Unit 4: Cell Communication and Cell Cycle (Life Science) Copied from: Biology AP (5.0) (Life Science), Copied on: 02/21/22

Content Area: **Science**
Course(s): **Biology AP**
Time Period: **OctNov**
Length: **9-11 days**
Status: **Published**

Title Section

Department of Curriculum and Instruction

Belleville Public Schools

Curriculum Guide

AP Biology

Unit 4: Cell Communication and Cell Cycle

Belleville Board of Education

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Board Approved: Not Approved

Unit Overview

In Unit 4, students continue to learn about the role of cells, focusing on how cells use energy and information transmission to communicate and replicate. Through systems of complex transduction pathways, cells can communicate with one another. Cells can also generate and receive signals, coordinate mechanisms for growth, and respond to environmental cues. To maintain homeostasis, cells respond to their environment. They can also replicate and regulate replication as part of the cell cycle that provides for the continuity of life. In Unit 5, students will move on to learn about heredity

Enduring Understanding

- **TOPIC 4.1 Cell Communication-** Cells communicate by generating, transmitting, receiving, and responding to chemical signals.
- **TOPIC 4.2 Introduction to Signal Transduction-**Cells communicate by generating, transmitting, receiving, and responding to chemical signals.
- **TOPIC 4.3 Signal Transduction-**Cells communicate by generating, transmitting, receiving, and responding to chemical signals.
- **TOPIC 4.4 Changes in Signal Transduction Pathways-**Cells communicate by generating, transmitting, receiving, and responding to chemical signals.
- **TOPIC 4.5 Feedback-**Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.
- **TOPIC 4.6 Cell Cycle-**Heritable information provides for continuity of life.
- **TOPIC 4.7 Regulation of Cell Cycle-**Heritable information provides for continuity of life.

Essential Questions

- In what ways do cells use energy to communicate with one another?
- How does the cell cycle aid in the conservation of genetic information?
- Why and in what ways do cells communicate with one another?
- How are external signals converted into cellular responses?
- How do living systems store, retrieve, and transmit genetic information critical to life processes?

Exit Skills

By the end of AP Biology Unit 4, Cell Communication and Cell Cycle, the student should be able to:

- Describe the ways that cells can communicate with one another.
- Explain how cells communicate with one another over short and long distances.
- Describe the components of a signal transduction pathway.
- Describe the role of components of a signal transduction pathway in producing a cellular response.
- Describe the role of the environment in eliciting a cellular response.
- Describe the different types of cellular responses elicited by a signal transduction pathway
- Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway.
- Describe how nervous systems detect external and internal signals.
- Describe how nervous systems transmit information.
- Describe positive and/ or negative feedback mechanisms.
- Explain how negative feedback helps to maintain homeostasis.
- Explain how positive feedback affects homeostasis.
- Describe the events that occur in the cell cycle.
- Explain how mitosis results in the transmission of chromosomes from one generation to the next.
- Describe the role of checkpoints in regulating the cell cycle.
- Describe the effects of disruptions to the cell cycle on the cell or organism.

New Jersey Student Learning Standards (NJSLS-S)

NextGen Science Standards

SCI.HS-LS1	From Molecules to Organisms: Structures and Processes
	Constructing explanations and designing solutions in 9–12 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories.
SCI.HS-LS1-2	Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
	Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds.
SCI.HS.LS1.A	Structure and Function
	Planning and carrying out in 9–12 builds on K–8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.
SCI.HS-LS1-4	Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
SCI.HS.LS1.B	Growth and Development of Organisms
SCI.HS-LS1-5	Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
	Developing and Using Models
SCI.HS.LS1.C	Organization for Matter and Energy Flow in Organisms
SCI.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.
SCI.HS.LS1.C	Organization for Matter and Energy Flow in Organisms
SCI.HS-LS1-7	Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
SCI.HS.LS1.C	Organization for Matter and Energy Flow in Organisms
SCI.HS-ESS2-2	Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
SCI.HS-ESS2-7	Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

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.
CS.9-12.8.1.12.CS.1	Describe ways in which integrated systems hide underlying implementation details to simplify user experiences.
CS.9-12.8.1.12.CS.2	Model interactions between application software, system software, and hardware.
CS.9-12.8.1.12.CS.3	Compare the functions of application software, system software, and hardware.
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.EC	Ethics & Culture
	The ability to ethically integrate new technologies requires deciding whether to introduce a technology, taking into consideration local resources and the role of culture in acceptance. Consequences of technological use may be different for different groups of people and may change over time. Since technological decisions can have ethical implications, it is essential that individuals analyze issues by gathering evidence from multiple perspectives and conceiving of alternative possibilities before proposing solutions.
	The usability, dependability, security, and accessibility of devices within integrated systems are important considerations in their design as they evolve.

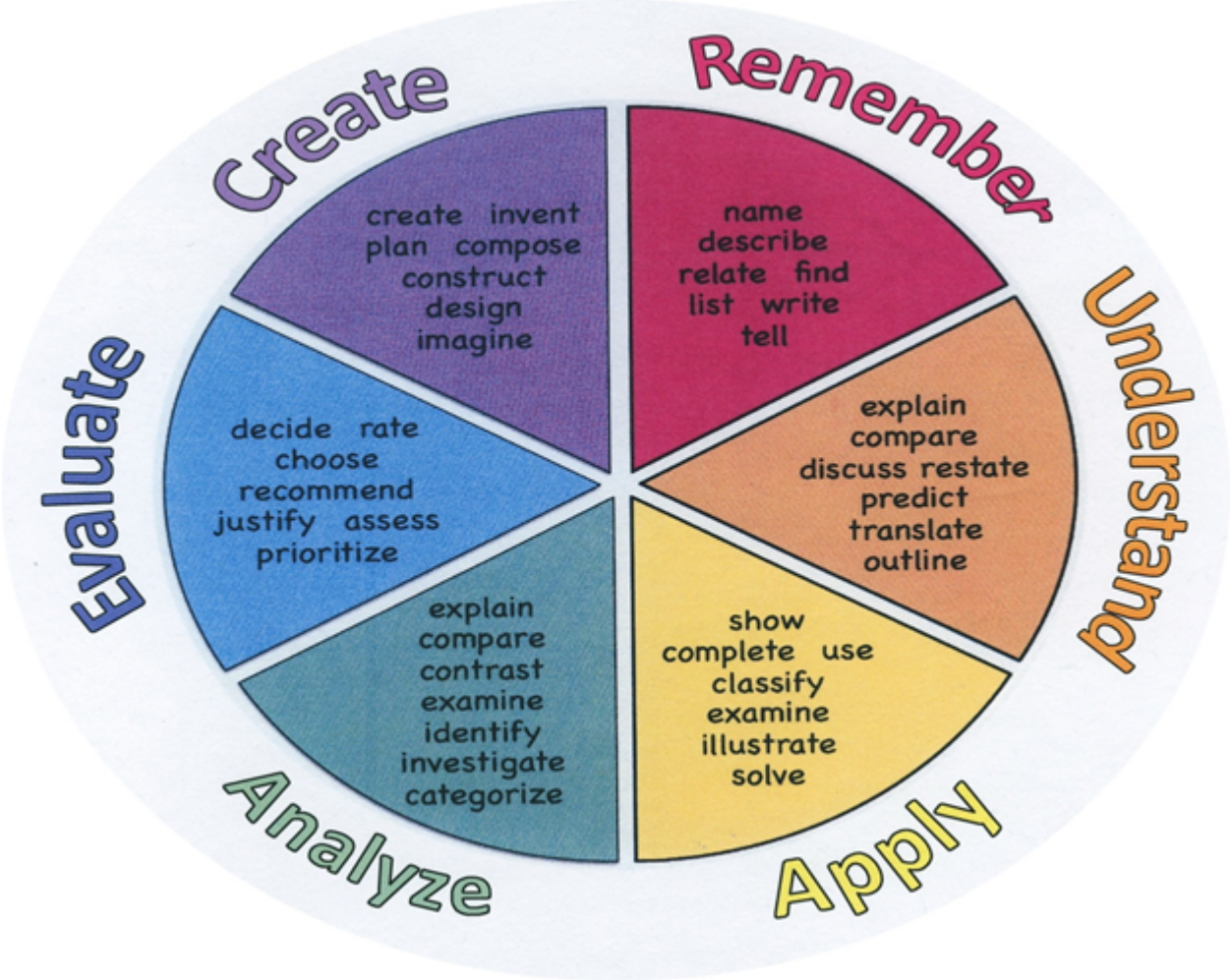
Learning Objectives

- SWDAT describe basic chemical processes for cell communication shared across evolutionary lines of descent.
- SWDAT generate scientific questions involving cell communication as it relates to the process of evolution.
- SWDAT use representations and appropriate models to describe features of a cell signaling pathway.
- SWDAT construct explanations of cell communication through cell-to-cell direct contact or through chemical signaling.
- SWDAT create representations that depict how cell-to-cell communication occurs by direct contact or from a distance through chemical signaling.
- SWDAT describe a model that expresses the key elements of signal transduction pathways by which a signal is converted to a cellular response.
- SWDAT justify claims based on scientific evidence that changes in signal transduction pathways can alter cellular response.
- SWDAT describe a model that expresses key elements to show how change in signal transduction can alter cellular response.
- SWDAT construct an explanation of how certain drugs affect signal reception and, consequently, signal transduction pathways.
- SWDAT construct an explanation, based on scientific theories and models, about how nervous systems detect external and internal signals, transmit and integrate information, and produce responses
- SWDAT connect how organisms use negative feedback to maintain their internal environments.
- SWDAT evaluate data that show the effect(s) of changes in concentrations of key molecules on negative feedback mechanisms.
- SWDAT make predictions about how organisms use negative feedback mechanisms to maintain their internal environments.
- SWDAT make predictions about how positive feedback mechanisms amplify activities and processes in organisms based on scientific theories and models.
- SWDAT justify that positive feedback mechanisms amplify responses in organisms.
- SWDAT make predictions about natural phenomena occurring during the cell cycle.
- SWDAT describe the events that occur in the cell cycle.

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 Compute Convert Discuss Estimate Extrapolate Generalize Predict	Graph Interpolate Manipulate Modify Operate Subtract			Transform



Suggested Activities & Best Practices

1. Online investigation: Students explain and justify the mechanism by which a specific disease is caused by a defective signaling pathway and investigate one drug that works by blocking a signaling pathway.

2. Students create an interactive model using cutout pieces of construction paper to describe the key features/components in a G-protein receptor system and explain the three stages of cell signaling: reception, transduction, and cellular response. Students share models for review and revision.

3. Based on information gleaned by reading The Immortal Life of Henrietta Lacks, students design and implement a project that reflects an issue raised by the author (e.g., the relationship between cancer cells and cell cycle control, the use of HeLa cells in

scientific research, the legal and ethical questions raised in the book).

4. Students can be divided into three groups. Each group will complete one of the three sections of the Signal Transduction POGIL. The teacher can debrief with each group to clarify misconceptions. Students will then rotate between groups so that they share their understandings of the model they studied and learn from one another.

5. Students can read a case study about cell signaling and then answer any questions that may accompany the case study. Alternately, teachers can provide appropriate questions and/or assignments to ensure that students understand the concepts addressed in the case study. Students can then do a fishbowl to discuss their learnings from the case study and applications to real life.

6. Students create a model of a neuron to explain how the vertebrate nervous system detects signals and transmits information. (Students should use the clips from Stimulus Response for inspiration.) Students use the model to predict how abnormal cell structure, drugs, and toxins can affect impulse transmission.

7. Students create a visual representation to illustrate the regulation of blood sugar levels, growth spurts in teenagers, and events associated with labor and childbirth. Students then explain how disruptions to these regulatory processes (e.g., failure to produce insulin) affect homeostasis in the organism.

8. HHMI Online Cell Cycle simulation- students explore and analyze and interactive website on the cell cycle and explain how mutated cell cycle regulators cause cancer

Assessment Evidence - Checking for Understanding (CFU)

- Common Benchmarks (Benchmark)
- Unit tests- Unit 4 Personal Progress Check from AP Classroom (Summative)
- Quizzes-cell communication quiz, cell cycle quiz (Summative)
- Unit review/Test prep- Campbell and Reece chapter 11, 12, 48 study guides (Formative)
- Web-Based Assessments- google form quizzes (Summative)
- DBQ's (Formative)
- Written Reports- CER's for lab activities (Alternate)
- Surveys (Alternate)

- Admit Tickets
- Anticipation Guide
- Common Benchmarks
- Compare & Contrast
- Create a Multimedia Poster
- DBQ's
- Evaluation rubrics
- Exit Tickets- google form exit ticket
- Fist- to-Five or Thumb-Ometer
- Illustration
- Journals
- KWL Chart
- Learning Center Activities
- Newspaper Headline
- Outline
- Question Stems
- Quickwrite
- Quizzes-cell communication quiz, cell cycle 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 11, 12, 48 study guides
- Unit tests- Unit 4 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 11, 12, 48

Ancillary Resources

- Pearson Education Test Prep Series for AP Biology (2017)

- Campbell and Reece chapters 11, 12, 48 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

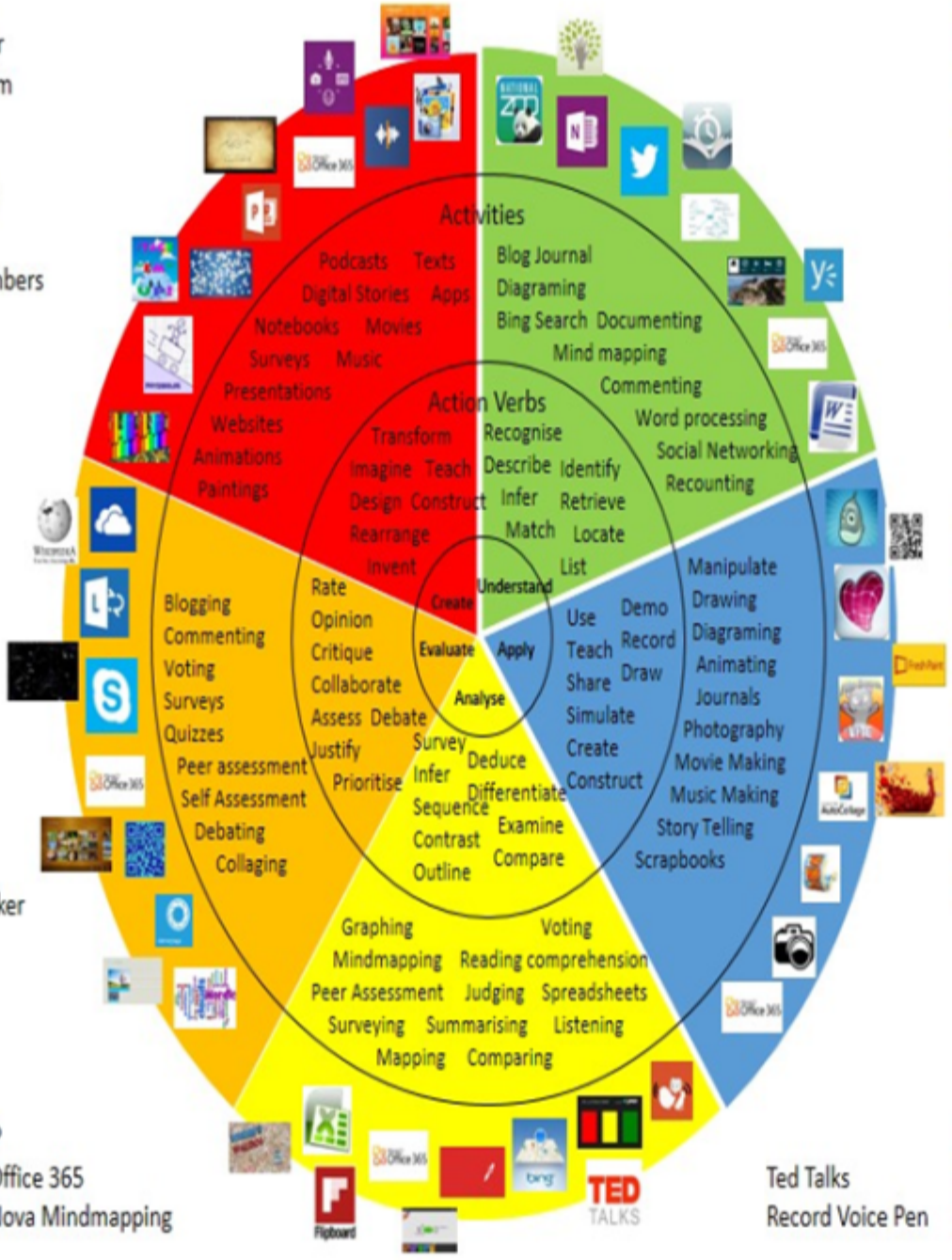
Technology Infusion

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

21st Century Skills/Interdisciplinary Themes

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

21st Century Skills

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

Differentiation

Differentiations:

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

Hi-Prep Differentiations:

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

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

Lo-Prep Differentiations

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

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

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

- modified test format
- modified test length
- 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 4: Cell Communication and Cell Cycle

NJSLS: Attached

Interdisciplinary Connection: Art (sketching or building models)

Statement of Objective: SWDAT justify claims based on scientific evidence that changes in signal transduction pathways can alter cellular response.

Anticipatory Set/Do Now: "What causes diseases?" - Think-pair-share

Learning Activity: Online investigation: Students explain and justify the mechanism by which a specific disease is caused by a defective signaling pathway and investigate one drug that works by blocking a signaling pathway.

Student Assessment/CFU's: Exit Ticket- Google form questions on how defective signal transduction pathways can cause disease and how certain drugs affect signal transduction pathways.

Materials: Smart TV for anticipatory set, chromebooks

21st Century Themes and Skills: Health and Environmental Literacy

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

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

SCI.9-12.HS-LS1-3	Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.