Teaching Philosophy:

In teaching AP Biology I find that I am working towards helping students understand more completely the complex world around us and how we influence this world. I like to focus on evolution as a way to describe the complexity and structure of the Earth. I also stress how humans and our evolution from hunter/gathers to a complex society have helped to influence the development of the current face of the Earth and that of the organisms that populate it. In doing this the three main topics of the AP Biology course are covered through class lectures, labs, and projects that students are required to complete. The three main topics are part and parcel of the course, allowing for specific topics and information to be covered and understood.

I. Cells and molecules
II. Heredity and Evolution
III. Organisms and Populations

In addition, I integrate the 8 themes of the AP Course throughout the curriculum. These themes allow students to receive a "Big Picture" sort of view of the course and a purpose for studying Biology. The 8 themes are:

I. Science as Process
II. Evolution
III. Energy transfer
IV. Continuity and change
V. Relationship of Structure to Function
VI. Regulation
VII. Interdependence in Nature
VIII. Science, Technology and Society

Throughout the course description and timetable these themes will be referenced during the separate topics that are covered in the class timetable.

Students are also required to complete about one essay per week. These essays are released free response questions from the AP Biology exam that will allow students to integrate the 8 themes of the AP Biology course into questions that help prepare them for the exam. These are referred to in the class timetable.

The textbook for the course is the seventh edition of Neil A. Campbell and Jane B. Reece's *Biology*. Students also use the *AP Biology Lab Manual for Students* and the lab protocols written by Ward's Natural Science. Additional labs are teacher generated or come from other sources.

Weeks	Topics/Discussion Threads	Labs/Activities
2.5 Wks	**Introduction & Scientific Method** Unifying Themes of Biology Chpt: 1 Brief overview of Campbell's themes and how these correlate to the 8 AP Biology themes, Scientific method basics **Evolution topics**: History of evolutionary thought, Darwin and the development of theory of natural selection, Natural Selection, Historical Geology, Evidence of Evolution, Speciation Chpts: 22 & Chapter questions **Themes and examples of their class integration:** *Science as Process* – Darwin's development of evolutionary theory based on work of Lyell, Malthus, and Cuvier *Evolution* – Natural selection and change in the species over time occurs in any population that has environmental pressures put on them *Continuity and change* – gradualism and punctuated equilibrium *Relationship of Structure to Function* – discussion of use and relationship of homologous and vestigial structures *Regulation* – organisms have different body regulation strategies, with higher animals having the most complex and showing simpler organisms are the less evolutionarily developed *Interdependence in Nature* – struggle for survival amongst all organisms results in competition for available resources *Science, Technology and Society* – carbon dating and DNA analysis allows for a deeper understanding of evolutionary trends and relationships	○Pillbug experiment (**AP Lab # 11**) ○Scientific Method Essay ○Camouflage and Protective coloration activity - Natural Selection Simulation using colored paper dots on various backgrounds where students look for various survival rates and discuss these effects on future populations ○Natural Selection essay ○Quiz 1
1.5 wks	**Chemistry**: Water & pH, Organic Molecules, Enzymes, carbohydrates, lipids, and nucleic acids, bonds and bonds formation Chpts: 2-5, 8 & Chapter questions ○Why water is important to life ○Organic compounds concept map ○Amino Acids and evolution worksheets ○Enzyme activity	○Water lab – inquiry lab where students examine and identify properties of water essential to life. Students work in pairs, rotating to different stations around the room. Students observe the materials at the station, formulate a hypothesis as to what will happen, test their hypothesis, and draw conclusions. They

	Themes and examples of their class integration: *Science as Process* – water inquiry lab *Energy Transfer* – exergonic reactions drive endergonic ones *Evolution* – amino acids as a way to determine evolutionary relationships of organisms *Continuity and change* – amino acids are organized in specific orders to make a protein, altering that alters the protein and it's functionality *Relationship of Structure to Function* – Enzymes have specific shapes that only allow for bonding with specific substrates (Lock & Key Model) *Regulation* – Water's unique properties help to regulate body temperature in organisms *Interdependence in Nature* – all organisms require water to live *Science, Technology and Society* – discussion on the effects of wide scale water pollution and waste on different populations	then use this information to discuss how these properties are helpful to organisms ○Water Essay ○Enzyme catalysis toothpickase simulation – designed to simulate action of enzymes and effect of environment on their activity levels. Students break toothpicks using their hands and then apply a change to their hands to see how this affects the enzyme rates. ○**AP Lab # 2: Enzymes** (modified CIBT inquiry lab) ○Enzyme Essay
2 Wks	**Cell Biology**: Cell structure, Organelle structure & function, Transport mechanisms (diffusion, osmosis, dialysis, active transport) Chpts: 6-7, 11 & Chapter questions **Themes and examples of their class integration:** *Science as Process* – discussion of cellular discoveries that led to the creation of the Cell Theory (Schleidel, Schwann, Brown, etc) *Energy Transfer* – transfer of energy within cell allows for eukaryotes to be larger than prokaryotes *Evolution* – prokaryote and eukaryote comparison and links to endosymbiotic theory *Continuity and change* – cells undergo mitosis, creating genetically similar cells, unless a mutation appears that might cause cells to alter their phenotypes *Relationship of Structure to Function* – cell membrane channels and the link of their structure to their function *Regulation* – Use of organelles to maintain conditions within cells *Interdependence in Nature* – all cells require nutrients and materials from the environment to synthesize organelles and macromolecules *Science, Technology and Society* – Electron microscopy and how this has increased our understanding of cell functions	○Diffusion Demonstration (potatoes and iodine) ○**AP Lab # 1: Osmosis** ○Osmosis essay ○Cell Projects & presentations ○Microscope and Cells Identification Lab – teacher generated lab where students examine and draw plant and animals cells, compare and contrast them, and discuss evolutionary relationships ○Quiz 2

3.5 wks	**Energetics**: Respiration, Laws of Thermodynamics, Fermentation, Glycolysis, Krebs Cycle, Oxidative phosphorylation Chpts: 9 & Chapter questions ○ETC transport chain simulation - students model ETC using all members of the class (student designed and led) **Photosynthesis**: Light reactions, Calvin Cycle, C3, C4, and CAM plants Chpts: 10 & Chapter questions ○Photosynthesis simulation - students model light reaction and Calvin Cycle using all members of the class (student designed and led) **Themes and examples of their class integration:** *Science as Process* – Discussion of discoveries over centuries dealing with plants and their needs and products (Engelmann's study of alga) *Energy Transfer* – transfer of energy from sunlight to make sugars for the plant, which is eaten by a heterotroph, providing energy to entire foodweb *Evolution* – Discussion of evolution of chloroplasts and adaptations plants have for different environments (C3, C4, and CAM plants) *Continuity and change* – both respiration and photosynthesis generate ATP through chemiosmosis, showing similarities between the two *Relationship of Structure to Function* – folded areas on both organelles increase surface area and allow for greater energy development *Regulation* – levels of ATP in the system regulate cellular respiration by turning on our off specific enzymes *Interdependence in Nature* – chart showing photosynthesis provides the oxygen that respiration uses and respiration provides the carbon dioxide that respiration uses *Science, Technology and Society* – discussion of effects of slash & burn policies of Amazonian and the long-term effect on carbon dioxide levels on the atmosphere	○Elodea Respiration activity – bromothymol blue, tin foil, a lamp, and 4test tubes with 2 pieces of elodea. Students design a lab with these materials to show how photosynthesis and respiration are related ○**AP Lab # 5: Respiration** ○Test 1 ○Respiration/Photosynthesis Comparison activity – students work in groups to understand the processes, then work in pairs to teach each other the opposite process ○**AP Lab # 4: Photosynthesis** ○Quiz 3

2.5 wks	**Cell Reproduction**: Chromosome structure, mitosis & meiosis phases & regulation schemes, crossing over, synapsis, and other sources of variation Chpts : 12, 13 & Chapter questions ○Mitosis class simulation – students model mitosis using all members of the class (student designed and led) ○Meiosis class simulation – students model meiosis model using all members of the class (student designed and led) **Themes and examples of their class integration:** *Science as Process* – Students work together to count the number of cells in each stage of mitosis from microscope slides and use that information to determine the length of time the cell spends in that phase *Energy Transfer* – discussion of ATP and energy needs of a cell for division *Evolution* – meiosis is an evolutionary adaptation that allows for variation in sexually reproducing species, as opposed to mitosis which maintains cellular genetics *Continuity and change* – cells undergoing meiosis are genetically different from the original, allowing for continuation of the parent species, but offering the variation in species *Relationship of Structure to Function* – cell plates form during telophase in plants, forming a new cell wall between the 2 new cells *Regulation* – G1, G0, and G2 phases of Interphase regulate mitotic division *Interdependence in Nature* – cell reproduction allows for replacement of damaged cells and reproduction of the individual *Science, Technology and Society* – ethics discussion on cloning and it's results- use of current newspaper articles about cloned meat and milk to facilitate	○Mitosis/Meiosis Comparison activity – students must match up descriptions of events in each stage after they have drawn pictures of the chromosomes at each stage. ○**AP Lab # 3 : Mitosis/ Meiosis Activity** ○Quiz 4

3 wks	**Classical Genetics**: Mendelian laws, Monohybrid & dihybrid crosses, Linkages, Chromosome mapping, human genetics, probability Chpts: 14, 15 & Chapter questions ○Discussion of book "Monk in the Garden" and Gregor Mendels' background and importance of work to both math and science ○Correlation of Mendel's work to Darwin's theory of natural selection ○Construction of simple family pedigree chart **Themes and examples of their class integration:** *Science as Process* – Discussion on Mendel's works, the time it laid unknown, and it's discovery by other scientists who had replicated his work *Energy Transfer* – return to discussion of ATP and how it's structure makes it suited to provide energy for cellular division *Evolution* – Mendel's work correlates directly to natural selection as a mechanism for the process of evolution *Continuity and change* – organisms would stay the same if not for the laws of Segregation and Independent Assortment that Mendel determined *Relationship of Structure to Function* – homologous chromosomes allow for independent assortment and segregation of alleles from each other *Regulation* – Discussion of dominant and recessive alleles and how these regulate the physical attributes of the organism *Interdependence in Nature* – dominant and recessive alleles allow for expression of phenotypes favorable to the environment *Science, Technology and Society* – video on the use of chromosome mapping and linkages and how they are used to study diseases and their affects on the both individuals and the population	○Probability Work – word problems utilizing probability to determine possible offspring ○M&M Chi Square Activity – using M&M's and color variations to demonstrate chi square math and relate it to probability and potentials ○Corn Genetics- use of corn plants to demonstrate parents and offspring, based on probabilities ○**AP Lab # 7 Nasonia Genetics** (Same a *Drosophila* work, but using the parasitic wasp species *Nasonia* instead) ○Make a Baby project ○Test 2
(Holiday recess)	○***Genetics Problem sets* –** genetics problems based on probability and Punnett squares	

3 Wks	**Molecular genetics**: Discovery & structure of Nucleic Acids, Protein synthesis, regulation of genes, genetic engineering, viruses and bacterial genetics compared to eukaryotes Chpts: 16, 17, 20, 21 & Chapter questions ○Jonathon Coulton DNA song ○Debate pro's and con's of Human Genome Project and possible uses/misuses of it in the future (student led) ○Use of DNA interactivate CD for animations of molecular processes ○Chapter 20 & 21 graphic organizer – student centered **Themes and examples of their class integration:** *Science as Process* – Contributions of Rosalind Franklin and Erwin Chargaff to Watson and Cricks' determination of the structure of DNA *Energy Transfer* – energy is needed to join amino acids into the polypeptide chains (dehydration synthesis) *Evolution* – discussion of potential of genetic engineering to influence evolution *Continuity and change* – DNA is passed on with only slight changes from parent to offspring, but accumulated changes cause the species to change *Relationship of Structure to Function* – structure of DNA allows for transfer of information, through base pairing and the use of hydrogen bonds *Regulation* – operons regulate the expression of genes, such as the Ara operon that allows the transformed E. Coli to glow in the presence of arabinose *Interdependence in Nature* – changes in DNA change the structure and function of polypeptides *Science, Technology and Society* – use of gel electrophoresis for DNA fingerprinting and identification of related species for classification and identification	○Class Activity Human DNA Model – students build DNA model using all members of the class ○Where's the Cat? Modified electrophoresis simulation from Access Excellence that allows student to better visualize what is happening in Gel Electrophoresis. Students use a scenario where a crime has been committed and students must determine who the criminal is using DNA from the site and 2 different suspects ○**AP Labs 6B: Electrophoresis** ○**AP Labs 6A: Transformation using pGlo** (Bio-rad kit) ○Newsweek articles and class discussion regarding Human Genome Project and future health care and insurance premiums (View clip from movie Gattaca to facilitate) ○Quiz 5

2 Wks	**Evolution**: Hardy-Weinberg Equilibrium, Mechanisms of Evolution, Evidence of Evolution, Speciation and prezygotic and postzygotic barriers to reproduction, gradualism and punctuated equilibrium Chpts: 23, 24, 29-30 & Chapter questions ○Practice Hardy-Weinberg problems ○Reading and discussion of letters to the editor regarding evolution & intelligent design ○Heterotroph Theory of Evolution ○Discussion of possible routes of evolution of plants **Themes and examples of their class integration:** *Science as Process* – Lynn Margulis and the Endosymbiotic theory – students determine the order of inclusion of primitive prokaryotes to form primitive eukaryotes *Energy Transfer* – prey organisms pass on their meat as energy to predator organisms and those that do not survive do not pass on their genes, therefore causing a change in the population *Evolution* – Discussion of evidence supporting evolution *Continuity and change* – Hardy-Weinberg population characteristics and how a change of these characteristics will result in a change in the population over time *Relationship of Structure to Function* – homologous and analogous structures in different organisms *Interdependence in Nature* – struggle for survival results in the change in species over time *Science, Technology and Society* – discussion of the differences between evolution and creationism/ intelligent design and evidence for each; discussion on school districts that push to teach intelligent design	○Evolution Poster – students design an organism and describe the features and characteristics of the species that allow it to survive in its environment. They then propose a mechanism for change and determine how that would affect the species ○Natural Selection Activity – students research organisms and propose events that could have caused speciation ○**AP Lab # 8: Pop Genetics & Evolution** ○Quiz 6

2 Wks	**Classification/Phylogeny** - Three Domains, Phylogenetic Trees, Prokaryote and Eukaryote Diversity, Animal Phylogeny and Diversity Chpts: 25, 26 & Chapter questions oParade through the Kingdoms – classification overview borrowed from Kim Foglia's Website oVideo short on Carolous Linneaus and phylogeny in the plant kingdom oDiscussion of the tree of life and modern genetic analysis on classification systems **Themes and examples of their class integration:** *Science as Process* – Discussion of why Linneaus needed to define a system of classifying organisms *Evolution* – how evolution plays a part in the construction of the tree of life *Continuity and change* – describe how branches are always forming on the tree of life, but not all organisms change *Relationship of Structure to Function* – discussion of different organism who have similar structures but aren't classified together (bats and birds) *Interdependence in Nature* – classification schemes can help show changes in one species have caused changes in another species *Science, Technology and Society* – modern genetic analysis allows for more complete and systematic classification of organisms	o Classification and evolution Worksheets – analysis of amino acid sequences is used as a method of classifying closely related organisms o Parade through the kingdoms – packet that covers several Campbell chapters and allows for coverage of more information

3 Wks	**Animals**: Physiology – Homeostasis, Digestion & Nutrition, circulatory system, respiratory system, immunology, nervous system, muscle physiology, endocrine systems, kidneys, reproductive system Chpts: 40-49 & Chapter questions o Student body system projects due o Student led discussion on similarities of animal system and correlation to evolution **Themes and examples of their class integration:** *Science as Process* – in the sea urchin development lab students monitor change and growth over a period of time *Energy Transfer* – discussion of how energy passes through the different systems and is used or changed *Evolution* – discussion of how the various systems have changed over time and how *Continuity and change* – different systems in various organisms are virtually the same, with minor changes that illustrate the different habits of the species *Relationship of Structure to Function* – heart is a muscle that pumps blood throughout the body, lungs are sacs that inflate with movement of diaphragm, expanding and filling with air, etc *Regulation* – Homeostatic organs, such as the hypothalamus, maintain control of body systems so correct internal conditions exist, and can be related to a thermostat in a house *Interdependence in Nature* – all body systems are necessary and provide support or materials for all other systems *Science, Technology and Society* – modern technology is better able to help those individuals who have serious problems with various organs (transplants, mechanical structures, etc) (discussion of new female knee implants)	o Quiz 7 o **AP Lab # 10: Circulatory System** o Body System Projects o Development Lab – Sea Urchin/ gonadotropin sperm & egg release. Students watch as the sea urchin releases large amount of gametes into water and then use microscopes, each day, to chart the development o In school field trip using distance learning to observe a real autopsy where students have specific information about the patient and must try to determine the cause of death. This activity is conducted through COSI Columbus Electronic Education. o Test 3

3 Wks	**Plants**: Life Cycles, Structure of Angiosperms, pollination & fertilization, transport and transpiration Chpts: 35-39 & Chapter questions ○Plant coloring sheets to illustrate different parts of flower ○Brief video on pollination **Themes and examples of their class integration:** *Science as Process* – Plant Germination experiments shows students that many experiments can be run together, all with a common goal of discovering an answer *Energy Transfer* – transfer of products of photosynthesis within the plant to mitochondria helps produce energy for growth, movement, and reproduction *Evolution* – discussion of evidence for evolution of land plants from charyophaceans and the links between bryophytes, ferns, conifers, and angiosperms (focus on reasons why adaptations allowed each successive family to be more successful) *Continuity and change* – discussion of production of tetraploid plants from diploid parents through non-disjunction events *Relationship of Structure to Function* – discussion of how phloem and xylem cell structures are designed to carry the their respective cargoes *Regulation* – plant hormones help to regulate the development of seeds, shoots, and roots – auxins and apical dominance, cytokinins and cell division, etc *Interdependence in Nature* – discussion of angiosperm dependence on insects for reproduction as a way to lower energy expenditures and increase success *Science, Technology and Society* – genetic engineering of crops for insect and disease resistance as an ethics debate	○Plant Germination Experiments – students choose 2 questions from a list of 6 different ones regarding seed germination and design experiments to test these questions. They have to collect data in their own tables and determine a valid conclusion, which they will they share with the class ○**AP Lab # 9: Transpiration** ○Quiz 8 & 9

3 Wks	**Ecology**: Communities & Ecosystems, Succession, Biomes, Populations Dynamics and trophic levels, Chpts: 50-55 & Chapter questions ○Discussion of community dynamics and predator-prey relationships ○Effects and examples of non-native species, focusing on zebra mussels and my research on them **Themes and examples of their class integration:** *Science as Process* – Development of the Global Warming theory is based on data from hundreds of scientists working together *Energy Transfer* – food webs represent a myriad of trophic interactions, with 90% of the energy lost between each level *Evolution* – adaptive features of organisms allow them to become best suited to their environment over time (Giraffes and food sources) *Continuity and change* – ecosystems stay stable over hundreds of thousands of years, but subtle changes in the environment cause differences that put evolutionary pressure on the organisms *Relationship of Structure to Function* – the chemical structure of ozone in the earth's atmosphere is important to the absorption of UV radiation from the sun, allowing life to exist *Regulation* - cycling of materials through an ecosystem (carbon, nitrogen, phosphorus, etc), *Interdependence in Nature* – discussion of symbiotic relationships, focus on ants and acacia trees *Science, Technology and Society* – discussion on improvements in hunting techniques and how this has affected populations over the past 100,000 years – including extinction and endangering populations	○Foodweb Creation – students use cards with identifications of each organism and the type of food it eats to create a large foodweb that correctly illustrates trophic levels and energy flow in an ecosystem ○Ecology Projects/Presentations ○**AP Lab #12: Dissolved O_2** ○Man's Impact on the Environment Project ○Write a letter to the editor regarding Global Warming and how we can stop it. ○Quiz 10

Lab Activities:

Lab Activities consist of the 12 required AP labs as well as other wet labs that have been created by me or modified from existing labs. All labs require students to collect data and demonstrate an understanding of the purpose and results of the lab. We have class discussions on the results and the ideas/implications of these results. I find that this works well as a way for students to more fully comprehend the lab objectives and therefore integrate this with the course content being studied.

Class meets 5 days a week, with three days meeting over 2 class periods (about 85 minutes) and 2 days meeting only one period (42 minutes). Labs usually require anywhere from 2 full periods to 2 days, with the occasional lab requiring a full week. This translates to 27 – 45% of class time used for these activities.

Group Projects:

Group Projects, assigned once per marking period. These require students to research a topic, idea, or subject about biology or processes in the curriculum. These are always presented to the rest of the class and graded using a project specific rubric. Students use outside time to prepare for these projects, but they comprise a large portion of their grade for the marking period.

Marking Period 1: Cell Projects (*Correlates to the Molecules & Cells component of the curriculum*)

Students pick from a choice of 8 different projects that help them to learn the organelles and functions of cells. While all projects are different in their presentation and creation, they are all fundamentally similar in the organelles that must be used, described, and that their functions must be explained.

Marking Period 2: Make a Baby Project (*correlates to the Heredity & Evolution component of the curriculum*)

Students will create charts of their personal phenotypes and genotypes, which they will then combine with another student to determine the genotypes and phenotypes of a possible offspring. They will create a karyotype using prepared chromosomes and analyze this for genetic abnormalities, which they will then research and write a report on. They will also solve genetic probability problem sets.

Marking Period 3: *Evolution Poster* (*correlates to the Heredity & Evolution component of the curriculum*)

Students develop their own species and show an environmental change that would provide pressure resulting in evolution of the species, the time between the 2, and the characteristics of the new organism. Students must discuss the types of speciation and the different requirements of the species.

Marking Period 4: Body System Projects (*correlates to Organisms and Populations component of the curriculum*)

Students chose a body system, correlating to a representative chapter in the text, and work with a group to make a poster of the system that shows the anatomy of the system, a PowerPoint of the functions/roles of the different parts/physiology of the system, determine and define key vocabulary terms, compare and contrast this system in other kinds of organisms, relate this system to at least 2 other systems, and create a handout that will help their classmates to understand this system.

Marking Period 5: Ecosystem Projects (*correlates to Organisms and Populations component of the curriculum*)

Students chose an ecosystem and make a poster of their biome describing the characteristics of the system, list biotic and abiotic factors, create a food web using pictures of actual animals, list main organisms and label producers, consumers, decomposers, carnivores, herbivores, scavengers, detail the CO_2, H_2O, C, & N cycles and organisms involved, and compare and contrast at least 2 interrelated organisms from this biome

Man's Impact on the Environment Projects (*correlates to Organisms and Populations component of the curriculum*)

Students work individually to chose and address one of 21 topics dealing with man's impact on the environment. The project asks them to address this as a 3-5 minute news story and list actions they can take to correct or improve the problem.

Marking Period 6: Choice Projects (*correlates to all components of curriculum*)

1. Research and present information regarding adult vs. embryonic stem cells.
2. Current HIV research and its area of focus. Who is doing the research, what are they looking for/at, what they seek to determine, etc.
3. Research ecology decisions. Two groups will work opposite each other for this. One group will focus on the affects of ecology decisions to the economy and the other group will focus on the ecological affects. This will be presented as a town meeting case where students must convince the class that their side of the case is correct.
4. Design an Ecologically sound city. This city will have buildings, laws, citizens, power sources, etc. Students need to include a list of the specific items (plus a few others) as well as a picture of the city and its layout.
5. Research invasive species and find ones that are damaging to Rochester.
6. Discuss the effects of high nutrient levels in Irondequoit Creek and Bay – see canoe trip below.
7. Create a lesson plan on a topic that we have discussed through this year. They will present this lesson twice. Once to the AP class and once to my Living Environment Honors 8 Biology class.
8. Create a game that can be used for review for the AP exam. It must cover all topics, contain correct answers, and require at least one class period. We play this game in class and students act as the leaders.
9. Come up with something that they are interested in learning. This must be approved by me prior to students beginning their research or project.

In addition, during the 6th Marking Period, after the AP exam, students take a field trip with the AP Environmental Science class and ride a canoe down Irondequoit Creek to Irondequoit Bay, which empties into Lake Ontario. During this trip they sample water for common pollutants, looking for differences between the different sample sites and correlating this information to major roadways, a local dog park, or any other place with an effluent into the creek. Students then present their data and discuss the potential for this information and possible ways to correct anything that is abnormal.

Online Autopsy website information:
http://www.cosi.org/educators/education-programs/electronic-education