# Science Assessment System Through Course Task

## Drought in the Galapagos

**Grade Level:**
9, 10, 11, 12

**Phenomena:**
Natural Selection

**Science & Engineering Practices:**
Analyzing and interpreting Data
Engaging in Argument from Evidence

**Crosscutting Concepts:**
Structure and Function

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.

# Preparing to implement Through Course Tasks in the Classroom

**What is a TCT?**

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

**How do I facilitate a Through Course Task (TCT)?**

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations.
   Success criteria include:
   - What is this task designed to get evidence of?
   - What is the task asking the students to do?
   - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
  - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

# Drought in the Galapagos Task Annotation

After **analyzing and interpreting data** about *changes in bird beak size and the characteristics of available food sources (seeds),* **develop an argument** *to identify the most probable food source for these birds after a drought* **using evidence and reasoning** from the structure/function relationship between beak size and seed characteristics.

**Phenomenon within the task**

This task is focused on the mechanism of natural selection as applied to a drought on the Galapagos Islands.

**How the phenomenon relates to DCI, if applicable**

DCI: LS4.C: Adaptation

- HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

LS4.B: Natural Selection

- By end of 5th grade: Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates and reproducing.
- By end of 8th grade: Genetic variations among individuals in a population give some individuals an advantage in surviving and reproducing in their environment. This is known as natural selection. It leads to the predominance of certain traits in a population and the suppression of others.
- By the end of grade 12: Natural selection occurs only if there is both (1) variation in the genetic information between organisms in a population and (2) variation in the expression of that genetic information—that is, trait variation—that leads to differences in performance among individuals. The traits that positively affect survival are more likely to be reproduced and thus are more common in the population.

LS4.C: Adaptation

- By end of 5th grade: Changes in an organism's habitat are sometimes beneficial to it and sometimes harmful. For any particular environment, some kinds of organisms survive well, some survive less well and some cannot survive at all.
- By end of 8th grade: 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.

- By the end of grade 12: Natural selection is the result of four factors: (1) the potential for a species to increase in number, (2) the genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for an environment's limited supply of the resources that individuals need in order to survive and reproduce and (4) the ensuing proliferation of those organisms that are better able to survive and reproduce in that environment. Natural selection leads to adaptation—that is, to a population dominated by organisms that are anatomically, behaviorally and physiologically well suited to survive and reproduce in a specific environment. That is, the differential survival and reproduction of organisms in a population that have an advantageous heritable trait leads to an increase in the proportion of individuals in future generations that have the trait and to a decrease in the proportion of individuals that do not. Adaptation also means that the distribution of traits in a population can change when conditions change. Changes in the physical environment, whether naturally occurring or human induced, have thus contributed to the expansion of some species, the emergence of new distinct species as populations diverge under different conditions and the decline—and sometimes the extinction—of some species. Species become extinct because they can no longer survive and reproduce in their altered environment. If members cannot adjust to change that is too fast or too drastic, the opportunity for the species' evolution is lost.

**What information/data will students use within this task?**

Students will have to infer from the data the bird adaptations needed to survive a drought based on the structural characteristics of the available plants. In addition, students will gauge plant survival based on the shift in the beak size after the drought. Students need to be familiar with the importance of deep roots vs. shallow roots and waxy leaves vs. non-waxy leaves and leaf shape and surface area.

**Ideas for setting up the task with students**

Students should have experience with the Claim-Evidence-Reasoning process including how to address a counter-argument. In science, a counter-argument acknowledges other interpretations of the data and points out flaws in those interpretations. Students may be overwhelmed with analyzing data so collaboration could be beneficial while they process the task. Collaboration will allow students to brainstorm and get clarification from their peers if there is any confusions or misconceptions. To assist students before the task, teachers could lead a discussion on droughts and how they impact living organisms. Teachers and students could brainstorm plant adaptations that are listed above to ensure students know the significance of plant characteristics listed in the data table.

**Intent of the Task for Assessment**

The intention of this task was to evaluate students' ability to analyze data and to engage in argument using evidence about how changes occur in biotic populations in response to environmental changes. Students will have to use minor background knowledge on plant structural adaptations to complete this task. They may need an overview of what happens during a drought and how plants and animals adapt to survive in these conditions. If student background knowledge about plant structures is lacking, the teacher could facilitate a group discussion so that this does not interfere with their ability to answer the task. Students are asked to use multiple pieces of evidence to support a claim. They must provide reasoning for why the evidence supports the claim. The evidence that should be used for their reasoning should connect the structure and function of beaks to a bird's survival during a drought. The product should be in writing.

**List components of the task / resources used with the task**

- Drought in the Galapagos Task
- Success Criteria Development

**Success Criteria**

*Evidence of Learning Desired based on Progression from Appendices*

Asking Questions and Defining Problems (pre-writing)

- Ask questions to determine relationships between independent and dependent variables. (Appendix F)

Analyzing and Interpreting Data (before and during writing)

- Analyze data using models in order to make valid and reliable scientific claims. (Appendix F)

Engaging in Argument from Evidence (writing)

- Construct use and or present an oral and written argument or counter-arguments based on data and evidence. (Appendix F)

Structure and Function: The way an object is shaped determines many of its properties and functions.

- The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used and the molecular substructures of its various materials (Appendix G)

*Success Criteria*

- Students will ask questions about how beak size might be influenced by seed availability.
- Students will analyze data about plant and bird species in order to make a valid and reliable scientific claim.
- Students will make and defend a claim about which plants can survive a drought and therefore a food source for the birds based on their structural adaptations and the structural adaptations of the birds.

*Possible Student Responses*

Plant B would be the best source of food for the birds. This is because the seed of this plant is more fitting to the beak size that will be able to survive the drought. Plant C is around the correct size but has a shallow root system making it unlikely that this plant will survive. Plant D has an extensive root system and would most likely survive the drought but the seed is too large for the beak.

**Other information teacher teams might find useful when preparing to use this task in the TCT process**

As a bell ringer before this activity, have students look at a picture of a cactus vs. a deciduous plant. This could lead to a group conversation about plant structures and adaptations for survival. In addition, the same could be done with various bird beaks.

**Extensions and/or other uses after the task is implemented**

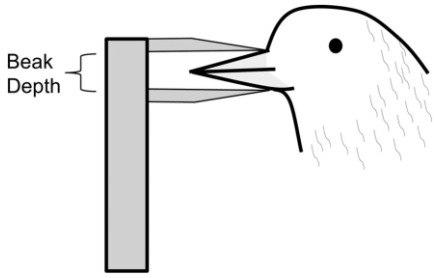
This task will lead to conversations about adaptations and natural selection. Students will learn that variation exists within a population and those organisms with beneficial traits are more likely to survive a hardship (such as a drought). This will lead to a population's characteristics to change over time. It could be beneficial to allow students to read samples of each other's work in order to analyze the process of argumentation in science. The strengths and weaknesses of each sample could analyzed and discussed as a group.

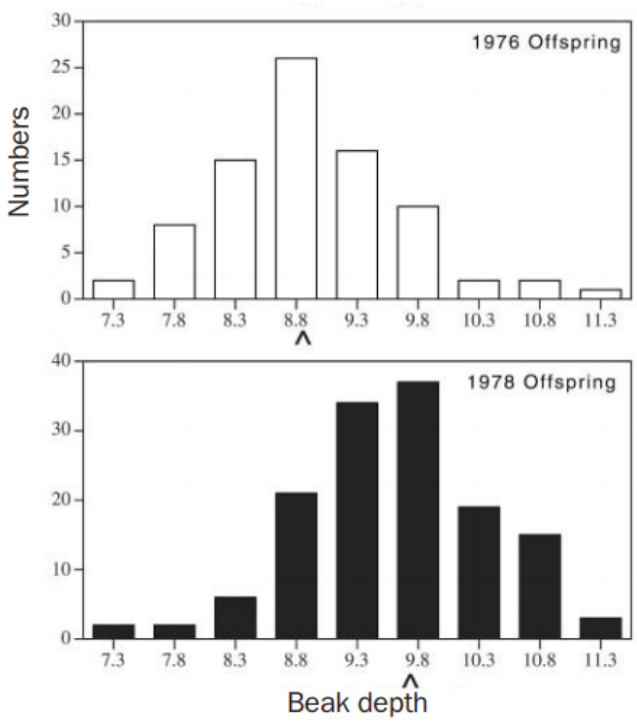
# Drought in the Galapagos Through Course Task

The Galapagos Islands are a group of volcanic islands off the western coast of South America. The following **plant species** lived on one of the islands, called Daphne, in the 1970's. The table below shows their characteristics.

| Plant ID | Characteristics |
|---|---|
| Plant A | ● Flower Color: White<br>● Seed Size: 15-20 mm<br>● Root System: Shallow<br>● Seed Texture: Smooth<br>● Leaf: Broad with no wax on outer layer<br>● Height: 25-30 cm |
| Plant B | ● Flower Color: Yellow<br>● Seed Size: 9-10 mm<br>● Root System: Extensive<br>● Seed Texture: Smooth<br>● Leaf: Modified into a needle shape<br>● Height 15-25 cm |
| Plant C | ● Flower Color: Purple<br>● Seed Size: 9-11 mm<br>● Root System: Shallow<br>● Seed Texture: Rough<br>● Leaf: Broad with no wax on outer layer<br>● Height: 20-30cm |
| Plant D | ● Flower Color: Cream<br>● Seed Size: 15-19 mm<br>● Root System: Extensive<br>● Seed Texture: Rough<br>● Leaf: Modified into a needle shape<br>● Height: 12-13 cm |

In addition to studying different plant species, scientists also tracked a population of medium ground finches (*Geospiza fortis)* from 1976-1978. The medium ground finches' beaks were adapted to pick up and crush seeds from the plants above. There was a severe drought on Daphne Island in 1977. The graphs below show the distributions of beak depths of fully grown offspring hatched in 1976 and 1978, respectively. The beak depth is measured from the top of the beak to the bottom of the beak (see picture below). The carets on the X-axis indicate the mean beak depths in the population before and after the drought.




**TASK**: After analyzing and interpreting data about changes in bird beak size and the characteristics of available food sources (seeds), develop an argument to identify the most probable food source for these birds after the drought using evidence and reasoning from the structure/function relationship between beak size and seed characteristics.