Unit 8: Ecology (Life Science)

Content Area:	**Science**
Course(s):	**Biology AP**
Time Period:	**April**
Length:	**18-21 days**
Status:	**Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Biology

Unit 8: Ecology

Belleville Board of Education

102 Passaic Avenue

Belleville, NJ 07109

Prepared by: Ms. Lauren Callaghan, Teacher of Biology

Board Approved: September 23, 2019

Unit Overview

As a culmination of this course, Unit 8 brings together all other units to show how a system's interactions are directly related to the system's available energy and its ability to evolve and respond to changes in its environment. When highly complex living systems interact, communities and ecosystems will change based on those interactions. The more biodiversity present in a system, the more likely that system is to maintain its health and success in the face of disruption. Energy flows through systems; the rate of flow determines the success of the species within the systems. By this point in the curriculum, a student should be able to accurately determine what happens within biological systems when disruptions occur.

Enduring Understanding

- **TOPIC 8.1 Responses to the Environment-**Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues. Transmission of information results in changes within and between biological systems.
- **TOPIC 8.2 Energy Flow Through Ecosystems-**The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- **TOPIC 8.3 Population Ecology-**Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 8.4 Effect of Density of Populations-**Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 8.5 Community Ecology-**Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- **TOPIC 8.6 Biodiversity-**Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
- **TOPIC 8.7 Disruptions to Ecosystems-**Evolution is characterized by change in the genetic make-up of a population over time and is supported by multiple lines of evidence. Competition and cooperation are important

aspects of biological systems.

Essential Questions

- How does diversity among and between species in a biological system affect the evolution of species within the system?
- How does the acquisition of energy relate to the health of a biological system?
- How do communities and ecosystems change, for better or worse, due to biological disruption?
- How does a disruption of a biological system affect genetic information storage and transmission?
- How do species interactions affect the survival of an ecosystem?
- How are growth and homeostasis of a biological system influenced by the system’s environment?
- How do interactions among living systems and with their environment result in the movement of matter and energy?
- How do interactions between and within populations influence patterns of species distribution and abundance?
- How does human activity affect the biodiversity of ecosystems?

Exit Skills

By the end of AP Biology Unit 8, Ecology, the student should be able to:

- Explain how the behavioral and/or physiological response of an organism is related to changes in internal or external environment.
- Explain how the behavioral responses of organisms affect their overall fitness and may contribute to the success of the population.
- Describe the strategies organisms use to acquire and use energy.
- Explain how changes in energy availability affect populations and ecosystems.
- Explain how the activities of autotrophs and heterotrophs enable the flow of energy within an ecosystem.
- Describe factors that influence growth dynamics of populations.
- Explain how the density of a population affects and is determined by resource availability in the environment.
- Describe the structure of a community according to its species composition and diversity.
- Explain how interactions within and among populations influence community structure.
- Explain how community structure is related to energy availability in the environment.
- Describe the relationship between ecosystem diversity and its resilience to changes in the environment.
- Explain how the addition or removal of any component of an ecosystem will affect its overall short-term and longterm structure.
- Explain the interaction between the environment and random or preexisting variations in populations.
- Explain how invasive species affect ecosystem dynamics.
- Describe human activities that lead to changes in ecosystem structure and/ or dynamics.

- Explain how geological and meteorological activity leads to changes in ecosystem structure and/or dynamics.

New Jersey Student Learning Standards (NJSLS-S)

[NextGen Science Standards]

SCI.9-12.HS-LS2-1	Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.
SCI.9-12.HS-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
SCI.9-12.HS-LS2-3	Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
SCI.9-12.HS-LS2-6	Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
SCI.9-12.HS-LS2-7	Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
SCI.9-12.HS-LS2-8	Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
SCI.9-12.HS-LS2-2	Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
SCI.9-12.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
9-12.HS-LS2-5.2.1	Develop a model based on evidence to illustrate the relationships between systems or components of a system.
9-12.HS-LS2-8.2.1	students understand that empirical evidence is required to differentiate between cause and correlation and to make claims about specific causes and effects. They suggest cause and effect relationships to explain and predict behaviors in complex natural and designed systems. They also propose causal relationships by examining what is known about smaller scale mechanisms within the system. They recognize changes in systems may have various causes that may not have equal effects.
9-12.HS-LS2-1.3.1	students understand the significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. They recognize patterns observable at one scale may not be observable or exist at other scales, and some systems can only be

	studied indirectly as they are too small, too large, too fast, or too slow to observe directly. Students use orders of magnitude to understand how a model at one scale relates to a model at another scale. They use algebraic thinking to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).
9-12.HS-LS2-5.4.1	Models (e.g., physical, mathematical, computer models) can be used to simulate systems and interactions— including energy, matter, and information flows—within and between systems at different scales.
9-12.HS-LS2-1.5.1	Use mathematical and/or computational representations of phenomena or design solutions to support explanations.
9-12.HS-LS2-2.5.1	Use mathematical representations of phenomena or design solutions to support and revise explanations.
9-12.HS-LS2-4.5.1	Energy cannot be created or destroyed— it only moves between one place and another place, between objects and/or fields, or between systems.
9-12.HS-LS2-4.5.1	Use mathematical representations of phenomena or design solutions to support claims.
9-12.HS-LS2-3.5.1	Energy drives the cycling of matter within and between systems.
9-12.HS-LS2-3.6.1	Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
9-12.HS-LS2-7.6.1	Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
9-12.HS-LS2-8.7.1	Evaluate the evidence behind currently accepted explanations to determine the merits of arguments.
9-12.HS-LS2-7.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
9-12.HS-LS2-6.7.1	Evaluate the claims, evidence, and reasoning behind currently accepted explanations or solutions to determine the merits of arguments.
9-12.HS-LS2-6.7.1	students understand much of science deals with constructing explanations of how things change and how they remain stable. They quantify and model changes in systems over very short or very long periods of time. They see some changes are irreversible, and negative feedback can stabilize a system, while positive feedback can destabilize it. They recognize systems can be designed for greater or lesser stability.
9-12.HS-LS2-2.LS2.A.1	Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
9-12.HS-LS2-1.LS2.A.1	Ecosystems have carrying capacities, which are limits to the numbers of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges such as predation, competition, and disease. Organisms would have the capacity to produce populations of great size were it not for the fact that environments and resources are finite. This fundamental tension affects the abundance (number of individuals) of species in any given ecosystem.
9-12.HS-LS2-3.LS2.B.1	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.

9-12.HS-LS2-4.LS2.B.1	Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
9-12.HS-LS2-6.LS2.C.1	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
9-12.HS-LS2-2.LS2.C.1	A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.
9-12.HS-LS2-7.LS2.C.1	Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.
9-12.HS-LS2-8.LS2.D.1	Group behavior has evolved because membership can increase the chances of survival for individuals and their genetic relatives.
9-12.HS-LS2-7.LS4.D.1	Biodiversity is increased by the formation of new species (speciation) and decreased by the loss of species (extinction).
9-12.HS-LS2-5.PS3.D.1	The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.

Interdisciplinary Connections

LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text’s explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author’s claim or a recommendation for solving a scientific or technical problem.

LA.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
LA.WHST.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.

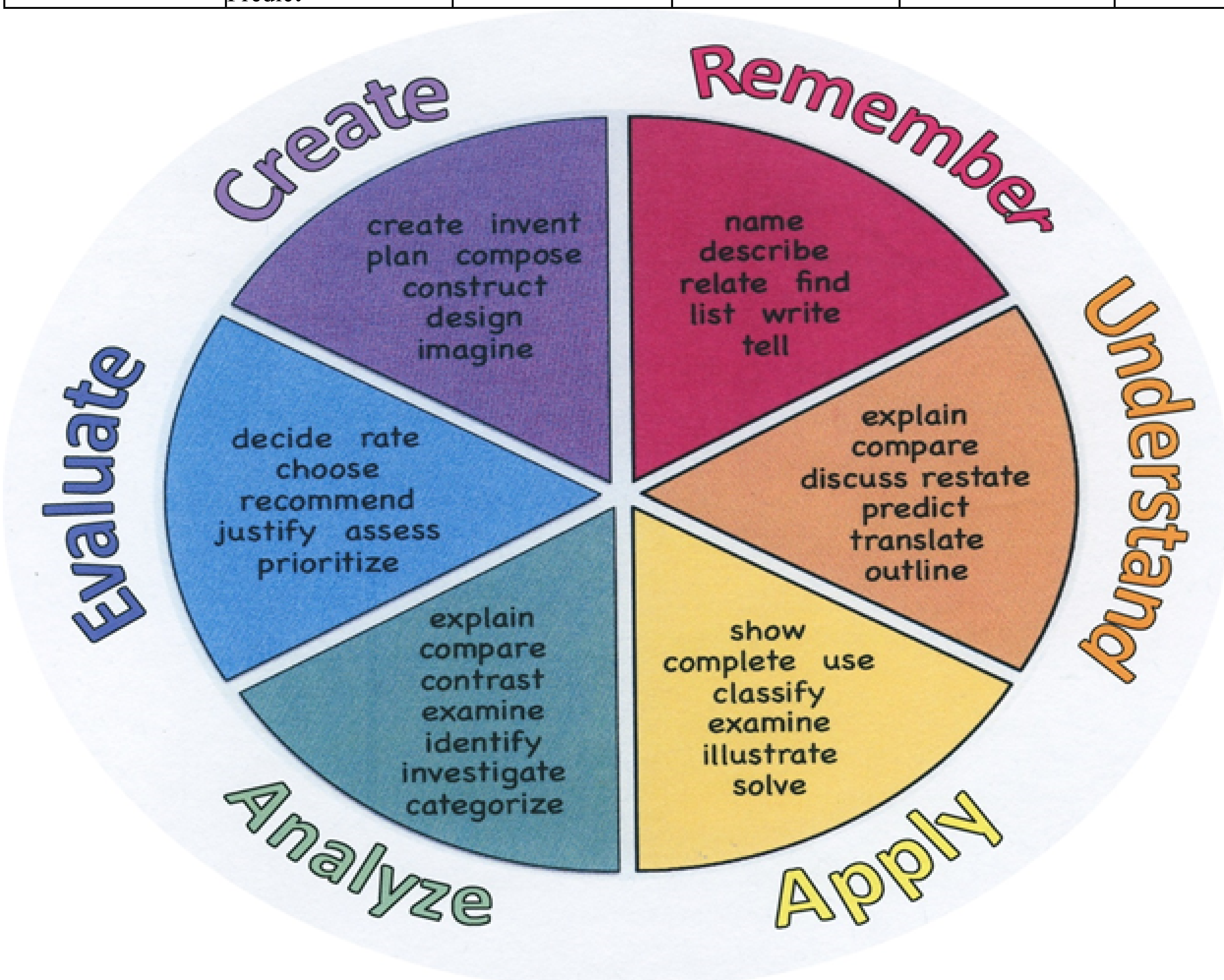
Learning Objectives

- SWDAT use representations or models to analyze quantitatively and qualitatively the effects of disruptions to dynamic homeostasis in biological systems.
- SWDAT explain how the distribution of ecosystems changes over time by identifying large-scale events that have resulted in these changes in the past.
- SWDAT refine scientific models and questions about the effect of complex biotic and abiotic interactions on all biological systems, from cells and organisms to populations, communities, and ecosystems.
- SWDAT design a plan for collecting data to show that all biological systems (cells, organisms, populations, communities, and ecosystems) are affected by complex biotic and abiotic interactions.
- SWDAT analyze data to identify possible patterns and relationships between a biotic or abiotic factor and a biological system (cells, organisms, populations, communities, or ecosystems).
- SWDAT justify scientific claims, using evidence, to describe how timing and coordination of behavioral events in organisms are regulated by several mechanisms.
- SWDAT analyze data that indicate how organisms exchange information in response to internal changes and external cues, and which can change behavior.
- SWDAT create representations and models to describe immune responses.
- SWDAT create representations or models to describe nonspecific immune defenses in plants and animals
- SWDAT construct an explanation, based on scientific theories and models, about how nervous systems detect external and internal signals, transmit and integrate information, and produce responses.
- SWDAT predict the effects of a change in a component(s) of a biological system on the functionality of an organism.
- SWDAT refine representations and models to illustrate biocomplexity due to interactions of the constituent parts.
- SWDAT justify the selection of the kind of data needed to answer scientific questions about the interaction of populations within communities.
- SWDAT apply mathematical routines to quantities that describe communities composed of populations of organisms that interact in complex ways.
- SWDAT predict the effects of a change in the community’s populations on the community.
- SWDAT predict the effects of a change of matter or energy availability on communities.
- SWDAT use data analysis to refine observations and measurements regarding the effect of population interactions on patterns of species distribution and abundance.
- SWDAT predict consequences of human actions on both local and global ecosystems.
- SWDAT make scientific claims and predictions about how species diversity within an ecosystem influences ecosystem stability.

Action Verbs: Below are examples of action verbs associated with each level of the Revised Bloom's Taxonomy.

Remember	Understand	Apply	Analyze	Evaluate	Create
Choose Describe Define	Classify Defend Demonstrate	Choose Dramatize Explain	Categorize Classify Compare	Appraise Judge Criticize	Combine Compose Construct

Label List Locate Match Memorize Name Omit Recite Select State Count Draw Outline Point Quote Recall Recognize Repeat Reproduce	Distinguish Explain Express Extend Give Examples Illustrate Indicate Interrelate Interpret Infer Match Paraphrase Represent Restate Rewrite Select Show Summarize Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Generalize Judge Organize Paint Prepare Produce Select Show Sketch Solve Use Add Calculate Change Classify Complete Compute Discover Divide Examine Graph Interpolate Manipulate Modify Operate Subtract	Differentiate Distinguish Identify Infer Point out Select Subdivide Survey Arrange Breakdown Combine Detect Diagram Discriminate Illustrate Outline Point out Separate	Defend Compare Assess Conclude Contrast Critique Determine Grade Justify Measure Rank Rate Support Test	Design Develop Formulate Hypothesize Invent Make Originate Organize Plan Produce Role Play Drive Devise Generate Integrate Prescribe Propose Reconstruct Revise Rewrite Transform



Suggested Activities & Best Practices

1. Earth has seen its share of recent environmental disasters, including hurricanes, floods, drought, wildfires, oil spills, earthquakes, tsunamis, and disease epidemics. Students investigate the short-term and long-term effects of two of these types of disruptions to populations or ecosystems. Students then present the results of their investigations in the form of a mini-poster.

2. Students create a mini-poster to compare, contrast, and analyze one physiological process in three different organisms from three different environments (e.g., osmoregulatory mechanisms in marine fish, desert reptiles, and tropical plants).

3. Students can read about the moose and wolves of Isle Royale to obtain background information on the two organisms. They can download a data spreadsheet and graph data about the two populations from the Internet. They can use their graph to make and justify predictions about how the two populations can change relative to each other.

4. For five different terrestrial or aquatic biomes, students create a visual representation to describe each biome and factors that affect its climate. Then they explain unique adaptations for one plant and one animal in each biome that help those plants and animals survive.

5. Students use a basic mathematical model to study disease in an idealized population of rabbits. The SIR (susceptible, infected, and recovered) model allows students to investigate the mechanisms of transmission and predictions about future outbreaks of infectious diseases.

6. **AP Biology Investigation 11: Transpiration**. Students design and conduct experiments to investigate the effects of environmental variables on transpiration rates.

7. Provided with a data table reflecting the results of an experiment investigating the effect of a biotic or abiotic factor on transpiration in plants, students graph the data and draw conclusions. Students work in teams and present their conclusions to the class in the form of a mini-poster for review and discussion.

8. Students can perform the “hula hoop diversity” activity. Divide students into groups, and give each group a hula hoop and a magnifying glass. Students should place their hula hoop in a grassy/woodsy area or garden and then make observations and collect a variety of data from their sampling area about the plants, animals, and abiotic factors inside the hula hoop. At the conclusion of the activity, have students predict what will happen to organisms in an ecosystem when its biodiversity changes, discuss the relationship between biodiversity and species endangerment, and predict what changes might occur in an ecosystem when a biotic or abiotic factor changes.

9. **AP Biology Investigation 12: Fruit Fly Behavior**. Students use choice chambers to explore behaviors that underlie chemotaxis.

10. Students create a mini-poster to compare non-specific defense systems in plants and animals.

11. ABO-Rh Blood Typing. Students use simulated blood and sera to investigate the relationship between antigens and antibodies.

12. Use Pearson workbook to investigate the methods that scientists use to determine population density and distribution. Students apply quantitative skills to determine the composition of populations.

13. Use Pearson workbook to explore models that scientists use to calculate population growth rates. Students apply the growth model $dN/dt=rN$ to several different populations.

14. Introducing a new species into a community can have a number of possible effects. Students design an experiment to predict some of these effects that should be conducted before the importation of the non-native species. (Use clips from “Hunters and

Hunted” for inspiration.)

15. Don’t Trash the Campus: Students investigate the impact of school litter on a surrounding ecosystem. They use data to create a proposal of short- and longterm solutions to the trash problem. Students may submit their proposal to the Student Council for consideration.

16. The Fox and the Chicken. Working in small teams, students think-pair-share a solution to the following question: When stranded on a space ship, in what sequence would you consume your cargo — a red fox, 10 kg of corn, and two chickens (a hen and a rooster) — to ensure the best chance of surviving until help arrives? Students share their answers with other groups, and then the class as a whole determines the best possible solution to the problem.

17. An ecosystem consists of earthworms, heterotrophic soil bacteria, grass, deer, beetles, and a lion. Students create mini-posters to describe the trophic structure of the ecosystem, how each organism receives inputs of energy and nutrients, where outputs (e.g., wastes) go, and the effect each organism has on the others. Students should include all energy transformations and transfers based on the hypothetical assumption that 9,500 J of net energy is available at the producer level. Students then present and explain their descriptions to the class for peer feedback.

Assessment Evidence - Checking for Understanding (CFU)

• Common Benchmarks (Benchmark)

• Unit tests- Unit 8 Personal Progress Check from AP Classroom (Summative)

• Quizzes- Responses to Ecosystems quiz, Population Ecology quiz, Immune Systems quiz (Summative)

• Unit review/Test prep- Campbell and Reece chapter 40,50,51,52,53,54,55 study guides (Formative)

• Web-Based Assessments- google form quizzes (Summative)

• DBQ's (Formative)

• Written Reports- CER's for lab activities (Alternate)

• Surveys (Alternate)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks

- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Evaluation rubrics
- Exit Tickets- google form exit ticket
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes- Responses to Ecosystems quiz, Population Ecology quiz, Immune Systems quiz
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share- large sticky posters
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep- Campbell and Reece chapter 40,50,51,52,53,54,55 study guides
- Unit tests- Unit 8 Personal Progress Check from AP Classroom
- Web-Based Assessments- google form quizzes
- Written Reports- CER's for lab activities

Primary Resources & Materials

- Campbell and Reece, AP Biology 11th Edition (2018)- Chapters 40,50,51,52,53,54,55

Ancillary Resources

- Pearson Education Test Prep Series for AP Biology (2017)
- AP Biology Investigative Labs- Investigation 11: Transpiration
- AP Biology Investigative Labs- Investigation 12: Fruit Fly Behavior
- Campbell and Reece chapters 40,50,51,52,53,54,55 study guide worksheets

- Molecular model kits or alternative (e.g., foam balls and toothpicks)
- Foglia powerpoints and review guides (www.explorebiology.com)
- PHET Interactive Simulations

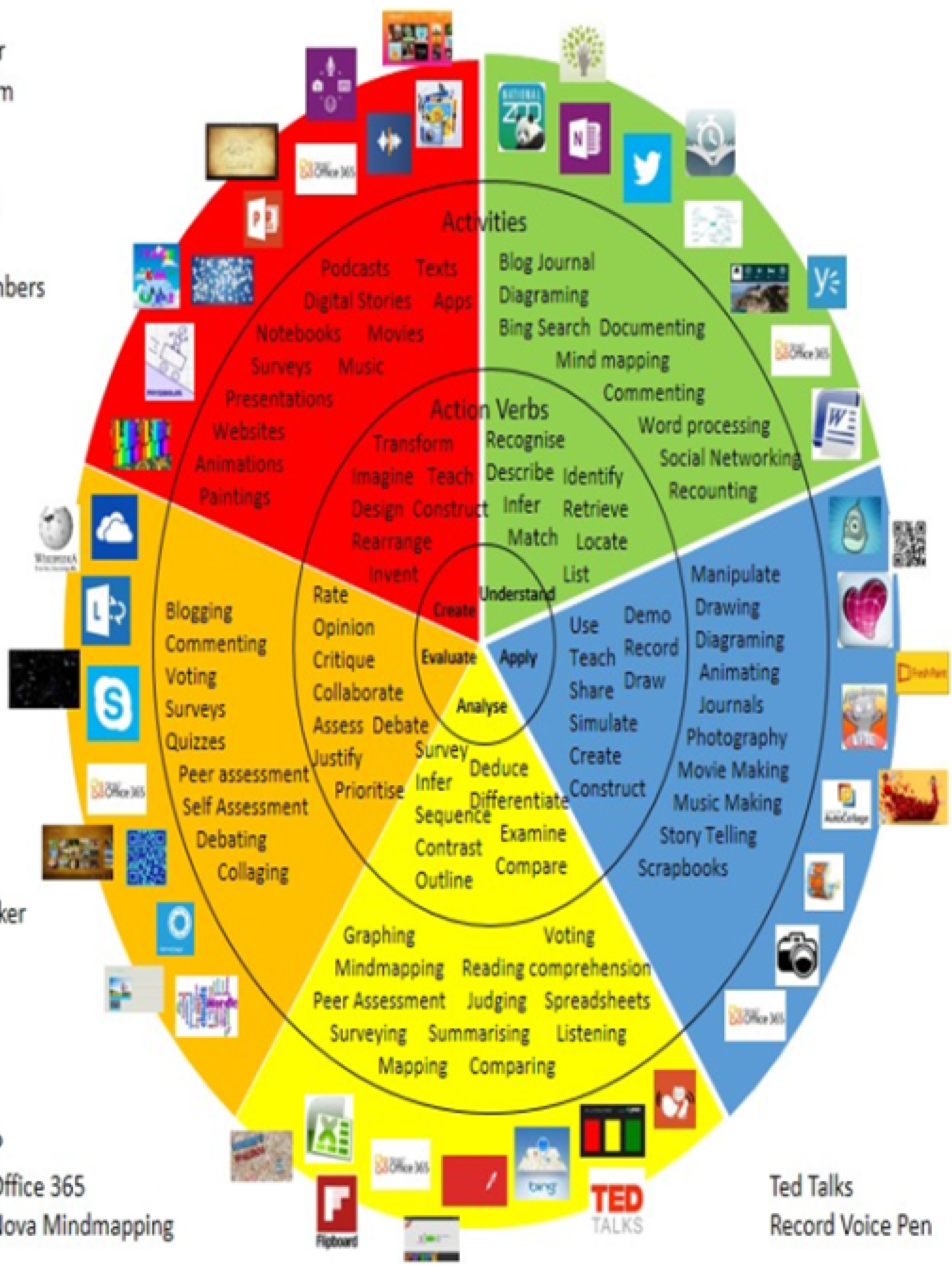
Technology Infusion

- Smart TV - (Responses to the Environment, Population Ecology, Biodiversity, Conservation Ecology slideshow presentations)
- Chrome Books for Projects/ Research/ Analysis
- Youtube - Amoeba sisters videos, Mr. Anderson videos, Crash course videos
- Khan Academy videos and quizzes
- Microsoft Powerpoint
- Google Drive
- Prezi
- Ted Talks
- Ted- ED
- Microsoft Excel: graphs, charts, calculations, equations

Win 8.1 Apps/Tools Pedagogy Wheel

Podcasts
Photostory 3
Kid Story Builder
Music Maker Jam
Paint A Story
Office 365
MS PowerPoint
Stack 'Em Up
NqSquared Numbers
Physamajig
Xylophone 8

Wikipedia
Skydrive
Lync
SkyMap
Skype
Office 365
Puzzle Touch
Easy QR
Memorylage
Life Moments
Word Cloud Maker



Where's Waldo?
MS Excel
Flipboard
Office 365
Nova Mindmapping

Ted Talks
Record Voice Pen

Originally taken from http://www.coetail.com/vzimmer/files/2013/02/iPadagogy-Wheel.001.jpg
And adapted for Windows 8.1 devices by Charlotte Beckhurst @CharBeckhurst

Alignment to 21st Century Skills & Technology

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP5	Consider the environmental, social and economic impacts of decisions.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CAEP.9.2.12.C.1	Review career goals and determine steps necessary for attainment.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
CAEP.9.2.12.C.3	Identify transferable career skills and design alternate career plans.
TECH.8.1.12.B	Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
TECH.8.1.12.C	Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
TECH.8.1.12.D	Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
TECH.8.1.12.F	Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.
TECH.8.2.12	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
TECH.8.2.12.E	Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

21st Century Skills/Interdisciplinary Themes

- Communication and Collaboration
- Creativity and Innovation
- Critical thinking and Problem Solving
- ICT (Information, Communications and Technology) Literacy
- Information Literacy
- Life and Career Skills
- Media Literacy

21st Century Skills

- Civic Literacy
- Environmental Literacy
- Global Awareness
- Health Literacy

Differentiation

Differentiations:

- Small group instruction
- Small group assignments
- Extra time to complete assignments
- Pairing oral instruction with visuals
- Repeat directions
- Use manipulatives
- Center-based instruction
- Token economy
- Study guides
- Teacher reads assessments allowed
- Scheduled breaks
- Rephrase written directions
- Multisensory approaches
- Additional time
- Preview vocabulary
- Preview content & concepts
- Story guides
- Behavior management plan
- Highlight text
- Student(s) work with assigned partner
- Visual presentation
- Assistive technology
- Auditory presentations
- Large print edition
- Dictation to scribe
- Small group setting

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas

- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments
- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

- Choice of books or activities
- Cubing activities
- Exploration by interest
- Flexible grouping
- Goal setting with students
- Jigsaw
- Mini workshops to re-teach or extend skills
- Open-ended activities
- Think-Pair-Share
- Reading buddies
- Varied journal prompts
- Varied supplemental materials

Special Education Learning (IEP's & 504's)

- printed copy of board work/notes provided
- additional time for skill mastery
- assistive technology
- behavior management plan
- Center-Based Instruction
- check work frequently for understanding
- computer or electronic device utilizes
- extended time on tests/ quizzes
- have student repeat directions to check for understanding
- highlighted text visual presentation
- modified assignment format
- modified test content
- modified test format

- modified test length
- multiple test sessions
- multi-sensory presentation
- preferential seating
- preview of content, concepts, and vocabulary
- Provide modifications as dictated in the student's IEP/504 plan
- reduced/shortened reading assignments
- Reduced/shortened written assignments
- secure attention before giving instruction/directions
- shortened assignments
- student working with an assigned partner
- teacher initiated weekly assignment sheet
- Use open book, study guides, test prototypes

English Language Learning (ELL)

- teaching key aspects of a topic. Eliminate nonessential information
- using videos, illustrations, pictures, and drawings to explain or clarif
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning;
- allowing students to correct errors (looking for understanding)
- allowing the use of note cards or open-book during testing
- decreasing the amount of workpresented or required
- having peers take notes or providing a copy of the teacher's notes
- modifying tests to reflect selected objectives
- providing study guides
- reducing or omitting lengthy outside reading assignments
- reducing the number of answer choices on a multiple choice test
- tutoring by peers
- using computer word processing spell check and grammar check features
- using true/false, matching, or fill in the blank tests in lieu of essay tests

At Risk

- allowing students to correct errors (looking for understanding)
- teaching key aspects of a topic. Eliminate nonessential information
- allowing products (projects, timelines, demonstrations, models, drawings, dioramas, poster boards, charts, graphs, slide shows, videos, etc.) to demonstrate student's learning

- allowing students to select from given choices
- collaborating (general education teacher and specialist) to modify vocabulary, omit or modify items to reflect objectives for the student, eliminate sections of the test, and determine how the grade will be determined prior to giving the test.
- decreasing the amount of workpresented or required
- marking students' correct and acceptable work, not the mistakes
- modifying tests to reflect selected objectives
- providing study guides
- tutoring by peers
- using authentic assessments with real-life problem-solving
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Create a blog or social media page about their unit
- Create a plan to solve an issue presented in the class or in a text
- Debate issues with research to support arguments
- Flexible skill grouping within a class or across grade level for rigor
- Higher order, critical & creative thinking skills, and discovery
- Multi-disciplinary unit and/or project
- Teacher-selected instructional strategies that are focused to provide challenge, engagement, and growth opportunities
- Utilize exploratory connections to higher-grade concepts
- Utilize project-based learning for greater depth of knowledge

Sample Lesson

Unit Name: Unit 8: Ecology

NJSLS: Attached

Interdisciplinary Connection: Math (creating tables and graphs)

Statement of Objective: SWDAT model how organisms exchange information in response to internal changes and external cues, and which can change behavior.

Anticipatory Set/Do Now: Teacher will show photos of isopods (pill bugs) that will be used in the lab. Students will list everything they know about the organism (what they eat, where they are found, etc.) and then share as a class.

Learning Activity: Students can perform an animal behavior lab using pill bugs. They can use choice chambers to study the responses of pill bugs to environmental stimuli. Create different environments on either side of the choice chamber. Place the same number of pill bugs on both sides of the choice chamber. Count the number of pill bugs on both sides of the choice chamber at regular intervals for a defined period of time. Chi-square can be used to analyze the null hypothesis.

Student Assessment/CFU's: Exit Ticket- Google form analysis questions to lab activity

Materials: Smart TV for anticipatory set, chromebooks for exit ticket, choice-chambers, pill bugs, supplies to create different environments (soil, water, foil)

21st Century Themes and Skills: Health and Environmental Literacy

Differentiation/Modifications: Visual Representation, extra time for task completion

Integration of Technology: Smart TV for anticipatory set, google classroom for exit ticket

SCI.HS-LS2-6	Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.