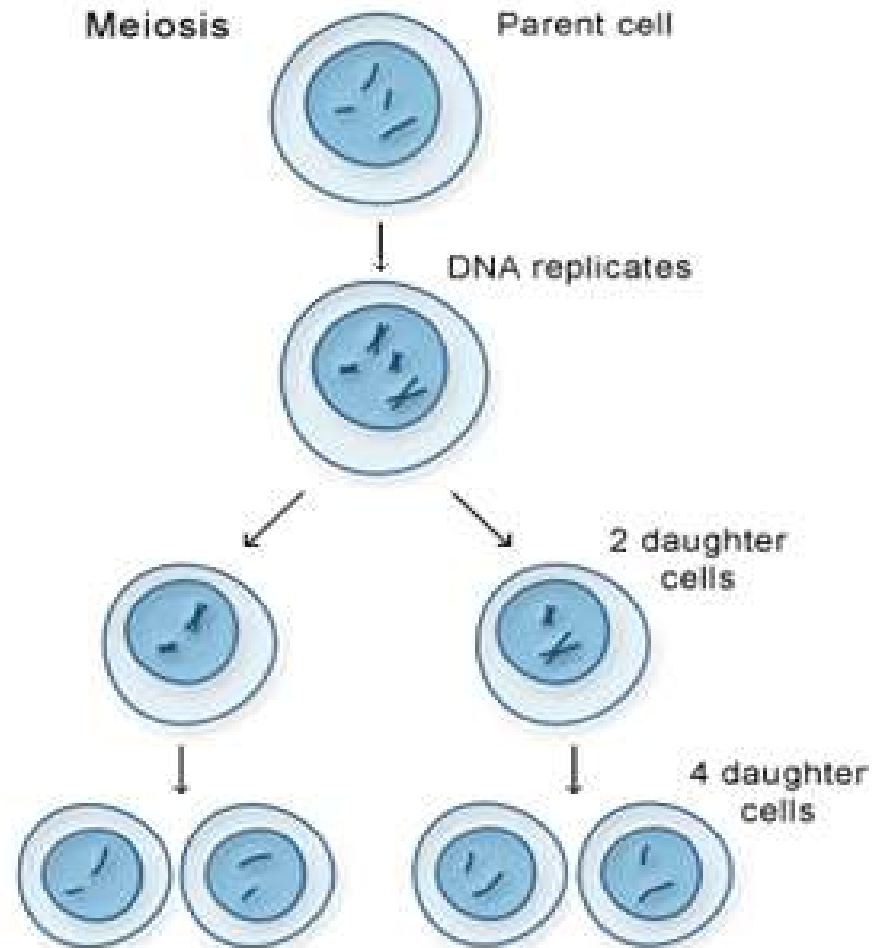
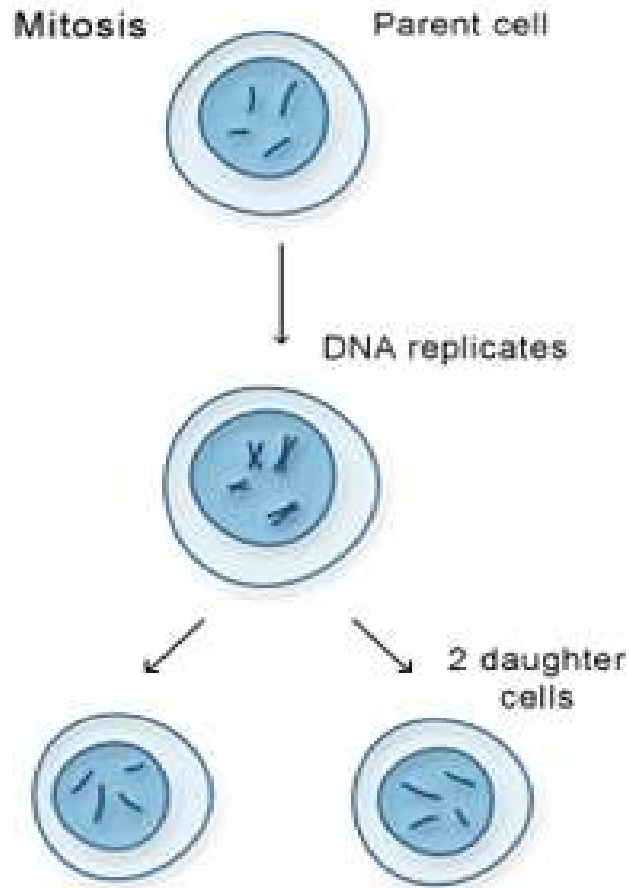
Chromosomes

Nucleus

MEIOSIS AND SEXUAL REPRODUCTION

- Almost all cells in an organisms contain two complete sets of chromosomes. Reproductive cells contain only one set.
- Cells produced by mitosis are diploid cells; produced by meiosis are haploid.
- **Meiosis keeps the number of chromosomes constant from generation to generation. During meiosis, homologous pairs of chromosomes separate to form four haploid daughter cell nuclei.**
- Meiosis makes sexual reproduction possible. Meiosis shuffles and individuals genes and chromosome then makes a unique gamete that is haploid. (Half the original Chromosome of the Individual)
- Sexual Reproduction Creates Variety in the Population.

Meiosis is Mitosis Twice



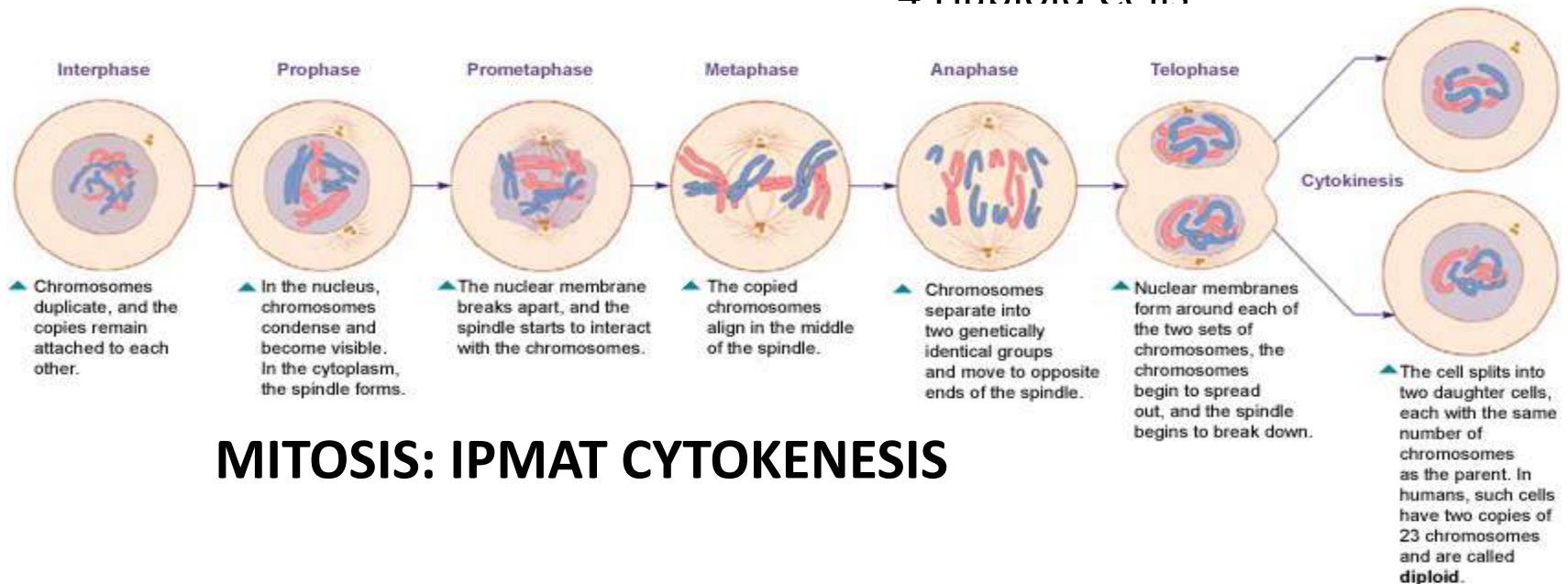
Meiosis vs. Mitosis

- **Mitosis**

- Growth, maintenance, repair
- Produces two identical daughter cells
- PMAT only once
- 2 Diploid Cells

- **Meiosis**

- Reproduction: variety in the offspring
- Produces four unique haploid cells (gametes)
- PMAT twice
- 4 Haploid Cells



GENETICS AND HEREDITY

- Genetics is the study of heritable characteristics or traits.
- Gregor Mendel used mathematics to study the inheritance of traits in pea plants.
- Alleles are alternate forms of a gene. In a hybrid organism, the dominant allele is expressed.



Principles of Inheritance

- The chromosome theory of heredity states that the inheritance of traits is controlled by genes, which are located on chromosomes.
- The genotype of an organism is all the alleles for a trait; the phenotype is the trait.
- The Law of Segregation describes how chromosome pairs separate during meiosis.
- The Law of Independent Assortment states that gene pairs separate independently of each other.
- The Law of Dominance states that the dominant allele, if present will be expressed.

GENETICS AND PREDICTIONS

Scientists use probability to predict traits in offspring.

A Punnett Square organizes information in order to make genetic predictions.

| | | Parent one (Bb) | |
|------------------|---|-----------------|----|
| | | B | b |
| Parent two Bb | B | BB | Bb |
| | b | Bb | bb |

PUNNETT SQUARES ARE USED TO MAKE GENETIC PREDICTIONS

Punnett Squares are used to organize allele information (meiosis) and predict the outcome of the offspring.

PUREBRED CROSS

| | | |
|----------|-----------|-----------|
| | B | B |
| b | Bb | Bb |
| b | Bb | Bb |

FIGURE 2

DI-HYBRID CROSS

| | | | | |
|-----------|-------------|-------------|-------------|-------------|
| | bY | by | bY | by |
| BY | BbYY | BbYy | BbYY | BbYy |
| By | BbYy | Bbyy | BbYy | Bbyy |
| bY | bbYY | bbYy | bbYY | bbYy |
| by | bbYy | bbyy | bbYy | bbyy |

FIGURE 4

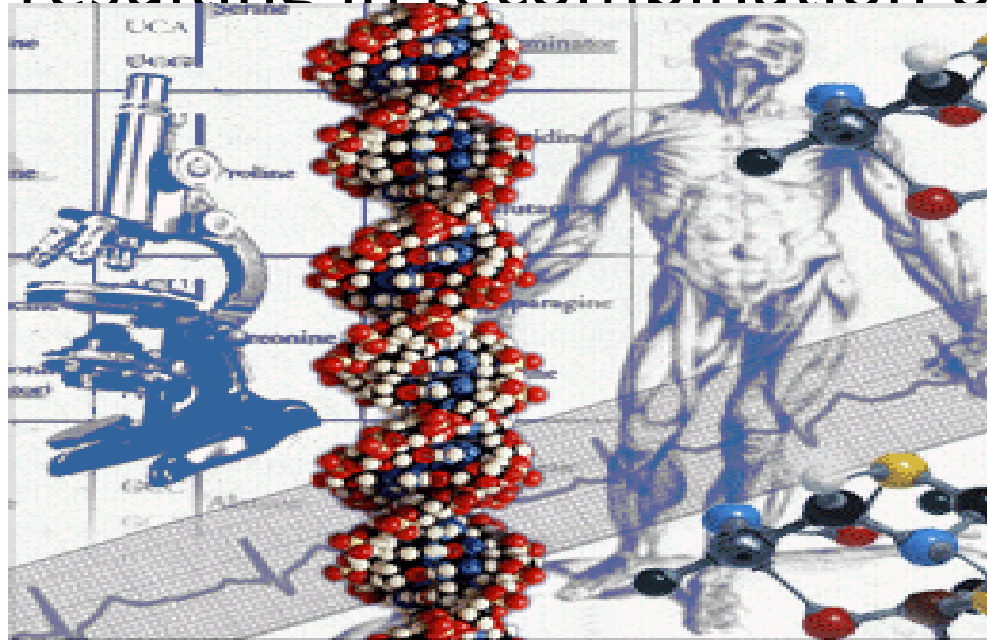
MONOHYBRID CROSS

| | | |
|----------|-----------|-----------|
| | b | b |
| B | Bb | Bb |
| b | bb | bb |

FIGURE 3

Linked Genes and Crossing Over

- Linked Genes are located in the same chromosomes and do not sort independently
- Chromosomes sometimes cross over during meiosis, resulting in recombination of alleles.

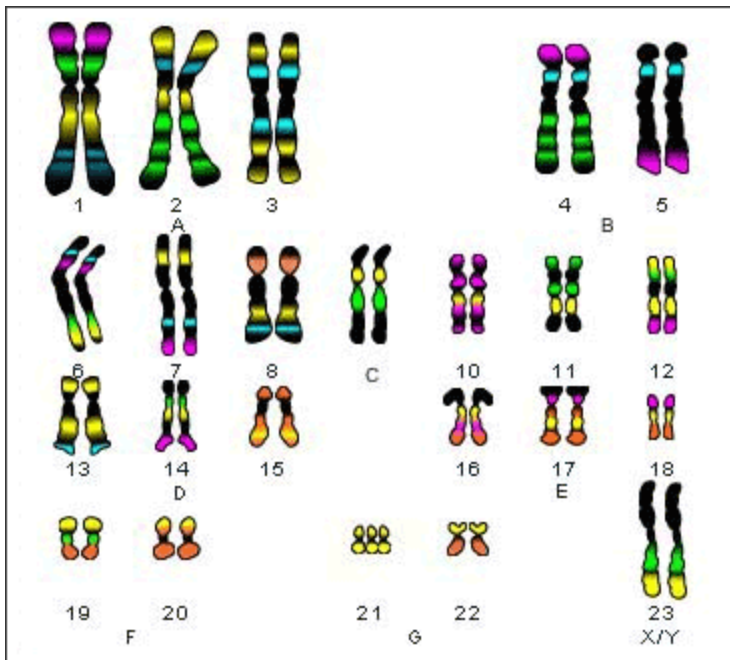


The Human Gene Map

- A karyotype is an image showing all of an organism's chromosomes.
- A genome is the base sequence of all of the DNA in an organism.
- The Human Genome Project is the effort to sequence the entire human genome.
- Non-disjunction occurs when chromosomes fail to separate during cell division.

HUMAN KARYOTYPE

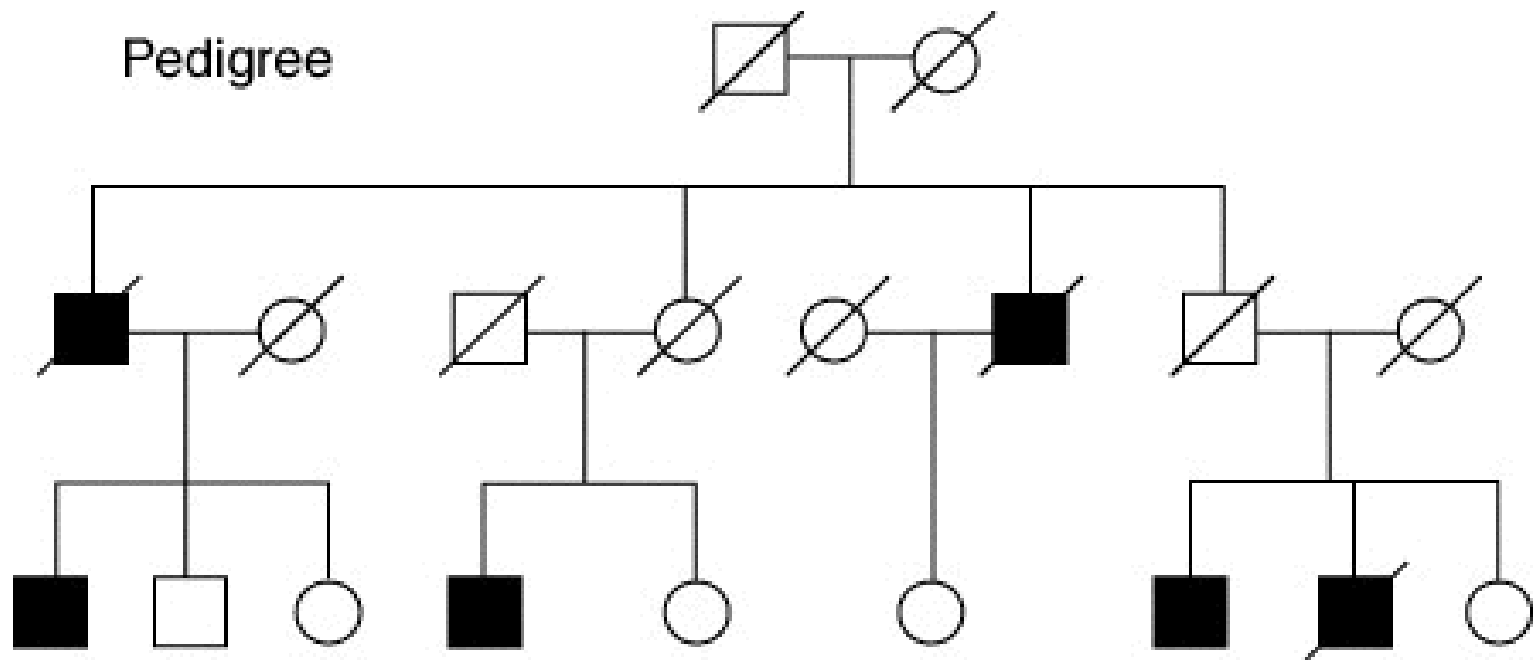
Notice chromosome 21 below has one extra chromosome caused by non-disjunction. This is known as trisomy. The disorder it causes is Down Syndrome. Can you tell what is the sex of this individual below?



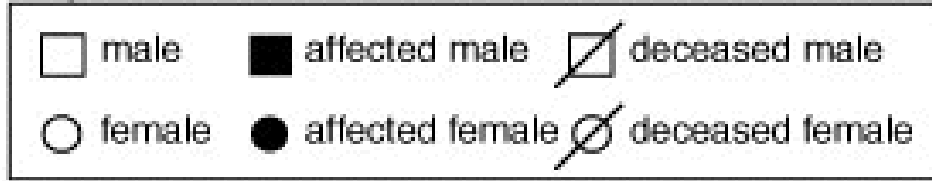
Predictions and People

- Pedigrees are used to trace the history of traits among relatives.
- Genetic counselors help identify the likelihood of a trait being passed to offspring.
- Hypercholesterolemia is a disorder caused by incomplete dominance.
- Huntington's Disease (deterioration of the brain) does not become active until the carrier is in their 40's, usually after they have passed the gene to their offspring.
- Phenylketonuria (PKU) A person with PKU lacks the enzymes needed to break down the amino acid phenylalanine, which is found in milk and many foods. If left untreated, PKU can lead to developmental disabilities and death.

Predictions and People Continued



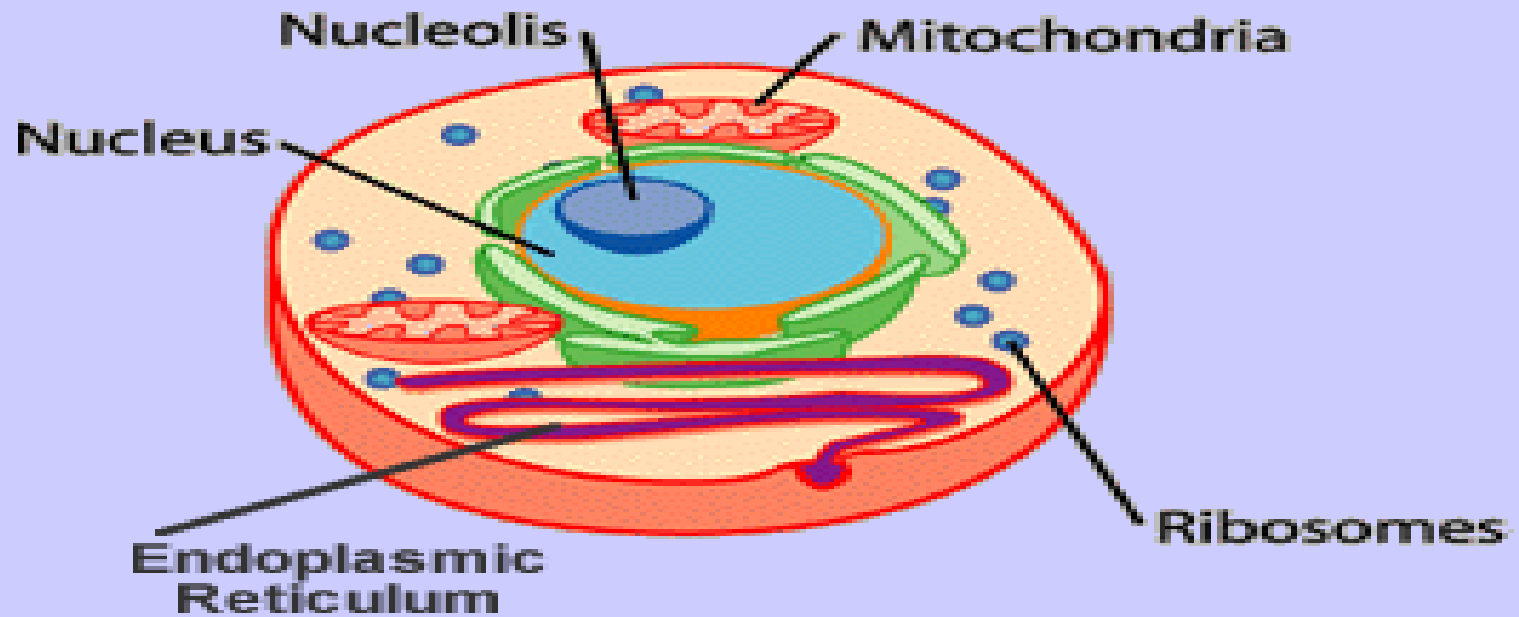
Key



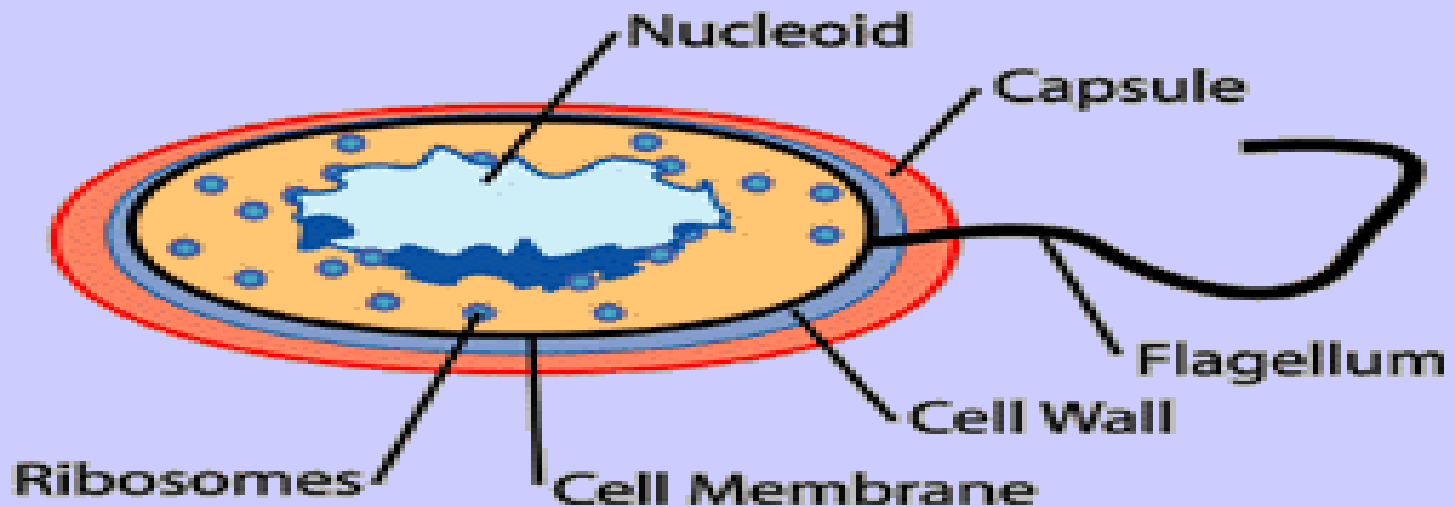
Prokaryote vs. Eukaryote

- When you see Prokaryote think **PR primitive**.
These cells are unicellular primitive bacteria with no organelles or clearly defined nucleus.
- When you see Eukaryote think **E evolved**.
Eukaryotes are highly evolved cells like yours. They have a nucleus and organelles with membranes.

Eukaryote

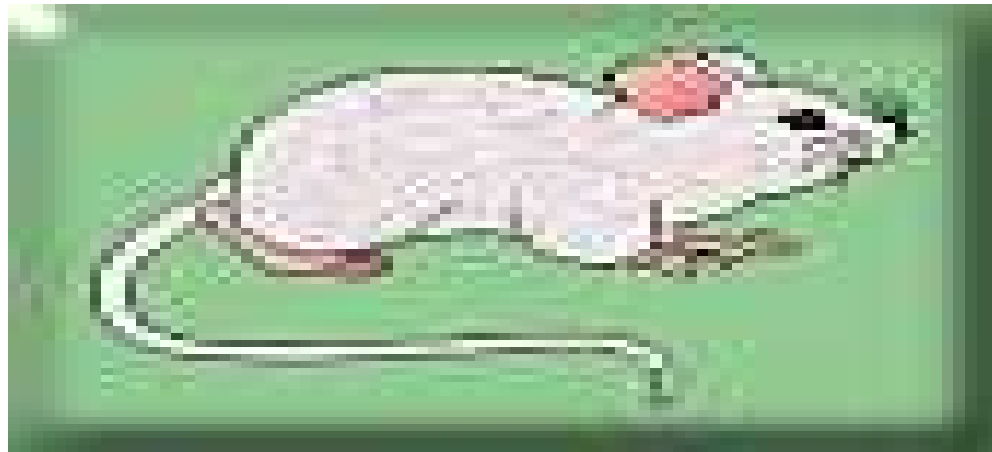


Prokaryote



MOLECULE OF HEREDITY

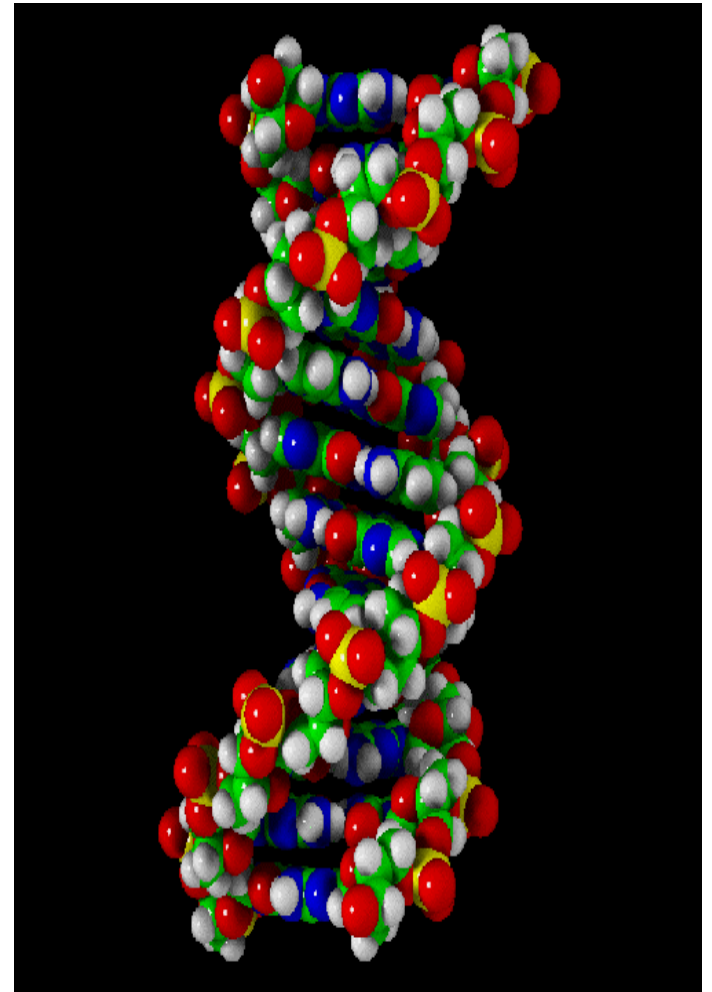
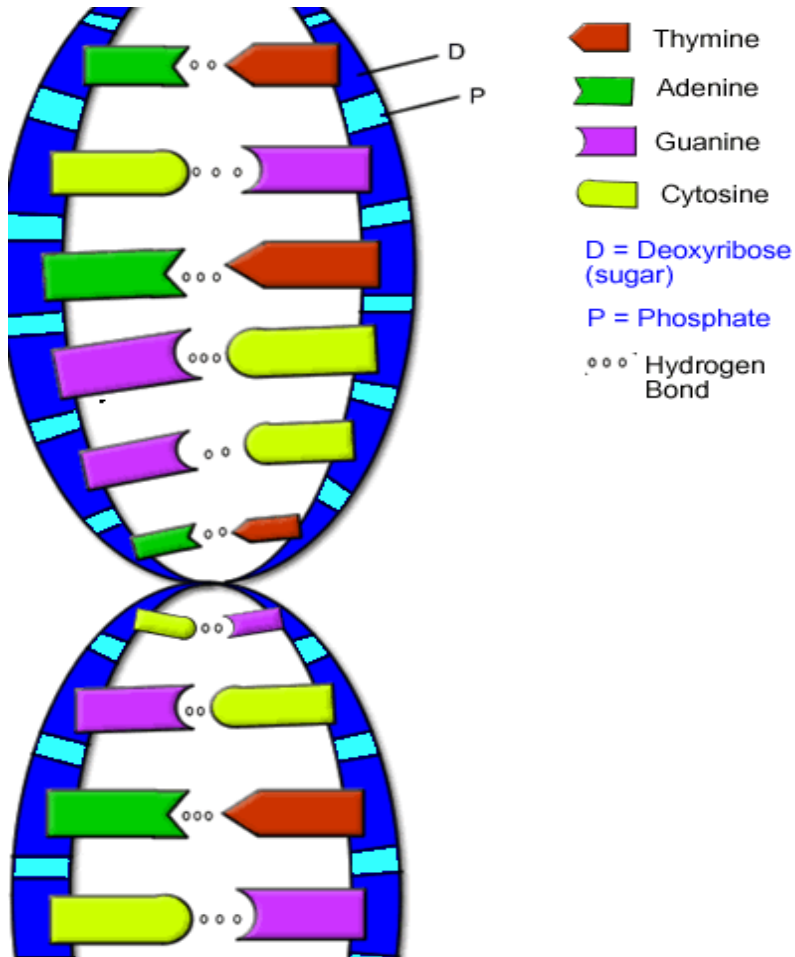
- Frederick Griffith's experiments showed that genetic material transformed cells.
- Martha Chase and Alfred Hershey proved that DNA is the genetic material of cells.



DNA STRUCTURE AND REPLICATION

- DNA is composed of nucleotides and is shaped like a double helix.
- A nucleotide has three parts: a sugar, a phosphate, and a nitrogenous base.
- Bases always form complementary base pairs. Adenine binds with thymine and guanine binds with cytosine.
- Complementary base pairing enables DNA to replicate, or copy itself. This is necessary for mitosis and meiosis.

DNA DOUBLE HELIX



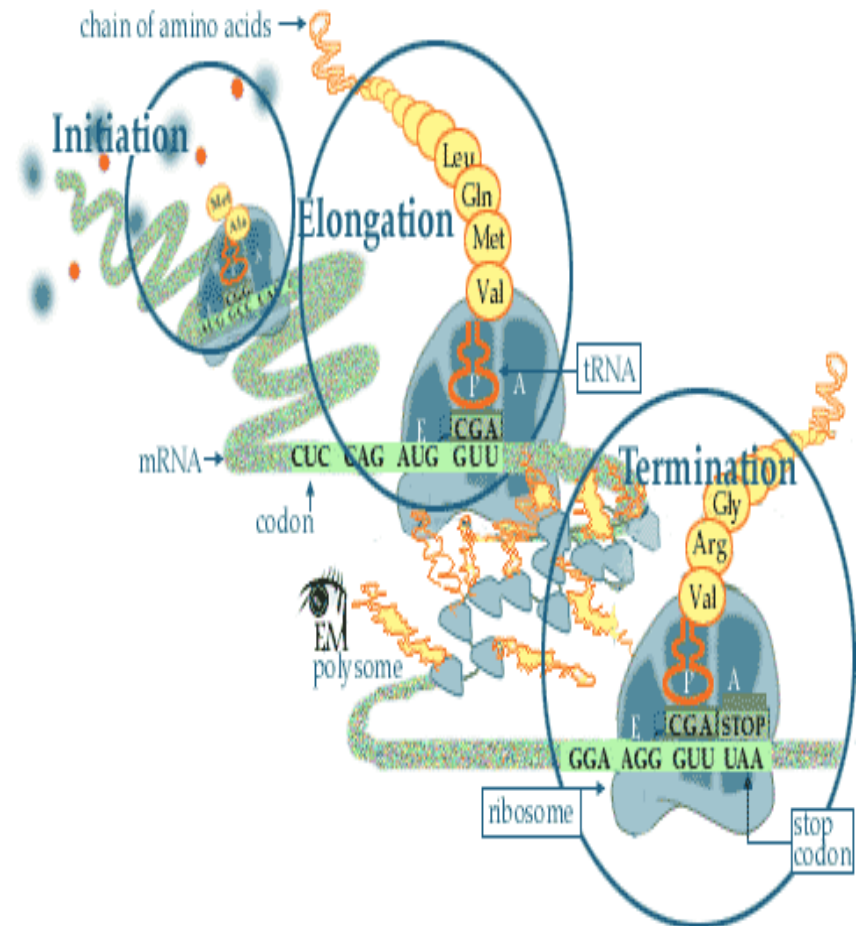
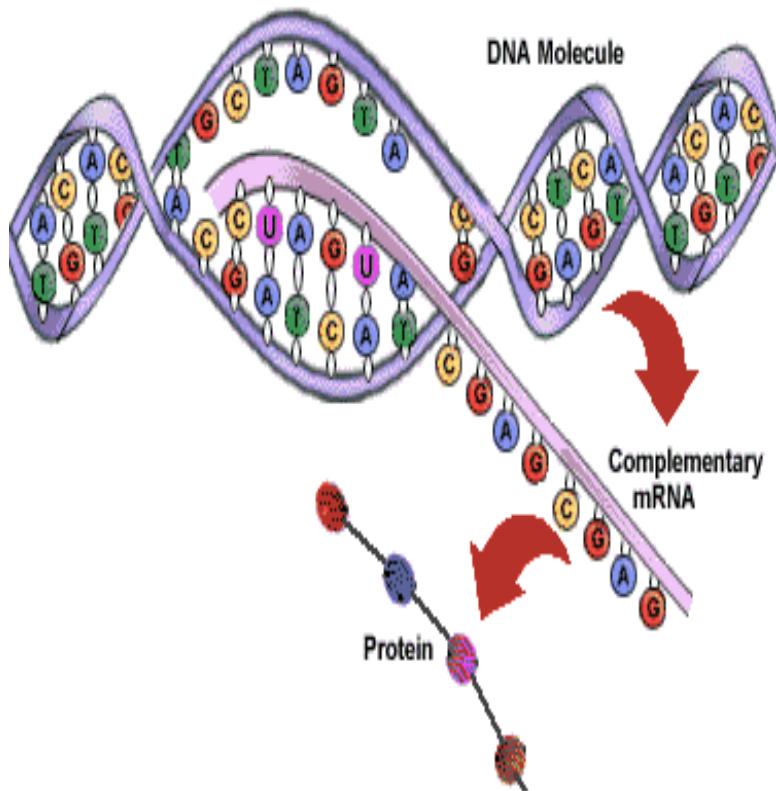
Protein Synthesis

- Protein synthesis occurs in two stages: transcription and translation. Transcription is the process by which information is copied from DNA to mRNA.
- Translation is the process by which the information from nucleic acids is coded for amino acids.
- mRNA splicing occurs between transcription and translation in eukaryotes

Protein Synthesis Has Two Stages

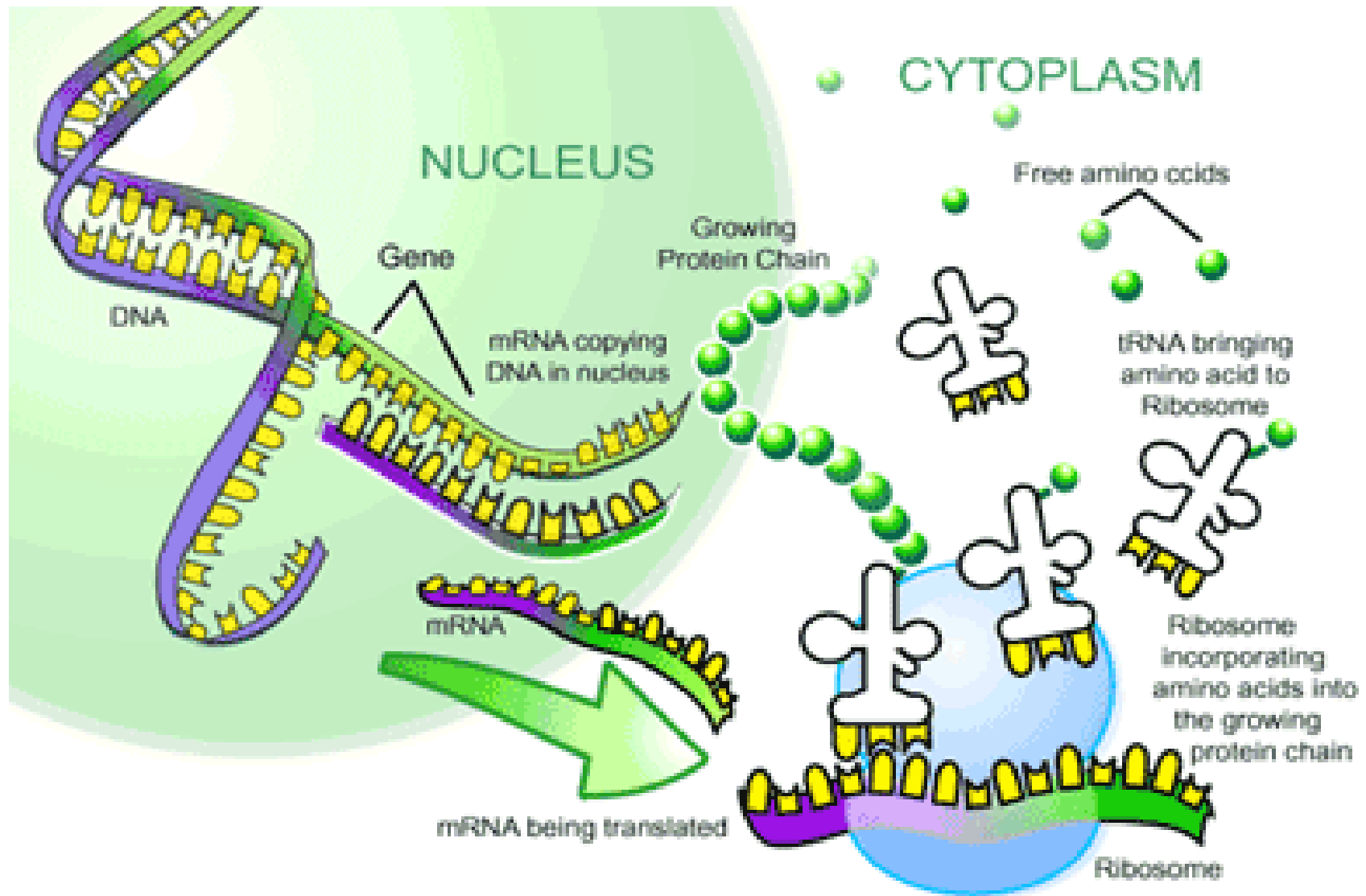
Transcription: DNA unzips and mRNA copies the genetic code.

Translation



Transcription and Translation: mRNA, tRNA, codons and anticodons, introns and exons

One Gene : One Protein



BIOTECHNOLOGY

- Humans have practiced selective breeding of plants and animals for centuries.
- Out-breeding is the crossing of two different breeds and can result in hybrid vigor
- Biotechnology is the use of living organisms to make products.
- National Seed Storage Laboratory (p208 NSSL)

Forms of Biotechnology

Selective Breeding to benefit man.



Hybrid Vigor / Out breeding



Earth's Early History

- Between 4.5 and 5 billion years ago, Earth formed when dust and rocks in the solar system condensed.
- Earth's early atmosphere differed from today's in many ways, such as the absence of both oxygen and a protective ozone layer.
- The seas that formed from condensed water vapor contained dissolved minerals and gases
- Most scientists agree that the origin of life simple organic molecules, polymers, protocells and cells.
- Other theories of the origin of life are creationism, spontaneous generation, and a meteorite from outer space.

Genetic Engineering

- Genetic engineering refers to any technique used to identify or change DNA sequences.
- Scientists use gel electrophoresis to determine the sequence of DNA bases and to obtain DNA fingerprints (profiles).
- Recombinant DNA is a combination of the genetic material of two different breeds.
- Genes can be cloned using recombinant technology.

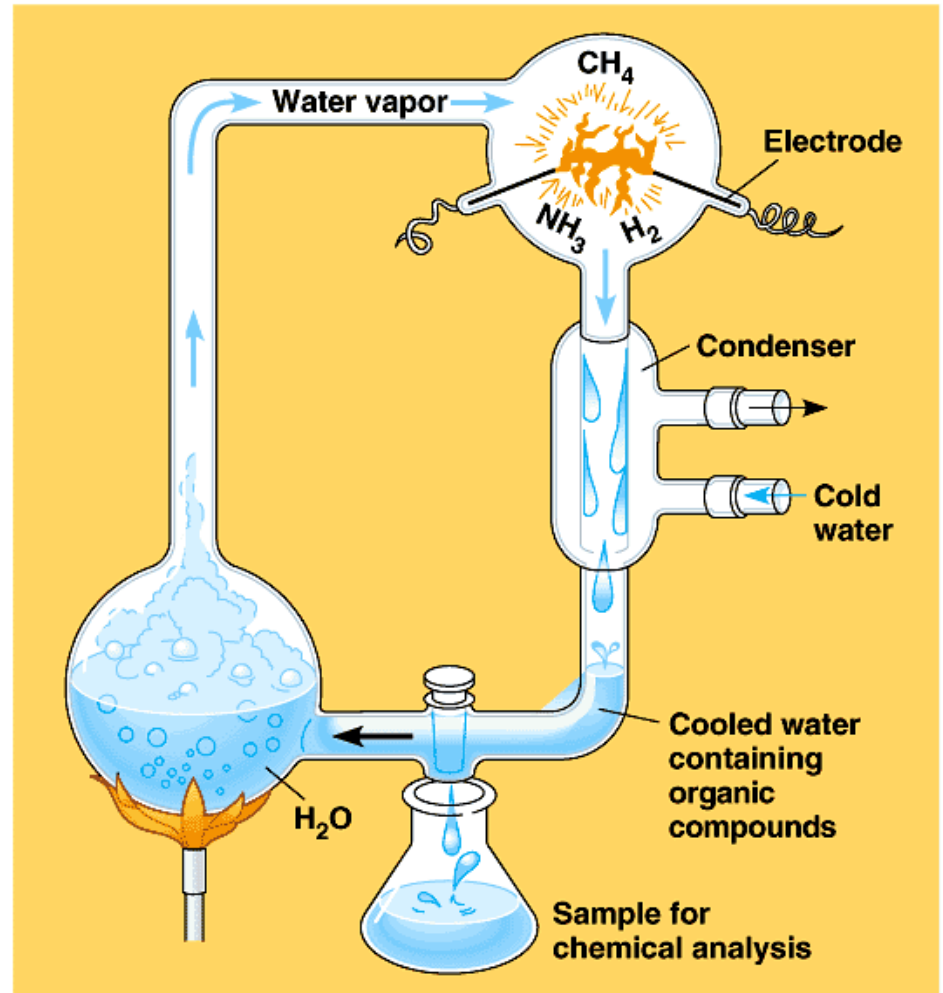
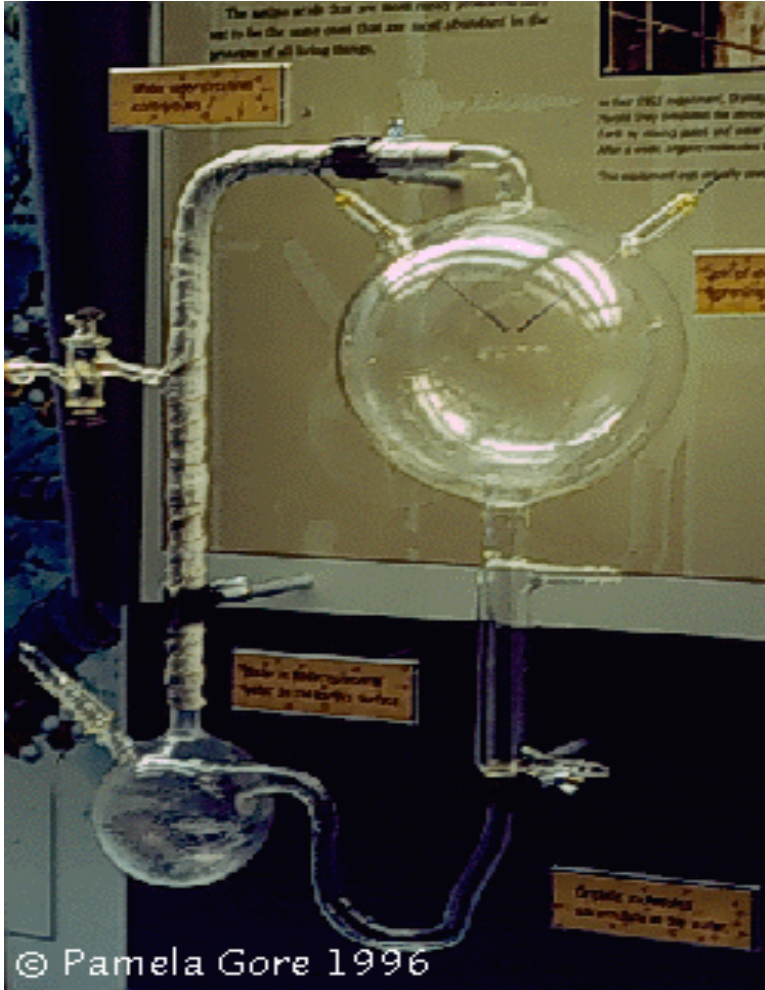
Applications of Genetic Engineering

- Genetic engineering has current and potential applications in agriculture (**Genetically engineered crops**), industry (**Oil consuming bacteria**), medicine (**production of human insulin**), and forensics (**DNA Fingerprints**).
- Genetic engineering enables scientists to perform gene therapy, develop medicines, diagnose disorders, and study genomes.
- **The different careers are endless.** Medical research, DNA Labs, Law enforcement, Agriculture...
- **Bioethical Issues** Just because we can manipulate genes and chromosomes, should we? Is this playing God. What if genetically engineered organism escapes lab?

The First Organisms

- Miller-Urey Apparatus simulated the earth's early atmosphere. The experiment produced amino acids, the building blocks of proteins.
- The oldest-known fossils are from bacteria that lived 3.5 billion years ago.
- As heterotrophs multiplied, they competed for a decreasing supply of organic nutrients. Around 2.5 billion years ago, autotrophs evolved that produced oxygen.
- Cells that could tolerate oxygen evolved into the first aerobes.
- The first eukaryotes evolved about 1.5 billion years ago.

Miller-Urey Apparatus



History of Living Things

- The first organic molecules were carbon dioxide, nitrogen, sulfur dioxide, hydrogen sulfide, ammonia, methane, oxygen, and argon gas
- Scientists theorize that multi-cellular organisms evolved from colonies of eukaryotes cells.
- Terrestrial organisms evolved about 450 million years ago. Adaptations for life on land included internal transport systems and methods to conserve water.
- The locations of Earth's continents have changed over time. Land movements and climate changes are major causes of speciation on Earth.
- Mass extinctions resulted in the adaptive radiation of surviving species.

Stromatolites First Organisms



Darwin and His Theory

- Based on observations made during his voyage, Darwin concluded that adaptation and the evolution of species were related.
- Darwin drew analogies between biological change and geological change, and between artificial selection and natural selection.
- Darwin was influenced by geologist Charles Lyel (gradualism), finches on the Galapagos Islands (variation/adaptation), and economist Thomas Malthus (survival of the fittest).
- When organisms compete for limited resources, those with favorable traits survive and pass those traits along to the next generation.
- Some scientists, including Darwin, propose that evolution occurs gradually. Other scientists infer from gaps in the fossil record that evolution occurs in short periods of rapid change.

Origin of Species

- Darwin's Four Points: **there is variation in the population**, **some of the variation is favorable**, **not all young produced can survive**, and **those who do survive and reproduce have the favorable variations**.
- To reconstruct evolutionary history, scientists examine fossils, compare structures of living and extinct species, study embryonic development, and analyze DNA.
- New species can develop when populations become separated and isolated. (**Speciation**)
- Similar traits can develop in unrelated species occupying comparable niches. (**Convergent evolution/divergent evolution**)
- Interactions with other organisms affect evolution. (**Coevolution**)
- Many diverse species can evolve from one ancestral species. (**Adaptive Radiation**)
- **Macroevolution** is evolution on a scale of separated gene pools. Macroevolutionary studies focus on change that occurs at or above the level of species, in contrast with microevolution, which refers to smaller evolutionary changes (typically described as changes in allele frequencies) *within* a species or population.

HOMINID EVOLUTION

- The oldest hominid fossils is about 1.1 million years old. About nine different hominid species have been identified. *Homo sapiens* is the only surviving hominid species.
- Archaeologist use fossils of primates' teeth and leg and pelvic bones to infer their diet and mode of locomotion.
- *Homo habilis* coexisted with *Australopethicus* species. *Australopethicus* died out, but *Homo habilis* gave rise to *Homo erectus* – a direct ancestor to modern humans.
- *Homo erectus* migragted from Africa to Europe and Asia.

Homo sapiens Homo sapiens

- Neanderthals lived in Europe, Asia and the Middle East as recently as 30,000 years ago.
- Neanderthals were shorter than modern humans, with heavier bones and larger brains. They made tools from bone and stone.
- Some scientists think that competition with Cro-Magnons caused the extinction of Neanderthals.
- Cro-Magnons are physically identical to modern humans. They had a complex culture with an organized social structure.
- Explanations for the origin of *Homo sapiens* include the multiregional and Out of “Africa Hypothesis”

TAXONOMY / CLASSIFICATION

- Biological Classification systems group organisms into categories based on shared characteristics.
- The modern classification system has seven taxa and is modeled after the system developed by Linnaeus in the 18th century.
- Modern classification systems group organisms into kingdoms based on such characteristics as cell structure, level of cell specialization, and method of obtaining nutrients.

TAXONOMY / CLASSIFICATION CONTINUED

- Based on recent biochemical data, some scientists use classification systems with additional kingdoms; others use three overarching categories called domains.
- Linnaeus introduced the system of binomial nomenclature, in which an organism is identified by its Genus and species name.
- Scientific Names: *Canis familiaris* (domestic dog)
If written in type it is always italicized. If written by hand it is underlined. Canis familiaris

The Seven (7) Taxa of Domestic Dogs

Kingdom > Animalia

Phylum > Chordata

Class > Mammalia

Order > Carnivora

Family > Canidae

Genus > Canis

Species > *Canis familiaris*

Phylogenetic Tree

