Unit 2: Cell Structure and Function (Life Science)

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Belleville Public Schools

Curriculum Guide

AP Biology

Unit 2: Cell Structure and Function

Belleville Board of Education

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Unit Overview

The cell is the basic unit of life. Cells contribute to the organization of life and provide the environment in which organelles function. Organelles in turn provide compartmentalization and organize cellular products for dispersal and waste for disposal. Cells have membranes that allow them to establish and maintain an internal environment. These membranes also control the exchange of material with the cell's external environment—an important, foundational concept. The maintenance of the internal and external conditions of a cell is called homeostasis. Student understanding of these concepts will be necessary in later units when the focus of instruction shifts to cellular products and by-products and when students learn why cellular exchange of energy and materials matters.

Enduring Understanding

- **TOPIC 2.1 2.1 Cell Structure: Subcellular Components-** Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 2.2 Cell Structure and Function-**Living systems are organized in a hierarchy of structural levels that interact.
- **TOPIC 2.3 Cell Size-**The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- **TOPIC 2.4 Plasma Membranes-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.5 Membrane Permeability-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.6 Membrane Transport-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.7 Facilitated Diffusion-**Cells have membranes that allow them to establish and maintain internal

environments that are different from their external environments.

- **TOPIC 2.8 Tonicity and Osmoregulation-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.9 Mechanisms of Transport-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.10 Cell Compartmentalization-**Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments.
- **TOPIC 2.11 Origins of Cell Compartmentalization**-Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence.

Essential Questions

- How do the mechanisms for transport across membranes support energy conservation?
- What are the advantages and disadvantages of cellular compartmentalization?
- What are the advantages and disadvantages of cellular compartmentalization?
- How do shared conserved cellular processes support the idea that all organisms are linked by lines of descent from common ancestry?
- How do cells create and maintain internal environments that are different from their external environments?
- How do structure and function of subcellular components and their interactions provide essential cellular processes?
- How do cells maintain dynamic homeostasis by the movement of molecules across membranes?

Exit Skills

By the end of AP Biology Unit 2, Cell Structure and Function, the student should be able to:

- Describe the structure and/ or function of subcellular components and organelles.
- Explain how subcellular components and organelles contribute to the function of the cell.
- Explain the effect of surface area-to-volume ratios on the exchange of materials between cells or organisms and the environment.
- Describe the roles of each of the components of the cell membrane in maintaining the internal environment of the cell.
- Describe the Fluid Mosaic Model of cell membranes.
- Explain how the structure of biological membranes influences selective permeability.
- Describe the role of the cell wall in maintaining cell structure and function
- Describe the mechanisms that organisms use to maintain solute and water balance.
- Describe the mechanisms that organisms use to transport large molecules across the plasma membrane.
- Explain how concentration gradients affect the movement of molecules across membranes.

- Explain how osmoregulatory mechanisms contribute to the health and survival of organisms.
- Describe the processes that allow ions and other molecules to move across membranes.
- Describe the membrane bound structures of the eukaryotic cell.
- Explain how internal membranes and membrane bound organelles contribute to compartmentalization of eukaryotic cell functions.
- Describe similarities and/or differences in compartmentalization between prokaryotic and eukaryotic cells.
- Describe the relationship between the functions of endosymbiotic organelles and their free-living ancestral counterparts.

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS4-1	Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
9-12.HS-LS4-1.1.1	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-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-LS1-3.3.1	Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.
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-LS1-3.7.1	Feedback (negative or positive) can stabilize or destabilize a system.
9-12.HS-LS4-1.8.1	Communicate scientific information (e.g., about phenomena and/or the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

9-12.HS-LS1-3.LS1.A.1	Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living 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-LS4-1.LS4.A.1	Genetic information provides evidence of evolution. DNA sequences vary among species, but there are many overlaps; in fact, the ongoing branching that produces multiple lines of descent can be inferred by comparing the DNA sequences of different organisms. Such information is also derivable from the similarities and differences in amino acid sequences and from anatomical and embryological evidence.

Interdisciplinary Connections

LA.RST.9-10.1	Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.
LA.RST.9-10.2	Determine the central ideas, themes, or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
LA.RST.9-10.3	Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.
LA.RST.9-10.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.
LA.RST.9-10.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.
LA.RST.9-10.8	Determine if the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
LA.RST.9-10.9	Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
LA.WHST.9-10.1	Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.
LA.WHST.9-10.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.
LA.WHST.9-10.9	Draw evidence from informational texts to support analysis, reflection, and research.

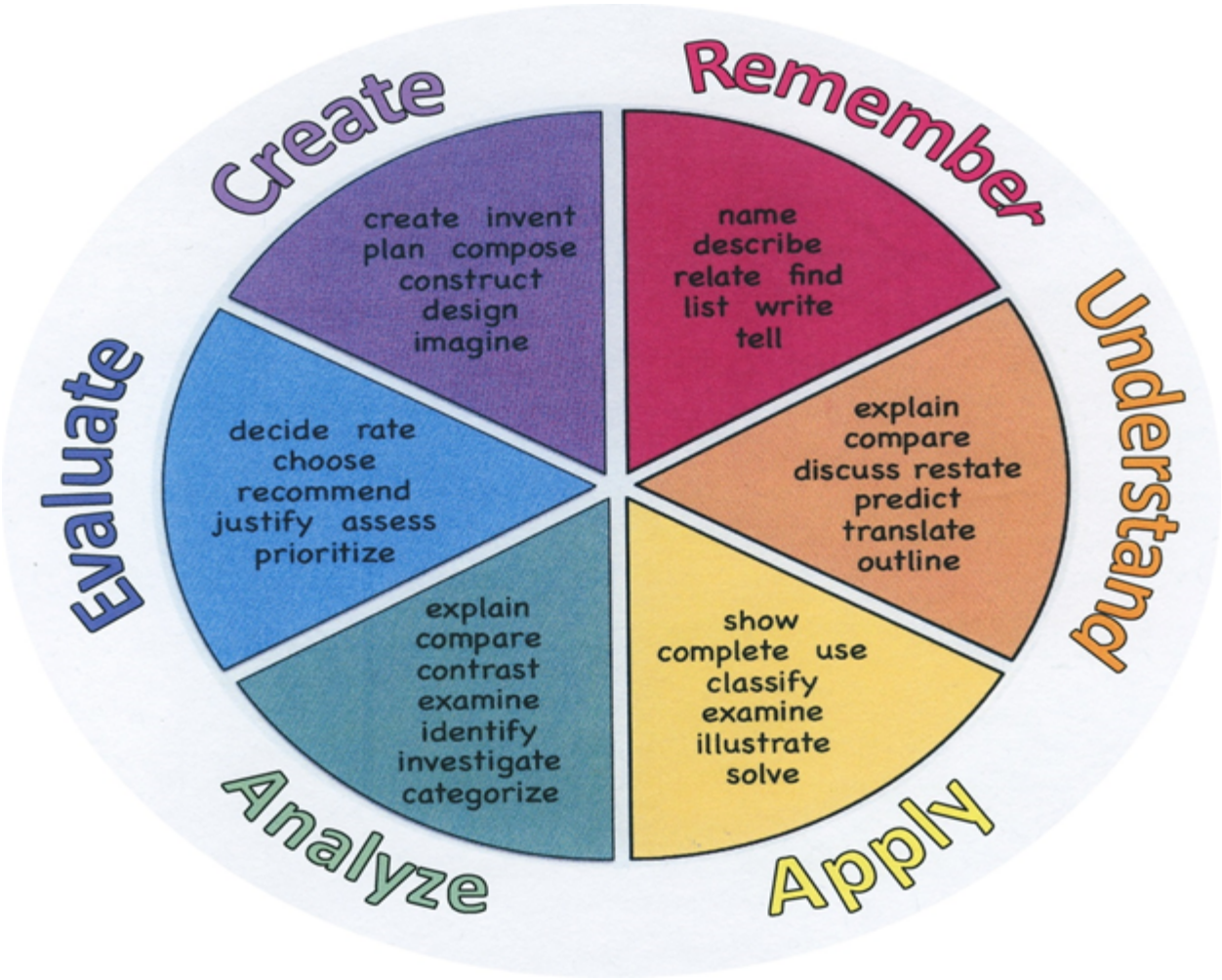
Learning Objectives

- SWDAT use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion.
- SWDAT explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination.
- SWDAT explain how internal membranes and organelles contribute to cell functions.
- SWDAT use representations and models to describe differences in prokaryotic and eukaryotic cells.
- SWDAT make a prediction about the interactions of subcellular organelles.

- SWDAT construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions.
- SWDAT use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions, provide essential functions.
- SWDAT use representations and models to pose scientific questions about the properties of cell membranes and selective permeability based on molecular structure.
- SWDAT construct models that connect the movement of molecules across membranes with membrane structure and function.
- SWDAT use representations and models to analyze situations or solve problems qualitatively or quantitatively to investigate whether dynamic homeostasis is maintained by the active movement of molecules across membranes.
- SWDAT justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- SWDAT pose scientific questions that correctly identify essential properties of shared, core life processes that provide insights into the history of life on Earth.

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

1. Ask the Expert- Students can be divided into groups and each group assigned a subcellular component to study. Students then rotate through the expert stations to learn about the subcellular components required for this topic.

2. Students can take agar cubes of different sizes that are soaked in phenolphthalein and soak them in vinegar. The students can measure how long it takes for the cubes to become clear as the vinegar diffuses into the cubes. Students will find that the smaller cubes become clear before the larger cubes and can use their observations to determine how cell size affects cell function.

3. One-Minute Essay- Before teaching the topic, have students read a case study about osmosis and answer questions (either those given with the case study or those you create) about the scenario. Ask students to draw what they they think is occurring on the cellular level. Then, teach the topic in the way that best fits your classroom. Once students have demonstrated an understanding of the topic, have them revisit their answers to the questions in the case study as well as their drawings.

4. Students create a diagram with annotation to explain how approximately 300 million alveoli in a human lung increase surface area for gas exchange to the size of a tennis court. Students should use the diagram to explain how the cellular structures of alveoli, capillaries, and red blood cells allow for rapid diffusion of O2 and CO2 between them.

5.Using inexpensive and common household items, students create a model of a specific cell (e.g., neuron, white blood cell, plant

leaf cell, Paramecium, sperm cell, bacterium) that includes a working organelle that defines the overall function of the cell. Students explain their cell and organelle to the class.

6. Students create a visual representation, such as a diagram with annotation or a PowerPoint slide, to explain how four organelles work together to perform a specific function in a cell of your choice. Students should predict how a defect in the function of one of the organelles can affect the overall function of the cell. Students present their visual representations to the class for review and revision.

7. Provided with a simple diagram of the fluid mosaic model of cell membrane structure, students revise and/or refine the diagram to illustrate the arrangement of the membrane's molecular components.

8. Using the revised cell membrane diagrams they created, students pose three questions about the relationship between the structure of the membrane and the movement of molecules across it (e.g., polar and non-polar molecules, small and large molecules). Then students explain how answers to the questions can be investigated.

9. **AP Biology Investigation 4: Diffusion and Osmosis**. Students explore the phenomenon of water potential and then model osmosis and diffusion using dialysis tubing. Using plant tissues and various sucrose solutions, students design and conduct an experiment to determine the water potential of the plant tissues.

Assessment Evidence - Checking for Understanding (CFU)

• Unit tests- Unit 2 Personal Progress Check from AP Classroom (Summative)

• Quizzes- cell components and cell size quiz/ cellular transport quiz (Summative)

• Unit review/Test prep- Campbell and Reece chapter 6,7,25,26,27 study guides (Formative)

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

• DBQ's (Formative)

• Common Benchmarks (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- cell components and cell size quiz/ cellular transport quiz
- Red Light, Green Light
- Self- assessments
- Socratic Seminar
- Study Guide
- Surveys
- Teacher Observation Checklist
- Think, Pair, Share- large 'Post-It' posters
- Think, Write, Pair, Share
- Top 10 List
- Unit review/Test prep- Campbell and Reece chapter 6,7,25,26,27 study guides
- Unit tests- Unit 2 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 6,7,25,26,27

Ancillary Resources

- Pearson Education Test Prep Series for AP Biology (2017)
- AP Biology Investigative Labs- Investigation 4: Diffusion and Osmosis
- Campbell and Reece chapters 6,7,25,26,27 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

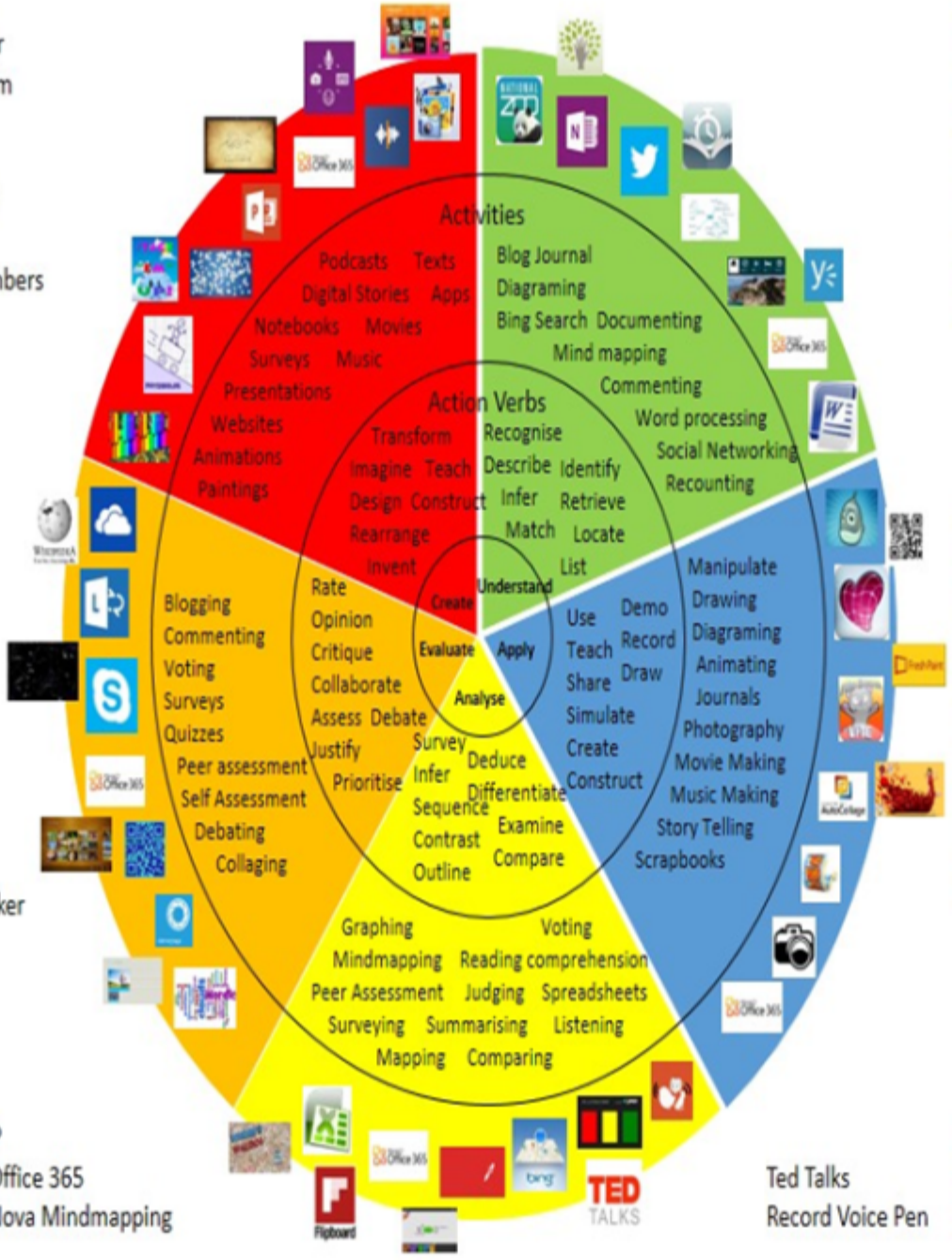
Technology Infusion

- Smart TV - (Cell Structure and Cell Transport 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

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

21st Century Skills/Interdisciplinary Themes

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

21st Century Skills

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

Differentiation

Differentiations:

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

Hi-Prep Differentiations:

- Alternative formative and summative assessments
- Choice boards
- Games and tournaments
- Group investigations
- Guided Reading
- Independent research and projects
- Interest groups
- Learning contracts
- Leveled rubrics
- Literature circles
- Multiple intelligence options
- Multiple texts
- Personal agendas
- Project-based learning
- Problem-based learning
- Stations/centers
- Think-Tac-Toes
- Tiered activities/assignments

- Tiered products
- Varying organizers for instructions

Lo-Prep Differentiations

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

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

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

NJSLS: Attached

Interdisciplinary Connection: Math (Calculating solution concentrations)

Statement of Objective: SWDAT construct models that connect the movement of molecules across membranes with membrane structure and function.

Anticipatory Set/Do Now: What is dialysis?- Introduction. Students will think-pair-share their prior knowledge on dialysis and dialysis tubing since it will serve as the model for cell membranes in the lab activity.

Learning Activity: AP Biology Investigation 4: Diffusion and Osmosis. Students explore the phenomenon of water potential and then model osmosis and diffusion using dialysis tubing. Using plant tissues and various sucrose solutions, students design and conduct an experiment to determine the water potential of the plant tissues.

Student Assessment/CFU's: Exit Ticket- Google form post-lab analysis questions.

Materials: Smart TV for anticipatory set, chromebooks for exit ticket, AP Biology Investigation 4: Diffusion and Osmosis lab supplies kit

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.