Unit 1: Chemistry of Life (Life Science)

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Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Biology

Unit 1: Chemistry of Life

Belleville Board of Education

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Unit Overview

This first unit sets the foundation for students to understand the chemical basis of life, which is needed for mastery of future areas of focus and provides students with a survey of the elements necessary for carbon-based systems to function. Students learn that water and the properties of water play a vital role in the survival of individuals and biological systems. They also learn that living systems exist in a highly complex organization that requires input of energy and the exchange of macromolecules. This unit also addresses in detail how and in what conformations molecules called monomers bond together to form polymers. The structure of monomers and polymers determines their function. In the units that follow, students will need to understand and explain the interaction and bonding of atoms to form molecules.

Enduring Understanding

- **TOPIC 1.1 Structure of Water and Hydrogen Bonding**- Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 1.2 Elements of Life**- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- **TOPIC 1.3 Introduction to Biological Macromolecules**- Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 1.4 Properties of Biological Macromolecules**- Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 1.5 Structure and Function of Biological Macromolecules**- Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 1.6 Nucleic Acids**- Heritable information provides for continuity of life.

Essential Questions

- What is the role of energy in the making and breaking of polymers?
- How do living systems transmit information in order to ensure their survival?
- How would living systems function without the polarity of the water molecule?
- How are biological molecules necessary for organisms to grow, to reproduce, and to maintain organization?
- How do the subcomponents of biological molecules determine the properties of that molecule?

Exit Skills

By the end of AP Biology Unit 1, Chemistry of Life, the student should be able to:

- Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.
- Describe the composition of macromolecules required by living organisms.
- Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.
- Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.
- Describe the structural similarities and differences between DNA and RNA.

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

HS-LS1-1	Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.
HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-6	Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
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-LS1-2.4.1	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-LS1-6.5.1	Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.
9-12.HS-LS1-1.6.1	Construct 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-LS1-1.6.1	students investigate systems by examining the properties of different materials, the structures of different components, and their interconnections to reveal the system's function and/or solve a problem. They infer the functions and properties of natural and designed objects and systems from their overall structure, the way their components are shaped and used, and the molecular substructures of their various materials.
9-12.HS-LS1-6.6.1	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-LS1-1.LS1.A.1	Systems of specialized cells within organisms help them perform the essential functions of life.
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-LS1-1.LS1.A.2	All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells.
9-12.HS-LS1-6.LS1.C.1	The sugar molecules thus formed contain carbon, hydrogen, and oxygen: their hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for example to form new cells.
9-12.HS-LS1-6.LS1.C.2	As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products.

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.

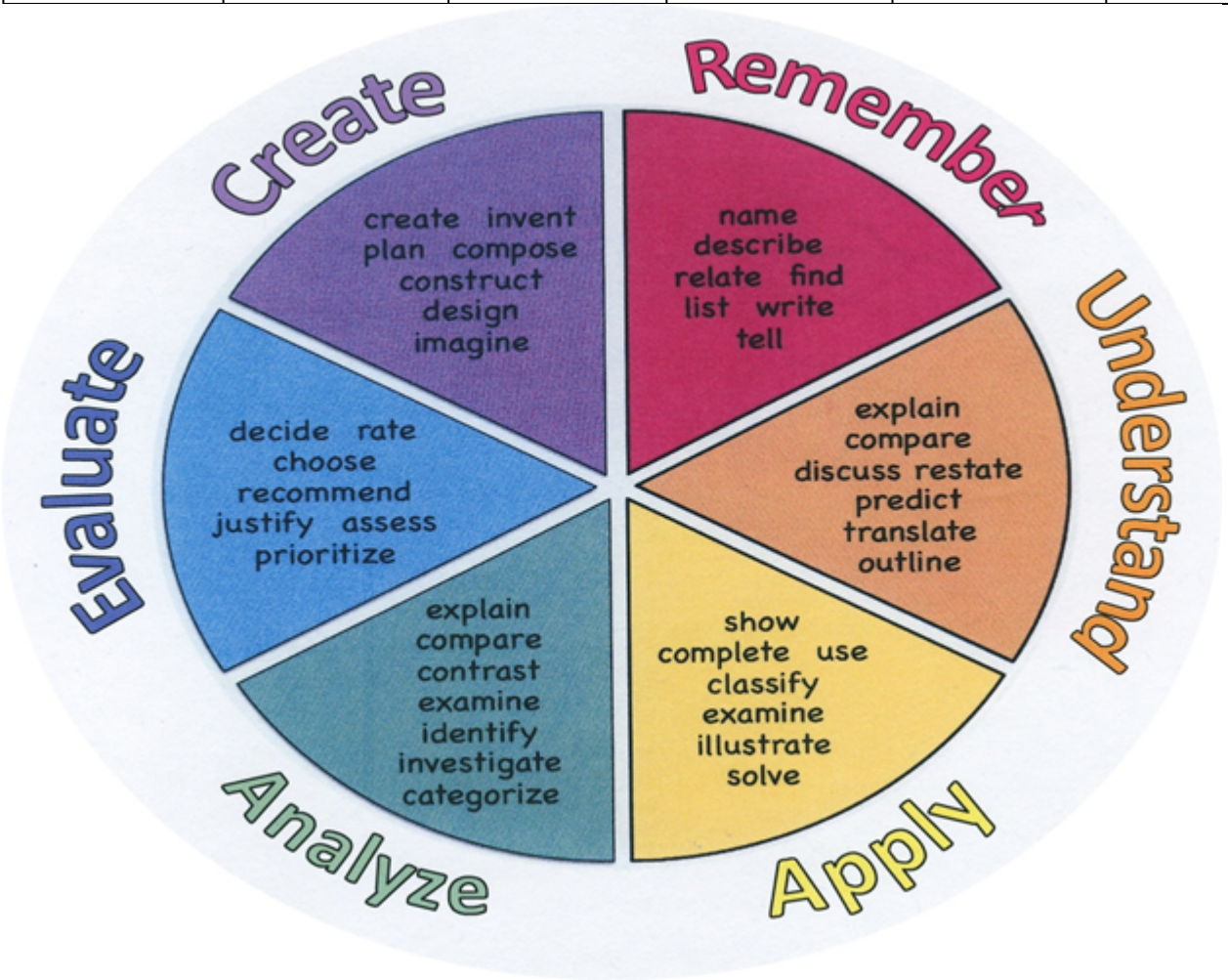
Learning Objectives

- SWDAT justify the selection of data regarding the types of molecules that an animal, plant, or bacterium will take up as necessary building blocks and excrete as waste products.
- SWDAT explain the connection between the sequence and the subcomponents of a biological polymer and its properties.
- SWDAT construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions.
- SWDAT represent graphically or model quantitatively the exchange of molecules between an organism and its environment, and the subsequent uses of these molecules to build new molecules that facilitate dynamic homeostasis, growth, and reproduction.
- SWDAT refine representations and models to explain how the subcomponents of a biological polymer and their sequence determine the properties of that polymer.
- SWDAT use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.
- SWDAT analyze data to identify how molecular interactions affect structure and function.

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 Select State Count Draw Outline Point Quote Recall Recognize Repeat Reproduce	Interrelate Interpret Infer Match Paraphrase Represent Restate Rewrite Select Show Summarize Tell Translate Associate Compute Convert Discuss Estimate Extrapolate Generalize Predict	Show Sketch Solve Use Add Calculate Change Classify Complete Compute Discover Divide Examine Graph Interpolate Manipulate Modify Operate Subtract	Survey Arrange Breakdown Combine Detect Diagram Discriminate Illustrate Outline Point out Separate	Grade Justify Measure Rank Rate Support Test	Organize Plan Produce Role Play Drive Devise Generate Integrate Prescribe Propose Reconstruct Revise Rewrite Transform



Suggested Activities & Best Practices

1. Students create mini-posters to explain how either the carbon or nitrogen cycles provide essential chemical elements to support life in an ecosystem. Students make predictions about the impact of human activity on the cycles.

2. Based on water's molecular properties, students create visual representations (e.g., diagrams or models) with annotations to explain how water travels up a 300-ft. California redwood tree.

3. Students create visual representations with annotations (e.g., diagrams or models) to explain how water's molecular structure results in unique properties and how these properties are vital to life processes.

4. Using molecular model kits, students justify the claim that organisms need the SPONCH elements to build complex molecules and recycle elements necessary for life by constructing models of key biomolecules from their monomers.

5.Students explain either through narrative or visual representations (e.g., diagram with annotation) how the SPONCH elements move from the environment to synthesize complex biomolecules (e.g., carbohydrates, lipids, proteins, nucleic acids, ATP) necessary for cellular processes.

6. "Picture Perfect." An inquiry-based case study built on concepts relating to enzymatic activity. Students design an experiment to examine factors affecting the action of amylase on starch to identify a stain on an antique dress.

7. **AP Biology Investigation 13: Enzyme Activity**. Students design and conduct investigations to explore the effects of environmental variables on the rates of enzymatic reactions.

Assessment Evidence - Checking for Understanding (CFU)

Unit tests- Unit 1 Personal Progress Check from AP Classroom (Summative)

Quizzes-macromolecules quiz, enzyme quiz (Summative)

Unit review/Test prep- Campbell and Reece chapter 2,3,4,5 study guides (Formative)

Web-Based Assessments- google form quizzes (Summative)

DBQ's (Formative)

Benchmark #1 (Benchmark)

- 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-macromolecules quiz, enzyme 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 2,3,4,5 study guides
- Unit tests- Unit 1 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 2,3,4,5

Ancillary Resources

- Pearson Education Test Prep Series for AP Biology (2017)
- AP Biology Investigative Labs- Investigation 13: Enzyme Activity

- Campbell and Reece chapters 2,3,4,5 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

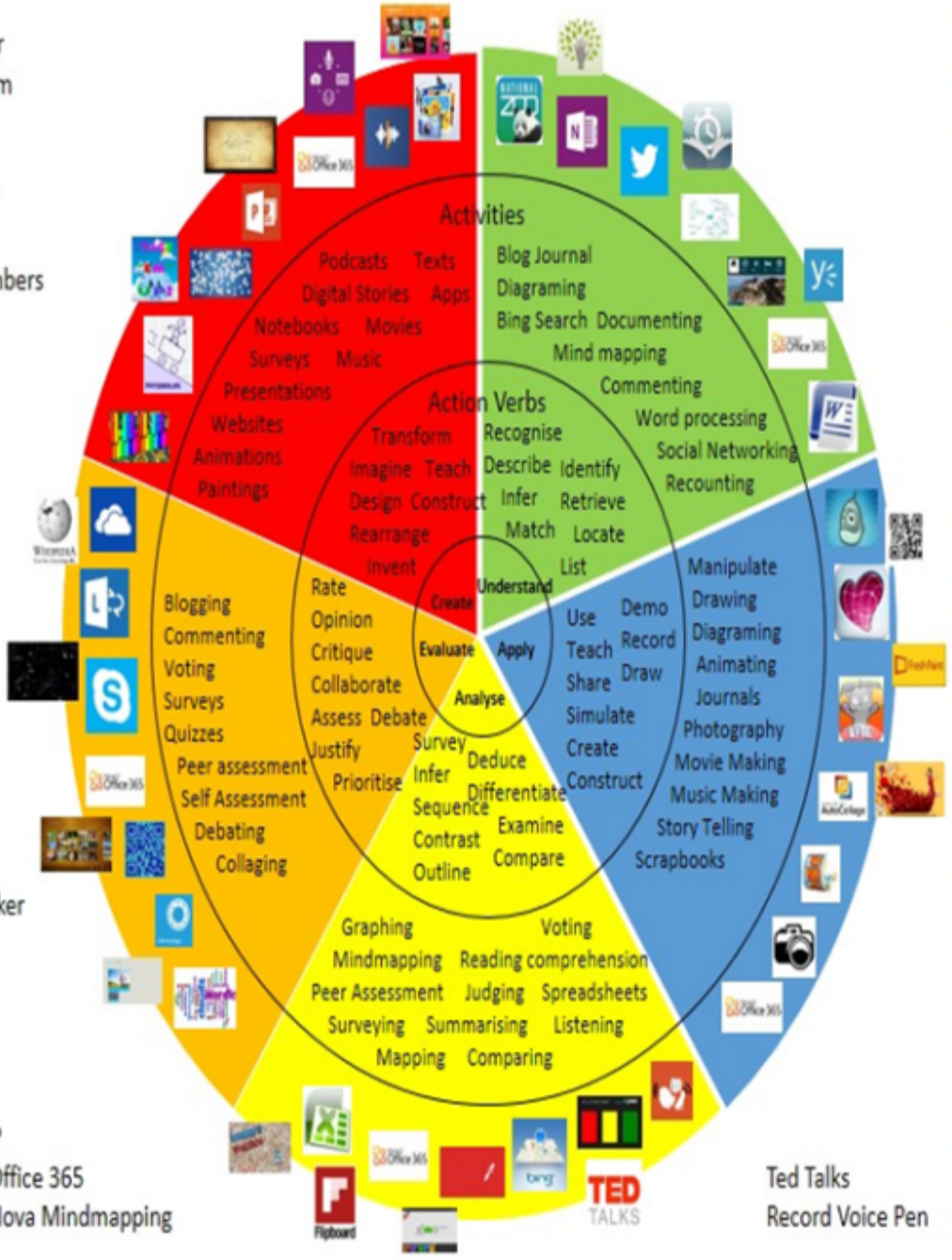
Technology Infusion

- Smart TV - (Properties of Water, Biological Macromolecules, Enzymes 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 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.CRP1	Act as a responsible and contributing citizen and employee.
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.CRP7	Employ valid and reliable research strategies.
CRP.K-12.CRP10	Plan education and career paths aligned to personal goals.
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

LA.RH.9-10.7	Integrate quantitative or technical analysis (e.g., charts, research data) with qualitative analysis in print or digital text, to analyze information presented via different mediums.

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.9-10.4	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.

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
- 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)

- 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 1: Chemistry of Life

NJSLS: Attached

Interdisciplinary Connection: Art (sketching or building models)

Statement of Objective: SWDAT use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.

Anticipatory Set/Do Now: Teacher will show photos of water striders and giant redwood trees and pose the questions, "How does a water strider "float" on water?" "How does water travel from the roots of giant redwood trees hundreds of feet up to the leaves?" Teacher wil review the properties of water responsible for allow these two situations occur such as adhesion, cohesion, and surface tension.

Learning Activity: Students create visual representations with annotations (e.g., diagrams or models) to explain how water's molecular structure results in unique properties and how these properties are vital to life processes.

Student Assessment/CFU's: Exit Ticket- Google form questions on water's uniques properties.

Materials: Smart TV for anticipatory set, chromebooks for exit ticket, poster board, coloring supplies, materials to build 3D model of water (styrafoam balls, toothpicks)

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

HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.