# Science Assessment System Through Course Task

## Coral Reef Changes

**Grade Level:**
8

**Phenomena:**
Impact of Phosphorous Pollution on Aquatic Ecosystem

**Science & Engineering Practices:**
Analyzing and interpreting Data
Constructing Explanations and Designing Solutions

**Crosscutting Concepts:**
Cause and Effect

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.

# Coral Reef Changes Task Annotation

Students will **analyze and interpret data** about *the effect of dissolved phosphorus from farming on coral reefs*, in order **to construct an explanation** for *how changes to a physical component in an ecosystem* affect *populations.*

**Overall intent**

This task was developed with the intention of evaluating students' ability to analyze and interpret data in order to successfully construct an explanation about changes in ecosystems. This task is designed for 8th grade students.

Note: The intent of this task could shift depending upon teacher/student needs. If teachers have a need to assess analyzing and interpreting data specifically, the task could stop after 1. Alternately, the task could become 2 separate, but connected tasks.

**Phenomenon within the task**

Phosphorous is a necessary nutrient for plants, and dissolved phosphorus is a natural part of an aquatic ecosystem. Too much phosphorus can enter coastal areas due to fertilizer runoff. This excess phosphorus can result in algal blooms, which can block out the sunlight to the symbiotic algae that lives within the coral below.

This task introduces students to a problem. There is a new coastal farming community that is located next to a coral reef. As a result of the farmers' crop fertilization, phosphates are released into the ocean. That increased dissolved phosphorus causes the algae population to explode.

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

This task should be facilitated after a learning sequence in which students have had multiple opportunities to engage in the following practices and crosscutting concepts: Analyzing and Interpreting Data (SEP 4) - Constructing Explanations (SEP 6) - Patterns (CCC 1) - Stability and Change (CCC 7) - Cause and Effect (CCC 2). Additionally, students should have prior learning experiences with the disciplinary core ideas as described in: LS2.C. Depending upon the needs of the teacher and students, teachers may choose to stop the class after completing part 1 of the task in to facilitate a whole-class discussion of their findings in order to calibrate student thinking before moving on to part 2.

Part 1 uses a template to scaffold the student's analysis of the data. The template supports the student's ability to identify the patterns that exist in the three robust data sets.

## Intent of the Task for Assessment

The intent of this task is to elicit evidence about a student's ability to analyze and interpret data in order to successfully construct an explanation, specifically looking for patterns in data in order to identify a cause and effect relationship between the abiotic and biotic components of an ecosystem. The relationship that should be identified is as follows: When phosphorus is introduced into the aquatic ecosystem it caused the growth of algae. The algae growth caused a decrease in the amount of sunlight reaching the coral. The reduced sunlight caused a reduction in coral growth. A reduced amount of coral can support fewer organisms, which caused organisms to die or move because of increased competition for habitat and food.

Part 2 asks students to construct a scientific explanation to explain the cause and effect relationships between abiotic and biotic factors of the ecosystem.

The **OPTIONAL** graphic organizer supports students' ability to connect their evidence to science concepts.

## Success Criteria

### *Evidence of Learning Desired based on Progression from Appendices*

Analyzing and Interpreting Data:

- Use graphical displays to identify temporal relationships.
- Analyze and interpret data to provide evidence for phenomena.

Constructing Explanations:

- Construct an explanation that includes quantitative relationships between variables that describe phenomena.
- Apply scientific reasoning to show why the data or evidence is adequate for the explanation in a natural system.

Cause and Effect:

- Students use cause and effect relationships to predict phenomena.

### *Success Criteria*

- Student makes a claim that shows a relationship between the amount of phosphorous and population change.
- The analysis of the data demonstrates a potential cause/effect relationship between the amount of phosphorous and population change.
- The explanation is an interpretation of the data that shows quantitative relationships that support the student's claim.
- Student explanation includes scientific reasoning to describe phenomena and support claim.

*Possible Student Responses*

- Disruptions to physical components of an ecosystem CAN lead to changes in biological components, such as when farmers applied phosphorus to the farms in Schell City that washed into the ocean ecosystem causing large changes.
- At sites 2 and 3, increased phosphorus caused an increase in algae and decrease in coral reef and species. However, phosphorus levels in site 1 remained steady due to its distance from the farms, causing few if any changes in the ecosystem. The resulting changes at sites 2 and 3 suggests that phosphorus is causing the changes.
- Site 1 dissolved phosphorus barely increased (.05), the coral reef decreased slightly by 2 sq meters and the algae, species and organisms stayed the same.
- Site 2 and 3, phosphorus levels increased more dramatically by .2 and .25 over 5 years. In addition, algae increased significantly by 11 and 10 sq meters, coral reef decreased significantly (17 sq meters), species decreased by 3 and organisms decreased by 100.
- In conclusion, as phosphorus levels increased, this caused surface algae to grow significantly at site 2 and 3. Since both surface algae and algae living in the coral reef need sunlight to grow, as the surface algae grew it blocked sunlight from the coral reef algae. The coral reef is home to many species and organisms so as the coral reef does not get sunlight, it will die, causing organisms that rely on the reef to die as well. When farmers disrupted the abiotic components of the coral reef by fertilizing their fields, this caused changes in populations to the coral reef ecosystem.

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

There is not enough data provided that demonstrates a cause/effect relationship. Teachers may wish to discuss the data sets to engage in a conversation about correlation vs causation.

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

- Students could engage in practice 6 by designing a solution to the coral reef problem.
- Teachers may want to extend the task by applying a different phenomenon to the same explanation prompt, asking students to pull evidence from other experiences throughout the school year.

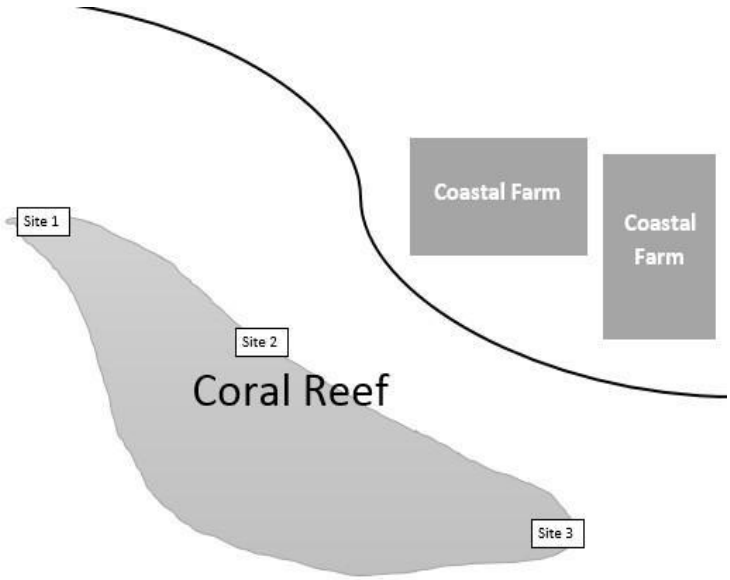
# Through Course Task – Coral Reef Changes

The coastal town of Schell City has just started to become a farming town. Most of the residents in the town now make their living from farming or fishing. The farmers have decided to use a phosphorus based fertilizer so their crops will grow quickly and plentiful. When it rains, the fertilizer from the fields washes off into the ocean.

The ocean plays a prominent role in Schell City as well. Just off the coast there is a coral reef. The coral reef ecosystem is a diverse collection of species that interact with each other and provide a variety of fish for Schell City residents.

The residents of Schell City have noticed algae starting to take over the surface area surrounding the coral reef. Algae can become an invasive species. Just like the photosynthetic algae that live among the coral, surface algae need sunlight to grow. They use the sunlight to make food. When surface algae growth is abundant, large areas grow tightly together blocking out the sunlight from reaching the coral reef algae below.

The data tables on the next page shows the impact of fertilizer from the farms on the coral reef. The town of Schell City became a farming town in the third year.



## Site 1 Data

| Year | Dissolved Phosphorus Concentration (Mg/L) | Size of Coral Reef (square meters) | Amount of Surface Algae (sq meters) | # of Species living at Site 1 (excluding algae) | # of Organisms living at Site 1 (excluding algae) |
|---|---|---|---|---|---|
| 1 | 0.00 | 65 | 0 | 16 | 800 |
| 2 | 0.00 | 65 | 0 | 16 | 800 |
| 3 | 0.05 | 63 | 0 | 16 | 800 |
| 4 | 0.00 | 63 | 0 | 16 | 810 |
| 5 | 0.05 | 63 | 0 | 16 | 800 |

## Site 2 Data

| Year | Dissolved Phosphorus Concentration (Mg/L) | Size of Coral Reef (square meters) | Amount of Surface Algae (sq. meters) | # of Species living at Site 2 (excluding algae) | # of Organisms living at Site 2 (excluding algae) |
|---|---|---|---|---|---|
| 1 | 0.01 | 70 | 0 | 16 | 850 |
| 2 | 0.01 | 70 | 0 | 16 | 850 |
| 3 | 0.10 | 60 | 6 | 15 | 800 |
| 4 | 0.20 | 57 | 8 | 14 | 775 |
| 5 | 0.20 | 53 | 11 | 13 | 750 |

## Site 3 Data

| Year | Dissolved Phosphorus Concentration (Mg/L) | Size of Coral Reef (square meters) | Amount of Surface Algae (sq meters) | # of Species living at Site 3 (excluding algae) | # of Organisms living at Site 3 (excluding algae) |
|---|---|---|---|---|---|
| 1 | 0.01 | 67 | 0 | 18 | 800 |
| 2 | 0.01 | 68 | 0 | 18 | 800 |
| 3 | 0.10 | 58 | 5 | 16 | 750 |
| 4 | 0.15 | 54 | 7 | 16 | 750 |
| 5 | 0.25 | 50 | 10 | 15 | 700 |

1. **Analyze the data in the three tables. Identify any changes to the abiotic and biotic components of the Coral Reef ecosystem.**

**Describe the changes (if any) at each site.**

| | **Abiotic/Physical/Non-Living Component** | **Biotic/Biological/Living Component** |
|---|---|---|
| **Site 1** | | |
| **Site 2** | | |
| **Site 3** | | |
| **Compare the changes that happened at the 3 sites to describe their cause and effect relationship.** | | |

2. **Using the information from the coral reef scenario and SPECIFIC data from part 1, construct a scientific explanation that answers the question:**

   **"How do disruptions to abiotic components of an ecosystem affect populations?"**

   **A scientific explanation has three parts:**
   - **Claim: a conclusion to a question or problem**
   - **Evidence: scientific data that supports the claim**
   - **Reasoning: a justification that links the evidence to the claim**

## OPTIONAL Scientific Explanation Graphic Organizer

**What question do you want to answer?**

**What claim can you make that answers the question?**

| **Evidence**<br>*What pieces of evidence do you have that is tied to your question?* | **Science Reasoning**<br>*What science concepts are connected to your pieces of evidence that support your claim?* |
|---|---|
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