3D Science Performance Assessment Tasks

Middle School:

Heredity and Variation in Traits

Task Title	DNA, Genes, and Traits! Oh My!

Standards Bundle Information

PEs:
- MS-LS3-1 Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
- MS-LS3-2 Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.

Science and Engineering Practices
- Developing and Using Models
- Constructing Explanations and Designing Solutions

Cross-Cutting Concepts:
- Cause and Effect
- Structure and Function

Disciplinary Core Ideas
- LS1.B: Growth and Development of Organisms
- LS3.A: Inheritance of Traits
- LS3.B: Variation of Traits

CCSS ELA:
- RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts. (MS-LS3-1),(MS-LS3-2)
- RST.6-8.4: 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 6-8 texts and topics. (MS-LS3-2)
- RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-LS3-1),(MS-LS3-2)
- SL.8.5: Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. (MS-LS3-1),(MS-LS3-2)

CCSS Mathematics:
- MP.4: Model with mathematics. (MS-LS3-2)
- 6.SP.B.5 Summarize numerical data sets in relation to their context. (MS-LS3-2)

Overview / Introduction of the Assessment Task

Students are introduced to mutations in DNA with several video clips from a Spiderman movie. Once video clip questions are answered during class discussion, students complete Mutation: Get the Point activity. Students next complete a simulation that shows how proteins are affected when various mutations occur. Finally, using the information learned, students write an explanation explaining the results of genetic testing to parents.

Teacher Background
Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins. Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations. Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.
Information for Classroom Use
Connections to Instruction: Lessons can be extended by introducing students to DNA fingerprinting and bioinformatics
Approximate Duration for the Summative Task: (all components) 7 days
Assumptions: This is not a unit plan but suggested lessons to help students achieve proficient or exemplary status on the performance expectations. The teacher will need to scaffold instruction based on student needs. Students should know the structure and function of eukaryotic cell organelles and understand the roles of mitosis and meiosis. Background knowledge on the structure and function of deoxyribonucleic acid (DNA) and proteins is recommended. Prior student survey of their own traits, provides further context for lessons.
Materials Needed: internet access. Please see following links for additional materials. Task 1: Activity 1, Applying the Law of Chance to Genetics (NeoSci) Task 2: https://www.biologycorner.com//worksheets/pipecleaner.html Task 3: A Recipe For Traits Task 4: Interpret a pedigree Final task: internet access, Get the Point Activity.
Supplementary Resources: Reading DNA Investigate Reproductive Strategies Cell Division - Chromosomes Generations of Traits Mutations Inventory of Traits The Code is Cracked

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Performance Assessments

Student Performances		
Formative Assessment Task 1	Learning Performance: I can develop a model (e.g., Punnett squares, diagrams, simulations) for a given phenomenon involving the differences in genetic variation that arise from sexual reproduction. How are characteristics of one generation passed to the next?	Expected Duration: 1 day
	Description (Phenomena, Scenario, Task) Task: Investigation	
	Directions: Please follow directions for Activity 1, Applying the Law of Chance to Genetics (NeoSci)	
	Scoring / Teacher Look-For's: 1. Completed Punnet Square and questions (expected genotype and phenotype). 2. Completed data table with 20 tosses and genotype ratio calculated (actual results). 3. Completed analysis questions. 4. Describe what the Punnett square would like for asexual reproduction.	
Formative Assessment Task 2	Learning Performance: I can develop a model of genes located on chromosomes and explain causal effects of asexual and sexual reproduction. How can individuals of the same species and even siblings have different characteristics?	Expected Duration: 1 day
	Description (Phenomena, Scenario, Task) Task: Modeling Chromosome Pair Begin lesson by asking these questions regarding the chromosome pair: 1. For which genes is this organism homozygous? 2. For which genes is this organism heterozygous?	
	Directions: Please see Pipe Cleaner Babies worksheet Directions: Please see asexual reproduction model video	

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	Scoring / Teacher Look-For's: 1. Make sure all questions are complete. 2. Complete model for asexual reproduction.	
Formative Assessment Task 3	Learning Performance: I can use, develop, and modify a model to show how changes in proteins may or may not affect the protein. Why do individuals of the same species vary in how they look, function, and behave?	Expected Duration: 1 day
	Description (Phenomena, Scenario, Task) Task: A Recipe For Traits	
	Directions: Please see linked directions in task.	
	Scoring / Teacher Look-For's: 1. Students have drawn and colored dog according to order of assembling DNA. 2. Since all students start with the same materials, question them as to why their dogs look different.	
Formative Assessment Task 4	Learning Performance: I can use, develop, and modify a model to show how changes in proteins may or may not affect the protein. How are the characteristics of one generation related to the previous generation?	Expected Duration:
	Description (Phenomena, Scenario, Task) Task: Scenario-Students are given a scenario for tracing hereditary characteristics over several generations.	
	Directions: Please follow directions for completing this pedigree.	
	Scoring / Teacher Look-For's: 1. Pedigree I is complete and questions are answered. 2. Students accurately draw a pedigree from information presented in a scenario. 3. Analysis questions are complete.	

Final Task: *(Model, Design, Explain, Argue, Investigate)*	Learning Performance I can use, develop, and modify a model to show how changes in proteins may or may not affect the protein. I can write an explanation to show how changes in proteins may or may not affect the protein. Task: Modeling, Explanation	
	Phenomena: Spiderman Peter Parker Gets His Powers: What is being shown in this video clip (30 sec mark)? Why do you think the movie producer placed this scene in the movie? Peter Parker DNA mutation: Describe what you saw in this clip. (DNA, double helix, mutation) Spiderman Gets His Powers: Predict whether or not Peter Parker will change after this incident. If so, will this change be beneficial or damaging? Based on the evidence gathered, does a change in DNA sequence affect the characteristics (physical traits) of living things? Please support claim with evidence gathered from the video clips. Explain why or why not the DNA change will lead to a harmful outcome.	Expected Duration: 2 days

Goal: Your task is to determine whether or not the unborn child will have sickle cell disease.	Role: You are a genetic counselor and have been asked to inform parents whether or not their child will have sickle cell disease.
Audience: One parent has sickle cell disease and the status of the other parent is unknown.	Situation: The mother has sickle cell disease but the status of the dad is unknown.

Product / Performance: You will write a scientific explanation in order to determine if parents should be concerned.

Teacher directions: Day one

1. Begin by reviewing base pairing rules of DNA using this simulation:

2. Guide students through the [following simulation](#) which shows students how to interpret genetic code chart.
3. Guide students through Mutation: [Get the Point Activity](#). Make sure all questions are answered except those that ask for type of mutation (assessment boundary)

Student directions:

The table below shows the sequence of bases in a short segment of DNA that controls the order of amino acids in the protein hemoglobin.

[Normal and sickled red blood cells](#)

Use the genetic code chart to determine the amino acids for normal and sickled hemoglobin.

[DNA base sequences](#)

1. Draw a model that helps explain how this phenomena occurs
2. Write an explanation to the parents about the results of genetic testing, using the model as supporting evidence.
3. Write a prediction about what might happen if a different DNA base is changed.

Seond letter

First letter	U	C	A	G	Third letter
U	UUU UUC } Phe UUA UUG } Leu	UCU UCC UCA UCG } Ser	UAU UAC } Tyr UAA Stop UAG Stop	UGU UGC } Cys UGA Stop UGG Trp	U C A G
C	CUU CUC CUA CUG } Leu	CCU CCC CCA CCG } Pro	CAU CAC } His CAA CAG } Gin	CGU CGC CGA CGG } Arg	U C A G
A	AUU AUC AUA } Ile AUG Met	ACU ACC ACA ACG } Thr	AAU AAC } Asn AAA AAG } Lys	AGU AGC } Ser AGA AGG } Arg	U C A G
G	GUU GUC GUA GUG } Val	GCU GCC GCA GCG } Ala	GAU GAC } Asp GAA GAG } Glu	GGU GGC GGA GGG } Gly	U C A G

CheckBric

Student Name _____

Teacher Name _____

Learning Performance: Use, develop, and modify a model to show how changes in proteins may or may not affect the protein and write an explanation to show how changes in proteins may or may not affect the protein					**Comments**
Evidence Statements:					
Model shows how protein structure determines protein function.	1	2	3	4	
Model shows how gene mutations may be beneficial, neutral, or harmful.	1	2	3	4	
LP Total:					
Learning Performance: Develop a model (e.g., Punnett squares, diagrams, simulations) for a given phenomenon involving the differences in genetic variation that arise from sexual and asexual reproduction.					**Comments**
Evidence Statement:					
Model shows a causal account for why sexual and asexual reproduction results in different amounts of genetic variation in offspring relative to their parents.	1	2	3	4	
LP Total:					
Learning Performance: develop a model of genes located on chromosomes and explain causal effects of asexual and sexual reproduction.					**Comments**
Evidence Statements:					
Model shows cause-and-effect relationships between the type of reproduction and the resulting genetic variation to predict that more genetic variation occurs in organisms that reproduce sexually compared to organisms that reproduce asexually.	1	2	3	4	
LP Total:					
CheckBric Total					

4 Exemplary	Work at this level is of exceptional quality. It is both thorough and accurate. It exceeds the standard. It shows a sophisticated application of knowledge and skills.
3 Proficient	Work at this level meets the standard. It is acceptable work that demonstrates application of essential knowledge and skills. Minor errors or omissions do not detract from the overall quality.
2 Developing	Work at this level does not meet the standard. It shows basic, but inconsistent application of knowledge and skills. Minor errors or omissions detract from the overall quality. Your work needs further development.
1 Emerging	Work at this level shows a partial application of knowledge and skills. It is superficial (lacks depth), fragmented or incomplete and needs considerable development. Your work contains errors or omissions.