

AP[®] Biology: Sample Syllabus 4

Curricular Requirements	Page(s)
CR1 Students and teachers use a recently published (within the last 10 years) college-level biology textbook.	1
CR2 The course is structured around the enduring understandings within the big ideas as described in the AP [®] Biology Curriculum Framework.	2,3,4,5,6,7,8,9
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.	3,7,8
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.	4
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.	6
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.	2,3,4,9
CR4a The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	2,3,7
CR4b The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.	2,3,4,5
CR4c The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.	3,6
CR4d The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.	3,9
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.	5,6,7,9
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.	1,2,3,4,5,6,7,8,9
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.	1
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.	1,2,3,4,5,8,9

Course Overview

In AP Biology, an emphasis is on students making connections between the big ideas within the AP Biology Curriculum Framework. I teach the equivalent of an introductory college-level biology course, and it is designed to prepare students for the AP Biology Exam.

My philosophy is to actively engage students in the process of science through class assignments and discussions which inform their laboratory experiences. For example, I increase students' critical thinking and problem solving abilities by actively requiring them to anticipate experimental set ups in group discussions, journal readings and hands-on labs. Emphasis is also given to journal article readings in order to expose students to present day technologies and procedures to familiarize them to limitations of testable hypotheses in order to develop better designed experimental investigations.

Lab techniques are learned through researching journal papers, hands-on labs which make up at least 25% of instructional time, and at least two field trips to pharmaceutical companies. **[CR7]** Labs emphasize development and testing of the hypothesis, collection, analysis and presentation of data, as well as discussion of results to discover unanswered questions about the particular topics addressed. A minimum of two labs in each big idea will be conducted. **[CR6]** Students are required to report on all laboratory investigations. **[CR8]** The student-directed and inquiry-based laboratory investigations used throughout the course enable students to apply the seven science practices as defined in the Curriculum Framework.

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.

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.

Materials

Campbell, Neil and Reece, Jane B. AP Edition Biology, Eleventh Edition. San Francisco, CA: Pearson Benjamin Cummings, 2016. **[CR1]**

Campbell, Neil. Student AP Edition Biology Student Study Guide, Eighth Edition. Biology Laboratory Manual, 8/e by Vodopich and Moore, 2008.

AP Biology Investigative Labs: An Inquiry-Based Approach, The College Board, 2012.

Extra interest reading: Survival of the Sickest. Maolem, Sharone.

Laboratory/classroom combination that includes the space, facilities, and equipment to safely conduct hands-on inquiry-based investigations.

Released multiple choice tests and Free Response biology questions from 1968 to present.

Selected websites and electronic media: (see longer list at end of document)

AP Central.

There are many sites available with labs, exercises, quizzes etc. to be used as supplementary study resources (indicated in each section as well).

Eduweblabs site offers labs as excellent online practice for students before coming into wet lab.

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.

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

Course Schedule

READINGS Include textbook/ journal articles. Students are provided with guided reading questions and are required to take notes.

ACTIVITY/LABS 1day = 1 class period [1week = 10days] Some activities are expected to be performed outside of class time & students are expected to hand in lab reports for evidence of completion. Eduweblabs explained above are all done on student time.

ASSESSMENT A variety of assessments are used throughout the course.

A representative sample is included here in the course schedule.

MOLECULES, CELLS & ENERGY BIG IDEAS 1, 2, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
A. MOLECULES Big idea 4	Using kits to build macro-molecule models [CR4a] (SP 1)	Student generated concept maps
Polarity of water & its importance to biological systems	Exercises: protein folding software [CR4b]	Reading quizzes
Carbon's role in the molecular diversity of life	Acid/base/buffer lab activity [CR6] (SP 2)	Unit test with free response practice
Monomers, polymers & reactions involved in building & breaking them down considering polar/ nonpolar interactions	Adhesion/ cohesion lab	Written lab reports [CR8]
Various levels of structures in protein & carbohydrates	Students do variations by adding different macro-molecules to solution to see effects adhesion etc. (EU4.A connects to BI 1) [CR3d] (SP 4)	
Enzyme structure as a special protein	Given specific heat equation, in groups students try to come up with a way to determine specific heat of water- 15min (EU 4.C connects to BI 1) [CR3d], [CR4a] & [CR4b] (SP 3)	
Cohesion, adhesion, specific heat of water & its importance to biological systems	LAB: Using and understanding how different indicators are used to identify proteins, lipids, carbohydrates (incl. reducing sugars analysis) using Biuret, Benedict's, Sudan etc. [CR6] (SP 6)	Students compose chart comparing structural differences & how indicators physically work
Acids, bases, and buffers		Students use chart to predict contents of unknown samples
Identifying macro-molecules in our foods		

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

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

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.

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.

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.

MOLECULES, CELLS & ENERGY BIG IDEAS 1, 2, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
Supplements & Add-ons: Cohesion/adhesion in nature Various macromolecules in our foods Cycling of chemical elements in ecosystem	Research exploring how animals use water's properties for survival (comparing specific heat) (EU 4.C connects to BI 1) [CR3d] Students make posters of different element cycles including relative amts. of transfer [CR4b], [CR4d] & [CR8]	Students share one example they have found how animals use water's properties for survival. Student generated short PowerPoints on macromolecules and nutrition. (Ex. Butter vs margarine vs oil OR summarizing different artificial sweeteners)
B. HISTORY OF LIFE Big idea 1 Theories of how macromolecules joined to support origin of life Was RNA 1st genetic material? Age of earth	Clay catalyzed RNA polymerization activity with role playing focus on theories, redevelopment of theories over time (EU 1.B connects to BI 3) [CR3a] & [CR4c] (SP 6, 7) Discussion of journal article	Concept maps Reflection on the development and reformulation of scientific theories (extra) model or cartoon explaining the theories of origin of life [CR4a]
C. CELLS (structure & function) Big idea 1 & 2 Explain similarities, differences & evolutionary relationships between prokaryotic & eukaryotic cells Cell membrane structure & function Cell communication (signals, receptors, responses hormones) Methods of transport across membranes	Mini poster/ models comparing structures of cells from 3 different cell types from 3 different kingdoms (EU 1.A connects to BI 3) [CR3a], [CR4a], [CR4c] & [CR8] LAB: Normal vs Plasmolyzed Cells using Plant cells (teacher generated) [CR6] Eduweblabs: Osmosis & diffusion prelabs 1 & 2 [CR4b], [CR4c] & [CR6] Cell size lab teacher generated Mini Poster Presentations comparing 3 feedback mechanisms [CR8]	Student generated concept maps Reading quizzes Mini poster comparing structures of cells from 3 different kingdoms Unit test with Free Response practice Written lab reports [CR8] Eduweblabs graph & calculations Cell Size lab calculations Formal Lab Writeup for Inquiry lab Diffusion & Osmosis [CR8]

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

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

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.

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.

MOLECULES, CELLS & ENERGY BIG IDEAS 1, 2, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
	<p>Inquiry lab # 4 Diffusion and Osmosis [CR6] (SP 3, 4)</p> <p>LAB: Microscope techniques for observing & measuring different types of cells.</p>	<p>Microscope drawings & calculation</p> <p>Analyze & Discuss chart comparing different types of cells & their functions in the human body</p> <p>Discussion of the endosymbiont hypotheses of the evolution of eukaryotic cells [CR3b]</p>
<p>D. IMMUNITY</p> <p>Big idea 2 & 3</p> <p>Innate vs Acquired Response</p> <p>Humoral responses B cells vs T cells</p> <p>Self vs non-self</p> <p>Field Trip to Pharmaceutical Company</p>	<p>LAB: Immunoassays: Antibody purification</p> <p>Dot Blot (1 full day at BTI Pharmaceutical company where students completely perform both labs) [CR6] (SP 5)</p>	<p>Student generated concept maps</p> <p>Flow chart for immunoassay labs</p> <p>Post-fieldtrip quiz</p>
<p>E. CELL ENERGY</p> <p>ATP structure & function</p> <p>Redox reactions in relation to cellular respiration</p> <p>Enzyme catalysis</p> <p>Activation energy & specificity</p> <p>Cellular respiration glycolysis, citric acid cycle, electron transport chain & chemiosmosis</p> <p>Mitochondria form & function</p>	<p>Eduweblabs: Prelab "Enzyme Catalysis"</p> <p>Investigative lab #13: Enzyme Activity (EU 4.A connects to BI 2) [CR3d] & [CR6]</p> <p>Prelab: Toothpickase</p> <p>Investigative Lab: Enzymes: Factors affecting the rate of activity [CR6] (SP 2, 5)</p> <p>Eduweblab: Respiration [CR4b]</p> <p>Investigative Lab #6 Cellular Respiration [CR6] (SP 2)</p>	<p>Student generated concept maps</p> <p>Reading quizzes</p> <p>Unit test with free response practice</p> <p>Eduweblab graphs</p> <p>Toothpickase graphs & questions</p> <p>Presentation of students group lab results to class [CR8]</p> <p>Eduweblabs graphs & calculations</p> <p>Presentations of lab data and results [CR8]</p>

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

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

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.

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

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.

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.

MOLECULES, CELLS & ENERGY BIG IDEAS 1, 2, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
Photosynthesis mechanisms; light/dark Compare/contrast to respiration Alternative mechanisms Understanding light energy & the nano scale (the size of small things inside cells)	Fermentation in Yeast Lab (Flynn kit) student generated variations required Eduweblabs: Prelab Plant pigments [CR4b] Eduweblabs: Prelab Photosynthesis [CR4b] Investigative Lab #5 Photosynthesis [CR6] Internet activity comparing different wavelengths of light in relation to photosynthesis (teacher generated) Discussion on nanotechnology & implications of our smaller world [CR5]	Graphs & discussion on Yeast Lab with variations [CR8] Eduweblabs chromatography calculations, graphs Presentations on lab results Lab writeup and analysis [CR8] Students make a chart comparing sizes of cellular parts & larger items to evaluate range of metric distance measurements down to the nano scale [CR4b]
HEREDITY, GENETICS & EVOLUTION BIG IDEAS 1 & 3 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
A. MOLECULAR BASIS OF INHERITANCE DNA structure & replication RNA structure Protein Synthesis transcription & translation Mutations – basis for natural selection	DNA extraction Comparing DNA & protein sequences from an internet based computer database in discussing evolutionary implications of mutations (SP 7)	Student generated concept maps Reading quizzes Journal article discussions Unit test with Free Response practice Bioinformatics results

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

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.

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.

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

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.

HEREDITY, GENETICS & EVOLUTION BIG IDEAS 1 & 3 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
B. MITOSIS & MEIOSIS Cell Cycle mechanism & control Chromosomes Sexual vs asexual reproduction & evolutionary advantages Stages of meiosis Genetic variation in offspring, mechanisms & impact on evolution Investigating genetics: environmental influences	Eduweblabs: Prelab Crossing Over Lab Investigative Lab #7: Mitosis and Meiosis (EU 3.A connects to BI 1) [CR3c] & [CR6] Karyotyping exercise (teacher generated- students will have to do this on their own time) [CR4c]	Student generated concept maps Reading quizzes Unit test with Free Response practice Eduweblabs results Investigative LAB Analyses Karyotyping results Students choose & research controversial topics and the arguments supporting their genetic and/or environmental basis. Ex. Obesity, alcoholism, etc. [CR5]
C. MENDELIAN GENETICS MENDEL'S LAWS Patterns of inheritance Predicting genetic outcomes genetic counseling Gene linkage & mapping Mutations revisited	Prelab activity: Looking at corn crosses & analyzing results Eduweblabs: Prelab Population Genetics Eduweblabs: Prelab Fruit fly genetics	Student generated concept maps Reading quizzes Journal article discussions Unit test with free response practice Eduweblabs prelab report
D. MOLECULAR GENETICS Regulation of gene expression Viruses Gene expression in bacteria	Eduweblabs: Prelab Bacterial transformation Eduweblabs: Prelab DNA Electrophoresis	Student generated concept maps Reading quizzes Journal article discussions Unit test with free response practice

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

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.

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.

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

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.

HEREDITY, GENETICS & EVOLUTION BIG IDEAS 1 & 3 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
Biotechnology DNA Technology, Recombinant DNA, PCR, Gel electrophoresis	Investigative lab #9: Biotechnology I and Biotechnology II. Bacterial Transformation and Restriction Enzyme Analysis of DNA [CR6]	Eduweblabs results for both transformation & electrophoresis labs
Applications of DNA technology		Analysis and group presentation of Investigative lab
Use of bioinformatics to analyze genomes	Field trip to Promega in Wisconsin will expose students to these techniques in industry	Post field trip test Report on Bioinformatics activity
Comparing & discussing genomic sequences in relation to evolution		
E. EVOLUTIONARY BIOLOGY Darwin's explorations and theory of descent with modification & natural selection	Activity: Genetics Survey Project analyzing traits of those around us	Student generated concept maps
Galapagos Islands Overview	Lab Investigation "2 Mathematical Modeling: Hardy-Weinberg [CR6] (SP2, 4, 5, 7)	Reading quizzes Book discussions
Evidence for evolution (molecular analyses & morphological analyses)	Activity: Students create Geologic timeline	Unit test with Free Response practice
Phylogeny & systematics	Activity: Hands on fossil analysis (obtained from nearby college) [CR4a] (SP 6, 7)	
Evolution of populations		
Hardy-Weinberg Law		
ORGANISMS & POPULATIONS BIG IDEAS 1, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
A. BIOLOGICAL DIVERSITY & MICROBIOLOGY Early life on earth	Students are to find an article involving genetic recombination using prokaryotes and present to class [CR5]	Article presentation to class
Evolution of prokaryotes & eukaryotes	Investigative LAB # 3: Analyzing Genes with BLAST (EU 1.B connects to BI 4) [CR3a] & [CR6]	Student generated concept map Section test

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

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.

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.

ORGANISMS & POPULATIONS BIG IDEAS 1, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
B. PLANTS & THEIR DIVERSITY How plants colonized land Evolution of seed plants Structure, growth & development Plants responses to internal & external stimuli Plant nutrition Angiosperm Reproduction	Eduweblabs: Prelab Transpiration Investigative LAB # 11: Transpiration (EU 1.B connects to BI 4) [CR3a] & [CR6] (SP 2, 3, 5) LAB: Flower dissection LAB: Students conduct a long term (exp't) lab investigation plant growth from seeds under various conditions in our greenhouse. [CR6] (SP 3.5, 6, 7)	Practical Test specimen identification & placing on phylogenetic tree Student generated concept map Section test Eduweblab transpiration results Investigative labs analysis Flower dissection practical Formal writeup for students' own plant lab [CR8]
C. ANIMAL DIVERSITY Characteristics (body plans & systems) of invertebrates as you go up the phylogenetic tree Basic anatomy principles Analysis of structure & function of body systems Digestive, Circulatory, Respiratory, Excretory, Endocrine, Nervous, Muscular Systems	Survey of animal phyla in concept map/chart form generated by students (Practical with actual animal specimens) Eduweblabs - Daphnea heart rate Eduweblabs - Cardiac Physiology Human Biology: Circulation and Blood Pressure Lab: Examining circulation of the goldfish [CR6] (SP 7) Lab: Dissection – either fetal pig or cat	Student generated concept maps (one for each system & animal diversity examination) Reading quizzes Unit test with Free Response practice Eduweblab reports Practical quiz observing various specimens and classifying them using students' own made chart of animal phyla Practical test with dissection specimen

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ORGANISMS & POPULATIONS BIG IDEAS 1, 3 & 4 [CR2]		
TOPICS	ACTIVITY/LABS	ASSESSMENT
D. ECOLOGY Ecological interactions– biotic vs abiotic Behavioral ecology– natural selection involvement Population dynamics– growth & its regulations Communities & Ecosystems energy levels & flows, cycles, symbiosis & impact on evolution Human influences positive & negative	Eduweblabs: Prelab Animal Behavior	Student generated concept maps
	Investigative LAB #12: Fruit fly behavior [CR6] (SP 3, 4)	Reading quizzes
	Animal Behavior: Taxis, Kinesis, and Agonistic Behavior [CR6] (SP 3, 4, 6)	Unit test with Free Response practice
	LAB:Termite Behavior (WARD’S) Wolbachia Project- PCR in conjunction with the Marine Biology Institute in Boston, students will conduct research looking at the presence of symbiotic relationship in insects with Wolbachia (EU 4.A connects to BI 1) [CR3d] & [CR4d] (SP 3, 4, 5)	Eduweblab reports
	Eduweblabs–Primary Productivity	Investigative Lab #11 report [CR8]
	LAB: Dissolved Oxygen & Aquatic Primary Productivity (EU 4.A connects to BI 1) [CR3d], [CR5] & [CR6] (SP 2, 3, 4, 5, 6, 7)	Termite lab questions, analysis and presentation [CR8]
	LAB: Local Burpee museum field trip where students perform water quality surveys including benthic macroinvertebrate survey (EU 4.C connects to BI 1) [CR3d] & [CR6]	Eduweblab report on primary productivity
Activity – “My footprint” (EU 4.A connects to BI 1) [CR3d] & [CR4d]	Presentation: Students present lab results to class with ways to improve water quality of their local river [CR5]	
	Personal Project: Students complete “My Footprint” online and write a paper discussing their individual impact on Earth [CR5]	

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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.

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

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Additional Websites:

Websites for student use for review/homework/lab-prep are an irreplaceable tool for instructional purposes and student understanding. The following is a partial list of some of the sites I use on a daily/weekly basis.

- The Biology Project - University of Arizona
- Online Campbell Biology Book
- Campbell Log in site for students with password
- Prentice Hall - The Biology Place
- Lab Bench
- Biocoach PBS.ORG
- Sunamasinc.com
- DNAFTB.ORG
- TALKORIGINS.ORG
- LEARN.GENETICS.UTAH.EDU
- Cells Alive

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