Unit 2 Energy Flow (Life, Physical Science, Engineering Design)

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Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Environmental Science 10-12

Unit 2: Energy Flow

Belleville Board of Education

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Unit Overview

- The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways (photosynthesis, respiration, nitrogen fixation, or decomposition).
- At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment. Continual input of energy from sunlight keeps the process going
- The use and transfer of energy from one trophic level to another can be calculated and the 'rule of Ten'
- The chemical elements that make up the molecules of living things pass through food webs and are combined and recombined in different ways. At each link in a food web, some energy is stored in newly made structures but much is dissipated into the environment. Continual input of energy from sunlight keeps the process going
- Living systems require a continuous input of energy to maintain their chemical and physical organizations and also understanding that with the cessation of energy input, living systems rapidly disintegrate.
- Although the various forms of energy appear very different, each can be measured in a way that makes it possible to keep track of how much of one form is converted into another. Whenever the amount of energy in one place diminishes the amount in other places or forms increases by the same amount. The abundance and distribution of living organisms are limited by the available energy and certain forms of matter such as water, oxygen and minerals.
- Although Earth has a great capacity to absorb and recycle materials naturally, ecosystems have only a finite capacity to withstand change without experiencing major ecological alterations that may also have adverse effects on human activities.
- The concept of Ecosystem Services is becoming popular as a way to encourage discussion about the

dependence of humans on nature and what that means socially and economically. Ecosystem services are transformations of natural assets (soil, water, air, and living organisms) into products that are important to humans. Examples include: provision of clean air and water; maintenance of soil fertility; maintenance of livable climates; pollination of crops and other vegetation; control of potential pests; provision of genetic resources; production of food and fiber; and provision of cultural, spiritual and intellectual experiences

- Decisions to slow the depletion of energy resources can be made at many levels, from personal to national, and they always involve trade-offs involving economic costs and social values
- All Earth processes are the result of energy flowing and mass cycling within and between Earth's systems. This energy is derived from the sun and Earth's interior. The flowing energy and cycling matter cause chemical and physical changes in Earth's materials and living organisms. For example, large amounts of carbon continually cycle among systems of rock, water, air, organisms, and fossil fuels such as coal and oil.
- The transport and transformation of substances through the Earth system are known collectively as biogeochemical cycles**.** These include the hydrologic (water), nitrogen, carbon, and oxygen cycles. Human activities can, deliberating or inadvertently, alter the equilibrium of these cycles.
- Much of the complex behavior of the Earth system can be thought of as cycles involving physical, chemical and biological processes that transfer components among various storage locations over time. (CB, 2009).
- The inputs and outputs connecting such reservoirs, the changes in the physical state or chemical characteristics of the components, and the time scale of these processes can all be recognized and quantified. (CB, 2009).
- Biogeochemical cycles, such as the water cycle and carbon cycle, are driven and sustained by solar and/or geothermal energy, which is transferred, utilized and lost as an integral aspect of the cycles. (CB, 2009).
- Differences in climate, based mostly on long-term differences in average temperature and precipitation, largely determine the types and locations of the earth's deserts, grasslands, and forests.
- Freshwater lakes, rivers, and wetlands provide important ecological and economic services that are being disrupted by human activities.
- Saltwater ecosystems provide major ecological and economic services that are being threatened by human activities.
- Saltwater and freshwater aquatic life zones cover almost three-fourths of the earth's surface, and oceans dominate the planet.
- In many areas, human activities are impairing ecological and economic services provided by the earth's deserts, grasslands, forests, and mountains.
- Differences in long-term average annual precipitation and temperature lead to the formation of tropical, temperate, and cold deserts, grasslands, and forests, and largely determine their locations.
- Key factors determining an area's climate are incoming solar energy, the earth's rotation, global patterns of air and water movement, gases in the atmosphere, and the earth's surface features.
- The misuse of soil reduces soil fertility pollutes streams, and requires expensive remedial measures As energy flows through ecosystems in food chains and webs, the amount of chemical energy available to organisms at each succeeding feeding level decreases. Matter, in the form of nutrients, cycles within and among ecosystems and in the biosphere. Human activities are altering these chemical cycles. Scientists use field research, laboratory research, and mathematical and models to learn about ecosystems. species plays a specific ecological role called its niche.
- *All Earth processes are the result of energy flowing and mass cycling within and between Earth's systems. This energy is derived from the sun and Earth's interior. The flowing energy and cycling matter cause chemical and physical changes in Earth's materials and living organisms. For example, large amounts of carbon continually cycle among systems of rock, water, air, organisms, and fossil fuels such as coal and oil.*
- *Earth exchanges mass and energy with the rest of the Solar System. Earth gains and loses energy*

through incoming solar radiation, heat loss to space, and gravitational forces from the sun, moon, and planets. Earth gains mass from the impacts of meteoroids and comets and loses mass by the escape of gases into space.

- *The transport and transformation of substances through the Earth system are known collectively as biogeochemical cycles***.** These include the hydrologic (water), nitrogen, carbon, and oxygen cycles. Human activities can, deliberating or inadvertently, alter the equilibrium of these cycles
- While urbanization may involve or provide a number of economic, social and environmental benefits, the global population demographic trend of increased urbanization that has been seen as more countries prepare to further industrialize may be associated with negative environmental and human health consequences.
- The size and rate of growth of the human population in any location are affected by economic, political, religious, technological and environmental factors. Some of these factors, in turn, are influenced by the size and rate of growth of the population.

Enduring Understanding

- All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain living systems.
- The earth's terrestrial and aquatic systems provide important ecological and economic services, which are being degraded and disrupted by human activities.
- Saltwater and freshwater aquatic systems cover almost three-fourths of the earth's surface, and oceans dominate the planet.
- Differences in climate, based mostly on long-term differences in average temperature and precipitation, largely determine the types and locations of the earth's deserts, grasslands, and forests.
- Movement of matter through Earth's system is driven by Earth's internal and external sources of energy and results in changes in the physical and chemical properties of the matter.

Essential Questions

- To what extent does understanding the flow of matter and energy through living systems effect personal and public policy decisions.
- Why Are the World's Oceans Important and How Have We Affected Them?
- What Are the Major Types of Aquatic Systems?
- How Have We Affected the World's Terrestrial Ecosystems?
- How Does Climate Affect the Nature and Location of Biomes?

Exit Skills

- Analyze a problem, developing hypothesis, and design a scientific experiment to test those hypothesis
- Use statistical analysis of data collected to make an argument based on purely scientific evidence
- Develop a vernacular of scientific terms and current environmental problems
- Data mine from scientific journals and articles evaluating their scientific methodology for validity

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

SCI.9-12.HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
SCI.9-12.HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
SCI.9-12.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
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-LS2-2	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-LS2-4	Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
SCI.9-12.HS-LS2-5	Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
SCI.9-12.HS-PS1-2	Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
9-12.HS-ETS1-1.1.1	Analyze complex real-world problems by specifying criteria and constraints for successful solutions.
9-12.HS-ETS1-2.6.1	Design 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-ETS1-3.6.1	Evaluate 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-ETS1-1.ETS1.A.1	Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.
9-12.HS-ETS1-1.ETS1.A.2	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
9-12.HS-ETS1-3.ETS1.B.1	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
9-12.HS-ETS1-2.ETS1.C.1	Criteria may need to be broken down into simpler ones that can be approached systematically, and decisions about the priority of certain criteria over others (trade-offs) may be needed.
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-LS2-2.3.1	Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale.
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-LS2-4.5.1	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-LS2-2.5.1	Use mathematical representations of phenomena or design solutions to support and revise explanations.
9-12.HS-LS2-3.5.1	Energy drives the cycling of matter within and between systems.
9-12.HS-LS2-4.5.1	Use mathematical representations of phenomena or design solutions to support claims.
9-12.HS-LS2-3.6.1	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-LS2-2.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-LS2-5.LS2.B.1	Photosynthesis and cellular respiration are important components of the carbon cycle, in which carbon is exchanged among the biosphere, atmosphere, oceans, and geosphere through chemical, physical, geological, and biological 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-LS2-3.LS2.B.1	Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.
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-LS2-5.PS3.D.1	The main way that solar energy is captured and stored on Earth is through the complex chemical process known as photosynthesis.
9-12.HS-PS1-2.1.1	students observe patterns in systems at different scales and cite patterns as empirical evidence for causality in supporting their explanations of phenomena. They recognize classifications or explanations used at one scale may not be useful or need revision using a different scale; thus requiring improved investigations and experiments. They use mathematical representations to identify certain patterns and analyze patterns of performance in order to reengineer and improve a designed system.
9-12.HS-PS1-2.6.1	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-PS1-2.PS1.B.1	The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

Interdisciplinary Connections

LA.RH.11-12.1	Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of primary and secondary sources, connecting insights gained from specific details to develop an understanding of the text as a whole.
LA.RH.11-12.2	Determine the theme, central ideas, information and/or perspective(s) presented in a primary or secondary source; provide an accurate summary of how key events, ideas and/or author's perspective(s) develop over the course of the text.
LA.RH.11-12.3	Evaluate various perspectives for actions or events; determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.
LA.RH.11-12.4	Determine the meaning of words and phrases as they are used in a text, including analyzing how an author uses and refines the meaning of a key term over the course of a text (e.g., how Madison defines faction in Federalist No. 10).
LA.RH.11-12.5	Analyze in detail how a complex primary source is structured, including how key sentences, paragraphs, and larger portions of the text contribute to the whole.
LA.RH.11-12.6	Evaluate authors' differing perspectives on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.
LA.RH.11-12.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, qualitatively, as well as in words) in order to address a question or solve a problem.
LA.RH.11-12.8	Evaluate an author's claims, reasoning, and evidence by corroborating or challenging them with other sources.
LA.RH.11-12.9	Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.
LA.RH.11-12.10	By the end of grade 12, read and comprehend history/social studies texts in the grades 11-

	CCR text complexity band independently and proficiently.
LA.RST.11-12.1	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.11-12.2	Determine the central ideas, themes, or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

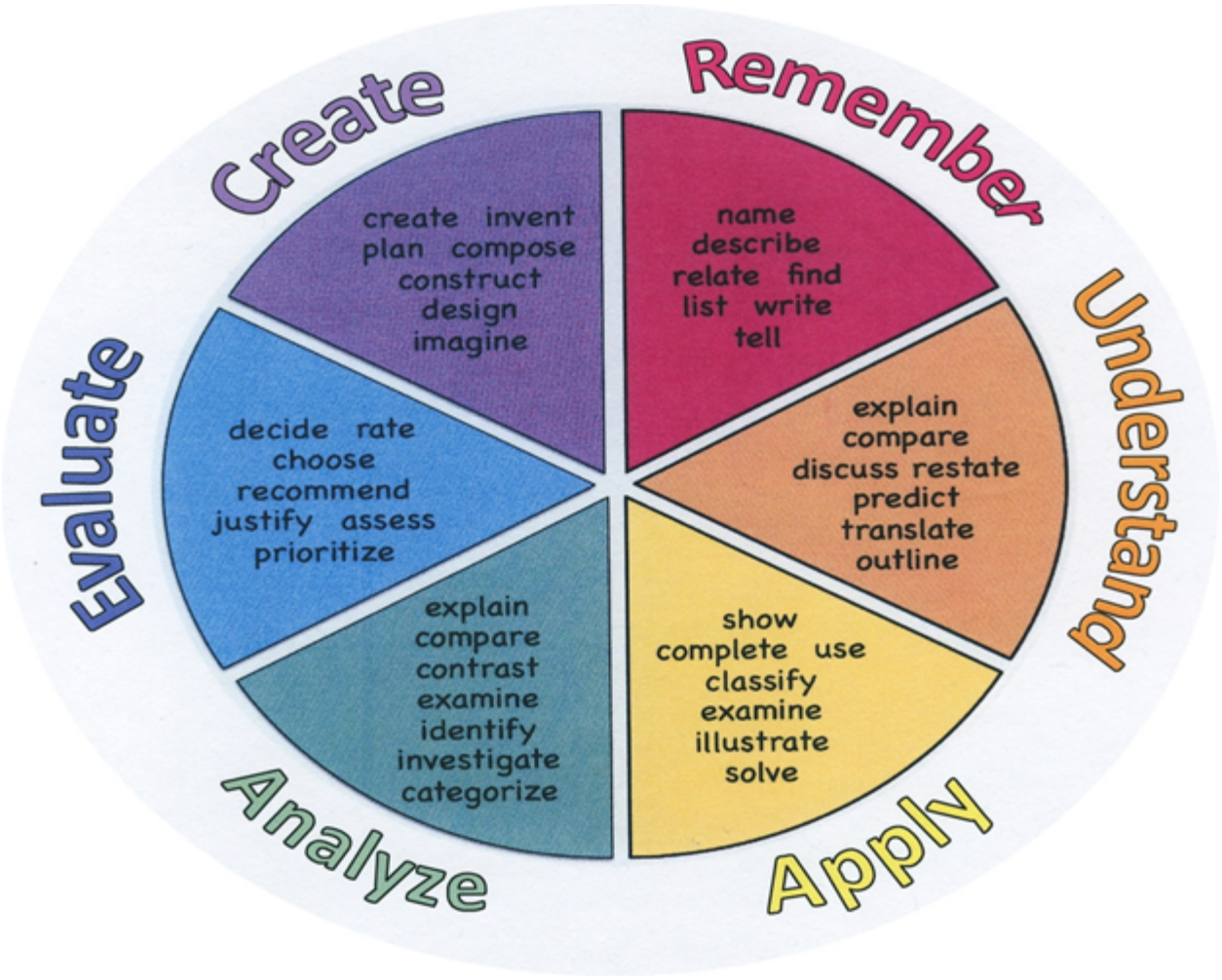
Learning Objectives

- Recognize the difference between primary and secondary succession. Predict what would happen to an ecosystem if an energy source was removed
- Use mathematical formulas to justify the concept of an efficient diet. Explain the unintended consequences of harvesting natural resources from an ecosystem
- Demonstrate, using models, how internal and external sources of energy drive the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles.
- Compare over time the impact of human activity on the cycling of matter and energy through ecosystems.
- Assess (using maps, local planning documents, and historical records) how the natural environment has changed since humans have inhabited the region.
- Relate information to detailed models of the hydrologic, carbon, nitrogen, phosphorus, sulfur, and oxygen cycles, identifying major sources, sinks, fluxes, and residence times.
- Explain how the climate in regions throughout the world is affected by seasonal weather patterns, as well as other factors, such as the addition of greenhouse gases to the atmosphere and proximity to mountain ranges and to the ocean.
- Describe the process of succession from pioneer to climax community in both terrestrial and aquatic situations
- Associate typical plants and animals with the various terrestrial biomes
- Recognize the physical environmental factors that determine the kind of climax community that will develop
- Differentiate the forest biomes that develop based on temperature and rainfall
- Describe the various kinds of aquatic ecosystems and the factors that determine their characteristics
- Explain why most major cities are located on rivers, lakes, or the ocean
- Describe the forces that result in farmland adjacent to cities being converted to urban uses
- Explain why floodplains and wetlands are often mismanaged
- Describe the economic and social values involved in planning for outdoor recreation opportunities
- Explain why some land must be designated for particular recreational uses, such as wilderness areas and why that decision sometimes invites disagreement from those who do not wish to use the land in the designated way
- List the steps in the development and implementation of a land-use plan
- Describe methods of enforcing compliance with land use plans
- Describe the advantages and disadvantages of the local and regional land-use planning
- Describe the concept of smart growth
- Students will be able to describe the different trophic levels and describe the loss of energy in the form of heat.
- Distinguish between various forms of energy and discuss the first and second laws of thermodynamics
- Describe the ways in which ecological systems depend on energy inputs.
- Explain how scientists keep track of inputs outputs, and changes to complex systems.
- Describe how natural systems change over time and space.
- Contrast the ways in which density-dependent and density-independent factors affect population size

- Explain growth models, reproductive strategies, survivorship curves, and meta-populations
- Describe species interactions and the roles of keystone species
- Discuss the process of ecological succession
- Explain how latitude, time, area, and distance affect the species richness of a community.
- Describe the potential limits to human population growth
- Describe important aspects of global and national population growth using demographic terminology and tools
- Evaluate the social, economic, and environmental factors that have contributed to decreasing growth rates in many countries.
- Analyze relationships among changes in population size, economic development, and resource consumption at global and local scales
- Explain how people have attempted to harmonize economic development with sustainable development.

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



Suggested Activities & Best Practices

Upon completion of this section, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

Guidelines for Suggested Activities:

- Includes activities **appropriate & specific** to the development of the Unit;
- Is comprised of the variety of learning activities that will be referenced in lesson plans, constructed/developed and instructionally delivered in the classroom;
- Are authentic;
- Recognizes the learning styles of the students;
- Integrates problem- or project-based learning.

Assessment Evidence - Checking for Understanding (CFU)

Assessments Generated using ExamView Test Generator and Test Bank from Toward a Sustainable Future 12e; Pearson Wright 7 Boorse 2014 (Summative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

Unit Test/Quiz (Summative)

"Do Now/Exit Ticket" Activity (Formative)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Define
- Describe
- Evaluate
- Evaluation rubrics
- Exit Tickets
- Explaining
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Multimedia Reports

- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep
- Unit tests
- Web-Based Assessments
- Written Reports

Primary Resources & Materials

Environmental Science – Toward a Sustainable Future 12e; Pearson Wright & Boorse 2014

Principles of Environmental Engineering and Science; McGraw Hill Davis & Masten 2014

Ancillary Resources

Abbey, E. *Desert Solitaire.* (1985). New York: Random House Publishers, Inc.

Bormann, H. and Kellert, S. (1991). *Ecology, Economics, and Ethics: The Broken Circle.* CT: Yale University Press.

Brown, L.and Gardner, G. (1991). *Beyond Malthus.* New York:W.W. Norton and Company, Inc.

Carson, R. (2002). *Silent Spring.* New York: Houghton-Mifflin Company.

Cohen, J.E. (1996). *How Many People Can the Earth Support?* New York: W.W. Norton and Company, Inc.

Diamond, J. (2005). *Guns, Germs, and Steel.* New York: W. W. Norton and Company.

Eldredge, N. *(2000). Life in Balance: Humanity and Biodiversity.* New Jersey: Princeton University Press.

Fossey, D. (2000). *Gorillas in the Mist.* New York: First Mariner Books/Houghton Mifflin.

Garret, L. (1994). *The Coming Plague: Newly Emerging Diseases in a World Out of Balance.* USA: Penguin Group.

Goodall, J. (2000). *A Reason for Hope.* New York: Grand Central Publishers.

Goodall, J. (2000). *In the Shadow of Man.* New York: Houghton Mifflin Harcourt.

Gore, A. (2000). *Earth in the Balance*. New York: Houghton- Mifflin, Company.

Harr, J. (1996). *A Civil Action.* New York: Knopf Publishers, Inc.

Kingsolver, B.(2003). *Small Wonder*. Philadelphia*:* Harper Collins Publishers.

Leopold, A. (1989). *A Sand Country Almanac.* New York: Oxford University Press.

Lewis, M. (1994). *Green Delusions.* Durham, North Carolina Press.

McPhee, J. (1990). *The Control of Nature.* New York: Farrar, Straus and Giroux.

McPhee J. (1977). *Encounters with the Archdruid.* New York: Farrar, Straus and Giroux.

Orr, D. (2004). *Earth in Mind: On Education, Environment and the Human Prospect.* Washington, D.C.: First Island Press.

Quinn, J(1995). *Ishmael: An Adventure of the Wind and Spirit.* New York: Bantam Books.

Rees, W. (1998). *Our Ecological Footprint: Reducing Human Impact on the Earth. British Columbia, Canada: New Society*

Publishers.

Reisner, M. (2003). *Cadillac Desert: The American West and Its Disappearing Water.* USA: Penguin Group.

Sessions, G. (1995). *Deep Ecology for the Twenty-First Century*. Boston: Shambhala Publications.

Steinberger, S. (1998). *Living Down Stream: Cancer and the Environment.* New York: Random House.

Todd, K. (2002). *Tinkering With Eden.* New York: W. W. Norton, Inc.

Turco, R. (2002). *Earth Under Siege: From Air Pollution to Global Change.* New York: Oxford University Press.

Wilson, E.O. (1999). *The Diversity of Life*. New York: W.W. Norton and Company, Inc.

Technology Infusion

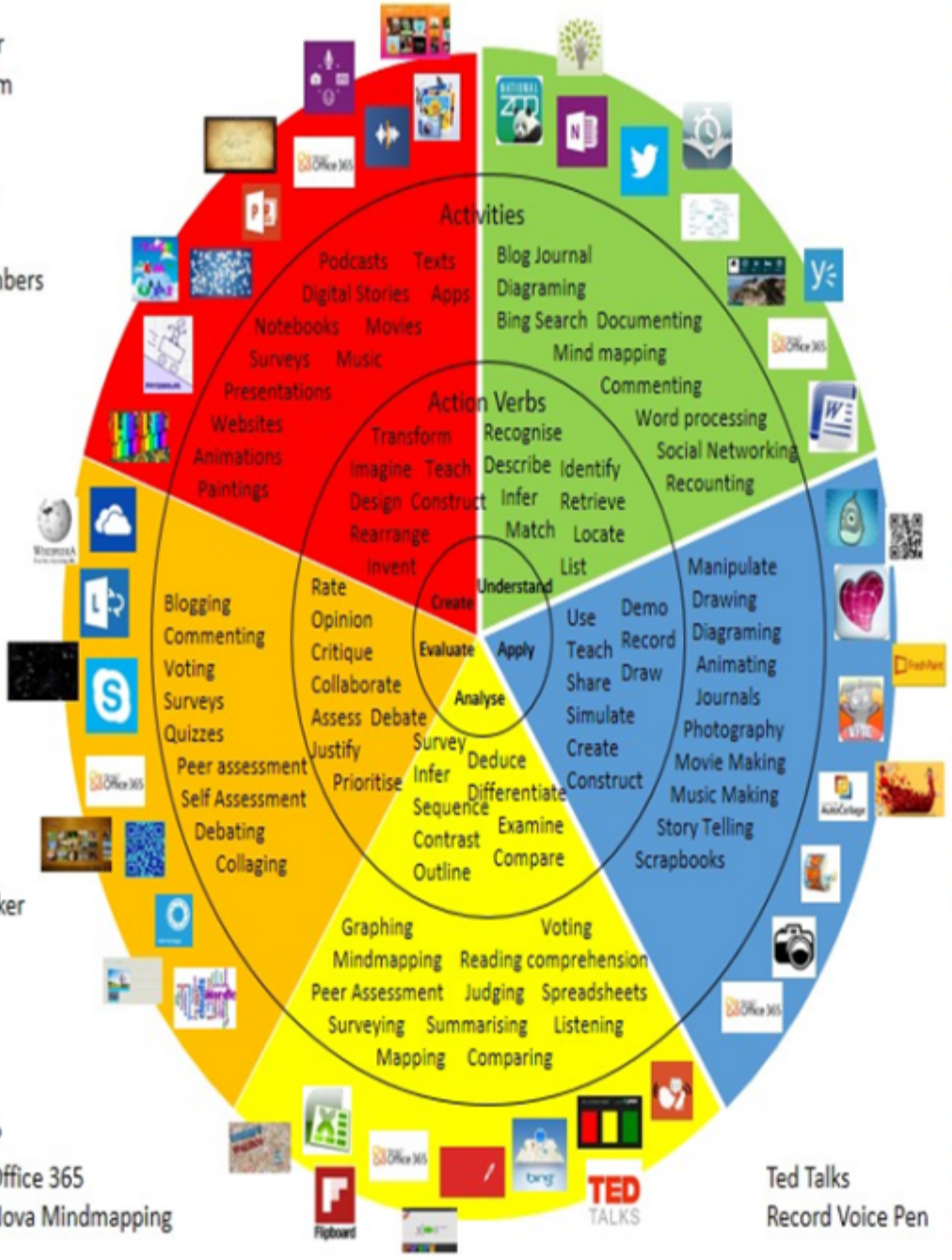
Upon completion of this sections, please remove all remaining descriptions, notes, outlines, examples and/or illustrations that are not needed or used.

What **Technology Infusion** and/or strategies are integrated into this unit to enhance learning? Please list all hardware, software and strategies. Please find a technology pedagogy wheel for assistance while completing this section.

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 Office 365
Flipboard 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

Mastery and infusion of **21st Century Skills & Technology** and their Alignment to the core content areas is essential to student learning. The core content areas include:

- English Language Arts;
- Mathematics;
- Science and Scientific Inquiry (Next Generation);
- Social Studies, including American History, World History, Geography, Government and Civics, and Economics;
- World languages;
- Technology;
- Visual and Performing Arts.

CRP.K-12.CRP1.1	Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.
CRP.K-12.CRP4.1	Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.
CRP.K-12.CRP5.1	Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.
CRP.K-12.CRP7.1	Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.
CRP.K-12.CRP8.1	Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP.K-12.CRP11.1	Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.
CRP.K-12.CRP12.1	Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.
CAEP.9.2.12.C.2	Modify Personalized Student Learning Plans to support declared career goals.
TECH.8.1.12.A.4	Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results.
TECH.8.1.12.A.5	Create a report from a relational database consisting of at least two tables and describe the process, and explain the report results.
TECH.8.1.12.A.CS2	Select and use applications effectively and productively.
TECH.8.1.12.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
TECH.8.1.12.C.CS1	Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
TECH.8.1.12.C.CS2	Communicate information and ideas to multiple audiences using a variety of media and formats.
TECH.8.1.12.E.CS1	Plan strategies to guide inquiry.
TECH.8.1.12.E.CS2	Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media.
TECH.8.1.12.E.CS3	Evaluate and select information sources and digital tools based on the appropriateness for specific tasks.
TECH.8.1.12.E.CS4	Process data and report results.
TECH.8.1.12.F.CS3	Collect and analyze data to identify solutions and/or make informed decisions.
TECH.8.1.12.F.CS4	Use multiple processes and diverse perspectives to explore alternative solutions.
TECH.8.2.12.A.CS2	The core concepts of technology.

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
- Financial, Economic, Business and Entrepreneurial 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
- allowing the use of note cards or open-book during testing
- 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
- having peers take notes or providing a copy of the teacher's notes
- marking students' correct and acceptable work, not the mistakes
- 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 authentic assessments with real-life problem-solving
- using true/false, matching, or fill in the blank tests in lieu of essay tests
- using videos, illustrations, pictures, and drawings to explain or clarify

Talented and Gifted Learning (T&G)

- Above grade level placement option for qualified students
- Advanced problem-solving
- Allow students to work at a faster pace
- Cluster grouping
- Complete activities aligned with above grade level text using Benchmark results
- 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