BIO 181
Introduction to Living Organisms

In this section, we will learn and discuss:

- **What defines a living organism**
- **What differentiates a living organism from a non-living organism**
- **Selected introductory concepts and terminology**

Readings:

Campbell & Reece, Chp. 1 "Introduction: Themes in the Study of Life," In: *Biology*, 8th ed., (1-27). Also in *Biology, vol.1: A Custom Edition for Phoenix College,* (1-27).

Terminology

matter
atoms
metabolism
homeostasis
reproduction
mutation
genetic diversity
DNA
biological molecules
cell
tissue
organ
organ system
organism
population
community
ecosystem
interdependence among living organism
producers
consumers
decomposers

BIO 181
Atoms and Chemical Bonds. The Molecule of Water

In this section, we will learn and discuss:

- **What is a chemical element, an atom, a molecule, and a compound**
- **How matter is organized**
- **How the atom is organized**
- **What subatomic particles are: neutrons, electrons, and protons**
- **How to determine the number of protons and electrons of an atom**
- **The physic-chemical behavior of subatomic particles**
- **How electrons are distributed in an atom, and how to distribute them within orbitals**
- **Chemical bonds that structure biological molecules**
- **The physic-chemical behavior of the molecule of water**
- **What is pH, and how it is measured**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chps. 2 & 3 "The Chemical Context of Life" and "Water and the Fitness of the Environment," In: *Biology*, 8th ed., (30-57). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (30-57).

Terminology

matter
element
atom
molecule
compound
subatomic particle
electron

proton
neutron
atomic number
atomic mass
orbital
s and *p* orbitals
anion
cation
ionic bond
non-polar covalent bond
polar covalent bond
polar molecules
hydrogen bond
electronegativity
dissociation of molecules
solubility
acid solution (acid pH)
basic solution (basic pH)
neutral solution (neutral pH)

BIO 181
The Atom of Carbon. Macromolecules

In this section, we will learn and discuss:

- **The physico-chemical properties of the atom of carbon**
- **What is an hydrocarbon**
- **What is a functional group, and different categories of functional groups**
- **What is an organic molecule, and the different categories of organic molecules**
- **The basic structure of biological macromolecules**
- **Carbohydrates and different types of carbohydrates**
- **Lipids and different types of lipids**
- **Proteins and different types of proteins**
- **How proteins are constituted**
- **Protein Structure and Protein Conformation**
- **What is an amino acid (aa)**
- **Nucleic Acids and different types of nucleic acids**
- **The difference between hydrophobic and hydrophilic molecules**
- **How polymers are formed: dehydration or condensation reactions**
- **How polymers are broken into monomers: hydrolysis reactions**
- **Some examples of defective proteins, and the condition they create**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chps. 4 & 5 "Carbon and the Molecular Diversity of Life" and "The Structure and Function of Large Biological Molecules," In: *Biology*, 8th ed., (58-91). Also in *Biology, vol.1: A Custom Edition for Phoenix College,* (58-91).

Terminology

hydrocarbon
functional group
hydroxyl group
carbonyl aldehyde group
carbonyl ketone group
carboxyl group
amino group
monomer
polymer
dehydration (condensation) reaction
hydrolysis reaction
macromolecule
carbohydrate
lipid
protein
nucleic acid
monosaccharide
disaccharide
polysaccharide
starch
glycogen
unsaturated fatty acids
saturated fatty acids
triglycerides
phospholipids
waxes and sterols
hydrophobic molecules
hydrophilic molecules
amino acid
protein conformation
peptide bond
primary structure of proteins
secondary structure of proteins
a- helix
ß-sheet
tertiary structure of proteins
quaternary structure of proteins

polypeptide chain
sickle cell anemia
cystic fibrosis

BIO 181
Enzymes

In this section, we will learn and discuss:

- **The chemical nature of enzymes**
- **Enzymatic proteins and ribozymes**
- **The major components of enzymatic reactions**
- **What factors affect enzyme activity**
- **How enzyme function is regulated: competitive, allosteric, and feedback regulation.**
- **What is a competitive and a non-competitive inhibitor**
- **Examples of human enzyme deficiencies**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chp. 8 "Enzymes …" In: *Biology,* 8th ed., (151-159). Also in *Biology, vol.1: A Custom Edition for Phoenix College,* (151-161).

Terminology

Catalyst
Activation energy
Enzymatic proteins
Ribozymes
Substrate
End product
Enzyme- substrate complex
Active site
Allosteric site
Enzyme inhibition
Enzyme activation
Competitive inhibition
Non-competitive inhibition
Competitive inhibitor
Non-competitive inhibitor
Feedback inhibition

BIO 181
Cell Structure: Cell Compartments and Cellular Organelles

In this section, we will learn and discuss:

- **The difference between prokaryotic and eukaryotic cells**
- **The difference between plant and animal cells**
- **Cell compartments: nucleus and cytoplasm**
- **The basic structure and function of the cell (plasma) membrane**
- **The basic structure and function of cell walls (bacterial and plant)**
- **Nuclear components: chromatin, nucleolus, and nuclear envelope**
- **Cytoplasmic organelles that constitute the endomembrane system: endoplasmic reticulum, Golgi apparatus, vesicles, and central vacuole**
- **Vesicle transport**
- **Energy-producing cytoplasmic organelles: mitochondria and chloroplasts**
- **Organelles involved in cell movement: cilia and flagella**
- **Cytoskeleton: what it is and what does it do**
- **Examples of cell movement**
- **What cytoplasmic organelles are unique to prokaryotic cells, to animal cells, and to plant cells**
- **Electromicrographs of selected cells**
- **Selected concepts and terminology**

<u>Readings:</u>

Campbell & Reece, Chp. 6 "A Tour of the Cell," In: *Biology,* 8th ed., (94-124). Also in *Biology, vol.1: A Custom Edition for Phoenix College,* (94-124).

Terminology

nucleus
cytoplasm
prokaryotic cell
eukaryotic cell
cell (plasma) membrane
bacterial cell wall
plant cell wall
chromatin
DNA associated proteins
histones
electromicrograph
electrodensity
inner nuclear membrane
outer nuclear membrane
intermembrane space
nuclear pore complexes
nucleolus
rough endoplasmic reticulum (RER)
smooth endoplasmic reticulum (SER)
cisternae
ribosomes
Golgi apparatus
Golgi apparatus' *cis* face
Golgi apparatus' *trans* face
Plant central vacuole
tonoplast
transport vesicles
secretory vesicles
lysosomes
peroxisomes
chloroplast
inner chloroplast membrane
outer chloroplast membrane
thylakoids
grana
stroma
mitochondria
inner mitochondrial membrane

outer mitochondrial membrane
mitochondrial matrix
cristae
cytoskeleton
microtubules
intermediate filaments
microfilaments
pseudopodial movement
flagellum/ flagella
cilium/ cilia
centriole

BIO 181
Membrane Structure and Function

In this section, we will learn and discuss:

- **The structure of the cell membrane**
- **Processes involved in the movement of molecules across the cell membrane: osmosis and diffusion**
- **What is an isotonic, a hypertonic, and a hypotonic solution**
- **What is an osmotic shock**
- **What is facilitated diffusion and active transport**
- **What is exocytosis and endocytosis**
- **Different types of exocytosis (or endocytosis)**
- **Examples of human deficiencies related with transport processes across the cell membrane: familial hypercholesterolemia**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chp. 7 "Membrane Structure and Function," In: *Biology*, 8th ed., (125-141). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (125-141).

Terminology

Phospholipids
Hydrophilic Heads
Hydrophobic Tails
Lipid Bilayer
Membrane Fluidity
Membrane Proteins
Carrier Proteins
Cholesterol
Isotonic
Hypertonic
Hypotonic

Plasmolysis
Osmosis
Diffusion
Concentration Gradient
Facilitated Diffusion
Passive Transport
Active Transport
Exocytosis
Endocytosis
Phagocytosis
Pinocytosis
Receptor-mediated Endocytosis
Coated Vesicle

BIO 181
Metabolism and Cellular Respiration

In this section, we will learn and discuss:

- **How producers, consumers, and decomposers relate**
- **Basic types of metabolic pathways**
- **Main categories of participants in metabolic pathways**
- **What is an exergonic and an endergonic reaction**
- **The structure of ATP**
- **What is cellular respiration**
- **What is aerobic respiration, fermentation, and anaerobic electron transport**
- **The difference between aerobic and anaerobic organisms**
- **The main steps involved in aerobic respiration**
- **Selected Concepts and Terminology**

Readings:

Campbell & Reece, Chp. 9 "Cellular Respiration: Harvesting Chemical Energy," In: *Biology*, 8th ed., (162-184). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (162-184).

Terminology

autotroph
photosynthetic autotroph
heterotroph
degradative pathway
biosynthetic pathway
substrate
intermediate product
end product
energy carrier
ATP
ADP
energy-releasing pathway

energy-acquiring pathway
strictly aerobe
facultative aerobe
strictly anaerobe
facultative anaerobe
phosphorylation
glucose
pyruvate
phosphofructokinase
acetyl CoA
NADH
$FADH_2$
ATP/ADP
flavoprotein
ubiquinone
chemiosmosis
ATP synthase

BIO 181
Photosynthesis

In this section, we will learn and discuss:

- **How producers, consumers, and decomposers relate**
- **What is photosynthesis**
- **What pigments are and how they work**
- **The main photosynthetic pigments**
- **The main steps involved in photosynthesis**
- **Some photosynthetic bacteria: Cyanobacteria**
- **Selected Concepts and Terminology**

Readings:

Campbell & Reece, Chp. 10 "Photosynthesis," In: *Biology*, 8th ed., (185-205). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (185-205).

Terminology

autotroph
photosynthetic autotroph
heterotroph
photosynthetic pigments
stroma
thylakoid membrane
chlorophyll a
chlorophyll b
carotenoids
antenna complex
reaction center
photosystem I
photosystem II
light-dependent reactions
plastoquinone
cytochrome complex
plastocyanin
light-independent reactions (Calvin cycle)

BIO 181
DNA Structure and DNA Replication

In this section, we will learn and discuss:

- **The structure of nucleic acids**
- **The structure of a nucleotide**
- **The structure of the deoxyribonucleic (DNA) acid**
- **The way in which the molecule of DNA replicates itself (DNA Replication)**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chp 16 "The Molecular Basis of Inheritance" In: *Biology,* 8th ed., (305-324). Also in *Biology, vol.1: A Custom Edition for Phoenix College,* (305-324).

Terminology

Nucleotide
DNA nitrogen-containing bases
RNA nitrogen –containing bases
Base complementarity
Complementary chain
DNA 5' end
DNA 3' end
DNA backbone
Leading strand
Lagging strand
Helicases
Single-strand binding proteins
Priming
Elongation
RNA primer
Primase
DNA polymerase

DNA ligase
Okazaki fragments
Replication fork
Continuous replication (leading strand)
Discontinuous replication (lagging strand)

BIO 181
Protein Synthesis

In this section, we will learn and discuss:

- **The way in which proteins are produced (Protein Synthesis**
- **Protein synthesis in prokaryotes**
- **Protein synthesis in eukaryotes**
- **What is transcription**
- **What is translation**
- **How to use the genetic code**
- **All the types of ribonucleic acids (RNAs) involved in protein synthesis**
- **What is a DNA triplet, an mRNA codon, and a tRNA anticodon**
- **What is mRNA splicing**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chp 17 "From Gene to Protein" In: *Biology*, 8th ed., (325-350). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (325-350).

Terminology

DNA triplet
RNA polymerase
Promoter region
Termination sequence
pre- mRNA
mRNA transcript
Intron
Exon
Spliceosome
Ribozymes
mRNA codons

tRNA anticodons
ribosomes
polyribosomes
ribosomal subunit
translational complex unit

BIO 181
Cell Cycle, Binary Fission, Mitosis, and Meiosis

In this section, we will learn and discuss:

- **The different phases of the cell cycle**
- **The mechanisms of cell division in prokaryotes (binary fission) and in eukaryotes (mitosis and meiosis)**
- **What is ploidy**
- **The difference between asexual and sexual reproduction**
- **The difference between sex cell (gametes) and somatic cells**
- **The phases of mitosis**
- **The phases of meiosis**
- **How gametes are produced (spermiogenesis and oogenesis)**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chps. 12 & 13 "The Cell Cycle," and "Meiosis and Sexual Life Cycles In: *Biology*, 8th ed., (228-245, 248-261). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (228-245, 248-261).

Terminology

Interphase
G_1 phase
S phase
G_2 phase
Binary Fission
Mitosis
Meiosis
Mother cell
Daughter cell(s)
Sex cells or gametes
Somatic cells

Ploidy
Haploid organism
Diploid organism
Chromosome
Homologous chromosomes
Chromatid
Sister chromatids
Centromere
Mitosis
Prophase
Prometaphase
Metaphase
Anaphase
Telophase
Cytokinesis
Spindle apparatus
Centrioles
Aster
Cleavage Furrow
Cell Plate
Meiosis I
Prophase I
Metaphase I
Anaphase I
Telophase I
Meiosis II
Prophase II
Metaphase II
Anaphase II
Telophase II
Crossing-over
Tetrads
Spermiogenesis
Oogenesis
Ova
Polar Bodies
Zygote
Fertilization

BIO 181
Mendelian and Non-Mendelian Genetics

In this section, we will learn and discuss:

- **The difference between phenotype and genotype**
- **What is a Mendelian trait and a non-Mendelian trait**
- **Mendel's contribution to Genetics**
- **What is a dominant gene and a recessive gene**
- **What is a dominant phenotype and a recessive phenotype**
- **What is complete dominance**
- **The difference between a monohybrid and a dihybrid cross**
- **How to resolve a monohybrid cross**
- **How to resolve a dihybrid cross**
- **What is incomplete dominance**
- **How to resolve a cross that involves incomplete dominance**
- **What is codominance**
- **How to resolve a cross that involves codominant genes (i.e. human blood types)**
- **The difference between autosomes and sex chromosomes**
- **How sex is determined**
- **What is a sex-linked trait**
- **How to resolve crosses that involve sex-linked genes**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chps. 14 & 15 "Mendel and The Gene Idea," and "The Chromosomal Basis of Inheritance" In: *Biology*, 8th ed., (262-285, 286-304). Also in *Biology*, *vol.1: A Custom Edition for Phoenix College*, (262-285, 286-304).

Terminology

Gene
Allele
Locus
Homozygous dominant
Homozygous recessive
Heterozygous
Parental generation (P)
First- generation offspring (F_1)
Second-generation offspring (F_2)
Monohybrid cross
Dihybrid cross
Dominant gene
Recessive gene
Complete dominance
Incomplete dominance
Codominant genes
Multiple allele system
Autosomes
Sex chromosomes
Sex-linked traits
X-linked genes
Y-linked genes

BIO 181
Genetic Control of Development

In this section, we will learn and discuss:

- **The main model organisms used for genetic studies of development**
- **Some key stages of development in plants and animals**
- **What is a differentiated and an undifferentiated cell**
- **What is morphogenesis**
- **What are stem cells**
- **What is cell determination and cell differentiation**
- **What is the role that genes play in pattern formation**
- **How genes involved in pattern formation are common to several organism**
- **Some examples of gene families that regulate pattern formation of several species**
- **Selected concepts and terminology**

Readings:

Campbell & Reece, Chp 21 "Genomes and Their Evolution" In: *Biology*, 8th ed., (426-449). Also in *Biology, vol.1: A Custom Edition for Phoenix College*, (426-449).

Terminology

zygote
2-cell stage
4-cell stage
8-cell stage
blastula
gastrula
morphogenesis
undifferentiated cell
differentiated cell
pluripotent cell
stem cell
homeotic genes