**Overview**: The following rubrics can be used to assess the individual project: Post-Discussion Report from a Think Tank Discussion. Each rubric is aligned to one section of the *Individual Project Criteria for Success*, located on the Culminating Project Student Instructions. \*If student provides no assessable evidence (e.g., “I don’t know” or leaves answer blank), then that student response cannot be evaluated using the rubric and should be scored as a zero.

Below we provide an alignment table that details the dimensions assessed for each criterion.

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|  | **Student Criteria for Success** | **Disciplinary Core Idea** | **Science and Engineering Practice** | **Crosscutting Concept** |
| 1 | * Draw a pretend fossil record using accurate scientific concepts to demonstrate how your species may have changed over time. * Show how your species may have changed over the last 50 years due to environmental change. * Predict and show how your species might be shown in future layers due to environmental change.   + Use fossil record data from past incidents of climate change to explain whether you think future changes to your species would be sudden or gradual.   + Provide captions that describe your pretend fossil record and explain how the fossil record shows relative dating of the history of your species. | ESS1.C: The History of Planet Earth   * The geologic time scale interpreted from rock strata provides a way to organize Earth’s history. Analyses of rock strata and the fossil record provide only relative dates, not an absolute scale.   LS4.A: Evidence of Common Ancestry and Diversity   * The collection of fossils and their placement in chronological order (e.g., through the location of the sedimentary layers in which they are found or through radioactive dating) is known as the fossil record. It documents the existence, diversity, extinction, and change of many life forms throughout the history of life on Earth. | N/A | Stability and Change   * Stability might be distributed either by sudden events or gradual changes that accumulate over time. |
| 2 | * Apply the idea of natural selection to explain the relationship between environmental change and the trait(s) of your species. * How does the cause-and-effect relationship of natural selection help you predict what your species will likely look like in the future? * Compare your species to the “Insect” simulation and use the results of the simulation as evidence for why you think your species will be affected this way. | LS4.B: Natural Selection   * Natural selection leads to the predominance of certain traits in a population, and the suppression of others.   LS4.C: Adaptation   * Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. | Constructing Explanations   * Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. * Construct a scientific explanation based on valid and reliable evidence obtained from sources (including one’s own experiments) 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. | Cause and Effect   * Some cause and effect relationships in systems can only be described using probability. |
| 3 | * Explain the multiple technologies that humans can use to affect traits in organisms. Use evidence from Task 4 to describe the processes and give examples. | LS4.B: Natural Selection  * In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring. | Constructing Explanations   * Apply scientific ideas to construct an explanation for real-world phenomena, examples, or events. | Cause and Effect   * Phenomena may have more than one cause. |
| 4 | * + Draw a model to show how a scientist could create a structural change to the genes of your organism. Explain how the change in genes would affect the structure and function of the organism. | LS3.A Inheritance of Traits   * Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits.   LS3.B: Variation of Traits   * In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. | N/A | Structure and Function   * Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function. |
| 5 | * Construct your argument to the question: Should humans intervene on the behalf of threatened or endangered species or allow nature to take its course? Include:   + Your claim.   + Evidence and scientific reasoning from your research and the Think Tank Discussion.   + A description of what the other side might say and a counter-argument to respond to the other side. | LS4.B: Natural Selection  * In *artificial* selection, humans have the capacity to influence certain characteristics of organisms by selective breeding. One can choose desired parental traits determined by genes, which are then passed on to offspring.   LS4.C: Adaptation   * Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions. Traits that support successful survival and reproduction in the new environment become more common; those that do not become less common. Thus, the distribution of traits in a population changes. | Engaging in Argument From Evidence  * Construct, use, and/or present an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. | N/A |

**Rubric 1**: Student creates a pretend fossil record for the past and future, which uses ideas of relative dating to show a sudden or gradual change of their species due to an environmental change.

* Dimensions Assessed: DCI – LS4.A. Evidence of Common Ancestry and Diversity, DCI – ESS3.C. The History of Planet Earth, CCC – Stability and Change

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student creates a pretend fossil record for the past and future, which uses **inaccurate** ideas of relative dating **and/or does not** show a sudden or gradual change of their species due to an environmental change. | Student creates a pretend fossil record for the past and future, which uses **inaccurate** ideas of relative dating to **partially** show a sudden or gradual change of their species due to an environmental change. | Student creates a pretend fossil record for the past and future, which uses **accurate** ideas of relative dating to **partially** show a sudden or gradual change of their species due to an environmental change. | Student creates a pretend fossil record for the past and future, which uses **accurate** ideas of relative dating to **completely** show a sudden or gradual change of their species due to an environmental change. |
| **Look Fors:**   * Student draws a mock fossil record inaccurately. For example, the oldest layers may be at the top (earliest form of their species) and the most recent at the bottom (most recent form of their species). * And/or student does not show the sudden or gradual change of their species over time. Their mock fossil record may show no change over time, is not specific to their species, or is not relevant to an environmental change caused by humans. | **Look Fors:**   * Student draws a mock fossil record inaccurately. For example, the oldest layers may be at the top (earliest form of their species) and the most recent at the bottom (most recent form of their species). * Student still shows a change of their species over time that is relevant to their environmental change, but it is not accurately documented because their layers are incorrect (See Advanced Look-Fors for description of this). | **Look Fors:**   * Student draws a mock fossil record accurately with the oldest layers at the bottom (earliest form of their species) and the most recent at the top (most recent form of their species). Student accurately describes this in captions. * Mock fossil record and captions are accurate but incomplete:   + Drawings of their species within the layers likely show a gradual change of a specific trait or population size over time, but this might not be explicit in captions. The change in species is relevant to a specific environmental change caused by humans.   + OR drawings of their species only show past layers but not future layers, in accordance with the prompt, or vice versa. | **Look Fors:**   * Student draws a mock fossil record accurately with the oldest layers at the bottom (earliest form of their species) and the most recent at the top (most recent form of their species). Student accurately describes this in captions. * Captions and drawings of their species within the layers likely show and explain a gradual change of a specific trait or population size over time. This change is relevant to a specific environmental change caused by humans. |

**Rubric 2**: Student explains the cause-and-effect relationship between an environmental change and their species’ population, applying the idea of natural selection and incorporating probability statements from the “insect” simulation.

* Dimensions Assessed: DCI – LS4.B. Natural Selection, DCI - LS4.C. Adaptation, SEP – Constructing Explanations, CCC – Cause and Effect

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student **inaccurately** explains the cause-and-effect relationship between an environmental change and their species’ population, applying **no** ideas of natural selection and incorporating **no** relevant probability statements from the “insect” simulation. | Student **incompletely** explains the cause-and-effect relationship between an environmental change and their species’ population, applying a **partial** idea of natural selection **but** incorporating **no** relevant probability statements from the “insect” simulation. | Student **generally** explains the cause-and-effect relationship between an environmental change and their species’ population, applying a **partial** idea of natural selection and incorporating **relevant** probability statements from the “insect” simulation. | Student **accurately** explains the cause-and-effect relationship between an environmental change and their species’ population, applying the **complete** idea of natural selection and incorporating relevant probability statements from the “insect” simulation. |
| **Look Fors:**   * Student explanation is inaccurate, is not specific to their species, does not use knowledge of natural selection, and/or does not include relevant evidence from the simulation. For example, “climate change is making the owls overheat and die.” | **Look Fors:**   * Student explanation is specific to their species, uses some principles of natural selection, but does not incorporate evidence from the simulation. * Student explanation includes the basic concept of natural selection depicted in the Proficient Look-Fors, using a chain of cause-and-effect reasoning. For example, “climate change and the resulting brown landscape are leading to a population with more brown bunnies because that trait better camouflages.” No relevant evidence from the “insect” simulation is given. | **Look Fors:**   * Student explanation is specific to their species, uses some principles of natural selection, and incorporates evidence from the simulation. * Student explanation includes most of the Advanced components connected by cause-and-effect reasoning, but lacks some of the steps and details in natural selection. For example, it includes: a specific change in environment; process of some individuals with a certain trait surviving and why; comparison to an insect from the simulation, how that insect changed over time, and how that justifies how their species will likely change (probability statements). | **Look Fors:**   * Student explanation is specific to their species, uses all principles of natural selection, and incorporates evidence from the simulation. * Student explanation includes all of the following components connected by cause-and-effect reasoning: the environmental pressure (ex: warming temperatures); description of variation in their species traits; process of some surviving and some dying based on a trait; the passing on of favorable traits by survivors; identification of change in population over time; comparison to an insect from the simulation, how that insect changed over time, and how that justifies how their species will likely change (probability statements). |

**Rubric 3**: Student constructs an explanation of multiple technologies that humans use to affect traits in organisms, using evidence from a past task to support their explanation.

* Dimensions Assessed: DCI – LS4.B: Natural Selection, SEP – Constructing Explanations, CCC – Cause and Effect

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student constructs an **inaccurate or irrelevant** explanation of multiple technologies that humans use to affect traits in organisms. | Student constructs an **accurate** explanation of multiple technologies that humans use to affect traits in organisms, using **no** evidence from a past task to support their explanation.  OR  Student constructs a **partial** explanation of multiple technologies that humans use to affect traits in organisms, using **partial** evidence from a past task to support their explanation. | Student constructs an **accurate** explanation of multiple technologies that humans use to affect traits in organisms, using **partial** evidence from a past task to support their explanation. | Student constructs an **accurate** explanation of multiple technologies that humans use to affect traits in organisms, using **complete** evidence from a past task to support their explanation. |
| **Look Fors:**   * Student explanation inaccurately describes the process of selective breeding and/or genetic engineering. For example, “humans could intervene by forcing brown bunnies to choose brown fur color as their trait.” * Thus any evidence from Task 4 is also inaccurate. | **Look Fors:**   * Student explanation accurately describes the processes of selective breeding AND genetic engineering. Student does not use any evidence from Task 4. * Student explanation accurately describes the process of selective breeding or genetic engineering, but not both. Student uses examples from Task 4 that are relevant to the process they describe. | **Look Fors:**   * Student explanation accurately describes the processes of selective breeding AND genetic engineering. * Student implicitly or explicitly references the article from Task 4, but explanation lacks complete detail. For example, the student may not include relevant examples for each process or does not completely and accurately describe the steps for each process. | **Look Fors:**   * Student explanation accurately describes the processes of selective breeding AND genetic engineering. * Student implicitly or explicitly references the article from Task 4, including relevant examples of how each process has been used successfully. For example, a dairy farmer selecting bulls from large-growth herds to breed with cows that have the best milk production in order to create the best dairy cattle and inserting a gene for insect-resistance in tomatoes. |

**Rubric 4**: Student draws a model that shows how a pretend human-created mutation could lead to a favorable change in trait, describing and depicting a structural change to genes that affects the structure and function of their organism.

* Dimensions Assessed: DCI – LS3.A. Inheritance of Traits, DCI – LS3.B. Variation of Traits, CCC – Structure and Function

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student draws an **inaccurate** model that shows how a pretend human-created mutation could lead to a favorable change in trait**.** | Student draws an **accurate but partial** model that shows how a pretend human-created mutation could lead to a favorable change in trait, **AND/OR** **does not explicitly** describe and depict a structural change to genes that affects the structure and function of their organism. | Student draws an **accurate and complete** model that shows how a pretend human-created mutation could lead to a favorable change in trait, **partially** describing and depicting a structural change to genes that affects the structure and function of their organism. | Student draws an **accurate and complete** model that shows how a pretend human-created mutation could lead to a favorable change in trait, **completely** describing and depicting a structural change to genes that affects the structure and function of their organism. |
| **Look Fors:**   * Student model is inaccurate or is not specific to their chosen organism. For example, student model may show humans inserting a protein into their organism, which creates a gene that affects the trait in the organism. | **Look-Fors**   * Model identifies a relevant trait that would help their organism to survive an environmental change. * Student accurately models some of the steps in the process from gene to trait. For example, they may show the mutated gene creating the new desired trait, but skipping the protein step. * AND/OR Student model does not explicitly show and describe how structure affects function, for whichever part is present in their model. | **Look-Fors**   * Model identifies a relevant trait that would help their organism to survive an environmental change. * Student accurately models all steps in the process from gene to trait: The mutated gene produces a different protein, which creates the new desired trait. * Student model also shows and describes structure and function at either the gene to protein step or the protein to trait step, but not both. | **Look Fors:**   * Model identifies a relevant trait that would help their organism to survive an environmental change. * Student accurately models all steps in the process from gene to trait: The mutated gene produces a different protein, which creates the new desired trait. * Student model also shows and describes how the change in the structure of the gene affects the structure and function of the protein, which changes the structure and function of the organism (trait). |

**Rubric 5**: Student constructs an argument for whether or not humans should intervene on the behalf of threatened or endangered species, and uses evidence and scientific reasoning to support their argument.

* Dimensions Assessed: DCI – LS4.C. Adaptation, DCI – LS4.B. Natural Selection, SEP – Engaging in Argument From Evidence

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| **Emerging (1)** | **Developing (2)** | **Proficient (3)** | **Advanced (4)** |
| Student constructs an argument for whether or not humans should intervene on the behalf of threatened or endangered species and uses **no** evidence orscientific reasoning to support their argument. | Student constructs an argument for whether or not humans should intervene on the behalf of threatened or endangered species, but uses **insufficient** evidence andscientific reasoning to support their argument. | Student constructs an argument for whether or not humans should intervene on the behalf of threatened or endangered species, and uses **multiple sources of** evidence and **accurate but partial** scientific reasoning to support their argument. | Student constructs an argument for whether or not humans should intervene on the behalf of threatened or endangered species, and uses **multiple sources of** evidence and **accurate and complete** scientific reasoning to support their argument. |
| **Look Fors:**   * Student makes a clear claim for human intervention or natural process. * Student uses no scientific reasoning and evidence to support his or her claim. For example, “I think we should intervene on the behalf of threatened or endangered species, because we caused this and it is the right thing to do.” | **Look Fors:**   * Student makes a clear claim for human intervention or natural process. * Student uses some scientific reasoning to support his or her claim, but the reasoning is not convincing. * Student cites only one source of evidence or a few sources that do not strongly support the claim. | **Look Fors:**   * Student makes a clear claim for human intervention or natural process. * Student uses scientific reasoning to support his or her own claim, but does not counter-argue the other claim. * Student cites multiple sources of evidence to support their reasoning. For example, their mock fossil record, the article about past incidents of climate change in Task 1, the simulation of natural selection in Task 3, the article in Task 4, any of their own research. | **Look Fors:**   * Student makes a clear claim for human intervention or natural process. * Student uses scientific reasoning to support his or her own claim and to counter-argue the other claim. * Student cites multiple sources of evidence to support their reasoning. For example, their mock fossil record, the article about past incidents of climate change in Task 1, the simulation of natural selection in Task 3, the article in Task 4, any of their own research. |

Additional Notes:

* Additional rubrics are provided in Task 2 to provide assessment for the Performance Expectations MS-LS4-2 and MS-LS4-3 (including the corresponding dimensions), which are not assessed explicitly in this Culminating Project.