

BIOLOGICAL PRINCIPLES  
STUDY GUIDE

GH 12 December 2003

To accompany Campbell, et.al.

**Life, Evolution and The Scientific Process, Chapters 1, 13 and 14**

\* Life's Levels of Organization: hierarchy

Ecosystem, community, Species, Population, Organism, Organ System, Organ, Tissue, Cell,  
Macromolecule, Small Molecule, Atom

\* Properties Common to all Living Things

\* species

\* evolution

\* Discovery (Descriptive) Science

Hypothesis-Driven Science (Scientific Method)

observations

questions

hypothesis

test (experiment)

one variable (control)

data (observation) then conclusion

\* theory

\* Mechanism

structure

function

\* domains

Archaeobacteria (Archaea)

Eubacteria (Bacteria)

Eukaryotes (Eukarya)

\* Evolution

\* Darwinian Evolution, chapter 13, pgs 257-266

Charles Darwin, *Beagle*, 1859, *On the Origin of Species by Means of Natural Selection*

Charles Lyell, *Principles of Geology*

Natural Selection and Mutation

evolutionary adaptation

evidence for evolution

Galapagos Islands

finches

age of the earth

fossil record

homologous structures

molecular biology (DNA)

How could a new species come into existence?

## Atoms, Molecules, Chemical Bonds, Water and Acids, Chapter 2

chemical elements

atom

nucleus

proton

neutron

electron

atomic number

atomic weight (mass), isotopes, radioactive isotope, *do not emphasize*

electron shell (orbit)

chemical bond

molecule

compound

organic molecule

covalent bond

nonpolar covalent bond

polar covalent bond

noncovalent bond

hydrogen bond

polar molecule

ion

ionic bond

water

cohesion

surface tension, liquid

adhesion

capillary action

heat

ice

density

solution

solvent and solute

ion

acid

acidic solution

base

basic solution

pH

buffer

pH of water is 7 ( $10^{-7}$ g H<sup>+</sup>/l), neutral

heat

calorie

chemical reaction

reactants

products

pg. 30 MC 1 - 4 & 6.

pg. 31 T/F 1 - 7, 9 & 10.

Science, Technology, and Society: number 1

### **Molecules of Cells, Chapter 3**

carbon skeleton

four functional groups

hydroxide group (alcohol)

carboxyl group (organic acid)

amino group (organic base)

carbonyl group (found in sugars)

monomers

polymers          dehydration synthesis, hydrolysis

#### **Questions**

- 3.1 What are the characteristics that identify living matter?
- 3.2 The metric system as used in lab.
- 3.3 Why must we study chemistry in order to understand biology?
- 3.4 Are atoms and molecules alive? Why?
- 3.5 How many covalent chemical bonds can be formed by H? C? N? O?
- 3.6 Cl stands for chlorine. What does the atomic number 17 for Cl represent on the periodic table?
- 3.7 Why is water so important to living systems?
- 3.8 Diagram the structures of a carbon atom, a hydrogen atom, a nitrogen atom, and an oxygen atom.

#### **Four Classes of Organic Molecules**

## carbohydrates

monosaccharide, eg. glucose

disaccharide

polysaccharide, egs. starch, cellulose, glycogen

## lipids, (fats)

triglycerides

glycerol

fatty acids

saturated fat

unsaturated fat

phospholipids

steroids (cholesterol)

## proteins

amino acids

Glycine, Serine, Aspartic Acid, Lysine

polypeptide, peptide bond

proteins egs. bone, cartilage, hair, ligaments, tendons

microtubules, hormones, enzyme,

primary structure, secondary structure, & tertiary structure

denaturation

pH and heat

## nucleic acids

nucleotides

5 carbon sugar, nitrogenous base, phosphate

DNA; deoxyribose, nitrogen bases (A, C, G, T) & phosphate

RNA; ribose, nitrogen bases (A, C, G, U) & phosphate

base pairing

Functions of DNA: replicaton, DNA --> DNA and  
protein synthesis, DNA --> RNA --> protein

### 1 Diagram the structures of the following molecules:

glucose (general)

glycerol

fatty acid

starch (general)

cellulose (general)

amino acids: Glycine, Serine, Aspartic Acid, Lysine

- 2 Diagram the dehydration synthesis of two glucose molecules.
- 3 Diagram a 14-carbon fatty acid.
- 4 Diagram a simple polypeptide made of three amino acids.
- 5 What are important functions of:

carbohydrates?

lipids?

proteins?

nucleic acids?

**6** How will a drop in pH effect the ionic charge and shape of a protein?

**7** pg. 48 M.C. 1-7;

D.C. and E. 2, 3, 4, 5

Thinking 2 & 3

## The Cell, Chapter 4

cell theory

prokaryotic cell

eukaryotic cell

light microscope

electron microscope

    magnification

    resolving power

limit on cell size

plasma membrane

    phospholipid bilayer

cytoplasm

nucleus

    DNA (chromatin)

organelle

    ribosome

    endoplasmic reticulum (ER)

        rough ER

    Golgi apparatus

    lysosome

    vacuole

    cytoskeleton

        microtubules

    flagella

organelles with their own DNA

    chloroplast

        photosynthesis, glucose

    mitochondria

        glucose, cellular respiration, ATP

cell wall

Describe the structure of the cell membrane, include a consideration of charge and hydrogen bonding.

Compare and contrast the prokaryotic cell and the eukaryotic cell.

Compare and contrast mitochondria and chloroplasts.

Describe the roles of the lysosome. Include four specific examples.

pg. 69    M.C. 2, 3, 4, 5;    Thinking as a Scientist (just for fun)



## The Cell at Work, Chapter 5

Define the following:

energy

potential energy

kinetic energy

chemical energy

adenosine-tri-phosphate (ATP)

the first law of thermodynamics

energy of activation

catalyst

enzyme

substrate (reactant) and product

active site

optimal conditions

denature

competitive inhibition

noncompetitive inhibition

plasma membrane (cell membrane)

fluid mosaic

phospholipid bilayer

proteins

selective permeability

**simple diffusion**

concentration gradient

heat, kinetic energy

osmosis, specific case

diffusion of water through a membrane

isotonic, eg. blood cells

egs. turgor pressure and lysis

**facilitated diffusion**

concentration gradient

heat, kinetic energy

plasma membrane (cell membrane)

carriers protein, (transport proteins)

**active transport**

heat, kinetic energy

plasma membrane (cell membrane)

carriers protein

ATP

other modes of moving molecules in and out of a cell: **phagocytosis, endocytosis**

## Test 2

### A little review

Define the following:

negative feedback

the second law of thermodynamics

entropy

simple reaction and summery reaction

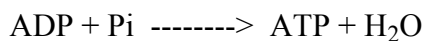


exergonic and endergonic reactions

coupled reactions

Cellular Respiration

phosphorylation (ATP production)



**Denaturation** of a protein

Effects of temperature and pH on enzyme activity.

**ATP and ADP**

stability verses potential energy

## BIOLOGICAL PRINCIPLES STUDY GUIDE, Chapter 6

24 October 2003

### Metabolic Pathways

egs. cellular respiration, ATP synthesis

usually include regulation, eg. enzyme feedback inhibition, noncompetitive

ATP synthesis by

chemiosmotic phosphorylation

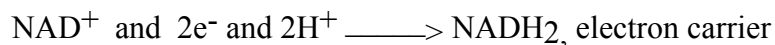
substrate-level phosphorylation

LEO

oxidation

GER

reduction



electron carriers, FAD and  $NAD^+$

electron transport chain is in a membrane

### Fermentation and Aerobic Respiration.

Review:

metabolic pathway

enzyme, only six different types of reactions speeded up by enzymes.

substrate (reactant)  
product  
competitive inhibition  
noncompetitive inhibition  
temperature and pH

nucleotide (ATP)

Define the following:

anaerobic

aerobic

cellular respiration

\* glucose

**glycolysis**

substrate-level phosphorylation

\* pyruvic acid

fermentation

\* ethanol

\* lactic acid

\* acetic acid (acetyl CoA)

\* = learn the structure of these molecules

**Krebs Cycle**

electron carriers      NAD & FAD

CO<sub>2</sub>

**Electron transport chain and chemiosmosis**

ATP synthase

O<sub>2</sub> and H<sub>2</sub>O

1. Pg. 107      MC Questions # 1 - 6.  
D., C. & E. # 1 - 3.  
Thinking as a Scientist # 3 and 4.
2. What are the 2 forms of energy that are particularly important to life?
3. What is the main purpose of cellular respiration?
4. In what organisms does aerobic respiration occur?
5. Where does glycolysis occur in a cell and what are the products of glycolysis?
6. What are the net results of the Krebs cycle?
7. Where does the electron transport chain occur in a cell and what are the net results of the electron transport chain?
8. What is O<sub>2</sub> used for in aerobic respiration?

9. About how many ATP molecules are produced from the oxidation of one molecule of glucose in aerobic respiration?
10. In what organisms does alcohol fermentation occur and about how many ATP molecules are produced from the oxidation of one molecule of glucose in this process?
11. In what organisms does lactic acid fermentation occur and about how many ATP molecules are produced from the oxidation of one molecule of glucose in this process?
12. Compare and contrast fermentation and aerobic respiration.

## BIOLOGICAL PRINCIPLES STUDY GUIDE

### Photosynthesis, Chapter 7

4 November 2003

autotroph

producers

heterotroph

photosynthesis (over all reaction)

leaf

mesophyll

stoma

chloroplast

chlorophyll

inner membrane

photon, electromagnetic energy

photosystems

electron transport chain

ATP synthase, chemiosmotic phosphorylation

photosynthesis

light reactions

chemiosmotic phosphorylation (photophosphorylation)

used: light, ADP, Pi, NADP & H<sub>2</sub>O produced: ATP, NADPH<sub>2</sub> & O<sub>2</sub>

Calvin cycle

used: ATP, NADPH & CO<sub>2</sub> produces: C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>, NADP, ADP, & P

greenhouse effect

1. Testing your Knowledge

Pg. 124 MC Questions # 1, 2, 4, 7.

Pg. 124 D., C. & E. # 1, 3 & 4. All very good things to think about.

2. Give an overall equation for photosynthesis and the equation for the two subpathways involved in the process.

3. Compare and contrast photosynthesis and aerobic cellular respiration.

5 November 2003

## The cellular basis of Reproduction and Inheritance, Chapter 8

Asexual reproduction

### Cell division in prokaryotes.

DNA replication

attachment to membrane

binary fission

*E. coli*, about 3000 genes

### Cell division in eukaryotes

somatic cells,  $60 \times 10^{12}$  per person

nucleus

mitosis, identical nuclei are produced, 1 error in 100,000 divisions

chromatin (DNA and protein)

chromatid

chromosomes

centromere

microtubules (spindle fibers)

humans, about 60,000 genes, (not 100,000) probably fewer

### cell cycle

Interphase

G<sub>1</sub>, S, G<sub>2</sub>

Mitoses

prophase, metaphase, anaphase, telophase

identical, DNA, about 2 meters in one cell, 46 chromosomes

cytokinesis

cancer

homologous chromosomes

somatic chromosomes, (autosomes, non sex chromosomes)

## **Sexual reproduction**

sperm and egg; one complete set of genetic material  
haploid, one copy of the genome

1n (haploid)

2n (diploid)

Meiosis

G1, S, G2, P1, M1, A1, T1, P2, M2, A2, T2 (egg, sperm)

tetrad

crossing-over

variation

genetic recombination and genetic diversity in the cells produced

## life Cycle

fertilization, Zygote (2n), mitosis, meiosis (1n)

gametes (egg, sperm)

1. pg 151 MC, 1-5, 8, 9 & 10      DCE, 1-3
2. What is the main purpose of mitosis?
3. Diagram and describe each phase of mitosis.
4. What is the main purpose of meiosis?
5. Diagram and describe each phase of meiosis.
6. Why is the first meiotic division called reduction division?
7. Compare and contrast mitosis and meiosis.
8. Why are variations in organisms important in evolution by natural selection?

## **Patterns of Inheritance, Chapter 9**

5 November 2003

### **Genetics Word List**

allele

diploid, 2n

dominant allele

carrier

codominance

fertilization

self-fertilize, cross-fertilize

gamete

gene

gene pool

genotype

haploid,  $1n$

heterozygous

hybrid

homozygous

haploid

incomplete dominance, *may not exist, similar to codominance*

Independent Assortment, Principle of

linked genes

locus (loci)

Mendel, Gregor, (1860s)

meiosis

mitosis

monohybrid cross

mutation

P generation, F1 and F2

Punnett square

phenotype

polygenic inheritance

ratio

recessive allele

Segregation, Principle of

sex chromosomes, X and Y

sex-linked ( X linked)

hemophilia

red-green color blindness

X chromosome

Y chromosome

trait

zygote

pg. 180 MC 1, 2, 4, 5 & 6. pg. 181 Additional Genetics Problems 2, 3, 4, 5 & 6.

**BIOLOGICAL PRINCIPLES**  
**Molecular Biology of the Gene, Chapter 10**

13 December 2003

Frederick Griffith, 1928

Bacteriophage, Hershey-Chase experiment. 1952

James Watson, Francis Crick, Rosalind Franklin, 1953

What is the function of DNA?

double helix

complementary base pairing

nucleotide

A, C, G, & T

3' OH

Explain how DNA replicates.

DNA polymerase. 50/sec.

DNA synthesized in pieces

DNA ligase

messenger RNA

RNA m, r, & t

codon

anticodon

What is the function of RNA?

RNA polymerase

transcription

RNA production

translation

protein synthesis

genetic code

start AUG

stop

redundancies in the gene code

gene mutations

point mutations

base substitution

base alteration

frameshift mutation, reading frame shift

base deletion

base addition

viruses, AIDS virus

reverse transcriptase

pg. 207 MC # 1, 2, 3 & 4. D.C. & E # 1 & 2.

If the nucleotide sequence in a strand of mRNA is

UUCGAUGGCGUCAUCCAGAGACAAAGGAUAA, what are the codons and what is the sequence of amino acids which would result from translation?

## Control of Genes, Chapter 11

expression of genes

operon

regulatory gene

repressor protein

promoter

RNA polymerase

operator

active repressor

inactive repressor

genes, (structural genes)

transcription

mRNA

translation

protein

the *lac* operon

cellular differentiation

inactive genes

RNA processing

RNA splicing

exon, expressed regions

intron, intervening sequences

post-translational control

cutting

protease

cancer

mutagens, carcinogens

pg. 228 MC # 1, 2 & 4.

D, C & E #2

Thinking like a Scientist, #1

## Technology and the Human Genome, Chapter 12

8 December 2003

DNA integration

Reverse transcriptase, complementary DNA, cDNA

recombinant DNA, transformation

plasmid

Probe,

Gel electrophoresis

restriction enzyme

Eco R1

recognition site

ligase

clone

PCR

genetically modified organisms

transgenic organisms

gene therapy

pg. 252 MC # 1-7.

**The end**

The following are other word lists which might be of some use

**Photosynthesis.**

Define the following:

autotroph

heterotroph

photosynthesis

chlorophyll

chloroplast

thylacoid membrane

chlorophyll a, chlorophyll b

carotene

photon

fluorescence

electron transport chain

ATP synthesis, chemiosmosis

photosynthesis

    light-dependent reactions

        Cyclic Photophosphorylation

    light-independent reaction (dark reactions)

        Calvin cycle

ATP

NADP

CO<sub>2</sub>

H<sub>2</sub>O

chemoautotrophs

1. Give an overall equation for photosynthesis and the equation for the two subpathways involved in the process.

2. Compare and contrast photosynthesis and aerobic cellular respiration.

**Photosynthesis, Fermentation and Aerobic Respiration.**

GH revised 20 October 1997.

**Part 2.**

BIOLOGICAL PRINCIPLES  
STUDY GUIDE 4

To accompany Brum et al.

GH revised  
4 November 1997

**Part 1. Cell division in prokaryotes.**

Define the following:

DNA replication  
attachment to membrane  
fission

**Part 2. Cell division in prokaryotes**

Define the following:

nucleus  
mitosis  
chromosomes  
chromatid (one molecule of DNA)  
centromere  
spindle fibers (microtubules)  
central  
phases  
prophase, metaphase, anaphase, telophase, interphase  
meiosis  
1N (haploid)  
2N (diploid)  
homologous chromosomes  
crossing-over  
gametes  
    spermatogenesis  
    oogenesis

2. What is the main purpose of mitosis?
3. Diagram and describe each phase of mitosis.
4. What is the main purpose of meiosis?
5. Diagram and describe each phase of meiosis.
6. Why is the first meiotic division called reduction division?
7. Compare and contrast mitosis and meiosis.
8. Why are variations in organisms important in evolution by natural selection?

BIOLOGICAL PRINCIPLES  
STUDY GUIDE 5

To accompany Brum et al.

GH revised  
11 November 1997

**Part 1. Genetics.**

allele  
diploid 2N  
dominant  
deletion  
carrier  
fertilization  
gamete  
gene  
gene pool  
genotype  
haploid 1N  
heterozygous  
homozygous  
haploid  
incomplete dominance  
inversion  
linkage group  
meiosis  
mitosis  
mutation  
phenotype  
ratio  
recessive  
sex-linked  
X chromosome  
Y chromosome  
trait  
translocation  
zygote

Review Questions pg. 262 # 1, 4 & 5.

**Part 2: DNA.**

double helix  
complementary base pairing  
nucleotide  
A, C, G, & T  
RNA, m, r, & t  
replication  
DNA polymerase  
James Watson

Francis Crick

Rosalind Franklin

What is the function of DNA?

Explain how DNA replicates.

messenger RNA

codon

anticodon

What is the function of RNA?

RNA polymerase

transcription

translation

protein synthesis

genetic code

start

stop

gene mutations

point mutations

base substitution

base alteration

frameshift mutation

base deletion

base addition

Review Questions. pg. 289 # 2, 3 & 5.

If the nucleotide sequence in a strand of mRNA is

TTCGAUGGCGUCAUCCAGAGACAAAGGAUAA, what are the codons and what is the sequence of amino which would result from translation.

### **Part 3: Regulation of Genes.**

operon

regulator gene

regulator protein

promoter

operator

structural gene

the lac operon

RNA processing

exon

intron

Review Questions. pg. 310 # 1.

March 1994

cofactors

proteins

chromatin

chromatid

cristae

cilia

vesicle

endosymbiosis hypothesis

a highly *avored* reaction

**and Movement** Describe three processes by which enzymes modify substrates

regulation of enzymes

competitive inhibition

noncompetitive inhibition

BIOLOGICAL PRINCIPLES  
STUDY GUIDE 3

To accompany Brum et al.