AP BIOLOGY CURRICULUM AUDIT

CURRICULAR REQUIREMENTS

		Page(s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level biology textbook.	3
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP® Biology Curriculum Framework.	2,4, 5
CR3a	Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea.	2,5,8,9
CR3b	Students connect the enduring understandings within Big Idea 2 (biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis) to at least one other big idea.	2,5,9,14
CR3c	Students connect the enduring understandings within Big Idea 3 (living systems store, retrieve, transmit, and respond to information essential to life processes) to at least one other big idea.	2,5,9,15
CR3d	Students connect the enduring understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.	2,5,9,12
CR4a	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	5,10,12,15,16, 17,18
CR4b	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.	5,10,12,14,16 17
CR4c	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.	5,10,11,12,15, 16, 17, 18
CR4d	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.	5,10,11,12, 14,16,17
CR5	The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.	2,5,8,11,12,13
CR6	The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.	2,6,7,8,18
CR7	Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.	2,3,4,6,8
CR8	The course provides opportunities for students to develop and record evidence of their verbal, written and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations	2,7,8

PREPARATION FOR SUCCESS WITH CURRICULUM CHANGES

The new AP Biology Curriculum Framework represents a shift in the emphasis in the way this class will be taught I have tried to prepare for success by doing the following:

1.) I attended two summer workshops
   - Catalyst Learning Curricula with Kristen Dotti (Asheville, NC)
   - Cherry Hill AP Bio workshop with Fred and Teresa Holtzclaw (Denver. CO)

2) I have been following the AP Teacher Community https://apcommunity.collegeboard.org for discussions on content changes, suggestions for redesign focus, and resources for labs and activities

COURSE OVERVIEW

This Advanced Placement Biology class is taught to juniors and seniors. Classes meet five days a week. On Monday, Tuesday, Thursday, and Friday classes are 50 minute periods and on Wednesdays classes are 44 minute periods. Students will also use time before and after school and during lunch to complete individual student designed lab explorations. In addition, two full lab days (7 class periods long/one each semester) will afford students to opportunity to complete more complicated labs/activities that require more time than a class period.

Students should have completed both a year of introductory Biology and a year of Chemistry prior to enrolling in AP Biology, so all students will come to the class with a solid foundation in these areas. I also know what topics students have previously covered because I also teach the Biology prerequisite. Thus, I will not spend class time re-teaching the basics. Instead, I will provide review opportunities for students to refresh their previous knowledge outside of class and spend class time teaching new concepts, conducting labs, making connections to overall themes, and helping students integrate new information with prior knowledge.

In addition, I am in the process of “flipping” my classroom to allow students to view podcasts/videos over some (not all) content prior to coming to class. This will allow more class time for student-designed lab explorations and hands-on activities to work with information, model science processes, discuss misconceptions, and “do” science.

GOALS

My goals for this course are to present an in depth, college level study of the Biological Sciences structured around the four big ideas, enduring understandings, and science practices so that students:

1) complete the course with a clear understanding of the biology concepts covered **[CR2]**
2) gain an appreciation for how those biological concepts are interrelated to each other, themselves, and the real world **[CR3] [CR4]**
3) develop college level critical thinking skills, writing skills, and study habits **[CR7]**
4) have an opportunity to design and complete student centered research labs **[CR6][CR7]**
5) develop an appreciation of the link between math and science and be able to appropriately choose and use a variety of mathematical processes to evaluate data **[SP2][SP5]**
6) create models and simulations to represent and explain biological concepts **[CR8]**
7) are prepared for the comprehensive AP Biology Exam in May

My AP Biology course is designed to offer students a solid foundation in introductory college-level biology. I hope to assist students in developing an appreciation for the study of life and help them identify and understand unifying principles within a diversified biological world. What we know today about biology is a result of inquiry. Science is a way of knowing. Therefore, the process of inquiry in science and developing critical thinking skills is an integral part of this course and **25% of this course is spent doing laboratory studies. [CR7]**

CR7: Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.

At the end of the course, students will have an awareness of the integration of other sciences in the study of biology, understand how the species to which we belong is similar to, yet different from other species, and be knowledgeable and responsible citizens in understanding biological issues that could potentially impact their lives.

INSTRUCTIONAL RESOURCES

Campbell, Neil and Reece, Jane B; *Biology*, Seventh Edition; 2005; San Francisco, CA: Pearson Benjamin Cummings. **[CR1]**

CR1: Students and teachers use a recently published (within the last 10 years) college -level biology textbook.

Waterman, Margaret and Stanley, Ethel; *Biological Inquiry* (to accompany Campbell- Reece Biology), 7th Edition, 2005, Pearson Benjamin Cummings.

Llewellyn, Douglas, *Teaching High School Science Through Inquiry: A Case study approach*; 2005; Corwin Press/NSTA Press.

Dotti, Kristen; *Experimental Biology,* Catalyst Learning Curricula; 2005

AP Biology Investigative Lab Manual: An inquiry-based approach. 2012. New York, NY: The College Board.

Holtzclaw, Fred and Holtzclaw, Teresa Knapp; *AP Biology Test Prep Series*, 2008, Pearson Benjamin Cummings

Matt Ridley; *Genome: The Autobiography of a Species in 23 Chapters.* 1999, Harper Perennial.

TEACHER RESOURCES

College Board AP Teacher Community https://apcommunity.collegeboard.org
David Knuffke's Wiki- http://dpapbio.wikispaces.com/
Kim Foglia's Explore Biology- http://explorebiology.com

ADDITIONAL WEBSITES:

Websites for student use for review/homework/lab-prep are an integral tool for instructional purposes and student understanding. The following are a partial list of some of the sites I use on a daily /weekly basis http://kr021.k12.sd.us/krscience My personal classroom website provides links to relevant videos, animations, podcasts, class lab data, handouts, review resources, student lab reports, current events, journal articles, etc. to enhance instruction)

Genetics labs/activities-http://learn.genetics.utah.edu/
Understanding Evolution- http://evolution.berkeley.edu/evolibrary/article/evo_01

CASE STUDIES
Dotti, Kristen; *Diabetes Case Study*, Catalyst Learning Curricula, 2012
Dotti, Kristen; *Hemoglobin Case Study*, Catalyst Learning Curricula, 2012
The National Center for Case Study Teaching in Science-
http://sciencecases.lib.buffalo.edu/cs/
Island biogeography and evolution: Solving a phylogenetic puzzle using molecular genetics http://www.ucmp.berkeley.edu/fosrec/filson.html

Google docs and a class Wiki will provide a forum for students to share class lab data, allow student collaboration, and participate in group discussions. **[CR8]**

CR 8: The course provides opportunities for students to develop and record evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations.

INSTRUCTIONAL CONTENT

This course is designed around inquiry in the lab and the AP Biology Curriculum Framework, which is centered on the FOUR BIG IDEAS, the ENDURING UNDERSTANDINGS identified in the Curriculum Framework, and the seven SCIENCE PRACTICES shown below. Units will be designed to include the ESSENTIAL KNOWLEDGE components and all LEARNING OBJECTIVES will be addressed through this curriculum.

THE FOUR BIG IDEAS: **[CR2]**

This course is structured around the four big ideas and the enduring understandings identified in the Curriculum Framework. **[CR2]** All essential knowledge will be taught and all learning objectives will be addressed through this curriculum. The course will focus on inquiry-based laboratory work and the use of the seven science practices in both lab and non-lab activities.

CR2: The course is structured around the enduring under-standings within the big ideas as described in the AP Biology Curriculum Framework.

Big idea 1: The process of evolution drives the diversity and unity of life.

Big idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

Big idea 3: Living systems store, retrieve, transmit, and respond to information essential to life processes.

Big idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

<u>SCIENCE PRACTICES</u> [SP]

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories.
7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

Students will be given a copy of the BIG IDEAS and the ENDURING UNDERSTANDINGS to self-monitor mastery of these major organizing tools. The big ideas and enduring understandings will also be posted in the room. As connections are made across big ideas, a line will join the related enduring understandings, visually building a web or relatedness as the course progresses. The learning objectives will be used as a guide to build the rest of the class discussion, not just as a checklist to be marked off through the year, but as a way to help students learn content along with the use of specific science process skills. **[CR2], [CR3], [CR4]**

Daily openers will reinforce current content, revisit concepts covered in previous units, and help students make connections to current events and past material **[CR3][CR4].** Quizzes are interspersed throughout the unit and will provide feedback on student knowledge and ways instruction may need to be adjusted to address misconceptions and improve student learning.

Tests will consist of multiple choice questions from released AP Exams and past Free Response questions (FRQ's), as well as questions from the Campbell Test Bank. The AP Teacher Community is currently compiling a GoogleDocs set of questions based on the new curriculum changes that will also be included. Students will write answers to FRQ's weekly and as part of their unit tests. Unit tests will cover several chapters at once and may include questions from past units to allow students to practice answering questions require them to make connections between content from other units. **[CR3]**

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Use of case studies will provide students with opportunities to make connections between the Big Ideas, as well as, a variety of biological concepts listed in Enduring Understandings from the Curriculum Framework.
[CR3][CR4][CR5]

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP® Biology Curriculum Framework.

CR3: Students connect the enduring understandings within each of the AP Biology big ideas with at least one other big idea.

CR4: The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within the Big Ideas.

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens

INVESTIGATIVE LABORATORY COMPONENT

The course will also focus on inquiry-based laboratory work and the use of the seven science practices shown below in both lab and non-lab activities. The lab investigations performed, and the science practices reinforced, will emphasize the understanding of science as a process rather than an accumulation of facts and stress development and testing of the hypothesis; collection, analysis, and presentation of data; and a clear discussion of results. Peer review by other students will be an integral part of creating student designed lab protocols, graphing, results analysis, and preparation of final lab presentations. Students are engaged in student-directed investigation during the 25% of instructional time devoted to laboratory work. **[CR7]**

CR7: Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time.

Students will conduct a minimum of eight inquiry-based investigations. There will be at least two laboratory experiences per big idea selected from the 13 labs described in the *AP Biology Investigative Lab Manual: An inquiry-based approach (2012)* **[CR6].** These labs will be spread throughout the school year and will be conducted during at least one out of every four class meetings during the year. **[CR7]** Varying levels of inquiry (structured, guided, open) will be employed, as appropriate to each investigation. For example the Lab 3: Blast analysis lab is designed to allow students to first complete the analysis in a more structured format to see how to do it, then they can come up with their own question to answer as an independent investigation. However, Lab 1: Artificial selection lab can be completed as an open investigation with little set up other than directions on starting the plants and how to pollinate the flowers. Wisconsin Fast plants seeds for Lab 1 will be started the first week of school and this lab will be ongoing throughout the school year. Supplemental labs and activities will also be used to widen the range of topics covered in a hands-on, discovery mode. By undertaking a variety of investigations throughout the course, all seven science practice skills will be used by students on a regular basis with a goal of leading students toward open inquiry investigations **[SP7].** The science practice skills need to be honed over the entire course and reinforced through opportunities to make observations, ask questions based on those observations, and investigate their own questions, both in and out of the designated lab times. The switch from "cook book" type labs to student-designed investigations is a vital part of the new curriculum. In addition to the 13 AP Biology labs, additional labs will be conducted to deepen students' conceptual understanding and to reinforce the application of science practices within a hands-on, discovery based environment. The course will provide opportunities for students to develop, record, and communicate the results of their laboratory investigations.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.

AP LABS THAT WILL BE COMPLETED:

SEE TABLE on PAGE 11 FOR INCLUDED SCIENCE PRACTICES [CR6]

BIG IDEA 1: EVOLUTION

BLAST Activity: Students will use the NCBI to compare DNA and protein sequences for organisms to test student-generated hypotheses on their relatedness

ARTIFICIAL SELECTION: Students will grow organisms such as Wisconsin Fast Plants and select for specific traits over several generations

BIG IDEA 2: CELLULAR PROCESSES; ENERGY AND MATTER

CELLULAR RESPIRATION: Students will investigate some aspect of cellular respiration in organisms

PHOTOSYNTHESIS: Students will investigate photosynthetic rate under a variety of student selected conditions

OSMOSIS and DIFFUSION: Students will investigate the factors that affect transport in cells

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.

BIG IDEA 3: GENETICS AND INFORMATION TRANSFER

CELL DIVISION: MITOSIS and MEIOSIS. Students compare mitotic rate after exposure to lectin or other substances presumed to affect mitotic rate

BACTERIAL TRANSFORMATION LAB: Students investigate bacterial transformation using the pGLO plasmid

RESTRICTION ENZYME ANALYSIS: Students investigate restriction enzyme analysis

BIG IDEA 4: INTERACTIONS

ENERGY DYNAMICS: Students develop and analyze model systems that describe energy flow.

TRANSPIRATION: Students investigate the movement of water through whole plants in a model system.

ENZYME INVESTIGATION: In an open inquiry lab, students will investigate and quantify factors that affect enzyme action.

Students will maintain a written record (portfolio) to document the laboratory investigations they conduct, as well as, many of other activities. [**CR8]** In addition they will be encouraged to choose and use a variety of methods to present their data/results including the following:

- Formal lab reports that emphasizes the development and testing of a hypothesis, the ability to organize collected data, and the ability to analyze and clearly discuss the results
- Mini posters that contain the main components of a formal lab in poster form which are presented to small groups or the whole class
- Videos of lab protocols, data analysis, and conclusions
- publication of lab on the class Wikipage or GoogleDocs.

All forms of communication must include the proper labeling of tables and graphs, and statistical analysis of data wherever possible.

CR 8: The course provides opportunities for students to develop and record evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations.

Students will complete journals summarizing daily activities, describing any questions or confusion they have, plus describing how the day's content connects with other topics in Biology and giving an elaboration or extended explanation of the content (beyond what was discussed in class) Journals will be collected once a week and graded on a 10 point scale. At the end of year students will compile their lab write ups for the year and describe and reflect on the scientific skills they gained. **[CR8]**

CR 8: The course provides opportunities for students to develop and record evidence of their verbal, written, and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic

MATHEMATICAL DATA ANALYSIS

Students will identify and use appropriate mathematical procedures to analyze data from their experimental investigations. **[SP2] [SP5]** These include, but are not limited to, an understanding of and ability to appropriately apply the concepts of Mean, Standard Error, and Standard deviation, paired and unpaired t-test, and Chi-square analysis.

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

SOUTH DAKOTA STATE UNIVERSITY/NSF GRANT

Students will also be participating in a research/outreach program with graduate students and faculty at South Dakota State University located in our town. As part of a National Science Foundation grant funding research dealing with *"Production of a cyclic hydrocarbon from CO_2 using the cyanofactory platform"* , this project's primary activities will be focused around bench-scale research along with faculty and graduate students, exposes students to cutting edge technologies, and provides real-world examples of sustainable energy technologies that are currently under development **[CR5][CR6].**

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.

EXAMPLES ILLUSTRATING CONNECTIONS MADE THROUGHOUT THE COURSE [CR3]

The 4 Big Ideas are interrelated and will not be taught in isolation. Learning to recognize these recurring themes provides a framework to see the "big picture", rather than just memorizing facts independently. This allows students to make connections to real world situations, and provides them with a foundation for answering unfamiliar questions, both on the AP Exam and in real life. The course will connect the enduring understandings from one big idea with those of the others whenever possible. Students will maintain a curricular map of the big ideas and enduring understandings showing the connections as they are made by the students themselves.

CR3a: Students connect the enduring understandings within Big Ideas to at least one other Big Idea.

Theodosius Dobzhansky stated "Nothing in biology makes sense except in the light of evolution". Evolution is the foundation upon which this entire course is based and it will be referenced throughout the entire course. **[CR3a]** In addition, science as a process will be woven throughout both the lab investigations and in-class activities.

The following are just some examples of activities/connections that will be incorporated into the curriculum. There are many other activities that will be included. **[CR3]**

Beta Globin Activity- Students analyze a map of the beta hemoglobin gene and corresponding amino acid sequence to come to an understanding about reading frames, introns, transcription of DNA into mRNA message and translation of this message into a polypeptide. This activity also allows links to discussion of mutations, sickle cell anemia, and heterozygote advantage, and evolution of allele frequencies in populations where malaria is prevalent. Connects Big Idea 1 and Big Idea 3 **[CR3a]**

1.A.2.c: Some phenotypic variations significantly increase or decrease fitness of the organisms and the population Ex: sickle cell anemia

3.A.3.c. Certain human genetic disorders can be attributed to the inheritance of single gene traits or specific chromosomal changes, such as nondisjunction EX: Sickle cell anemia

CR3a: Students connect the enduring understandings within Big Idea 1 to at least one other big idea.

Neuron/Synapse activity–Diagram and compare/contrast all the types of passive/active transport involved with the depolarization/repolarization of a neuron/muscle cell during the transmission of a signal across a synapse. Connects Big Idea 2 and Big Idea 3 **[CR3b]**

2.B.2a Passive transport does not require the input of metabolic energy; the net movement of molecules is from high concentration to low concentration

2.B.2.b Active transport requires free energy to move molecules from regions of low concentration to regions of high concentration

3.E.2.a The neuron is the basic structure of the nervous system that reflects function

3.E.2.b Actions potentials propagate impulses along neurons

3. E.2.c Transmission of information between neurons occurs across synapses

CR3b: Students connect the enduring understandings within Big Idea 2 to at least one other big idea.

Frankenfoods Case study/Genetically Modified Food Debate-Students research the pros and cons of GMO's and participate in a classroom debate over their use. Connects Big Idea 3 and Big Idea 4 **[CR3c]**

3.A.1.f: Illustrative examples of produces of genetic engineering include: Genetically modified food

4.A.6.f Human activities impact ecosystems on local, regional, and global scales

CR3c: Students connect the enduring understandings within Big Idea 3 to at least one other big idea.

Pool Noodle operons- Students model how *lac* and *trp* operons work and then compare and contrast the two types of gene regulation Connects Big Idea 4 and Big Idea 3 **[CR3d]**

4.C.2.a. Environmental factors influence many traits both directly and indirectly EX: effect of adding lactose to a Lac^+ bacterial culture

3.B.1.a.1 Regulatory sequences are stretches of DNA that interact with regulatory proteins to control transcription

3.B.1.b.2. The expression of specific genes can be inhibited by the presence of a repressor.

CR3d: Students connect the enduring understandings within Big Idea 4 to at least one other big idea.

This is by no means a complete listing of all possible links between Big Ideas; it merely provides a few examples used to show interconnectedness. Links abound in Biology and students will be asked to look for, write about, and map a variety of connections as they move through the year.

MEETING LEARNING OBJECTIVES WITH NON-LABORATORY ACTIVITIES [CR4]
I think science isn't just facts to read about in a book. It needs to be felt, touched, acted out, modeled, and put to music. I think that presenting science knowledge in a variety of different ways helps students to more easily grasp concepts and retain information, but it also makes learning science fun. Students learn in a variety of ways and planning activities that use a variety of formats (auditory, visual, kinesthetic) allows students to come into their understanding of content through "different doors". Students will frequently be required to create visuals such as flow charts, labeled diagrams, theatrical representations, and models that clarify and connect complex topics to the big ideas and enduring understandings. In addition, all of these different activities provide opportunities to meet the Learning Objectives outside of laboratory investigations. **[C4]** Not only does teaching science in this way allow students to make connections between Big Ideas and learn in different ways using some of their "other intelligences", it also provides a huge variety of opportunities to model scientific processes, see concepts in a variety of scaling dimensions, work with scientific explanations and theories, and connect to real world examples Some examples are provided below.

CR4a:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.

CR4b:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

CR4c:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

Students can:

- Use biogeography, morphology, and DNA sequence data to explore evolution in lizard populations and create a cladogram showing phylogenetic relationships in the Lizard Evolution case study

  LO 1.19 The student is able to create a phylogenetic tree or simple cladogram that correctly represents evolutionary history and speciation from a provided data set.
  [CR4a][SP 1.1] Essential Knowledge 1.B.2

  LO 1.9 The student is able to refine evidence provided by data from many scientific disciplines that support biological evolution ***[CR4a][SP5.3] Essential Knowledge 1.A.4***

  LO 1.18 The student is able to evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a simple cladogram to determine evolutionary history and speciation
  [CR4a][SP 1.1] Essential Knowledge 1.B.2

- *Build red blood cells to model blood typing and immune response using Pool noodles*
  LO 2.29 The student can create representations and models to describe immune responses ***[CR4b] [SP1.1 & 1.2] Essential Knowledge 2.D.4***

- Diagram and compare/contrast all the types of passive/active transport involved with the depolarization/repolarization of a neuron/muscle cell during the transmission of a signal across a synapse
  LO2.11 The student is able to construct models that connect the movement of molecules across membranes with membrane structure and function
  [CR4b][SP1.1,7.1] Essential Knowledge 2.B.1

- compare and contrast inducible and repressible gene regulation with *lac* and *trp* operons made from pool noodles
  LO 3.21 The student can use representations to describe how gene regulation influences cell products and functions ***[CR4c][SP1.4] Essential Knowledge 3.B.1***

- become a DNA molecule and act out replication
  LO 3.3 The student is able to describe representations and models that illustrate how genetic information is copied for transmission between generations
  [CR4c][SP1.2]Essential Knowledge 3.A.1

- model the process of translation by making baby linker polypeptide chains
  LO 3.4 The student is able to describe representations and models that illustrate how genetic information is translated into polypeptides
  [CR4c][SP1.2] Essential Knowledge 3.A.

- model cell signaling, and organelle function in action via the T & T (transcription & translation) Café activity
  LO 3.4 The student is able to describe representations and models that illustrate how genetic information is translated into polypeptides
  [CR4c][SP1.2] Essential Knowledge 3.A.1

  LO4.6 The student is able to use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions, provide essential functions
  [CR4d][SP1.3] Essential Knowledge 4.A.2

- Use Home Range Data from mice and vole populations to create territory maps, look at dispersion patterns, and make predictions about mating systems
  LO4.19 The student is able to use data analysis to refine observations and measurement regarding the effect of populations interactions on patterns of species distribution and abundance ***[CR4d][SP5.2] Essential Knowledge 4.B.3***

CR4c: The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

CR4d:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

This is by no means a complete listing of all possible links between LEARNING OBJECTIVES and activities. It merely provides a few examples used to show interconnectedness. Links abound in Biology and students will be asked to look for, write about, and map a variety of connections as they move through the year.

<u>INCORPORATION SOCIAL and ETHICAL CONCERNS</u>: **[CR5]**
It is vitally important that students connect their classroom knowledge to socially important issues. Discussion of science articles in the science sections of newspapers, popular science magazines such as <u>Scientific American</u> and <u>Discover</u>, and science journals such as *Science* and *Nature* will be used throughout the course, to link biology topics covered in the chapter to real world environmental and social concerns. The course will allow students to learn about and discuss many issues in a variety of formats. Examples of topics may include, but are not limited to, the following: stem cell research, global climate change, antibiotic resistant bacteria, and genetically modified food.

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

For example news reports of the incidence of West Nile virus in populations in South Dakota could add an additional connection to content on viruses and host/virus interactions **[CR5][CR4d][CR4c].** This last year the South Dakota legislature passed a non-binding resolution declaring that Global warming was 'just a theory' and therefore shouldn't be taught in schools led to a great discussion about the nature of science, the scientific process, peer review, and how the word theory is used differently by a scientist compared to a lay person. **[CR5]**[**CR4d]** A news story on the increase in childhood obesity in the United States is a great segue into a whole host of topics including digestion, evolution, molecules (carbohydrates, insulin), body systems (cardiovascular), diabetes, hormone regulation, feedback loops, etc. **[CR5]**[**CR4]**[**CR3]**

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

USING CASE STUDIES TO MAKE CONNECTIONS BETWEEN THE BIG IDEAS

The connections between the big ideas will be introduced and reinforced throughout the year. One way to make connections between Big Ideas is to incorporate case studies into the curriculum. Students will be participating in several case studies throughout the year.

1) LIZARD EVOLUTION CASE STUDY: http://www.ucmp.berkeley.edu/fosrec/Filson.html

Students hypothesize a scenario then use actual data based on biogeography, geology, morphology, and analysis of DNA sequences from lizard populations to create a cladogram showing evolutionary relationships between several species of lizards on the Canary island chain. This activity will be used prior to doing Lab 3: BLAST analysis. **[CR4a]**

CR4a:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.

2) FRANKENFOODS CASE STUDY: [CR4c] & [CR4d]

Biotechnology is now an integral part of agricultural and vegetable production and the stakes are high for industry and agriculture as well as the consumer. In working through the case study, students examine the scientific and ethical issues of agricultural biotechnology and are asked to consider the following:

- The advantages and disadvantages of genetically modified crops.
- The economic and socio-political issues associated with increasing corporate control of our food supply.
- The ethics of modifying the genes of an organism.

CR4c: The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

CR4d:The students are provided with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

3) DIABETES CASE STUDY

With the rising incidence of obesity and Type II Diabetes in our state, most students will be touched directly or indirectly by this disease **[CR5]**. Students will learn about the importance of carbohydrates as the basis of cellular energy and the consequences that occur when supply exceeds demand within an organism. **[CR3b & CR3d]** They will examine the delicate control mechanisms that occur inside cells and between cells to maintain a constant supply of energy and how cell signals are used **[CR3c]** to monitor and regulate organs to provide homeostasis for

the entire system. The interaction of insulin and glucagon with various tissues teaches the mechanisms of cell membrane transport, cell communication and regulatory feedback that hold blood sugar levels in a tightly defined range. Students will learn the impact of high blood sugar on the kidneys and other organs and what actions can be taken to avoid irreparable damage. This case study will impress upon students that, while there are issues of genetic predisposition that affect metabolism, the actions they take now will have a great impact on their probability of developing diabetes as adults.

CR3b: Students connect the enduring understandings within Big Idea 2 to at least one other big idea.

CR3d: Students connect the enduring understandings within Big Idea 4 to at least one other big idea.

ADDITIONAL READING SELECTIONS

In addition, students will use short readings from books, such as Matt Ridley's *Genome*: *An Autobiography of a Species in 23 Chapters*; Michael Pollan's *The Omnivore's Dilemma: A Natural History of Four Meals*, Neil Shubin's *Your Inner Fish*, and Sharon Moalem's *Survival of the Sickest* to help them make connections from content they are learning to real world examples. **[CR5].** The intent of these short readings are to 1) be exposed to the "story" of science as a dynamic process impacted by biological, social, economic, and ethical influences, 2) learn science from a source other than a textbook, as I believe that gaining science-related information from more "popular press" sources is a life-long skill (and source of enjoyment!), and 3) pique the interest of the student to the point that they choose to read the entire book.

CR5: The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens.

EXAM REVIEW

Students will have practice answering AP BIO exam-type questions in each of the units including multiple choice and free-response questions. Students will also have the opportunity to both answer and grade (using a rubric) free-response questions from previous AP Exams, in order to better understand what is expected and how write the best answers they can on the AP Exam. We will also spend the last week of class before the AP Exam reviewing content and practicing free response format questions.

AFTER AP EXAM: SPECIAL PROJECTS

Once students have taken the AP BIOLOGY exam, the remaining class time (8 days) will be used for special projects. Students will be asked to demonstrate their knowledge of a biological concept by creating a children's book or designing a game that explains their chosen topic. Other activities will include discussions of videos such as "Lorenzo's Oil", "Super-size me", or "March of the Penguins", more time for student designed experimentation, or other activities of interest to students.

<u>COURSE SCHEDULE</u> Includes 175 class periods plus TWO "In-school AP Bio Field trip" days which adds 12 additional class periods to the schedule. *LABS/ACTIVITIES listed are representative and are NOT a complete list of all those that are included in unit design. See LABS/ACTIVITIES section for descriptions

WEEK (DAYS)	**TOPICS <u>I. Molecules and Cells –</u> (38 days)**	**LABS & ACTIVITIES ***
8/29-31 (3)	<u>INTRO/SCIENTIFIC METHOD (Chapter 1)</u> • Big Ideas • Designing an experiment • Peer review process • Data analysis • Evolution review	◦ Catch the Scent: Termite/pheromone Activity ◦ Pillbug Preferences Lab ◦ Measurement lab ◦ Start Fast Plants for LAB 1
9/4-7 (4)	<u>UNIT 1- CHEMISTRY OF LIFE</u> <u>BIG IDEAS 2, 3 & 4</u> Water (Chapter 3) • Properties of water **[2.A.3a.3]** Macromolecules (Chapter 4 & 5) • C, H, O, P, S **[2.A.3a]** • Carbon compounds/isomers • Monomers/Polymers [• Nucleic acids **[3.A.1] [4.A.1.b.1]** • DNA vs RNA **[3.A.1.b.2]**	◦ Properties of water Lab **[CR4b]** ◦ Kim Foglia's cut& paste Molecules **[SP1]**
9/10-14 (5)	• types of RNA (RNAi) **[3.A.1.b.4]** • Proteins **[4.A.1.a2]** • Protein folding **[4.A.1.b.2]** • Lipids **[4.A.1.a.3]** • Carbohydrates **[4.A.1.a.4]** • Directionality **[4.A.1.b]** • Emergent properties **[Big Idea 4]**	◦ 3-D Toober protein folding Activity **[SP1]** ◦ Biomolecule concept maps **[CR4d]**
9/17-19 (3)	<u>UNIT 2- CELLS</u> **[Big IDEAS 2,3,& 4]** The Cell (Chapter 6) • Sub-cellular components structure & function **[4.A.2]** • Cell walls **[2.B.1.c] [3.D.2]**	◦ Pool Noodle Blood typing activity **[CR4b]**
9/20-21 (2)	• Organelle interactions **[4.A.2]** • Prokaryotic and eukaryotic cells **[2.B.3]** Cell membranes (Chapter 7) **[2.B.1]** • Fluid mosaic model **[2.B.2]** • Phospholipids **[4.C.1]** • Passive/Active Transport **[2.B.2 a & b]** • Role of membrane proteins **[2.B.2]**	◦ Cell parts charades **[CR4b]** LAB 4 Osmosis and diffusion
9/24-25 (2)	• Surface area/volume **[2.A.3.b.1 & 2]** • Selective permeability **[2.B.1]** • Tonicity **[2.B.2]**	LAB 11: Transpiration
9/26-28 (3)	• Neuron Structure/function **[3.E.2.b]** • transmission/neurotransmitters **[3.E.2.c]** • Vertebrate brain **[3.E.2.d]**	◦ Neuron/synapse transport activity **[CR4b]**
10/1-5 (5)	<u>UNIT 3 Metabolism & Enzymes</u> <u>BIG IDEAS 2 & 4</u> Metabolism (Chap 8) • Free Energy (ATP) **[2.A.1]** • Coupled reactions **[2.A.1.b.3]**	◦ Be an enzyme modeling activity **[CR4b]** LAB 13 Enzyme Activity

10/9-12 (4) 10/15-16 (2)	• Enzymes **[4.B.1]** • Energy used for cell processes **[2.A.1.d]** • Free energy in ecosystems **[2.A.1.e & f]** Cellular Respiration (Chap 9) **[2.A.1] [2.A.2]** • Glycolysis, fermentation, & aerobic respiration **[2.A.1.c]** Photosynthesis (Chapter 10) • Light dependent/Light independent pathways **[2.A.1] [2.A.2]** • C3, C4 & CAM Photosynthesis	LAB 6 Cellular Respiration LAB 5 Photosynthesis
10/22-23 (2) 10/17-19 (3)	<u>UNIT 4</u>- Cell division (BIG IDEA 3) Mitosis (Chapter 12) • Mitosis and cytokinesis **[3.A.2]** • Cell cycle regulation**[3.A.2]** • Cancer **[3/A/2/a/2]** • Apoptosis **[2.E.1.c]** Meiosis and Sexual Life Cycles (Chapter 13) • Sexual and Asexual reproduction • Meiosis and gametogenesis **[3.C.2.c]** • Mitosis/meiosis comparison	LAB #7 Mitosis/Meiosis
DATES	<u>Genetics & DNA –</u> (60 days)	LABS & ACTIVITIES
10/24-26 (3) 10/29-31 (3) 11/1-2 (2) 11/5-8 (4)	<u>UNIT 5 GENETICS</u> (Chapters 13 – 21) **[BIG IDEAS 3 & 4]** • Probability **[3.A.3.a]** • Origins of genetic variation **[3.C.1] [4.C.1]** • Evolutionary significance of genetic variation **[3.C.1.d]** Heredity (Chap 14) **[3.A.3]** • Mendel's Laws and probability **[3.A.3.b]** • Inheritance patterns **[3.A.3.b.3]** • Human genetic disorders **[3.A.3.c]** • Ethical issues: Genetic testing; DNA privacy & ownership; stem cell research **[3.A.3.d] [CR5]**	○ M & M Chi square Activity **[CR4a]** ○ Fruit fly genetic crosses **[CR4c]** ○ Stem cell Ethics debate **[2.E.1] [CR5] [CR4c]**
11/12-16 (5) 11/19-20 (2) 11/26-30 (5) 12/3-7 (5) 12/10-14 (5) 12/17-20 (4)	<u>UNIT 6 – DNA I</u> **[BIG IDEAS 3 & 4]** Chromosomal Basis of Inheritance (Chap 15) •DNA/RNA structure & function **[3.A.1]** • Sex linked/limited genes **[3.A.4.b]** • Chromosomal abnormalities **[3.C.1]** • Non-Mendelian genetics **[3.A.4]** • Environmental influence on gene expression **[4.C.2]** • Non-nuclear DNA **[3.A.4.c]** Molecular Genetics (Chap 16) • DNA structure **[3.A.1] [4.A.1]**	○ Genetic disorders concept maps **[SP1] [CR4c]** ○ Kim Folgia replication Cut & Paste **[SP1] [CR3c]**

(+ 6) FIELD TRIP DAY XMAS BREAK 1/3-4 (2) 1/7-11 (5) 1/14-18 (5) 1/22-25 (4)	From Gene to Protein (Chap 17) • Replication **[3.A.1.a.5]** • Transcription & translation **[3.A.1]** • Post transcriptional processing **[3.A.1.c.2]** • Regulation of gene expression **[3.B.1]** • intracellular signals/expression **[3.B.2]** • Mutations **[3.C.1]** Bacteria/Viruses (Chap 18) • DNA and RNA Viruses **[3.C.3]** • Horizontal gene transfer **[3.C.2]** • Operons **[2.C.1.a]** Eukaryotic Genomes (Chap 19) • Organization of DNA **[3.A.1.b]** • Regulation of Gene Expression **[2.E.1] [3.B.1]** DNA Technology (Chapter 20) **[3.A.1.e]** • Recombinant DNA • DNA electrophoresis • Restriction enzyme analysis • PCR • Ethics- Genetically Modified Food, Transgenic animals, cloning **[CR5]** Genetic Basis of Development (Chap 21) • Development and differentiation **[2.E.1]** • Hox genes **[2.E.1] [3.B.2.b]**	○ T & T Cafe activity **[SP1] [CR4b, 4c, & 4d]** ○ 3-D Molecular Designs Beta Globin gene **[CR4c]** ○ Pool Noodle operons **[SP1] [CR4b,c,& d]** ○ Frankenfoods Case study **[CR5] [CR4 c]** ○ Recombinant Plasmid Cut & Paste Activity **[SP1] [CR4c]** LAB 9 DNA analysis LAB 8 pGLO Bacterial transformation
	<u>Evolution and Organisms (24 days)</u>	
1/28-2/1 (5) 2/4-8 (5) 2/11-15 (5) 2/19-22(4) 2/25-3/1 (5)	<u>UNIT 7 -Evolution</u> (Chapters 22 – 26) **[BIG IDEA 1]** Descent with Modification (Chapter 22) • Darwin's theory **[1.A.1-3]** • Descent with modification & Natural selection **[1.A.1]** • Evidence for Darwin's theory **[1.A.4] [1.B.1]** Evolution of Populations (Chapter 23) **[1.A.1]** • Gene pools and allele frequencies **[1.A.4]** • Hardy-Weinberg equilibrium **[1.A.1]** • Natural selection & genetic drift **[1.A.3]** Origin of Species (Chapter 24) • Speciation **[1.C.2]** • Patterns of evolution **[1.C.1]** Phylogeny and Systematics (Chapter 25) • Phylogenetic classification **[1.B.2]** • Cladograms **[1.B.2]** Tree of Life (Chapter 26) • Early Earth/Origin of life **[1.D.1&2]** • Fossil record/dating **[1.D.2]** • History of life on Earth **[1.D.2.a]**	○ Case Study: Lizard Evolution **[SP1] [CR4a]** LAB 2 Hardy-Weinberg **[1.A.1]** ○ Grebe Grebe **[SP1] [CR4a]** LAB 1 Artificial Selection using Fast plants **[1.a.2.d]** LAB 3 BLAST **[1.A.4.b.4]** ○ Access Excellence; Phylo tree activity **[CR4a]**

DATES	Homeostasis, Signaling, Organ systems (45 Days)	LABS/ACTIVITIES
	UNIT 8: Homeostasis, Signaling, & Organisms	
	[BIG IDEAS 2. 3. 4]	
3/4-8 (5)	Animal Systems (Chap 32,33,34, 40 – 49)	
	• Structure and function **[2.D.2]**	
	• Homeostasis **[2.B.2] [2.C.2] [2.D.3]**	○ Insulin Case Study
	• Feedback mechanisms **[2.C.1]**	**[CR4 b,c,& d]**
	•Thermoregulation**[2.A.1.D.1]**	
	• Endothermy/Ectothermy	
3/11-15 (5)	Body systems **[2.D.2] [4.B.2]**	
	Nervous **[3.E.2] [4.A.4]**	
3/18-22 (5)	Immune **[2.D.3 & 4]**	
3/25-27 (3)	Excretory **[2.D.2]**	○ Virtual Rat Endocrine Activity
	Endocrine/hormones **[3.D.1-4]**	**[CR4 c & d]**
SPRING	Animal development **[4.A.4]**	
BREAK	Cell Communication (Chapter 11)	
	•Stimulus/response **[2.C.2.a] [2.E.2]**	○ Hormone Wanted Posters
4/2-4/5 (4)	• Cell signaling **[3.B.2.b]**	**[CR4c &d]**
	• Signal Transduction **[3.D.1]**	
	• Cyclic AMP **[3.D.3.b]**	
	Plants (parts of Chapters 29, 30, 35 – 39)	
	• Reproduction	
	• Cell Signaling/Hormones	○ Cell Signaling theater
	• Tropism and photoperiodicity	**[SP1] [CR4c & d]**
	[2.C.2] [2.F.2] [2.E.3]	
	UNIT 9- Ecology (BIG IDEAS 2, 3, & 4)	
4/8-12 (5)	Ecology and Biosphere (Chapter 50)	
	• Energy & trophic levels **[2.A.1.f]**	
	• Biotic/abiotic factors **[2.D.1.c]**	
	• Organism interactions **[2.D.1.b]**	
	• Food webs **[4.A.6]**	LAB 12 Fruit fly Behavior Lab
	Behavioral ecology (Chapter 51) **[2.E.3]**	
	• Innate/Learned behaviors **[2.E.3.a]**	
4/15-19 (5)	• Natural selection of traits **[2.E.3.b]**	○Home Range data analysis
	• Communication/responses **[3.E.1]**	mice & voles **[CR4 a, c, & d]**
4/22-26 (5)	Population ecology (Chapter 52)	
	• Density and dispersion **[4.A.5.c]**	
4/29-30 (2)	• Carrying capacity **[4.A.5]**	LAB 10: Energy Dynamics
	• Population modeling **[4.A.5.c]**	
(+ 6) FIELD	Community ecology (Chapter 53)	○Mark and Recapture activity
TRIP DAY	• Ecosystem interactions **[4.B.3]**	**[CR4d]**
5/6-10	• Keystone species **[4.B.3][4.C.4]**	
(5 days)	Ecosystems (Chapter 54)	
	• Energy flow and cycles **[2.A.3.a]**	
	• Human impact **[4.A.6] [4.B.3 & 4] [4.B.3.c]**	
	Conservation and Restoration (Chapter 55)	
	• Biodiversity threats **[4.A.6] [2.D.3]**	
5/13 (1)	AP BIO EXAM	
5/14-17 (3) 5/20-23 (4)	Special projects: Children's book, review games, video discussions, cookie contest	See "AFTER AP EXAM"

CR3: Students connect the enduring understandings within each of the AP Biology big ideas with at least one other big idea

CR4: The course provides opportunities outside of the laboratory investigations to meet the learning objectives within Big Ideas.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.

UNITS and ACTIVITIES **BIG IDEAS/SCIENCE PRACTICES** **Matrix** **Activities/labs listed are NOT a complete list, but are a representation of a variety of those that will be used.**	**1. use representations and models**	**2. use mathematics**	**3. engage in scientific questioning**	**4. plan & implement data collection strategies**	**5. perform data analysis & evaluation of evidence**	**6. work with scientific explanations/theories**	**7. connect & relate knowledge**	**Big Idea 1; Evolution**	**Big Idea 2: Energy Processes**	**Big Idea 3: Information**	**Big Idea 4: Interactions**
INTRO/Scientific method/Peer review process/Data analysis											
Termite/Pheromone Activity **[CR4.c & d]**		X	X	X	X	X	X			X	X
Science as a Process: Measurement lab		X	X	X	X	X	X				
Pillbug preferences lab **[CR4.c & d]**		X	X	X	X	X	X			X	X
LAB #1: Artificial Selection **[CR6]** Start Fast Plants/will continue throughout year	X	X	X	X	X	X	X	X			
UNIT 1:BIOCHEMISTRY OF LIFE											
Kim Foglia's Macromolecule Cut & Paste **[CR4b]**	X					X	X			X	
Properties of water lab **[CR4a]**		X	X				X		X		
Toobers: 3-D Protein folding **[CR4.b,c,& d]**	X		X			X	X		X	X	X
UNIT 2:CELLS											
LAB 4 : Diffusion & osmosis **[CR6]**	X	X	X	X	X	X	X		X		
Pool noodle Blood types activity **[CR4.c & d]**	X					X	X			X	X
LAB 11 :Transpiration **[CR6]**		X	X	X	X	X	X		X		
UNIT 3: METABOLISM & ENZYMES											
Be an enzyme activity **[CR4.c & d]**	X					X	X		X	X	

Lab 13: Enzymes **[CR6]**		X	X	X	X	X	X				X
Lab 6: Cellular Respiration **[CR6]**		X	X	X	X	X	X		X		
LAB 5: Photosynthesis **[CR6]**		X	X	X	X	X	X		X		
UNIT 4: CELL DIVISION											
LAB 7: Mitosis & Meiosis **[CR6]**		X	X	X	X	X	X	X		X	
UNIT 5: GENETICS											
Fruit fly genetics crosses	X	X	X	X	X	X	X			X	
M & M Chi square activity **[CR4.c]**	X	X	X	X	X	X	X	X			
Stem Cell Ethics Debate **[CR4.c] [CR5]**						X	X				X
Unit 6:DNA											
T & T Café activity **[CR4.c & d]**	X					X	X	X		X	X
Pool noodle operons **[CR4.c]**	X					X	X	X		X	
LAB 3: BLAST (student-designed) **[CR6]**	X	X	X	X	X	X	X	X	X	X	
LAB 8: pGLO Bacterial Transformation **[CR6]**		X	X	X	X	X	X	X		X	
LAB 9: DNA analysis **[CR6]**		X	X	X	X	X	X	X		X	
Frankenfoods Case Study **[CR5] [CR4**							X	X		X	
Kim Foglia Replication Cut & Paste **[CR4.b & c]**	X		X			X	X		X	X	
Recombinant Plasmid Cut & Paste **[CR4.c]**	X		X			X	X			X	
◦ Beta Globin gene activity **[CR4c]**	X					X	X	X		X	X
UNIT 7: EVOLUTION/BIODIVERSITY											
Lizard Evolution Case study **[CR4a]**	X	X	X	X	X	X	X	X		X	
LAB 3: BLAST lab **[CR6]**	X	X	X	X	X	X	X	X		X	
LAB 1: Fast Plant Artificial Selection lab **[CR6]**	X	X	X	X	X	X	X	X			
Grebe Grebe **[CR4a]**	X					X	X	X			
LAB 2 : Hardy-Weinberg **[CR6]**	X	X	X	X	X	X	X	X			
Access Excellence; Phylo tree activity **[CR4a]**	X	X	X	X	X	X	X	X		X	

UNIT 8: HOMEOSTASIS, SIGNALING, & ORGANISMS											
Insulin Case study **[CR4.a,b,c & d]**						X	X	X	X	X	X
Hormone Wanted Posters **[CR4.b,c & d]**	X					X	X		X	X	X
Cell Signaling theater **[CR4.b,c,& d]**	X					X	X		X	X	X
Virtual Rat Endocrine Physiology **[CR4c & d]**	X					X	X	X		X	X
UNIT 9: ECOLOGY/BEHAVIOR											
Lab 10: Energy Dynamics **[CR6]**	X	X	X	X	X	X	X		X		X
Lab 12: Fruit fly behavior **[CR6]**		X	X	X	X	X	X				X
Home Range data analysis mice/voles **[CR4 a,c,& d]**		X			X	X	X	X		X	X
Mark and Recapture Activity **[CR4d]**	X	X	X	X	X	X	X				X