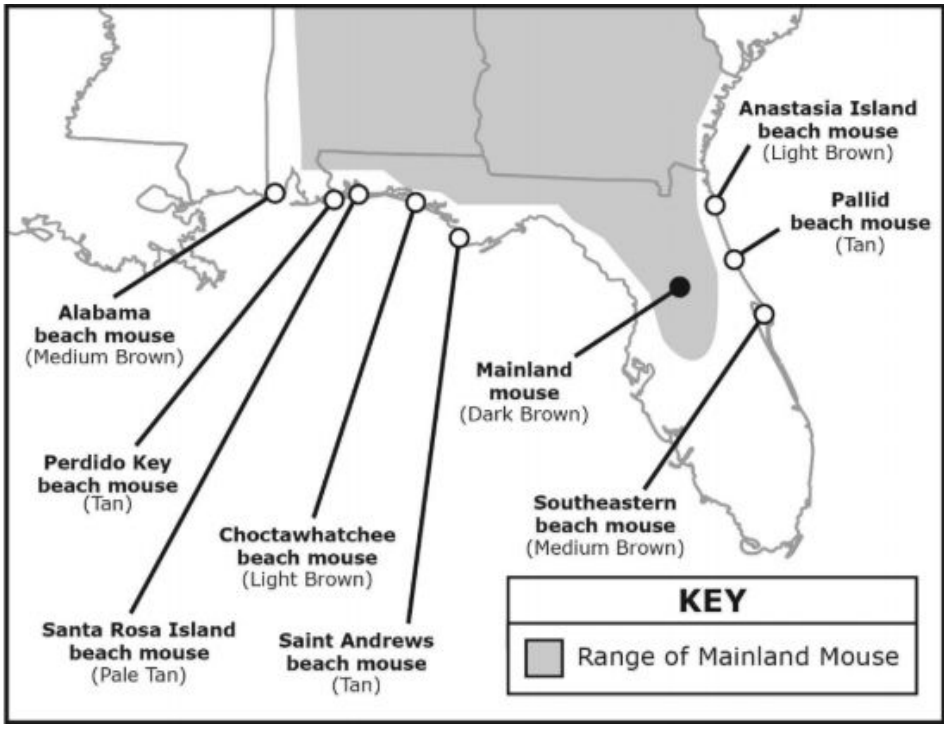
Extended Constructed Response
Benchmark: HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. [Clarification Statement: Emphasis is on using evidence to explain the influence each of the four factors has on number of organisms, behaviors, morphology, or physiology in terms of ability to compete for limited resources and subsequent survival of individuals and adaptation of species. Examples of evidence could include mathematical models such as simple distribution graphs and proportional reasoning.] [Assessment Boundary: Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.]
DOK level: 3

Oldfield mice (Peromyscus polionotus) are native to the state of Florida and surrounding areas. Different subspecies of P. polionotus are found in central Florida and along the coastal beaches and islands. The species originally inhabited the forests of central Florida, which have dark soils. When Florida's coastline formed 6,000 years ago, populations moved onto the sandy beaches. Oldfield mice range from dark brown to pale tan, with different coat colors found in different populations, as shown in the map.

Distribution Map of Mainland Oldfield Mice and Subspecies



Oldfield mice feed on seeds, nuts, and insects. Predators of oldfield mice include birds of prey, snakes, cats, foxes, and weasels. The mice live in tunnels they dig into the sand or soil, and they use the tunnels to hide from predators. Female oldfield mice can breed throughout the year and produce three to four mice per litter. The length of gestation (pregnancy) is 24 days.
Explain why the beach populations of oldfield mice differ in color from the original forest population. Include at least four factors that explain the evolution of the mice through natural selection.

Response Area:

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Scoring Rubric and Exemplar

Rubric:

4	4 points: A score of four indicates that the student has demonstrated a thorough understanding of the scientific concepts and/or procedures embodied in the task. The student has completed the task correctly, used scientifically sound procedures, and provided clear and complete explanations and interpretations. The response may contain minor flaws that do not detract from a demonstration of a thorough understanding.
3	3 points: A score of three indicates that the student has demonstrated an understanding of the scientific concepts and/or procedures embodied in the task. The student's response to the task is essentially correct, but the scientific procedures, explanations, and/or interpretations provided are not thorough. The response may contain minor flaws that reflect inattentiveness or indicate some misunderstanding of the underlying scientific concepts and/or procedures.
2	2 points: A score of two indicates that the student has demonstrated only a partial understanding of the scientific concepts and/or procedures embodied in the task. Although the student may have arrived at an acceptable conclusion or provided an adequate interpretation of the task, the student's work lacks an essential understanding of the underlying scientific concepts and/or procedures. The response may contain errors related to misunderstanding important aspects of the task, misuse of scientific procedures/processes, or faulty interpretations of results.
1	1 point: A score of one indicates that the student has demonstrated a very limited understanding of the scientific concepts and/or procedures embodied in the task. The student's response is incomplete and exhibits many flaws. Although the student's response has addressed some of the conditions of the task, the student has reached an inadequate conclusion and/or provided reasoning that is faulty or incomplete. The response exhibits many flaws or may be incomplete.
0	0 points: A score of zero indicates that the student has not provided a response or has provided a response that does not demonstrate an understanding of the scientific concepts and/or procedures embodied in the task. The student's explanation may be uninterpretable, lack sufficient information to determine the student's understanding, or contain clear misunderstandings of the underlying scientific concepts.

Exemplar:

4	First, the original P. polionotus population had a high reproductive potential because the individuals can produce many offspring in a relatively short period of time. This allowed them to expand into the new beach habitats that formed 6,000 years ago. Second, genetic variation within each population allowed parents to pass on different coat color traits to their offspring. Third, predation by other species, and competition for space and food, limited the number of P. polionotus individuals that survived in each population. Finally, individual mice that were better at blending into the habitat (due to a coat color that matches the soil or sand) were more likely to survive and pass on their genes to future generations. Over time, this process increased the genes for lighter coloration in the beach populations.
3	3 Genetic variation within each beach population allowed parents to pass on different coat color traits to their offspring. Also, predation by other species, and competition for space and food, limited the number of P. polionotus individuals that survived in each population. Finally, individual mice that were better at blending into the habitat (due to a coat color that matches the soil or sand) were more likely to survive and pass on their genes to future generations. Over time, this process increased the genes for lighter coloration in the beach populations.
2	2 Predation by other species, and competition for space and food, limited the number of P. polionotus individuals that survived in each beach population. Individual mice that were better at blending into the habitat (due to a coat color that matches the soil or sand) were more likely to survive and pass on their genes to future generations. Over time, this process increased the genes for lighter coloration in the beach populations.
1	1 Individual mice that were better at blending into the habitat (due to a coat color that matches the soil or sand) were more likely to survive and pass on their genes to future generations. Over time, this process increased the genes for lighter coloration in the beach populations.

No 0-point exemplar is required.

Gridded Response

Benchmark: HS-ESS1-4. Use mathematical or computational representations to predict the motion of orbiting objects in the solar system. [Clarification Statement: Emphasis is on Newtonian gravitational laws governing orbital motions, which apply to human-made satellites as well as planets and moons.] [Assessment Boundary: Mathematical representations for the gravitational attraction of bodies and Kepler's Laws of orbital motions should not deal with more than two bodies, nor involve calculus.]

DOK level: 2

Kepler's third law states that, for every planet, the ratio of the period of its orbit squared to the average distance from the Sun cubed is the same. In the ratio, shown below, period T has units of earth years and distance R is in astronomical units. The astronomical unit (au) is defined as the average distance from the Earth to the Sun, such that the Earth is 1.00 au from the Sun.

$\frac{T^2}{R^3}$ is the same for every planet

In 1978, NASA scientists launched an orbiter to study the atmosphere of Venus. If Venus orbits the Sun in 0.615 of an Earth year, what is the average distance from Earth to Venus, in astronomical units? Assume that Earth, Venus, and the Sun form a straight line.

Correct Answer: 0.28 au

Rationales

Correct Answer	$\frac{T_1^2}{R_1^3} = \frac{T_2^2}{R_2^3}$ $\frac{1^2}{1^3} = \frac{(0.615)^2}{R_2^3}$ $R_2^3 = (0.615)^2$ $R_2 = \sqrt[3]{(0.615)^2} = 0.72$ 1.00 au from Earth to Sun – 0.72 au from Venus to Sun = 0.28 au from Earth to Venus
Incorrect Answer	Incorrectly interpreting the formula or plugging in wrong the values could produce an incorrect answer. Also, students may stop at the distance of Venus to the Sun and answer 0.72 au.

Selected Response

Benchmark: HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).]

DOK level: 2

Soil organisms release carbon dioxide, which reacts with water to form a weak carbonic acid.

Because of this, soil water is more acidic than atmospheric water. This carbonic acid helps weather rocks under the soil, releasing nutrients used by plants.

Hiro conducts an experiment. He places small pieces of igneous rock into three test tubes. He uses three different types of igneous rock: calcium-feldspar, olivine, and quartz. He uses the same total volume of rock pieces and uses pieces of about the same size. Hiro records the masses of the rock pieces before the experiment. He adds weak carbonic acid to each test tube and allows the rocks to sit in the acid for 30 days. At the end of the experiment, Hiro records the masses of the rocks again.

What question was Hiro trying to answer with his experiment?

a) How does carbonic acid affect the rate of chemical weathering in igneous rocks?

b) How does the rate of chemical weathering differ for different types of igneous rocks?

c) How does initial mass and volume affect the rate of chemical weathering in igneous rocks?

d) How does the rate of chemical weathering differ for different-sized pieces of igneous rocks?

Rationales:

a	Incorrect. While carbonic acid is used in the experiment, Hiro did not use a control or alter the acid concentration.
b	Correct.
c	Incorrect. While Hiro did measure the initial mass and volume of the rock pieces used before and after the experiment, he did not manipulate this variable.
d	Incorrect. While the rate of weathering would differ based on the surface area of the rock pieces, Hiro used consistently sized pieces of rock and did not purposefully vary the sizes.