Cliffside Park Biology Unit 1: Structure & Function

CONTENT AREA: Biology	GRADES: 9-12	UNIT: 1 of 8

Pacing:

Performance Expectations: NJSLS-S-HS-LS1-1, NJSLS-S-HS-LS1-2, NJSLS-S-HS-LS1-3

Evidence Statement(s): NJSLS-S-HS-LS1-1, NJSLS-S-HS-LS1-2, NJSLS-S-HS-LS1-3

Essential Question: How do the structures of organisms enable life's functions?

21st Century Skills: 9.2.8.B.3, 9.2.8.B.4

Career Ready Practices: CRP4, CRP6, CRP7

Technology:

Technical Terms (Suggested)	Core Instructional Materials	Assessment Statement
*All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.	NJSLS-S-HS-LS1-1 NJSLS-S-HS-LS1-2 NJSLS-S-HS-LS1-3	

Modifications

English Language Learners	Special Education	At Risk	Gifted & Talented
Scaffolding	Word walls	Teacher tutoring	Curriculum compacting
Word walls	Visual aides	Peer tutoring	Challenge assignments
Sentence/paragraph frames	Graphic organizers	Study guides	Enrichment activities
Bilingual dictionaries/translation	Multimedia	Graphic organizers	Tiered activities
Think alouds	Leveled readers	Extended time	Independent research/inquiry
Read alouds	Assistive technology	Parent communication	Collaborative team work
Highlight key vocabulary	Notes/summaries	Modified assignments	Higher level questioning
Annotation guides	Extended time	Counseling	Critical/Analytical thinking tasks
Think-pair-share	Answer masking		Self-directed activities
Visual aides	Answer eliminator		
Modeling	Highlighter		
Cognates	Color contrast		

5E Model	
Performance Expectation: NJSLS-S-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.	
Engage: Anticipatory Set	The lesson will begin by: ● allowing students to explore and research what substance is responsible for "building" a living organism ● performing a DNA extraction from strawberries, bananas, or wheat germ (Carolina Biological science kit) ● viewing a video from DNews, Using Your DNA as a Hard Drive- https://www.youtube.com/watch?v=_O-kLA3uEyA
Exploration: Student Inquiry	Students will begin by viewing the video, "What is DNA and How Does it Work?" https://www.youtube.com/watch?v=zwibgNGe4aY In cooperative groups, students will research and explain how all cells contain genetic information and how the DNA base pairs code for amino acid chains that produce proteins (gene expression). Students will then provide an explanation of how the the Human Genome Project was instrumental in displaying genome sequences in DNA sequencing. The student inquiry would include the video, http://ed.ted.com/lessons/how-to-sequence-the-human-genome-mark-j-kiel In cooperative groups, students will then be allowed to explore the following interactive site, http://www.ck12.org/biology/DNA/ . Groups will be responsible for constructing an explanation of DNA functions based upon the website interactions and exploration. Explanations can be either written or shared digitally through email or through website use. Students will read text about the discovery of DNA and answer questions while citing textual evidence. Students will create models of DNA Students will watch a www.youtube.com science music videos, animations, programs and lecturtes on DNA Students will be given codes of DNA to transcribe and translate into protein sequences. Students will make comparisons of sequences of DNA and analyze mutation Students will analyze the role of RNA and it's importance. Students will explore the role of epigenetics and RNA interferon Students will extract DNA from bananas
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): ● Systems of specialized cells within organisms help them perform the essential functions of life. (NJSLS-S-HS-LS1-1) ● 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. (NJSLS-S-HS-LS1-1) ● DNA nucleotide structure ● Characteristics of living organisms ● Macromolecule structure and function ● Transcriptional and Translational processes ● Description of genetic code ● Cellular structures and function (organelles) ● Cell structures of eukaryotic versus prokaryotic organisms

Elaboration: Extension Activity	Once students have constructed their explanations of DNA structure and function of DNA, students will further extend their mastery of concept by providing evidence of concept mastery by accessing the interactive website http://www.ck12.org/life-science/DNA-Structure-and-Replication-in-Life-Science/ and submitting responses via email or directly from the website. DNA model building- paper model and/or DNA bracelets Close reading: cloning Adenine, Amino acid, Anticodon, Antiparallel, Base pair, Chargaff's Rule, Codon, Cytosine, Deoxyribonucleic acid (DNA), DNA Helicase, DNA Polymerase, Double Helix, Franklin Rosalind, Griffith's Transformation, Guanine, Hershey & Chase, Histone, Hydrogen bond, mRNA, Mutagens, Mutation, Nucleosome, Nucleotide, Phosphate, Polypeptide, Protein, Ribonucleic acid, Ribosome, Semiconservative replication, Supercoil, Thymine, Transcription, Translation, tRNA, Uracil, Watson and Crick, Point mutation, Frame shift mutation
Evaluation: Assessment	

5E Model	
Performance Expectation: NJSLS-S-HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.	
Engage: Anticipatory Set ***1 Day**	The lesson will begin by: ● asking the questions "how do organisms react to their environments?" and "what allows an organism to react?" ● working with two different organisms to observe how they react to stimuli ● working with worms to observe how they respond to light and water ● working with plants to observe how they respond to light and water The second component of the engage section of the lesson will utilize a video ● https://www.youtube.com/watch?v=vZNa_I4xBnk ● Video looks at the old/new way of transporting hearts for heart transplants. ● Discussion to follow. Alternative: Lab on heart rate and exercise - model building (graphing data)
Exploration: Student Inquiry ***3 Days**	Day 1: Students will work collaboratively on a virtual lab that studies the workings of an organ and organ systems. Day 2 & 3: In cooperative groups, students will build a model that demonstrates the working mechanisms of the circulatory system. The model would include the workings of the heart, distribution and flow of blood, return of blood flow to the heart and stimulus of the heart (ie. exercise or "fight or flight" responses). Students may use any common items to construct their models. Some examples for models of the heart-pump system are (but are not limited to) http://www.hometrainingtools.com/a/make-a-heart-pump-science-project Students will then navigate the following interactive activity , http://interactivehuman.blogspot.com/2008/10/heart-heart-information-cardiovascular.html to reinforce content mastery.
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): LS1.A: Structure and Function ● 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. (NJSLS-S-HS-LS1-2) ● Homeostasis ● Stimulus and response mechanisms ● Organ systems ● Organ system interactions
Elaboration: Extension Activity	http://www.ngsslifescience.com/science.php?/biology/lessonplans/C453/

***1 Day**	Students will complete the "Human Body Systems Disorder Project". The is multi-part investigation that will lead into homeostasis (NJSLS-S-HS-LS1-2). Students will utilize a NCBI BLAST of the hemoglobin protein and investigate the repercussions of sickle cell anemia on homeostatic interactions between organ systems. insulin-feedback examples of homeostasis group project
Evaluation: Assessment	

5E Model	
<u>Performance Expectation: NJSLS-S-HS-LS1-3</u> Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis	
Engage: Anticipatory Set *** 1 Day**	The lesson will begin by: ● Students will watch a video that illustrates the fight or flight response and relates it to homeostasis. Video: "How to Stop Shaking When You're Nervous"- https://www.youtube.com/watch?v=yJhI0Du5jO4 or appropriate alternative ● Completion of "The Effect of Exercise on Homeostasis" - http://gpschools.schoolwires.net/cms/lib05/MI01000971/Centricity/Domain/2027/Homeostasis%20Exercise%20Lab.pdf ○ Students will investigate how exercise affects their breathing and heart rates, blood pressure, perspiration levels, skin color, etc.

Exploration: Student Inquiry
*** 2 Days**
	<u>Day 1</u>
	● Students will plan and conduct their own investigations about the effects water and sunlight have on root growth in pea plants.
	● Investigations may match the following lab outlines:
	  ○ http://www.odinity.com/measuring-respiration-in-peas/
	  ○ http://web.mph.net/academic/science/mvural/Life%20Science/Pea%20Plant%20Experiments.htm
	<u>Day 2</u>
	● Students will explore stomata response to moisture and light by designing an investigation using bean plants.
	● Investigations may match the following lab outlines:
	  ○ http://www.biologyjunction.com/leaf_stomata_lab.htm

Explanation: Concepts & Practices	<u>In these lessons:</u> Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. <u>Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas):</u> LSI.1: Structure and Function ● 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. (NJSLS-S-HS-LS1-3) ● Feedback mechanisms ● Scientific method review ● Control versus Experimental groups ● Independent and dependent variables
Elaboration: Extension Activity *** 1 Day**	Students will conduct an independent research project that shows the correlation of the loss of homeostasis controls that lead to a systemic disease (breakdown of homeostatic control) of their choice.
Evaluation: Assessment	

How do the structures of organisms enable life's functions?

Students investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. Students demonstrate understanding of how systems of cells function together to support the life processes. Students demonstrate their understanding through critical reading, using models, and conducting investigations. The crosscutting concepts of structure and function, matter and energy, and systems and system models in organisms are called out as organizing concepts. (p. 2, Life Science Topics Storyline).

#	STUDENT LEARNING OBJECTIVES	CORRESPONDING PEs and DCIs
1	Explain the connection between the sequence and the subcomponents of a biomolecule and its properties. *[Clarification Statement: Emphasis is on the general structural properties that define molecules. Examples include r-groups of amino acids, protein shapes, the nucleotide monomers of DNA and RNA, hydrophilic and hydrophobic regions.]* [Assessment Boundary: Assessment does not include identification or the molecular sequence and structure of specific molecules*]*	LS1.A
2	Construct models that explain the movement of molecules across membranes with membrane structure and function. *[Clarification Statement: Emphasis is on the structure of cell membranes, which results in selective permeability; the movement of molecules across them via osmosis, diffusion and active transport maintains dynamic homeostasis.]*	LS1.A
3	Create representations that explain how genetic information flows from a sequence of nucleotides in a gene to a sequence of amino acids in a protein.	LS1.A
4	**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.** *[*Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.*]*	**NJSLS-S-HS-LS1-1**
5	**Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. One example a student might develop is an artery depends on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level, or identification of specific cells, tissues and organs.]** **Teacher Note: Human body systems (circulatory, excretory, digestive, respiratory, muscular, and nervous systems) are addressed in middle school.**	**NJSLS-S-HS-LS1-2**
6	**Provide examples and explain how organisms use feedback systems to maintain their internal environments.**	**LS1.A**
7	**Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to water levels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]**	**NJSLS-S-HS-LS1-3**

The Student Learning Objectives above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models (pp. 56-59. NRC, 2012)
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.

- Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (NJSLS-S-HS-LS1-2)

Planning and Carrying Out Investigations (pp. 59-61, NRC, 2012)
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.

- 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. (NJSLS-S-HS-LS1-3)

Constructing Explanations and Designing Solutions (pp. 67-71, NRC, 2012)
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.

- 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. (NJSLS-S-HS-LS1-1)

Disciplinary Core Ideas

LS1.A: Structure and Function (pp. 143-145, NRC, 2012)

- Systems of specialized cells within organisms help them perform the essential functions of life. (NJSLS-S-HS-LS1-1)
- 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. (NJSLS-S-HS-LS1-1) *(Note: This Disciplinary Core Idea is also addressed by NJSLS-S-HS-LS3-1.)*
- 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. (NJSLS-S-HS-LS1-2)
- 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. (NJSLS-S-HS-LS1-3)

Crosscutting Concepts

Systems and System Models (pp. 91-94, NRC, 2012)

- 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. (NJSLS-S-HS-LS1-2)

Structure and Function (pp. 96-98, NRC, 2012)

- Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (NJSLS-S-HS-LS1-1)

Stability and Change (pp. 98-101, NRC, 2012)

- Feedback (negative or positive) can stabilize or destabilize a system. (NJSLS-S-HS-LS1-3)

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Connections to Nature of Science

Scientific Investigations Use a Variety of Methods (pp. 96-101, Appendix H)
Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. (NJSLS-S-HS-LS1-3)

Connections to other DCIs in this grade-band:
HS.LS3.A (NJSLS-S-HS-LS1-1)

Articulation of DCIs across grade-bands:
MS.LS1.A (NJSLS-S-HS-LS1-1),(NJSLS-S-HS-LS1-2),(NJSLS-S-HS-LS1-3); **MS.LS3.A** (NJSLS-S-HS-LS1-1); **MS.LS3.B** (NJSLS-S-HS-LS1-1)

Common Core State Standards Connections:
ELA/Literacy -

RST.11-12.1	Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (NJSLS-S-HS-LS1-1)
WHST.9-12.2	Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes. (NJSLS-S-HS-LS1-1)
WHST.9-12.7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (NJSLS-S-HS-LS1-3)
WHST.11-12.8	Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (NJSLS-S-HS-LS1-3)
WHST.9-12.9	Draw evidence from informational texts to support analysis, reflection, and research. (NJSLS-S-HS-LS1-1)
SL.11-12.5	Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (NJSLS-S-HS-LS1-2)