**Unit Essential Question:** *Why do species change over time and should we intervene?*

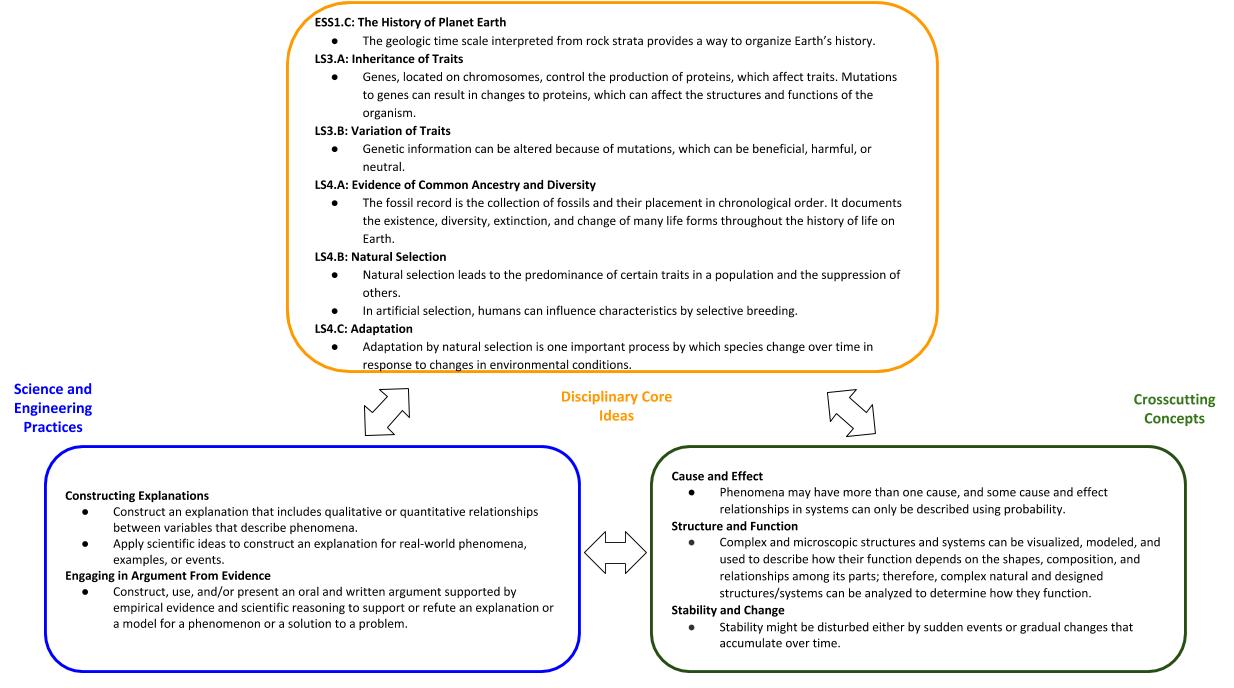
**Introduction**

In this unit students are examining the ways in which species and populations change over time and the mechanisms for those changes. The culminating project has students consider these changes in a particular context. Humans are causing changes in our environment—pollution, climate change, loss of habitat, etc.—which are having a huge impact on many species around the world. As these plants and animals struggle to adapt to rising temperatures and other effects of environmental change, we see the list of endangered species growing longer and longer. While we already know there are actions we can take to prevent more harmful environmental changes, some of the damage we’ve done can’t be undone. As we watch more species struggle with the changing environmental conditions, the question becomes: Should we intervene or allow nature to take its course?

In this project, students’ task is to develop an argument that answers this question, contextualized within research they do on one species affected by changing environmental conditions. Each group will select one species affected by an environmental change and use their own research and the scientific concepts they learn throughout the unit to decide whether humans should intervene or not. Each group will then prepare for a whole-class Think Tank Discussion\* centered around the question: Should humans intervene on the behalf of threatened or endangered species or allow nature to take its course? As individuals, they will then write a Post-Discussion Report, detailing the scientific background on their own species as well as their argument, using the discussion as additional evidence and reasoning.

\*Note: A “Think Tank Discussion” provides students an opportunity to address a specific issue in a structured, interactive workshop. Specific questions are used to allow for participants to problem-solve approaches to a common problem—in this case the problem of species that are affected by environmental change.

**3-Dimensional Assessment**



**Time Needed (Based on 45-Minute Periods)**

6-8 Days at end of unit

* Group Project: 2-3 periods
* Individual Project: 4-5 periods
  + First draft: 2-3 periods
  + Feedback: 1 period
  + Revision: 1 period

**Materials**

* Computers or hand-held devices with internet capabilities for research
* Lined Paper or Index Cards
* Blank Paper, print-outs of project template, or computers with word processing software
* Color pencils/pens
* Optional Online Resources
  + Article of Species Affected by Climate Change: <https://www.smithsonianmag.com/science-nature/ten-species-are-evolving-due-changing-climate-180953133/>
  + TedEd Video of wildlife adapting to climate change: <https://www.youtube.com/watch?v=ZCKRjP_DMII> (Stop at 3:56)

**Instructions for The Culminating Project**

1. Introduce the Culminating Project at the end of the Lift-Off task, including both the group and individual components outlined in the Challenge.
2. Read over the Culminating Project Task Card with the students. We recommend only reading the challenge and group criteria for success at this time in order to not overwhelm students with information.

* Take questions for clarification
* Optional: You may want to show a video to spark student interest. The following link is one option: <https://www.youtube.com/watch?v=QwLyscT3NgI> (Show until 0:38).

1. Remind students that as they go through the Project Organizer, they will be planning parts of their argument and recording information they may need for their individual project. However, there is nothing wrong with going back and changing their ideas over the course of the unit. The students won’t fully develop their argument and prepare for the Think Tank Discussion until the end of the unit, so change is acceptable and often experienced.
2. Make sure the students fill out the Project Organizer after each task, which will help the students think about how their chosen species may have changed over time and how it might be affected by environmental changes. This process allows students to both apply and document relevant scientific concepts as they move through the unit. This will inform both their group and individual projects.

* We recommend that students complete the Project Organizer individually. They might discuss ideas first as a group, but should then respond individually. This allows students time to process concepts on their own and generate their own ideas, which can be used later when it comes to developing their group project. In this particular unit, there is one exception to this guideline—after the Lift-Off task, each student group should research and pick a species, so that all group members are working with the same species throughout the unit.

1. The table below summarizes how the Project Organizer guides the students through developing different components of the Think Tank Discussion and Post-Discussion Report:

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| --- | --- | --- |
| **Task** | **Project Organizer** | **Group and Individual Culminating Projects** |
| **Lift-Off**  The Case of the Peppered Moths | Select and research a species that is being negatively affected by a change in their environment that is caused by humans.   * Describe the change in the environment and its effect on this species. | * Discussion and Post-Discussion Report give background on species. |
| **Task 1**  The Fossil Record and Geologic Time Scale | * Draw a pretend fossil record. * How might the fossil record in the last 50 years show the species changing over time? * Given how our planet is changing, predict what future layers might look like? | * Discussion uses examples of previous incidents of climate change in the fossil record. * Post-Discussion Report contains a pretend fossil record depicting how species may have changed in the past and will change in the future due to an environmental change. Uses fossil record to explain relative dating. |
| **Task 2**  Evidence of Change Over Time | * Draw in a pretend common ancestor at the beginning of your fossil record and a pretend modern species also related to this common ancestor. * What similar anatomy or embryological development might your species have with this related species? | * The Culminating Project does not assess the Performance Expectations addressed in this task. These Performance Expectations are assessed with rubrics provided in this task. |
| **Task 3**  Natural Selection | * How would changes in the environment that are caused by humans affect your species? * Explain within the context of natural selection. You may choose to explain using a paragraph or a flowchart with pictures. * Compare your species to the “insect” simulation. Is the situation for your species more similar to the black “insects”, the white “insects”, or the newspaper “insects”? | * Discussion and Post-Discussion Report explain how environmental change affects species in terms of natural selection. |
| **Task 4**  Human Intervention | * What change in trait might help that species survive? * Model the process of changing this trait, using what you have learned in this task. | * Discussion and Post-Discussion Report argue for or against human intervention. * Post-Discussion Report contains a model and explanation of genetic intervention (gene to trait), including emphasis on structure and function. |

1. After all the learning tasks are completed, and the Project Organizers are completed, the students can start to plan how they will participate in the Think Tank Discussion. We highly recommend that students use the Group Project Criteria for Success to draft notes they can use during the class Think Tank Discussion. Students may also want to transcribe these notes onto notecards. Different members of the group can be responsible for different notecards during the Think Tank Discussion to ensure more equitable participation. Both the Project Organizer and Criteria for Success should be used as reference for the students to remind them of all that they have learned throughout the task to include in their project.

* As always, we recommend the use of group roles for Culminating Project work time (See “How to Use This Curriculum” document for details). We recommend changing the roles every work day.

1. For an authentic experience, we recommend setting up chairs in a circular format so that students may face each other as they discuss. There are many ways to facilitate a large group discussion, like this Think Tank Discussion, but some suggestions are listed below:
   * We recommend reviewing discussion norms that you use in your classroom to ensure more equitable discussion (For example, “Step Up – Step Back). Throughout the discussion, you will likely need to facilitate by calling on different groups who have not had as much sharing time.
   * As stated above, we recommend student groups come to the discussion with notes or note cards prepared.
   * Optional: Start the discussion by having each group present their background on their species. Then open up the discussion to the argument: Should humans intervene on the behalf of threatened or endangered species or allow nature to take its course? We recommend keeping the Group Project Criteria For Success in front of you, both for assessment purposes and also as a source of facilitating questions to guide the discussion as needed.
   * It may be helpful for students to have some writing time right after the discussion, so they may note any additional piece of evidence or reasoning from the discussion that they would like to include in their individual project.
2. Once the Think Tank Discussion is complete, students are ready to move on to their individual project. Students will write a Post-Discussion Report that details the scientific background on their species as well as their argument, using the discussion as additional evidence and reasoning. Remind students to check that their Post-Discussion Report meets all the criteria in the student handout.
   * Depending on the needs of your students, you may want to provide a template to help them organize the information they will include in their Post-Discussion Report. An option is provided at the end of this teacher guide.
3. Conduct a peer review of the Post-Discussion Report after students have completed a first draft.

* Copy the Post-Discussion Report Peer Review Feedback form found in the Student Instructions. Another option is to use the Student 3-Dimensional Individual Project Rubric.
* Assign each student a partner, preferably a partner from a different group.
* Students switch drafts and assess them using the peer review feedback form or 3-Dimensional Rubric.
  + Remind each student to give one positive comment and one constructive comment for each section on the checklist.
  + Allow students time to present their feedback to their partner, so their partner may ask clarifying questions if needed.

1. After receiving feedback, allow students time to complete a final draft based on the feedback they received.

**Assessment**

The Project Organizer can be formatively assessed using:

* *Criteria of your choice.* We recommend using the 3-Dimensional Assessment matrix from the Unit Overview to inform your criteria.

The Group Culminating Project will be summatively assessed using:

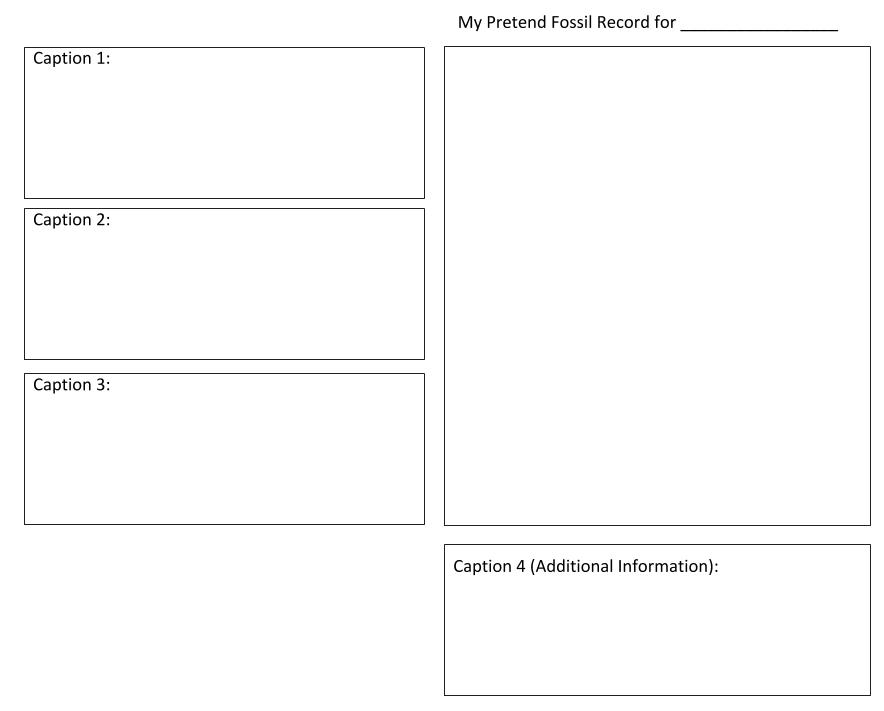
* The *Group Project Criteria for Success* Checklist

The Individual Culminating Project will be summatively assessed using:

* The *3-Dimensional Individual Project Rubric*.
* Keep in mind that the Proficient level indicates that the student has successfully demonstrated understanding of the criteria. Because we are in the early stages of NGSS adoption, it may take multiple opportunities throughout the course of the year for students to reach Proficient.
* If you wish to give students a numeric score, you could take the average score of all of their rubrics or add up rubric scores to give students a summation out of the total. Because of the note above, this scoring may not correlate to traditional grading systems.
* While we recommend scoring all of the project criteria with the rubrics for each student, we understand the burden of that level of scoring.
  + One option is to select the rubrics that you wish to focus on for this project and use those to assess each student’s individual project.
  + Another option is to review the Proficient level of each of the project’s rubrics and use the descriptions to generally analyze all student work for trends.

**Post-Discussion Report**

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| **Background on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |



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| **How a Change in Environment is Affecting \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |

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| **Technologies That Humans Can Use to Affect Traits in Organisms** |
| **The Most Appropriate Technology for Human Intervention** |
| **A Model of Genetic Engineering** |

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| **My Argument: Should humans intervene on the behalf of threatened or endangered species or allow nature to take its course?** |