Science Assessment System Through Course Task

Termite Training

Grade Level:
6, 7

Phenomena:
Pheromones – Experimental Design

Science & Engineering Practices:
Planning Carrying Out Investigations
Analyzing and Interpreting Data

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.

Termite Training Task Annotation

Part 1 of Task: After **analyzing and interpreting data** about *termite pheromone behavior*, **describe a** pattern that you observe.
Parts 2 & 3 of Task: After **analyzing and interpreting data** about *termite pheromone behavior*, **evaluate the** effectiveness **of an investigation designed to explore this behavior** and **modify the experimental design to yield** effective **results, if necessary.**

Phenomenon within the task

Termites follow each other by laying down a "scent," which is called a pheromone. Some ink pens contain a chemical that mimics a termite's pheromone; therefore, if you draw a line with this ink on a piece of paper, the termites will follow that line. Consequently, if you draw a shape, then the termites will follow the shape. Other variables that could be tested include width of the line, color of line, type of paper, etc. The task facilitates students through an investigation dealing with termites' ability to track the ink.

How the phenomenon relates to DCI

Biological Evolution: Unity and Diversity. Disciplinary Core Ideas - LS4.B

Grades 3 – 5 Differences in characteristics between individuals of the same species provide advantages in surviving and reproducing.

> Performance Expectation - Sometimes the differences in characteristics between individuals of the same species provide advantages in surviving, finding mates and reproducing. (3-LS4-2)

Grades 6 – 8 Both natural and artificial selection result from certain traits giving some individuals an advantage in surviving and reproducing, leading to predominance of certain traits in a population.

> 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. (MS-LS4-6)

Grades 9 – 12 Natural selection occurs only if there is variation in the genes and traits between organisms in a population. Traits that positively affect survival can become more common in a population.

The traits that positively affect survival are more likely to be reproduced, and thus are more common in the population. (HS-LS4-3)

What information/data will students use within this task?

A "student created" data chart is at the top of the first page. You may want to lead a discussion about different features of the chart before asking the students to answer the first question. What does the different colors of ink at the top of the data chart mean? Why do you need multiple trials? Why isn't three trials enough? Do you need more trials? What does sec. stand for? Why did the students calculate an average at the bottom of the chart? By the way, the average at the bottom of the data chart is not calculated correctly. Middle school students often calculate averages incorrectly and the deliberate mistake could be an opportunity for a teaching moment. Please note to students that the data chart used in the first question is the same as the data chart in the second question.

A brief description of the phenomenon is located at the top of the second page. After students read the description, you may want to show the accompanying video. https://www.youtube.com/watch?v=4ClwpgtWP_Y

Below the first question in the TCT is the question asked for the investigation. You may want to have students brainstorm other questions that could have been asked. A conversation about other possible questions will prompt students to realize the TCT is more about their ability to deal with scientific practices and crosscutting concepts than the termite tracking phenomenon.

A student created procedure is provided next. A good procedure provides enough detail for other scientists to verify the results reported. This procedure lacks details such as the type of paper, number of termites, room conditions, etc. But, most importantly, the procedure does not guide the scientist to collect evidence that is useful in answering the original question. If you follow this procedure, you will learn about how different color of ink affects the phenomena, but you will not learn about different shapes. Middle school students have a tough time visualizing an experiment simply based on written directions. In a normal class, teachers will supplement the written directions with demonstrations and questioning for understanding. You will want to facilitate a similar discussion, however, guide the discussion away from evaluation of the procedure. Reminder - you want to evaluate students' ability to notice a procedure's capacity to provide useful evidence; don't give that idea away during the discussion. Furthermore, as noted

in the question, useful evidence is defined as evidence that can be used to support or refute a claim. The evidence must connect back to the original question or else the procedure needs improvement.

Ideas for setting up the task with students

1. Students would benefit from experiencing a student driven investigation, including practice asking their own question, designing their own experimental design and developing a claim based on the data/evidence collected with be valuable.
2. Give the 1st question dealing with patterns as a lone question.
3. A brief description of the phenomenon is located at the top of the TCT. After students read the description, you may want to show the accompanying video. https://www.youtube.com/watch?v=4ClwpgtWP_Y
    a. Depending on your students, you may prefer to watch the video first and allow students to predict what they thought was the reason for the phenomena before handing them the second question handout that describes the phenomena.
4. You may want to have students brainstorm other questions that could have been asked. A conversation about other possible questions will prompt students to realize the TCT is more about how scientists make sense of the world (i.e., scientific practices and cross-cutting practices) rather than the tracking termite phenomenon.
5. Above question two is the investigation question. Does the shape of the ink line affect the amount of termites following the path after 10 seconds?
6. A student created procedure is provided next. The procedure lacks detail. You may want to have a discussion that helps students visualize the steps in the procedure. However, guide the discussion away from evaluation of the procedure.
7. A student created data chart is at the bottom of the page. You may want to lead a discussion about different features of the chart. What does the different colors of ink at the top of the data chart mean? Why do you need multiple trials? Why isn't three trials enough? Do you need more trials? Why did the students calculate an average at the bottom of the chart?

Intent of the Task for Assessment

This task is designed to determine if students can identify patterns in data, analyze the data's ability to support or refute the question and to evaluate the investigation effectiveness in answering a question. Students are asked to revise the investigation procedures in order to collect data that would help to answer the question presented. They must be able to recognize patterns in data given, but also recognize that the pattern does not apply to the question.

Question one: Identifying patterns

The question evaluates their ability to find patterns within a data chart. Students are taught through math class that a pattern is something like ABCABCABC and is very precise. In science, we look for trends. Our patterns in science are frequently messy but still useful. This questions allows teachers to quickly assess for misconceptions of what patterns in data must entail in science. If students struggle with identifying patterns they may not be prepared to decide if data supports or refutes the investigative question in the later questions.

The data chart in question one is the same as the data chart used throughout the experience. Later in the evaluation, we evaluate a student's ability to determine the usefulness of the data (does it help support or refute). This initial question gives students time to engage with the data before they think about bigger issues such as usefulness of the data to the investigation.

We separated this question from the rest of the experience, because we wanted to evaluate student ability to find patterns before the teacher facilitated any discussion. A discussion of the phenomena would certainly give away basic patterns in the data. Some possible patterns include:

- *The red ink has the longest times and averages, followed by blue and, finally, green.*
- *The fifth trial's time is always longest.*
- *The fifth trial's time is similar for each color.*
- *Excluding the fifth trial, the times get smaller each trial.*

A correct answer is dependent on students finding a pattern. The pattern does not have to be useful to the investigation. Be aware the data used in the task has common student mistakes made during data collection.

Question two: Analyzing data

The question evaluates a student's ability to analyze the patterns in the data and decide if the data collected is useful in answering the question. Be aware the data used in the task has common student mistakes made during data collection.

- The data collected describes the color of lines, although the question asks students to investigate different shapes.
- The averages are incorrectly calculated. The numbers in the data table are the sums of the data and have not been divided by the total number of trials. This is an example of a common mistake middle school students make.

A correct answer involves students recognizing and explaining the lack of connection between the data collected and the question asked.

Question three: Planning and Carrying out Investigations

The question evaluates the student's ability to examine an experimental design and recognize if the design is faulty.

The procedure does not address the question being asked. The investigation as stated explores how the color of ink affects the behavior instead of the shape of the line. Students will need to recognize the mistake in the experimental design and suggest changes in the design.

One possible solution is changing line one in the procedure to "draw different shapes" rather than different colors of ink. A design indicating the actual shape to be drawn would decrease variables such as loops, straight lines, curves, etc.

As your discussion with students about planning investigations continues, ask students to point out other weaknesses in the procedure. A solid procedure should include fundamentals such as: planning for multiple trials, created a way to measure the results and not rely on "looking" details e.g, how much, how far, when and an average of your data collected.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Part 1 of Task:

Analyzing and interpreting data

- Analyze and interpret graphical displays of data

Constructing Explanations

- Construct an explanation that includes quantitative relationships between variables that describes a phenomenon

Patterns

- Graphs, charts, and images can be used to identify patterns in data.

Parts 2 & 3 of task:

Analyzing and interpreting data

- Analyze and interpret graphical displays of data

Planning and Carrying out investigations

- Evaluate and/or revise the experimental design to produce data to serve as the basis for evidence that meet the goals of the investigation

Cause and Effect

- "Cause and effect relationships may be used to predict." (The use of cause and effect in this task is specific to experimental design. What about the experimental procedure "causes" results that will be useful? Is the experimental design "effective" in yielding results to answer the question?)

Success Criteria

- *Students are able to identify patterns in the provided data chart.*
- *Students explain why (what causes) the provided data is or is not useful in supporting or refuting the question.*
- *Students evaluate the investigation and the provided data to determine if there is an **effective** correlation between the data and the question. The students then make revisions to the investigation so that it could produce data that would connect with the question.*

Possible Student Responses

- *"Patterns in the data are that termites followed the green ink the longest based on the average."*
- *"A pattern would be that the longest amount of time for blue and green were the final trial"*
- *"The data collected is for different colors of ink and not shape."*
- *"I would revise the procedure to be more specific and say you should draw one shape on a piece of paper and have a total of 4 papers with one shape on each."*
- *"Place all of the termites on one piece of paper at a time and record the number of termites that follow the shape within 10 seconds.*
- *"Repeat steps 2 and 3 for each shape."*

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

Tips for facilitating student created investigations

Termite Lab Graphic Organizer

Extensions and/or other uses after the task is implemented

There is a tendency to work with student created investigations early in the year, but not throughout the year. Student created investigations can be related to any content and students get much better at managing the investigations with multiple exposures. For example, during a unit about forces and motion, give the students marbles and ramps, ask students to ask a question, and then have students collect the data necessary to learn about their question. The following link will help your thinking. Initially, students will have a difficult time with these sort of open ended experiences. You may need to guide their thinking considerably at the beginning. But, after a few exposures, they will get better with the scientific practices.

If you give this evaluation early in the year, consider giving the evaluation again later in the year after you have guided students through more student-created investigations. As students practice the reasoning necessary to create a procedure that is effective, their understanding of how scientist "know" the world will grow.

Through Course Task – Termite Training

Name: _____ Date: _____

Directions: Look at the data chart given below and answer the question to the best of your ability.

Data Chart:

Trial	Blue Ink	Red Ink	Green Ink
1	10 sec	25 sec	6 sec
2	9 sec	23 sec	3 sec
3	8 sec	19 sec	2 sec
4	7 sec	18 sec	1 sec
5	16 sec	16 sec	17 sec
Average	50 sec	101 sec	29 sec

1a. Describe a pattern found you found in the data.

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1b. Explain how this pattern might tell a scientist about their world.

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Termites follow each other by laying down a “scent.” The scent is called a pheromone. Some ink pens contain a chemical that mimics a termite’s pheromone, allowing you to draw a line on a piece of paper the termites will follow. We can train termites!

Investigation Question: Does the shape of the ink line affect the amount of termites following the path after 10 seconds?

Simple Procedure/Experimental Design:

1) Use different colors to draw lines on a piece of paper.
2) Place termites on the paper.
3) Count the number of termites after 10 seconds.
4) Repeat.

Data Chart:

Trial	Blue Ink	Red Ink	Green Ink
1	10 sec	25 sec	6 sec
2	9 sec	23 sec	3 sec
3	8 sec	19 sec.	2 sec
4	7 sec	18 sec	1 sec
5	16 sec	16 sec	17 sec
Average	50 sec.	101 sec	29 sec

2) Analyze the patterns in the data and explain how the data supports or does not support the question asked in the investigation. Be aware the data chart is the same as question one.

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Investigation Question: Does the shape of the ink line affect the amount of termites following the path after 10 seconds?

Simple Procedure/Experimental Design:

1) Use different colors to draw lines on a piece of paper.
2) Place termites on the paper.
3) Count the number of termites after 10 seconds.
4) Repeat.

3) Analyze the experimental design and explain how the experimental design would produce useful data/evidence or suggest changes that would allow for collection of more useful data. Useful means the data is helpful as evidence of your claim, and your claim would answer the investigation question.

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