2. Unit 2- Ecology: Matter and Energy Transformations and Interdependent Relationships in Ecosystems (Life Science) Copied from: Biology (Life Science), Copied on: 12/15/21

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Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

Biology, High School

Ecology: Matter and Energy Transformations and Interdependent Relationships in Ecosystems

Belleville Board of Education

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Unit Overview

In this unit of study, students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. Students also understand organisms' interactions with each other and their physical environment and how organisms obtain resources. Students utilize the crosscutting concepts of matter and energy and systems, and system models to make sense of ecosystem dynamics. Students are expected to use students construct explanations for the role of energy in the cycling of matter in organisms and ecosystems. They apply mathematical concepts to develop evidence to support explanations as they demonstrate their understanding of the disciplinary core ideas.

In this unit of study, students formulate answers to the question "how and why do organisms interact with each other (biotic factors) and their environment (abiotic factors), and what affects these interactions?" Secondary ideas include the interdependent relationships in ecosystems; dynamics of ecosystems; and functioning, resilience, and social interactions, including group behavior. Students use mathematical reasoning and models to make sense of carrying capacity, factors affecting biodiversity and populations, the cycling of matter and flow of energy through systems. The crosscutting concepts of scale, proportion, and quantity and stability and change are called out as organizing concepts for the disciplinary core ideas. Students are expected to use mathematical reasoning and models to demonstrate proficiency with the disciplinary core ideas.

Enduring Understanding

- Interactions within biological systems lead to complex properties.
- Energy cannot be created or destroyed—it only moves between one place and another place, between objects and/or fields, or between systems.
- 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.
- 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.
- Models (e.g., physical, mathematical, computer) can be used to simulate systems and interactions—including energy, matter, and information flows—within and between systems at different scales.
- Competition and cooperation are important aspects of biological systems.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
- Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support
- Most scientific knowledge is quite durable, but is, in principle, subject to change based on new evidence and/or reinterpretation of existing evidence
- • 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.

Essential Questions

- How does matter and energy cycle in ecosystems?
- What are the limitations of the model of a 'food chain?'
- How can the process of photosynthesis and respiration in a cell impact ALL of Earth’s systems?
- When they relocate bears, wolves, or other predators, how do they know that they will survive?
- What are the interrelationships between organisms and their environment and how do these relationships contribute to the stability of the ecosystem?
- What limits the number and types of different organisms that live in one place?
- How can a one or two inch rise in sea level devastate an ecosystem?
- How do matter and energy cycle through ecosystems?
- How do organisms interact with the living and nonliving environments to obtain matter and energy?

Exit Skills

By the end of this Unit Students Should be able to:

- Compare and contrast abiotic and biotic factors
- Explain various ways that consumers obtain energy and nutrients
- Model how energy flows through ecosystems
- Model all biochemical cycles and explain their importance
- Identify factors that determine global climate
- Graph and interpret predator prey dynamics
- Summarize the different modes of ecological succession
- Identify various biomes on a world map
- List the major categories of aquatic ecosystems
- Calculate and graph different modes of population growth
- Identify limiting factors, that affect carrying capacity of a population

New Jersey Student Learning Standards (NJSLS-S)

Interdisciplinary Connections

MA.K-12.2	Reason abstractly and quantitatively.
MA.K-12.4	Model with mathematics.
MA.N-Q.A.2	Define appropriate quantities for the purpose of descriptive modeling.
MA.N-Q.A.3	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
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.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.9-10.5	Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
CS.9-12.8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
CS.9-12.8.2.12.ETW.2	Synthesize and analyze data collected to monitor the effects of a technological product or system on the environment.
CS.9-12.8.2.12.ETW.3	Identify a complex, global environmental or climate change issue, develop a systemic plan of investigation, and propose an innovative sustainable solution.
CS.9-12.8.2.12.ITH.1	Analyze a product to determine the impact that economic, political, social, and/or cultural

	factors have had on its design, including its design constraints.
CS.9-12.8.2.12.ITH.2	Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
CS.9-12.8.2.12.ITH.3	Analyze the impact that globalization, social media, and access to open source technologies has had on innovation and on a society's economy, politics, and culture.
CS.9-12.ETW	Effects of Technology on the Natural World
CS.9-12.ITH	Interaction of Technology and Humans
	Decisions to develop new technology are driven by societal and cultural opinions and demands that differ from culture to culture.
	Changes caused by the introduction and use of a new technology can range from gradual to rapid and from subtle to obvious, and can change over time. These changes may vary from society to society as a result of differences in a society's economy, politics, and culture.
	Development and modification of any technological system needs to take into account how the operation of the system will affect natural resources and ecosystems. Impacts of technological systems on the environment need to be monitored and must inform decision-making. Many technologies have been designed to have a positive impact on the environment and to monitor environmental change over time.

Learning Objectives

Students who understand the concepts are able to:

• Construct and revise an explanation for the cycling of matter and flow of energy among organisms in an ecosystem using conceptual thinking and mathematical representations of phenomena.

• Use a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and to show how matter and energy are conserved as matter cycles and energy flows through ecosystems.

• Use a mathematical model to describe the conservation of atoms and molecules as they move through an ecosystem.

• Describe the cycling of matter and flow of energy through an ecosystem.

• Develop a model, based on evidence, to illustrate the roles of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

• Use quantitative analysis to compare relationships among interdependent factors and represent their effects on the carrying capacity of ecosystems at different scales.

• Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

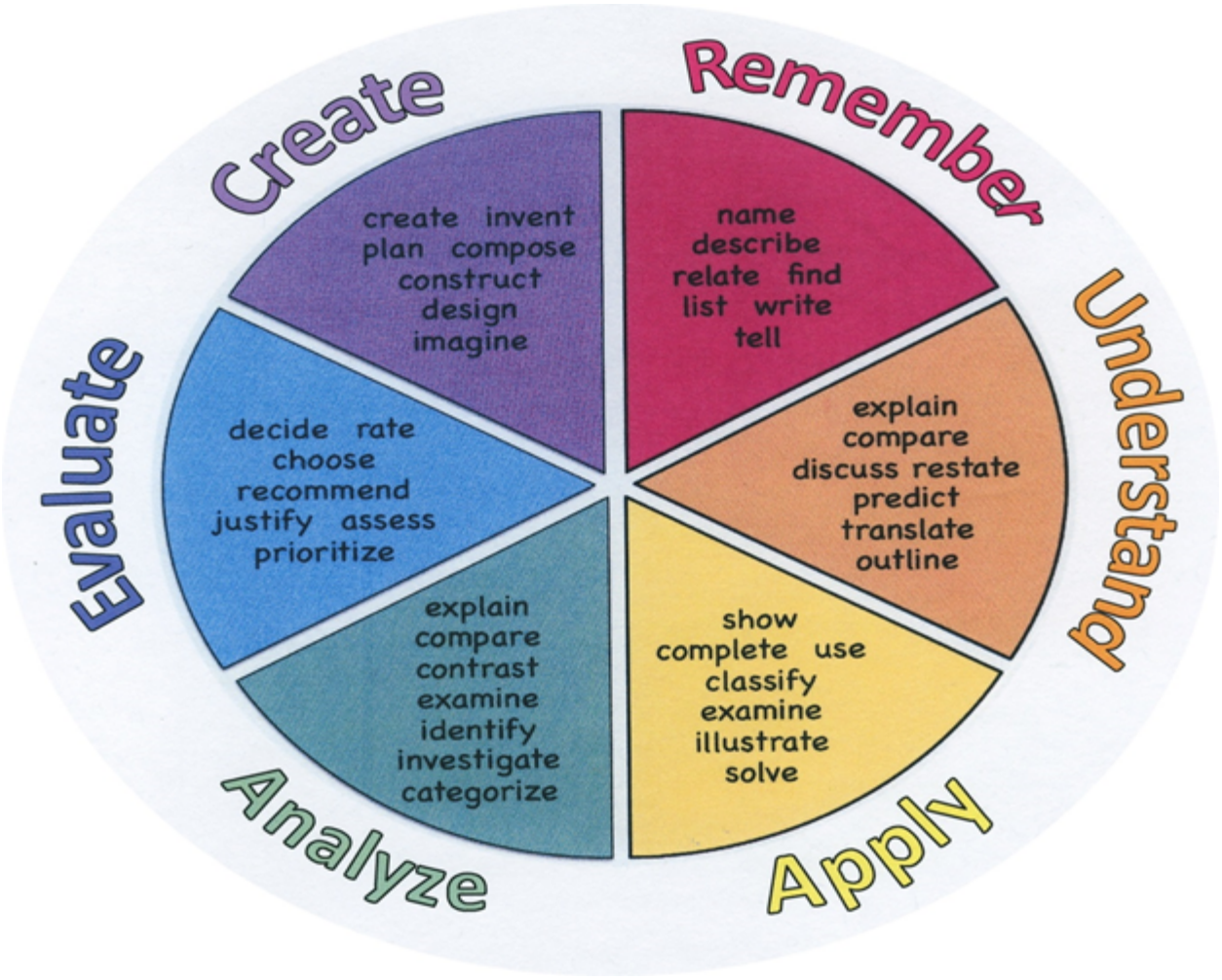
• Evaluate the claims, evidence, and reasoning that support the contention that complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

• Construct explanations of how modest biological or physical changes versus extreme changes affect stability and change in ecosystems.

Research and present the contribution of African-American physicians/anatomists to science and society
• Research and present the contribution of LGBTQ+ physicians/anatomists to science and society
• Research and present the effect of the Holocaust on medicine
• Discuss the effect of global climate change on human health

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

- Weather and Climate Venn Diagram
- Trophic Level Lab Activity
- Symbiotic Relationships Class Presentations
- Planet Earth: Pole to Pole Video Clips
- Construct a Food Web Activity
- Feeding Pyramids Reading and Analysis
- Ecological Succession Reading and Analysis
- Coral Reefs and Climate Change Journal
- Visit a Zoo! Food Web Activity
- Biome Travel Project
- Biogeochemical Cycles Station Activity
- Biome Travel Plans Activity
- Carbon Travels Simulation
- Research and present the contribution of African-American physicians/anatomists to science and society

• Research and present the contribution of LGBTQ+ physicians/anatomists to science and society
• Research and present the effect of the Holocaust on medicine
• Discuss the effect of global climate change on human health

Assessment Evidence - Checking for Understanding (CFU)

Assessments Generated using ExamView Test Generator and Test Bank from Miller/Levine Biology 2017 (Summative)

Common, Department Quarterly Benchmarks (Benchmark)

Oncourse Assessment Tools (Formative)

"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

Prentice Hall: Biology

Kenneth R Miller, Ph.D. - Joseph Levine, Ph.D. - New Jersey - Pearson Prentice Hall, Upper Saddle River - 2014

Ancillary Resources

- PearsonEasyBridge.com
- Chrome Book Projects/ Research/ Analysis
- Google Classroom
- On-line Databases via Media Center

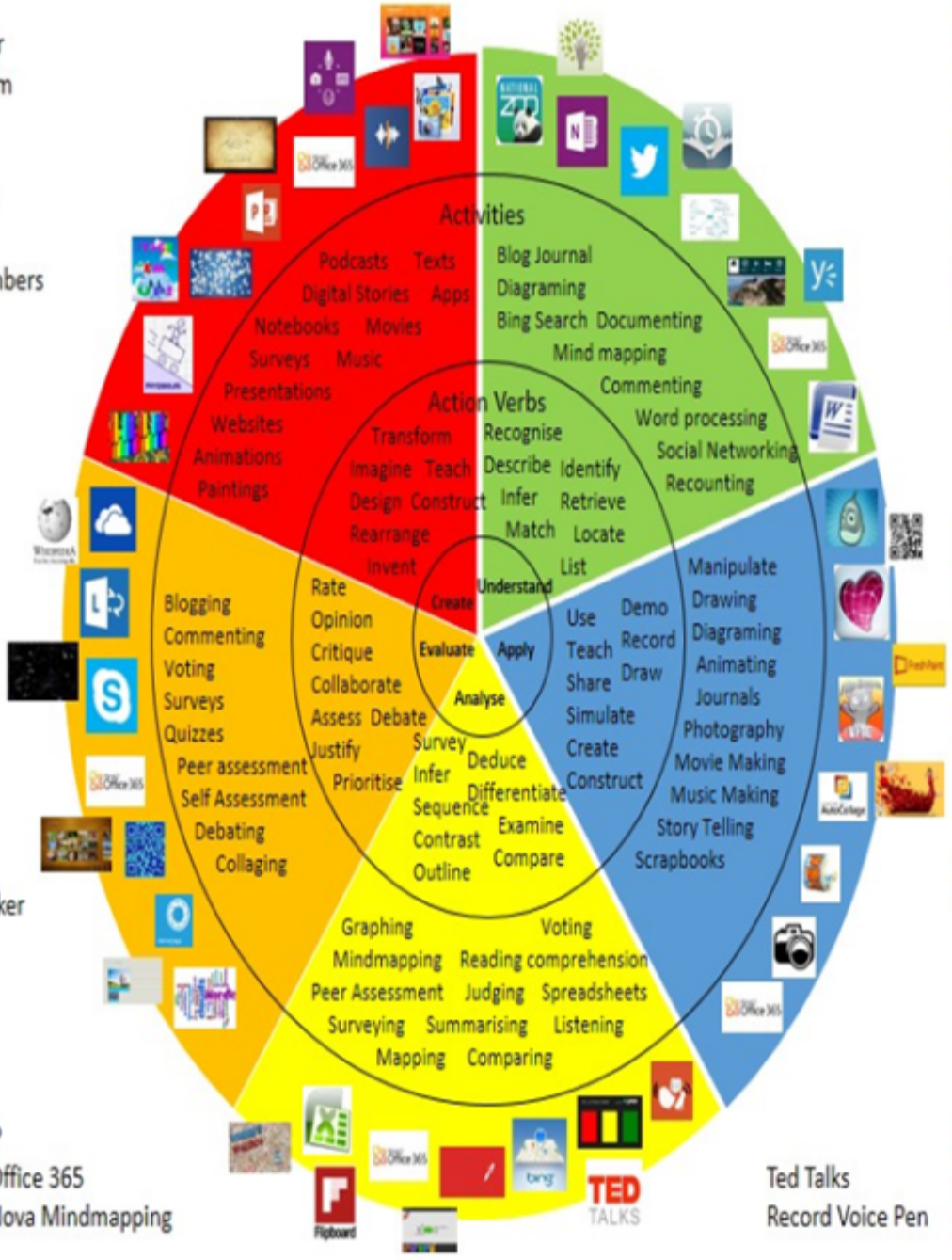
Technology Infusion

- Virtual Labs- i.e.Constructing Food Webs
- Online Resources available via Easybride website

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

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP3	Attend to personal health and financial well-being.
CAEP.9.2.12.C.7	Examine the professional, legal, and ethical responsibilities for both employers and employees in the global workplace.
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.B.CS1	Apply existing knowledge to generate new ideas, products, or processes.
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.

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

Allow different numbers and descriptions of organisms in creating food webs.

Selective Lab Grouping

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)

Students are provided with written notes and digital copies of presentations, as well as hard copy and digital textbook access.

Provide visual representation of organisms in food webs.

- 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
- multi-sensory presentation
- multiple test sessions
- 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)

Students are provided with glossary in their native language.

Spanish speaking students may utilize Spanish Edition of Textbook for in class assignments.

- 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

Student provided access to digital learning tools via EasyBridge platform.

This should include virtual labs, presentations, videos, and practice questions.

- 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)

Students will prepare classroom presentation for preparation of Biome travel activity.

Students design, execute, and report an original lab experiment.

- 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

Unit Name:Ecology: Matter and Energy Transformations and Interdependent Relationships in Ecosystems

NJSLS: see Standards below

Interdisciplinary Connection: see Standards below

Statement of Objective: SWBAT research a noteworthy African-American zoologist and present his/her contribution to science and society as a small group project

Anticipatory Set/Do Now: Entrance ticket (MC&T/F): review of research techniques

Learning Activity: group research and oral/multimedia presentation activity

Student Assessment/CFU's: Entrance ticket, observation of research/visual presentation techniques using teacher checklist, rubric for presentation

Materials: Chromebooks with Google Classroom, posted lab activity worksheet, posted Use of Microscope refresher, microscopes, various slides of muscle tissue, sketch paper, pencils

21st Century Themes and Skills: see list below

Differentiation/Modifications: see list below

Integration of Technology: Chromebooks, internet access, Google Classroom, microscopes

21st Century Themes and Skills:
• Small group setting and instruction
• Preview content and concepts
• Group investigations
• Multisensory approach
• Behavior management plans
• Project-based learning
• Open-ended activities

Differentiations:

• Small group instruction
• Small group assignments
• Extra time to complete assignments
• Pairing oral instruction with visuals
• Repeat directions
• Use manipulatives
• Teacher reads assessments allowed
• Rephrase written directions
• Multisensory approaches
• Additional time
• Preview vocabulary
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• Behavior management plan
• Highlight text
• Student(s) work with assigned partner
• Small group setting

Hi-Prep Differentiations:
• Group investigations
• Independent research and projects

• Multiple intelligence options
• Project-based learning
• Tiered activities/assignments
Lo-Prep Differentiations
• Exploration by interest
• Flexible grouping
• Goal setting with students
• Open-ended activities

LA.RST.11-12.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
9-12.HS-LS1-1.LS1.A.1 Systems of specialized cells within organisms help them perform the essential functions of life.
9-12.HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
9-12.HS-LS1-2.2.1 Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system.
9-12.HS-LS1-2.LS1.A.1 Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level.
9-12.HS-LS1-2.4.1 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.
LA.RST.11-12.4 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 11-12 texts and topics.
LA.RST.11-12.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
LA.WHST.11-12.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
LA.WHST.11-12.1 Write arguments focused on discipline-specific content.
LA.WHST.11-12.2 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.