# ADVANCED BIOLOGY

Revised September 2010
D. Schiller

**ADVANCED BIOLOGY**

## I. Course Description

Advanced biology is a full year study designed primarily as a course for high school and college credit offered by Syracuse University. It is a body of systematized knowledge gained from observation, study and experimentation. By studying advanced biology you will be able to understand the nature of living organisms and the environment around you.

Students of advanced placement biology will study the eight major themes stressed throughout the course. The major themes are as stated:
I. Science as a process
II. Evolution
III. Energy transfer
IV Continuity and change
V. Relationship of Structure to Function
VI. Regulation
VII. Independence in Nature
VIII Science, Technology and Society.

Students will be able to develop career and technical awareness and planning skills.
SDS 9.3
Students will be able to develop critical thinking skills in solving scientific problems.
SDS 9.1.12.A.1,(9.4.120(2).3),(9.4.120(2).2)
Students will be able to develop interpersonal skills by working cooperatively with other students in a classroom and laboratory setting.
SDS 9.1.12.C.4) (9.1.12.C.5),(9.1.12B.3),(9.4.120.7)

## II. Course Objectives/Outline

### A. Molecules and Cells Time 2 weeks Unit 1

Readings and supplemental lecture notes: Solomon, Berg & Martin

The student will be able to: SD5.2.12.A.1,SD 5.212.A.4
1. Define element and compound
2. State four elements essential to life that make up 96% of living matter
3. Describe the structure of an atom
4. Define and Distinguish among atomic number, mass number, atomic weight and valence
5. Given the atomic number and mass number of an atom, determine the number of neutrons.
6. Explain why radioisotopes are important to biologists.
7. Explain how electron configuration influences the chemical behavior of an atom.
8. Explain the octet rule and predict how many bonds an atom might form
9. Explain why the noble gasses are so unreactive.
10. Define electronegativity and explain how it influences the formation of chemical bonds.
11. Distinguish among nonpolar covalent, polar covalent, and ionic bonds.

12. Describe the formation of a hydrogen bond and explain how it differs from a covalent or ionic bonds.
13. Describe how the relative concentrations of reactants and products affect a chemical reaction.
14. Describe the chemical conditions of the early Earth and explain how they are different from today.

**B. Water and the Environment**

The student will be able to. SD5.31.
1. Describe how water contributes to the fitness of the environment to support life.
2. Describe the structure and geometry of a water molecule, and explain what properties emerge as a result of this structure.
3. Explain the relationship between the polar nature of water and its ability to form hydrogen bonds.
4. List five characteristics of water that are emergent properties resulting from hydrogen bonding.
5. Describe the biological significance of the cohesiveness of water.
6. Distinguish between heat and temperature.
7. Explain how water's high specific heat, high heat of vaporization and expansion upon freezing affect both aquatic and terrestrial ecosystems.
8. Explain how the polarity of the water molecule makes it a versatile solvent.
9. Define molarity and list some advantages of measuring substances in moles.
10.Write the equation for the dissociation, and explain what is actually transferred from one molecule to another.
11.Explain the basis for the pH scale.
12.Describe the causes of acid precipitation, and explain how it adversely affects the fitness of the environment.

**C. Carbon Molecules**

The student will be able to: SD5.2.12.B.2
1. Explain how carbon's electron configuration determines the kinds and number of bonds carbon will form.
2. Describe how carbon skeletons may vary, and explain how this variation contributes to the diversity and complexity of organic molecules.
3. Distinguish among the three types of isomers: structural, geometric and enantiomers.
4. Recognize the major functional groups, and describe the chemical properties of organic molecules in which they occur.

**D. Structure and Function of Macromolecules**

The student will be able to: SD5.3.12.A.1
1. Explain how organic polymers contribute to biological diversity.
2. Describe how covalent linkages are formed and broken in organic polymers
3. Describe the distinguishing characteristics of carbohydrates, and explain how they are classified.

4. List four characteristics of a sugar.
5. Identify a glycosidic linkage and describe how it is formed.
6. Describe the biological functions of polysaccharides.
7. Distinguish between the glycosidic linkages found in starch and cellulose, and explain why the difference is biologically important.
8. Explain what distinguishes lipids from other major classes of macromolecules.
9. Describe unique properties, building block molecules and biological importance of the three important groups of lipids: fats, phospholipids and steroids.
10. Distinguish between a saturated fat and unsaturated fat, and list some unique properties that are a consequence of these structural differences.
11. Describe the characteristics that distinguish proteins from other major classes of macromolecules, and explain biologically important functions if this group.
12. List and recognize four major components of an amino acid, and explain how amino acids may be grouped according to the physical and chemical properties of their side chains.
13. Identify a peptide bond and explain how it is formed.
14. Explain what determines protein conformation and why it is important.
15. Define primary structure and describe how it may be deduced in the laboratory.
16. Describe the two types of secondary protein structure, and explain the role of hydrogen bonds in maintaining the structure.
17. Explain how weak interactions and disulfide bridges contribute to tertiary protein structure.
18. Using collagen and hemoglobin as examples, describe quaternary protein structure.
19. Define denaturation and explain how proteins may be denatured.
20. Describe the characteristics that distinguish nucleic acids from other groups of macromolecules.
21. List the major components of a nucleotide, and describe how these monomers are linked together to form a nucleic acid.
22. Distinguish between a pyrimidine and a purine.
23. Briefly describe the three-dimensional structure of DNA.

**E. Cell Structure and Function**
---Readings and Lecture topics (Time frame 2 weeks)

The student will be able to: SD5.3.12.A.6
1. Describe techniques used to study cell structure and function
2. Distinguish between magnification and resolving power.
3. Describe the principles, advantages, and limitations of different types of microscopy.
4. Describe the major steps of cell fraction and explain why it is a useful technique.
5. Distinguish between prokaryotic and eukaryotic cells.
6. Explain why there there are both upper and lower limits to cell size.
7. Explain why compartmentalization is important in eukaryotic cells.
8. Describe the structure and function of the nucleus. Explain the relation of the nucleus in protein synthesis.
9. Describe the structure and function of a eukaryotic ribosome.
10. List the components of the endomembrane system, describe structures and functions.
11. Summarize their relationships.
12. Explain how lysosomal function causes symptoms of storage diseases.

13. Describe the types of vacuoles and how their functions differ
14. Explain the role of peroxisomes in eukaryotic cells.
15. Describe the structure and function of the mitochondrion in eukaryotes.
16. Distinguish among amyloplast, chromoplast, and chloroplast.
17. Identify the three functional compartments of a chloroplast and explain structure and function.
18. Describe the probable functions of the cytoskeleton.
19. Describe the structure, monomers, and functions of microtubules, microfilaments, and intermediate filaments.
20. Explain how the ultrastructure of cilia and flagella relates to their function.
21. Describe the development of cell walls.
22. Describe the structure and list some functions of the extracellular matrix in animal cells.
23. Describe the structure and function of intercellular junctions found in plant and animal cells.

**F. Cell Membrane Structure and Function**

SD 5.312.A.3, SD5.3.12.A.6
The student will be able to:
1. Describe the function of the plasma membrane.
2. Explain how scientists used early experimental evidence to make deductions about membrane structure and function.
3. Describe the Davson-Danielli membrane model. Explain how it relates to modern membrane structure and function.
4. Describe the contributions of Robertson, Singer, and Nicholson made to clarify membrane structure.
5. Describe the fluid properties of the cell membrane and explain how membrane fluidity is influenced by membrane composition.
6. Explain how hydrophobic interactions determines membrane structure and function.
7. Describe how proteins are arranged in the cell membrane and how they contribute to membrane function.
8. Describe factors that affect selective permeability of membranes.
9. Define diffusion; explain what causes it and why it is a spontaneous process
10. Explain what regulates the process of passive transport.
11. Explain why a concentration gradient across a membrane represents potential energy.
12. Define osmosis and predict the direction of water movement based on differences in solute concentration.
13. Explain how bound water affects the osmotic behavior of dilute biological fluids.
14. Describe how living cells with and without cell walls regulate water balance.
15. Explain how transport proteins are similar to enzymes.
16. Describe one model for facilitated diffusion.
17. Explain how active transport differs from diffusion
18. Explain what mechanisms can generate a membrane potential or electrochemical gradient.
19. Explain how potential energy generated by transmembrane solute gradients can be harvested by the cell and used for transport.
20. Explain how large molecules are transported across a cell membrane.
21. Give an example of receptor-mediated endocytosis.

22. Describe a simple signal-transduction pathway across a membrane including the roles of first and second messengers.

Evolution and Diversity of Life (2 weeks)
Readings from Text Chapters 22-25 Solomon and Berg, Martin

Lecture topics and objectives:
Historical background—Darwin's theory and discoveries
Evidence for Evolution
Modern synthesis, population genetics, Hardy-Weinberg law of genetic equilibrium
Natural Selection, microevolution events, types of selection, preservation of variation
Speciation, prezygotic and postzygotic mechanisms, allopatric and sympatric speciation.
Gradualism/punctuated equilibrium
Fossil record, extinctions, dating of fossils

Unit test on evolution
LAB AP 8 population genetics

Unit 3 Ecology Time frame 2 weeks
Readings from Solomon & Berg chapters
Readings, outline notes and lectures.

Topics:
Biomes: aquatic and terrestrial biomes and the factors that influence them.
Community ecology, ecological succession, soil and the role in succession.
Ecosystem ecology, trophic structure, and productivity
Population ecology—organisms and populations.

Independent research project:
Student use of internet resources to give descriptions of their assigned biomes.
Latitude, temperatures, rainfall, flora and fauna of biomes.

Effects of introduction of a non-native species to an environment.

**G. Metabolism – Photosynthesis**
-Time frame- 2 weeks

The student will be able to: SD5.3.12.B.4
1. Distinguish between autotrophic and heterotrophic nutrition.
2. Distinguish between photosynthetic autotrophs and chemosynthetic autotrophs.
3. Describe the location and structure of the chloroplast.
4. Explain how chloroplast structure relates to its function.
5. Write a summary equation for photosynthesis.
6. Explain van Niel's hypothesis and describe how it contributed to our current understanding of photosynthesis.
7. Explain the role of redox reactions in photosynthesis.

8. Describe the wavelike and particle like behaviors of light.
9. Describe the relationship between an action spectrum and an absorption spectrum for photosynthesis.
10. List the wavelengths of light that are most effective for photosynthesis.
11. Explain what happens when chlorophyll or accessory pigments absorb photons.
12. List the components of a photosystem and explain their function.
13. Trace electron flow through photosystems II and I.
14. Compare cyclic and noncyclic electron flow and explain the relationship in the light reactions.
15. Summarize the light reactions with an equation and describe where they occur.
16. Describe the important differences in chemiosmosis between oxidative phosphorylation in the mitochondria and photophosphorylation in chloroplasts.
17. Summarize the carbon-fixing reactions of the Calvin cycle and describe changes that occur in the carbon skeletons.
18. Describe the role of ATP and NADPH in the Calvin cycle.
19. Describe what happens to rubisco when the $O_2$ concentration is much higher than $CO_2$
20. Describe the major consequences of photorespiration.
21. Describe two important photosynthetic adaptations that minimize photorespiration.
22. Describe the fate of photosynthetic products.

## H. **Metabolism-Cellular Respiration**

The student will be able to: S5.3.12..B.5, SD5.3.12.B.6
1. Describe the overall summary equation for cellular respiration
2. Distinguish between substrate-level phosphorylation and oxidative phosphorylation.
3. Explain how exergonic oxidation of glucose is coupled to endergonic synthesis of ATP.
4. Define oxidation and reduction.
5. Explain how redox reactions are involved in energy changes.
6. Define coenzyme and list those involved in respiration.
7. Describe the structure of coenzymes and explain their function in redox reactions.
8. Describe the role of ATP in coupled reactions.
9. Explain why ATP is required for the preparatory steps of glycolysis.
10. Describe the changes in the carbon skeleton of glucose during glycolysis.
11. Identify where in glycolysis that sugar oxidation, substrate-level phosphorylation and reduction of coenzymes occur.
12. Write a summary equation for glycolysis and describe where it occurs in the cell.
13. Describe where pyruvate is oxidized to acetyl CoA, what molecules are produced and how it links glycolysis to the Krebs cycle.
14. Describe the location, molecules in and molecules out for the Citric Acid cycle.
15. Explain at what point during cellular respiration glucose is completely oxidized.
16. Describe the process and mechanism of chemiosmosis.
17. Explain how membrane structure is related to membrane function in chemiosmosis.
18. Summarize the net ATP yield from the oxidation of glucose during cellular respiration.
19. Describe the fate of pyruvate in the absence of oxygen.
20. Explain why fermentation is necessary.

21. Distinguish between aerobic and anaerobic metabolism.
22. Describe how food molecules other than glucose can be oxidized to make ATP.
23. Describe the evidence that the first prokaryotes produced ATP by glycolysis.
24. Explain how ATP production is controlled in the cell and the role of allosteric enzymes.

**I. A-Cell Reproduction Mitosis**

The student will be able to: SD5.3.12.A.4
1. Define genome and state what major events occur during cell division.
2. Describe the process of binary fission in prokaryotes.
3. Describe the composition of chromosomes and explain structure and function during cell division.
4. Describe how chromosome number changes throughout the human life cycle.
5. List the phases of the cell cycle and describe the sequence of events that occurs during each phase.
6. Describe the major events that occur during the cell cycle.
7. Distinguish between interphase and mitosis proper.
8. List the phases of mitosis and describe the events characteristic of each phase.
9. Recognize the phases of mitosis from diagrams or micrographs.
10. Draw or describe the spindle apparatus including related structures.
11. Describe what characteristic changes occur in the spindle apparatus during each phase of mitosis.
12. Explain the current models for pole ward chromosomal movement and elongation of the cell's polar axis.
13. Compare cytokinesis in animals and plants.
14. List several growth factors which stimulate or inhibit cell growth.
15. Describe what point in the cell cycle determines whether a cell divides and explain the role of volume-to-genome ratio.
16. Explain how abnormal cell division of cancerous cells differs from normal cell division.

**I. B- Cell Production Meiosis**

The student will be able to:SS.12.A.4
1. Explain why organisms only reproduce their own kind, and why offspring more closely resemble their parents than unrelated individuals of the same species.
2. Explain what makes heredity possible.
3. Distinguish between asexual and sexual reproduction.
4. Diagram the human life cycle and indicate where in the human body that mitosis and meiosis occur. Describe the difference between diploid and haploid cells.
5. Distinguish among the life cycle patterns of animals, fungi, and plants.
6. Distinguish sporophyte from gametophyte and explain how plant life cycles differ from those of animals and fungi.
7. List the phases of meiosis I and meiosis II and describe the events characteristic of each phase.
8. Recognize the phases of meiosis from diagrams or micrographs.
9. Describe the process of synapsis during prophase I and explain how genetic recombination occurs.

10. Describe key differences between mitosis and meiosis; explain how their end results differ.
11. Explain how independent assortment, crossing over, and random fertilization contribute to genetic variation.

**J. DNA Structure and Replication**

The student will be able to: SD5.3.12.D.1
1. Explain why researchers originally thought protein was the genetic material.
2. Summarize the experiments by scientists which provide evidence that DNA is the genetic material: Fred Griffith, Alfred Hershey and Martha Chase, Erwin Chargaff.
3. List the three components of a nucleotide.
4. Distinguish between deoxyribose and ribose.
5. List the nitrogen bases found in DNA. And distinguish between pyrimidine and purine.
6. Explain how Watson and Crick deduced the structure of DNA, and describe evidence that they used.
7. Explain the base pairing rule and describe its significance.
8. Describe the structure of DNA and explain the chemical bonds that connect the nucleotides of each strand and the chemical bond that holds the strands together.
9. Explain, in your own words, semiconservative replication, and describe the Meselson-Stahl experiment.
10. Describe the process of DNA replication, and explain the role of replication enzymes.
11. Explain what energy source drives endergonic synthesis of DNA.
12. Define antiparallel, and explain why continuous synthesis of both DNA strands is not possible.
13. Distinguish between the leading and lagging strand.
14. Explain how the lagging strand is synthesized when DNA polymerase can add nucleotides only to the 3' end.
15. Explain the role of DNA polymerase, ligase, and repair enzymes in DNA proofreading and repair.

**K. Protein synthesis—gene to protein**
The student will be able to: SD5.3.12.D.1

1. Give early experimental evidence that implicated proteins as the link between genotype and phenotype.
2. Describe the significance of Beadle and Tatum's experiments with Neurospora and the relation to gene control
3. Distinguish between "one gene—one enzyme" hypothesis and "one gene-one polypeptide," and explain why the original hypothesis was changed.
4. Explain how RNA differs from DNA.
5. Explain briefly how information flows from gene to protein.
6. Distinguish between transcription and translation.
7. Describe where transcription and translation occur in prokaryotes and in eukaryotes; explain why it is significant that in eukaryotes, transcription and translation are separated.
8. Define codon, and explain what relationship exists between the linear sequence of codons on mRNA and the sequences of amino acids in a polypeptide.

9. List the three stop codons and the one start codon.
10. Explain the evolutionary significance of a universal genetic code.
11. Explain why the genetic code is redundant and unambiguous.
12. Explain the process of transcription including the three major steps of initiation, elongation, and termination.
13. Describe the general role of RNA polymerase in transcription.
14. Distinguish among mRNA, tRNA, and rRNA.
15. Describe the structure of tRNA and explain how the structure is related to function.
16. Given a sequence of bases, predict the corresponding codons transcribed on mRNA and the corresponding anticodons of tRNA.
17. Describe the wobble effect.
18.Explain how an amino-acyl-tRNA synthetase matches a specific amino acid to its appropriate tRNA.
19. Describe the structure of a ribosome, and explain how its structure relates to function.

**L. A Genetics**
Time frame 3 weeks:

The student will be able to: SD5.3.12.D
1. Explain how Mendel's hypothesis of inheritance differed from the blending theory of inheritance.
2. List several features of Mendel's methods that contributed to his success.
3. Describe Mendel's Law of segregation.
4. Use a Punnett square to predict results of a monohybrid cross and state the phenotypic and genotypic ratios of the F2 generation.
5. Distinguish between genotype and phenotype; heterozygous and homozygous; dominant and recessive.
6. Explain how a testcross can be used to determine if a dominant phenotype is homozygous or heterozygous.
7. Define random event, and explain why it is significant that allele segregation during meiosis and fusion of gametes at fertilization are random events.
8. Use the multiplication rules of probability to calculate F2 individual phenotypes and genotypes.
9. Given a Mendelian cross, use the rule of addition to calculate the probability that a F2 individual will be heterozygous.
10. State and describe Mendel's Law of independent assortment.
11. Use a punnet square to predict the results of a Dihybrid cross and state the phenotype and genotype ratios of the F2 generation.
12. Using the Laws of probability, predict the results of a trihybrid cross between two individuals that are heterozygous for all three traits, what the expected outcomes would be.
13. Give an example of incomplete dominance and explain why it is not evidence for the blending theory of inheritance.
14. Explain how the phenotypic expression of the heterozygote is affected by complete dominance, incomplete dominance, and codominance.
15. Describe the inheritance of the ABO blood system and why the alleles AB are said to be codominant.

16. Define and give examples of pleiotropy.
17. Explain epistasis and how it affects the phenotype ratio for a Dihybrid cross.
18. Describe a simple model for polygenic inheritance, and explain why most polygenic characters are described in quantitative terms.
19. Describe how environmental conditions can influence the phenotypic expression of a character.
20. Given a simple family pedigree, deduce the genotypes for some of the family members.
21. Describe the inheritance of cystic fibrosis, Tay-Sachs disease, and sickle- cell disease.
22. Explain how a lethal recessive gene can be maintained in the population.
23. Explain why consanguinity increases the probability of homozygosity in offspring.
24. Explain why lethal dominant are much more rare than lethal recessive genes.
25. Give an example of a late acting lethal dominant in humans and explain how it can escape elimination.
26. Explain how carrier recognition, fetal testing and newborn screening can be used in genetic screening.

**L. B---Chromosomal Genetics**

The student will be able to: SD5.3.12..D.1
1. Explain how the observations of scientists provided the basis for the chromosomal theory of inheritance.
2. Describe the contributions that Morgan, Sutton, and Sturtevant made to the understanding of chromosomal inheritance.
3. Explain why Drosophila melanogaster is a good experimental organism.
4. Define linkage and explain why linkage interferes with independent assortment.
5. Distinguish between parental and recombinant phenotypes.
6. Explain how crossing over can unlink genes.
7. Map a linear sequence of genes on a chromosome using given recombination frequencies from experimental crosses.
8. Explain what information cytological maps provide over crossover maps.
9. Distinguish between a heterogametic sex and a homogametic sex.
10. Describe sex determination in humans.
11. Describe the inheritance of a sex-linked gene such as color-blindness.
12. Describe why a recessive-sex –linked gene is always expressed in human males.
13. Explain how an organism compensates for the fact that some individuals have a double dosage of sex-linked genes while others have only one.
14. Distinguish among, nondisjunction, aneuploidy, and polyploidy; explain how these major chromosomal changes occur and describe the consequences.
15. Distinguish between trisomy and triploidy.
16. Distinguish among deletions, duplications, translocations, and inversions.
17. Describe the effects of alterations in chromosome structure, and explain the role of position effects in altering the phenotype.
18. Describe the type of chromosomal alterations implicated in chromosomal disorders caused by nondisjunction. Provide examples of autosomal and sex chromosome disorders.
19 .Define genomic imprinting and provide evidence to support this model.
20. Explain how complex expression of a human genetic disorder, such as Fragile-X syndrome,

can be influenced by triplet repeats and genomic imprinting.
21. Give some exceptions to the chromosome theory of inheritance, and explain why cytoplasmic genes are not inherited in a Mendelian fashion.

**L. C---Genetic Engineering DNA Technology**
Time frame 1 week

The student will be able to: SD5.3.12.D.3
1. Explain how advances in recombinant DNA technology have helped scientists study the eukaryotic genome.
2. Describe the natural function of restriction enzymes.
3. Describe how restriction enzymes and gel electrophoresis are used the isolate DNA fragments.
4. Explain how the creation of sticky ends by restriction enzymes is useful in producing a recombinant DNA molecule.
5. Outline the procedures for producing plasmid and phage vectors.
6. List how vectors are used in recombinant DNA technology.
7. List and describe the two major sources of genes for cloning.
8. Describe the function of reverse transcriptase in retroviruses and explain how they are useful in recombinant DNA technology.
9. Describe how genes of interest can be identified with a probe.
10. Explain the importance of DNA synthesis and sequencing to modern studies of eukaryotic genomes.
11. Describe how bacteria can be induced to produce eukaryotic gene products.
12. List some advantages for using yeast in the production of gene products.
13. List and describe four complementary approaches used to map the human genome.
14. Explain how RFLP analysis and PCR can be applied to the Human Genome Project.
15. Describe how recombinant DNA technology can have medical applications such as diagnosis of genetic disease, development of gene therapy, vaccine productions, and development of pharmaceutical products.
16. Describe how gene manipulation has practical applications for agriculture.
17. Describe how plant genes can be manipulated using plasmids and vectors.
18. Explain how foreign DNA may be transferred into monocot plants.

**L. D-Gene Expression – Eukaryotic Genomes**

The student will be able to: SD5.3.12.D.3
1. Compare the organization of prokaryotic and eukaryotic genomes.
2. Describe the current model for progressive levels of DNA packing.
3. Explain how histones influence folding in eukaryotic DNA.
4. Distinguish between heterochromatin and euchromatin.
5. Using the Barr Body as an example, describe the function of heterochromatin in interphase cells.
6. Describe where satellite DNA is found and what role it may play in the cell.
7. Describe the role of telomeres in solving the end-replication problem with the lagging DNA strand.
8. Using the genes for rRNA as an example, explain how multigene families of indentical genes

can be advantageous for a cell.
9. Using alpha-globin and beta-globin genes as examples, describe how multigene families of nonidentical genes probably evolve, including the role of transposition.
10. Explain the potential role of promoters and enhancers play in transcriptional control.
11. Explain why the nuclear envelope in eukaryotes offers a level of post-transcriptional control beyond that found in prokaryotes.
12. Explain why the ability to rapidly degrade mRNA can be an adaptive advantage for prokaryotes.
13. Describe the importance of mRNA degradation in eukaryotes, describe how it can be prevented.
14. Explain how gene expression may be controlled at the translational and post-translational level.
15. Compare the arrangement or coordinately controlled genes in prokaryotes and eukaryotes.
16. Explain how eukaryotic genes can be coordinately expressed and give some examples of coordinate gene expression in eukaryotes.
17. Provide evidence from studies of polygene chromosomes, that eukaryotic gene expression is controlled at transcription and that gene regulation responds to chemical signals such as steroid hormones.
18. Describe the key steps of steroid hormone action on gene expression in vertebrates.
19. In general terms, explain how genome plasticity can influence gene expression.
20. Describe the effects of gene amplification, selective gene loss and DNA methylation.
21. Explain how rearrangements in the genome can activate or inactivate genes.
22. Explain the genetic basis for antibody diversity.
23. Describe the normal control mechanisms that limit cell growth and division
24. Briefly describe the four mechanisms that can convert proto-oncogenes to oncogenes.
25. Explain how changes in tumor-suppressor genes can be involved in transforming normal cells into cancerous cells.
26. Explain how oncogenes are involved in virus-induced cancers.

**M. Viruses: SS5.3.12.A.2**

The student will be able to:
1. Recount the history leading to the discovery of viruses and discuss the contributions of scientists.
2. List and describe structural components of viruses.
3. Explain why viruses are obligate parasites.
4. Describe three patterns of viral genome replication.
5. Explain the role of reverse transcriptase in retroviruses.
6. Describe how viruses recognize host cells.
7. Distinguish between lytic and lysogenic cycles using phages.
8. Outline the procedure for measuring phage concentration in a liquid medium.
9. Describe several defenses bacteria have against phage infection.
10. Using viruses with envelopes and RNA viruses as examples, describe variations in replication cycles of animal viruses.
11. Explain how viruses may cause disease symptoms and describe medical weapons to fight viral infections.

12. List some viruses that have been implicated in cancers, and explain how tumor viruses transform cell.
13. Distinguish between horizontal and vertical routes of viral transmission in plants.
14. List some characteristics that viruses share with living organisms, and explain why viruses do not fit our usual definition of life.
15. Provide evidence that viruses probably evolved from fragments of nucleic acid.

**N. Bacteria SS5.3.12.A.1**

The student will be able to:
1. Describe the structure of a bacterial chromosome.
2. Describe the process of binary fission in bacteria and replication of the chromosome.
3. List and describe three natural processes of genetic recombination in bacteria.
4. Distinguish between generalized transduction and specialized transduction.
5. Explain how the F plasmid controls conjugation in bacteria.
6. Explain how bacterial conjugation differs from sexual reproduction.
7. Predict the consequences of conjugation between F plasmid cells.
8. Define transposon, and describe two nucleotide sequences found in transposon DNA.
9. Distinguish between an insertion sequence and a complex transposon.
10. Describe the role of transposase and DNA polymerase in the process of transposition.
11. Explain how transposons can generate genetic diversity.
12. Briefly describe two main strategies cells use to control metabolism.
13. Explain why grouping genes into to an operon can be advantageous.
14. Describe the lac and tryp operon in prokaryotes.
15. Describe how E. coli uses the negative and positive controls of the lac operon to economize on RNA and protein synthesis.
16. List unique characteristics that distinguish archaea from bacteria
17. Describe the three domain system of classification.
18. Using a diagram or micrograph, distinguish among the three common shapes of prokaryotes.
19. Describe the structure and function of the prokaryotic cell walls.
20. Distinguish between the staining properties of gram-positive and gram-negative cell walls.
21. Explain why disease causing gram-negative bacterial species are generally more pathogenic than disease-causing gram-positive bacteria.
22. Describe three mechanisms motile bacteria use to move.
23. Explain how prokaryotic flagella work and the difference between eukaryotic flagella.
24. Explain how the prokaryotic genome differs from that in eukaryotic cells.
25. List the sources of genetic variation in prokaryotes.
26. Distinguish between autotrophs and heterotrophs
27. Distinguish among obligate anaerobes, obligate aerobes, and facultative anaerobes-give examples of each.
28. Explain how molecular systematics has been used in developing a classification of prokaryotes.
29. List the three main groups of Archaea, describe distinguishing features among the groups and give examples of each.
30. List the major groups of bacteria, describe their mode of nutrition, some characteristic features and examples.

31. Explain how endospores are formed and why endospore forming bacteria are important.
32. Explain how the presence of E. coli in the water supplies can be used as an indicator of water quality.
33. State which organism is responsible for the most common STD in the United States
34. Explain why all life on Earth depends upon the metabolic diversity of prokaryotes.
35. Distinguish among mutualism, commensalism and parasitism.
36. List Koch's posulates that are used to identify pathogens.
37. Distinguish between exotoxins and endotoxins.

**O. Protista: SS5.3.12.A.1**

The student will be able to:
1. List the characteristics of protests
2. Explain the major models of Eukaryotic origins.
3. Provide three major lines of evidence for the endosymbiotic hypothesis.
4. Explain why Kingdom Protista is a polyphyletic group
5. List five candidate Kingdoms of protests and describe a major feature of each.
6. Describe amoeboid movement
7. Outline the life cycle of Plasmodium
8. Describe the function of contractile vacuoles in ciliates.
9. Distinguish between macronuclei and micronuclei.
10.Using diagrams describe conjugation in Paramecium caudatum
11.Distinguish the algal groups based upon pigments, cell wall components storage products, number and position of flagella. and habitat.
12. Describe three possible evolutionary trends that led to multicellularity in the Chlorophyta.
13. Outline the life cycles of algae.
14. Distinguish between isogamy and oogamy; sporophyte and gametophyte isomorphic and heteromorphic generations.
15. Compare the life cycles of plamodial and cellular slime molds and describe their major differences.
16. Explain the most widely accepted hypothesis for the evolution of multi-cellularity.

**P. Fungi SS5.3.12.A.1**

**Students will be able to:**
1. List the characteristics that distinguish fungi from organisms in other kingdoms.
2. Explain how fungi acquire their nutrients.
3. Explain how non-motile fungi seek new food sources and how they disperse.
4. Describe the basic body plan of a fungus.
5. Distinguish between septate and aseptate(coenocytic) fungi.
6. Describe some advantages to the dikaryotic state.
7. Distinguish among fungi and list some common examples of each.
8. Describe asexual and sexual reproduction in Zygomycota, Ascomycota, and Basidiomycota, and the sexual structure that characterizes each.
9. Explain the difference between conidia and endospores.
10. Explain why ascomycetes can be useful to geneticists studying genetic recombination.

11. Explain why the Deuteromycota are called imperfect fungi
12. Describe the anatomy of lichens and explain how they reproduce.
13. Provide evidence for both sides of the debate on whether symbiosis in lichens is parasitic or mutualistic.
14. Describe the ecological importance of lichens.
15. Explain why fungi are ecologically and commercially important.
16. Describe the mutualistic relationship in mycorrhize and its importance in ecosystems.

**Q---A---Plant Structure and Nutrition**
SS5.3.12.A.6 Time Frame 2 weeks

The student will be able to:
1. List the characteristics of an angiosperm.
2. Explain the differences between monocots and dicots.
3. Describe the importance of root systems and shoot systems to plants and explain how they work together.
4. Explain how taproot systems and fibrous root systems differ.
5. Explain the differences between stolons and rhizomes.
6. Describe how plant cells grow.
7. Distinguish between parenchyma and collenchyma cells with regards to structure and function.
8. Describe the differences in structure and function of the two types of sclerenchyma cells.
9. Explain the importance of tracheids and vessel elements in plants.
10. Distinguish between water- conducting cells and sieve-tube members with regards to structure and function.
11. Explain the differences between simple tissues and complex tissues.
12. Explain the importance of a cuticle on the aerial parts of a plant and its absence on roots.
13. Describe the functions of the dermal tissue system, vascular tissue system and ground tissue system.
14. Distinguish among annual, biennial, perennial plants.
15. Explain the importance of zones of cell division, cell elongation, and cell differentiation in primary growth of roots.
16. Explain the importance of the endodermis to a plant.
17. Describe the importance of an apical meristem to the primary growth of shoots.
18. Distinguish between the arrangement of vascular tissues in roots and shoots.
19. Describe how wood forms due to secondary growth of stems.
20. Using a diagram, describe the basic structure of a root, a stem, and a leaf.

**Q---B---Plant Nutrition**
SS.5.3.12.A.6

The student will be able to.
1. Describe the chemical composition of plants including: percent of wet weight as water, percent of dry weight as organic substances, and percent of dry weight as inorganic minerals.
2. Explain which minerals are essential nutrients.
3. Distinguish between macronutrient and micronutrient.
4. Recall nine macronutrients required by plants and describe their importance in normal plant

structure and metabolism.
5. List seven micronutrients required by plants and explain why plants only need minute quantities of these elements.
6. Explain how a nutrient's role and mobility determine the symptoms of a mineral deficiency.
7. Explain how soil is formed.
8. Explain what determines the texture of topsoil and list the type of soil particles from the coarsest to smallest.
9. Describe the composition of loams and explain why they are the most fertile soil.
10. Explain how humus contributes to the texture and composition of soil
11. Explain why plants cannot extract all the water of soil.
12. Explain how the presence of clay in soil helps prevent leaching of minerals.
13. Define cation exchange, explain why it is necessary for plant nutrition, and describe how plants can stimulate the process.
14. Explain why soil management is necessary in agricultural systems but not in natural ecosystems such as forests and grasslands.
15. List the three mineral elements that are most commonly deficient in soils.
16. Describe the environmental consequence of overusing fertilizers.
17. Explain how soil pH determines the effectiveness of fertilizers and a plant's ability to absorb specific mineral nutrients.
18. Describe the problems resulting from farm irrigation in arid regions and list several current approaches to solving these problems.
19. Describe precautions that can reduce wind and soil erosion
20. Define nitrogen fixation and write the overall equation representing the conversion of gaseous nitrogen to ammonia.
21. Distinguish between nitrogen-fixing bacteria and nitrifying bacteria.
22. Recall the forms of nitrogen that plants can absorb and describe how they are used by plants.
23. Beginning with free-living rhizobial bacteria, describe the development of a root nodule.
24. Explain why the symbiosis between a legume and its nitrogen-fixing bacteria is considered to be mutualistic.
25. Recall two functions of leghemoglobin.
26. Describe the basis of crop rotation.
27. Describe the relationships between root nodule formation and mycorrhizae development.
28. Describe modifications for nutrition that have evolved among plants including parasitic plants, carnivorous plants, and mycorrhizae.

**Q. C—Transport in Plants**

The student will be able to: SD5.312.A.3

1. List three levels in which transport in plants occurs and describe the role of aquaporins.
2. Trace the path of water and minerals from outside the root to the shoot system.
3. Provide experimental evidence that links plant cellular respiration to mineral accumulation.
4. Explain how a proton pump may affect mineral transport in plants.
5. Explain the function of the Casparian strip.
6. Explain how solutes are transferred between thesymplast and the apoplast.
7. Define water potential.

8. Explain how solute concentration and pressure affects water potential.
9. Predict the direction of net water movement based upon differences in water potential between a plant cell and a hypoosmotic environment, a hyperosmotic environment or an isoosmotic environment.
10. Explain how root pressure is created by some plants and how it causes guttation.
11. According to the transpiration-cohesion-adhesion theory, describe how xylem sap can be pulled away upward in xylem vessels.
12. Explain why a water potential gradient is required for the passive flow of water through a plant from soil.
13. Compare the transpiration-to-photosynthesis ratio between C3 and C4 plants.
14. Describe the benefits and disadvantages of transpiration.
15. Explain how guard cells control the stomatal aperture and how this, in turn, can affect photosynthetic rate and transpiration.
16. Explain how K+ fluxes across the guard cell membrane affects guard cell function.
17. List three cues that contribute to stomatal opening at dawn.
18. Describe environmental stresses that can cause stomatal opening at dawn.
19. Describe environmental stresses that can cause stomata to close during the daytime.
20. Explain how xerophytes can be adapted to arid climates.
21. Explain how crassulacean acid metabolism allows CAM plants to reduce the transpiration rate.
22. Describe the source-to-sink transport in phloem and explain what determines the direction of phloem sap flow.
23. Compare the process of phloem loading between plants.
24. Give one explanation for how a proton pump can allow for selective accumulation of sucrose in the symplast.
25. Explain what causes phloem sap to flow from source to sink and describe how a scientist can study pressure- flow in phloem.

**Q. D- Plant Development and Hormones**

The student will be able to: SD5.3.12.A.2
1. List 5 classes of plant hormones, describe their major function, and recall where they are produced in the plant.
2. Explain how a hormone may cause its effect on plant growth and development.
3. Describe a possible mechanism for polar transport of auxin.
4. According to the acid- growth hypothesis, explain how much auxin can initiate cell elongation.
5. Explain why 2,4-D is widely used as a weed killer.
6. Explain how the ration of cytokinin to auxin affects cell division and cell differentiation.
7. Define apical dominance and describe the check-and-balance control of lateral branching by auxins and cytokinins.
8. List several factors besides auxin from the terminal bud that may control apical dominance.
9. Describe how stem elongation and fruit growth depend upon a synergism between auxin and gibberellins.
10. Explain the probable mechanism by which gibberellins trigger seed germination.
11. Describe how abscisic acid (ABA) helps prepare a plant for winter.

12. Explain the antagonistic relationship between ABA and gibberellins, and how it is possible for growing buds to have a higher concentration of ABA than dormant buds.
13. Give an example how ABA can act as a stress hormone.
14. Describe the role of ethylene in plant senescence, fruit ripening and leaf abscission.
15. Discuss how the study of mutant varieties of plants has heightened our understanding of plant hormones.
16. Describe the components of a signal- transduction pathway.
17. List two environmental stimuli that induce tropisms and a consequent change of body shape.
18. Explain how light causes a phototropic response.
19. Describe how plants respond to gravitropism and explain why roots display positive gravitropism and shoots exhibit negative gravitropism.
20. Distinguish between thigmotropism and thigmomorphogenesis.
21. Provide a plausible explanation for how a stimulus that causes rapid leaf movement can be transmitted through the plant.
22. Define circadian rhythm and explain what happens when an organism is artificially maintained.
23. List some common factors that entrain biological clocks.
24. Define photoperiodism.
25. Distinguish among short-day plants, long-day plants, and day neutral plants. Give examples of each.
26. Provide evidence for existence of a florigen.
27. Explain the interconversion of phytochrome and how plants detect sunlight.
28. Explain how an integrated control system can regulate a plant process such as flowering.

**R. Animal Nutrition**

The student will be able to: SD5.3.12.A.6
1. Distinguish among herbivores, carnivores, and omnivores.
2. Describe the following feeding mechanisms and give examples of animals that use each: filter-feeding, substrate-feeding, deposit-feeding, and fluid-feeding.
3. Define digestion and describe why it is a necessary process.
4. Distinguish between intracellular and extracellular digestion.
5. Explain why intracellular digestion must be sequestered in a food vacuole, and give examples of organisms which digest their food in vacuoles.
6. Define gastrovascular cavity and explain why extracellular digestive cavities are advantageous.
7. Using hydra as an example, describe how a gastrovascular cavity functions in both digestion and distribution of nutrients.
8. List major animal phyla which use gastrovascular cavities for digestion.
9. Describe some advantages that complete digestive tracts have over gastrovascular cavities.
10. List major phyla with alimentary tracts.
11. Define peristalsis and describe its role in the digestive tract.
12. Describe how salivation is controlled and list the functions of saliva.
13. Describe the role of salivary amylase in digestion.
14. Describe the sequence of events which occur as a result of the swallowing reflex.

15. Describe the function of the esophagus, and explain how peristalsis in the esophagus is controlled.
16. Describe the role of cardiac and pyloric sphincters.
17. List the three types of secretory cells found in the stomach epithelium and what substances they secrete.
18. Recall the normal pH of the stomach, and explain the function of stomach acid.
19. Describe the function of pepsin.
20. Explain why the stomach normally does not digest itself.
21. Explain how pepsin and acid secretion are regulated and describe the roles of the hormones gastrin and enterogastrone.
22. Describe the cause of ulcers, and explain why they are frequently found in the duodenum.
23. Explain how chyme is moved through the small intestine.
24. Describe the sequence of events which occur in response to acid chyme entering the duodenum and include the roles of digestive enzymes and hormones.
25. Describe the enzymatic digestion of carbohydrates, proteins, lipids and nucleic acids.
26. Explain the function of bile, described where it is produced and stored, and describe its composition.
27. Explain where most nutrient absorption occurs.
28. Explain the many folds, villi, and microvilli are important in the small intestine.
29. Describe how specific nutrients are absorbed across the intestinal epithelium and across the capillary or lacteal wall, and indicate whether the transport is with or against the concentration gradient.
30. Explain what happens to glycerol and fatty acids after they are absorbed into the intestinal epithelium, and describe the fate of chylomicrons and lipoproteins.
31. Explain where in the digestive tract that most reabsorption occurs.
32. Describe the composition of feces, and explain what the main source of vitamin K is for humans.
33. Give examples of vertebrates with the following digestive adaptations and explain how adaptations are related to diet: variation in dentition, variation in length of digestive tract, fermentation chambers.
34. Explain why animals need a nutritionally adequate diet.
35. List four classes of essential, and describe what happens if they are deficient in the diet.
36. Describe the effects of under nourishment or starvation.
37. List some risks of obesity.
38. List and distinguish between water-soluble and fat-soluble vitamins, and explain how they are used by the body.
39. Describe the dietary sources, major body functions and effects of deficiency for required minerals in the human diet.

Activity—Calorie and Exercise expenditure activity—LAB
Calorie guide, list of diet and activities, body fat index tables.

**S. Circulation and Gas Exchange-Time frame 3 weeks**
Readings from text, supplemental lectures, labs and independent activities.—Research project written paper, hands on project-building a heart model.
The student will be able to: SD5.3.12.A.6

1. List the major phyla with gastrovascular cavities, and explain why they do not need a circulatory system.
2. Distinguish between open and closed circulatory systems.
3. Using an arthropod as an example, describe the circulation of hemolymph
4. Explain how hemolymph differs from blood.
5. Using an earthworm as an example, describe circulation of blood, and explain how it exchanges materials with interstitial fluid.
6. List the components of a vertebrate cardiovascular system.
7. Distinguish between an artery and a vein.
8. Using diagrams, compare and contrast the circulatory systems of birds, amphibians, and mammals.
9. Distinguish between pulmonary and systemic circuits, and explain the function of each.
10. Explain the advantage of double circulation over a single circuit.
11. Trace a drop of blood through the human heart, listing the structures it passes through en route.
12. List the four heart valves, describe their location, and explain their function.
13. Distinguish between systole and diastole.
14. Describe the events of the cardiac cycle, and explain what causes the first and second heart sounds.
15. Define heart murmur, and explain its cause.
16. Define pulse, and describe the relationship between size and pulse rate among different mammals.
17. Define cardiac output, and explain how it is affected by a change in heart rate or stroke volume.
18. Define myogenic, and describe some unique properties of cardiac muscle which allows it to contract in a coordinated manner.
19. Define pacemaker, and describe the location of two patches of nodal tissue in the human heart.
20. Describe the origin and pathway of the action potential (cardiac impulse) in the normal human heart.
21. Explain the cardiac conduction pathway through the heart.
22. Compare the structures of arteries and veins, and explain how differences in their structures are related to their functions.
23. Describe how capillary structure differs from other vessels, and explain how this structure relates to function.
24. Define blood pressure and describe how it is measured.
25. Explain how peripheral resistance and cardiac output affect blood pressure.
26. Explain how blood returns to the heart, even though it must travel from the lower extremities against gravity.
27. Define microcirculation and explain how blood flow through capillary beds is regulated.
28. Explain how osmotic pressure and hydrostatic pressure regulate the exchange of fluid across capillaries.
29. Describe the function of lymph, and explain how the lymphatic system helps the normal functioning of the circulatory system.
30. List the components of blood and describe a function for each.
31. Outline the formation of erythrocytes from stem cells to destruction by phagocytic cells.

32. Outline the sequence of events that occur during blood clotting, and explain what prevents spontaneous clotting in the absence of injury.
33. Explain how arteriosclerosis affects the arteries.
34. Distinguish between thrombus and embolus; arteriosclerosis and arteriosclerosis; low - density lipoproteins (LDLs) and high-density lipoproteins (HDLs).
35. List the factors that have been implicated with an increased risk of cardiovascular disease.

**T. Respiration in Animals**

The student will be able to:SD5.3.12.A.6
Time frame- 2 weeks
1. Describe the general requirements for a respiratory surface and list the variety of respiratory organs adapted for this purpose.
2. Describe respiratory adaptations of aquatic animals.
3. Describe countercurrent exchange, and explain why it is more efficient that concurrent flow of water and blood.
4. Describe the advantages and disadvantages of air as a respiratory medium, and explain how insect tracheal systems are adapted for efficient gas exchange in a terrestrial environment.
5. For the human respiratory system, describe the movement of air through air passageways to the alveolus, listing the structures it must pass through on the journey.
6. Define negative pressure breathing, and explain how respiratory movements in humans ventilate the lungs.
7. Define the following lung volumes, and give a normal range of capacities for the human male: tidal volumes, Vital capacity, and residual volume.
8. Explain how breathing is controlled
9. List three barriers oxygen must cross from the alveolus into the capillaries, and explain the advantage of having millions of alveoli in the lungs.
10. Describe how oxygen moves from the alveolus into the capillary, and explain why a pressure gradient is necessary.
11. Distinguish between hemocyanin and hemoglobin.
12. Describe the structure of hemoglobin, explain the result of cooperative binding, and state how many oxygen molecules a saturated hemoglobin can carry.
13. Draw the Hb-oxygen dissociation curve, explain the significance of its shape, and explain how the affinity of hemoglobin for oxygen changes with oxygen concentration.
14. Describe the Bohr effect, and explain how the oxygen dissociation curve shifts with changes in carbon dioxide concentration and changes in pH.
15. Describe how $CO_2$ is picked up at the tissues and deposited in the lungs, describe the role of carbonic anhydrase, and state the form most of the carbon dioxide is in as it is transported.
16. Explain how hemoglobin acts as a buffer.
17. Describe respiratory adaptations of diving mammals including the role of myoglobin.

**U. Chemical Control in Animals**

The student will be able to: SD5.3.12.A.3
1. Compare the response times of the two major systems of internal communication: the nervous system and the endocrine system.

2. On the basis of structure and function, distinguish among types of chemical messengers.
3. Distinguish between endocrine and exocrine glands.
4. Describe the relationships among the endocrine system components; hormones, endocrine glands, target cells, and target cell receptors.
5. List the general chemical classes of hormones and give examples of each.
6. Explain how pheromone function differs from hormone function.
7. Provide indirect evidence that humans may communicate with pheromones.
8. State which of the two classes of hormones is lipid soluble, and explain how this property affects hormone function.
9. Describe the mechanism of steroid hormone action, and explain the location and role of steroid hormone receptors.
10. Explain how to account for specificity in target cell response to hormonal signals.
11. Compare and contrast the two general modes of hormone action.
12. Describe hormonal regulation of insect development including the roles of ecdysone, brain hormone, and juvenile hormone.
13. Describe the location of the hypothalamus, and explain how its hormone-releasing cells differ from both endocrine gland secretory cells and other neurons.
14. Describe the location of the pituitary, and explain the functions of the posterior and anterior lobes.
15. List the posterior pituitary hormones, and describe their effects on target organs.
16. Using antidiuretic hormone as an example, explain how a hormone contributes to homeostasis and how negative feedback can control hormone levels.
17. Define tropic hormone, and describe the functions of tropic hormones produced by the anterior pituitary.
18. Explain how the anterior pituitary is controlled.
19. List hormones of the thyroid gland, and explain their role in development and metabolism.

**REQUIRED LABORATORY EXERCISES:**

1) Measurement Lab-tools & methodology
2) Microscopy & tests for biological molecules
3) Diffusion and Osmosis Lab---Cells and Transport Unit
4) Dialysis experiment
5) Cell Structure
6) Enzyme Catalysis Lab---Biochemistry Unit
7) Mitosis and Meiosis Lab- slides of mitosis and meiosis
8) Plant Pigments and Photosynthesis
9) Cellular Respiration
10) DNA, Transcription & Translation
11) DNA Technology
12) Genetics of Organisms (Statistical Section)
13) Population Genetics and Evolution
14) Transpiration---Plant structure and Physiology
15) Evolutionary History & Evidence
16) Blood Pressure Lab
17) Protists culture lab

## III. List of Textbooks, Instructional Materials and Software

Required Text:
Solomon, Berg and Martin, Biology 8th Edition Copyright 2008
Thomson/Brooks Cole

Student Study Guide: Solomon, and Martin 8th Ed

Supplemental Teaching Resources: Diagrams and Handouts
Lab manuals: Fetal pig dissection guide.
Videos and DVDS—Body Atlas, Discovery Channel videos

## IV. Teaching Strategies:

I include lecture-discussions and interactive class debates. I stress student involvement in class and homework activities. Lecture outlines are provided to students. The students are responsible for adding details to the outlines. Science is taught as a process that is interactive with other disciplines.

Lab activities include hands on work and interpretive skills in analysis of data.
In addition to required labs, dissection of a frog and cat are included as representative Vertebrates. Students hand in a full written lab report for each lab exercise.

Idependent Research paper writing included in the Ecology, Genetics and Cardiovascular areas.
Simulated computer modeling of lab activities are also included.
Students present current research articles.
Students practice writing free response essays to practice for AP exams.

**Assessment**

Mastering of the core proficiencies of Biology shall be evaluated in accordance with the grading policies in the student handbook.

1.Tests----------40%
2.Lab Reports/ Research projects----20%
3.Quizzes----------20%
4.Classwork/Notebook/Homework—10%
5.Class participation ----------10%
Assessment of Project Advance grades with Syracuse college credit with follow Guidelines set in the Syracuse College Syllabus provided to students.

**Scope and Sequence Chart Advanced Biology**
Key: I-introduced D-developed in Depth, R –Reinforced

| **Skill and Concepts to be learned** | 9 | 10 | 11 | 12 |
|---|---|---|---|---|
| Select and use technology to present the design and results of Investigation. | | | IDR | IDR |
| Identify and follow safety procedures for lab experiments. | | | IDR | IDR |
| Identify and explain the structure and function of molecules that control molecular and cellular activities. | | | IDR | IDR |
| Recognize the interrelationships of living organisms and their contributions to a stable ecosystem. | | | IDR | IDR |
| Describe complex steps of molecular pathways in plants, animals and microorganisms. | | | IDR | IDR |
| Identify and analyze DNA and the information encoded at the molecular level. | | | IDR | IDR |
| Explain modern techniques and developments in molecular Biology, apply to the advanced study of biological principles. | | | IDR | IDR |
| Explain the theories and evidence for evolution. | | | IDR | IDR |

# ADVANCED BIOLOGY

Student handout

## Course Description

Advanced Biology is a full year study designed primarily as a course for high school and college credit offered by Syracuse University. It is a body of systematized knowledge gained from observation, study and experimentation. By studying advanced biology you will be able to understand the nature of living organisms and the environment around you. The study of the history and major discoveries in Biology will facilitate the understanding and give insight into modern and future problems and their solutions. Advanced Biology has a required laboratory component corresponding to the materials studied in the classroom. The students will learned how to use classical contemporary lab equipment in a laboratory setting to demonstrate practical application for biological principles.

Advanced Biology has required research and independent study skills which are designed to assist a student in preparing for college level academic study of General Biology I and II.

## Proficiencies:

Students will demonstrate the ability to:

1. Use laboratory instruments, apparatus and technologies of biology.
2. Proficient use of compound light microscopes for live specimens and fixed slides.
3. Demonstrate safe laboratory procedures.
4. Identify ways in which the study of biology applies to future career opportunities.
5. Develop an understanding and appreciation of interactions of living organisms with their environment.
6. Develop critical thinking and analytical skills for interpreting scientific data.
7. Represent and explain the relationship of biochemical molecules and reactions at the molecular, cellular, and organism level of organization.
8. Analyze interrelationships and interdependency among different organisms, and explain their function in an ecosystem
9. Provide scientific explanation for evidence of theories of Evolution and the history of life on Earth.
10. Develop a solid academic foundation in the study of Biology for further rapid advancement in college degree programs.
11. Explain the value of study of classical genetics and the progress of molecular genetics has contributed to modern discoveries in science.
12. Compare and contrast normal physiologic function and disease processes in organisms.
13. Investigate mechanisms of metabolism at the cellular level of plants, animals, and microbes.
14. Enhance and develop further knowledge of biological principles covered in a high school and college level science course.