Science Assessment System Through Course Task

Worms, the Dirty Work

Grade Level:
5

Phenomena:
Decomposition

Science & Engineering Practices:
Planning Carrying Out Investigations
Engaging in Argument from Evidence

Crosscutting Concepts:
Cause and Effect

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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.

Worms, the Dirty Work Task Annotation

After critiquing the design of two investigation proposals using set criteria, develop an argument that identifies which investigation would result in (cause) **evidence to support** *whether or not earthworms* affect *decomposition.*

Overall intent

The task is intended to measure a student's ability to provide a reasoned explanation for the selection of one investigation proposal over another after evaluating the design using a set of criterion.

Phenomenon within the task

The phenomenon within the task relates to decomposition, specifically the role of earthworms in recycling matter into the soil. It serves as the foundation for two proposed investigations that students must critique and choose from based on reasoned judgment. This important role in the cycling of matter takes place over time and in conjunction with other decomposers on the macroscopic and microscopic level.

Misconceptions about the process of decomposition are important to note. Students are often unaware of the role of decomposers and think that "things just deteriorate" or "break down." Initially, students tend to believe that decomposition occurs solely as a result of obvious organisms such as insects, worms and scavengers. Most decomposers, however, are microscopic – tiny organisms such as fungi and bacteria that we call microbes. These microscopic microbes are responsible for most of the matter recycling in ecosystems. Even when students are aware of the role of microbes, they still don't realize just how critical microbes are to the process of matter recycling and how matter recycling is important in making elements (nutrients) available for new life forms. It is important at this age for students to begin to identify the role of microscopic level decomposers (LS2.A/LS2.B grade 5). Although the focus of this task is on the role of earthworms in decomposition, it is important not to mislead students to believe that earthworms work alone to break down the food in the bins. It is recommended that you provide other opportunities to address other decomposers that are at the microscopic level as an extension to this task.

How the phenomenon relates to DCI

This content relates to LS2A which indicates that the food of almost any animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants, while decomposers

restore some materials back to the soil. LS2B is also addressed in that matter cycles between the air and soil and among organisms as they live and die.

Regarding KAS Science, students should have had multiple opportunities to study organisms in previous grades. In first and fourth grade, they learned about body structures and functions as well as sensory processing. In second and third grade they are introduced to systems in the form of pollination and ecosystems. Third grade spends considerable time on life science by introducing life cycles, reproduction/heredity and how organisms respond to changes in ecosystems. The idea of systems is developed more fully in 5th grade. Students are introduced to the flow of energy from the sun, to plants and then to organisms. An important part of that system is what happens to organic matter after death. Decomposition represents a process in which matter is cycled back into the soil and can be useful for future living organisms.

What information/data will students use within this task?
Students will be evaluating two investigation design proposals using a criteria for success.

Ideas for setting up the task with students
We suggest allocating at least two hours to complete the task, with extra time depending on student understanding of controlling variables. We recommend using heterogeneous groups of the three to four students for the variable activity and using the criteria for success to evaluate the two design proposals. The final task of selecting an investigation based on evidence from the criteria should be completed individually in order to gather evidence of each student's ability to use the identified skills.
Prerequisite:

- Students need some familiarity with decomposition to provide more context for the task, but is not absolutely necessary since the tasks focuses on critiquing the investigation design and engaging in argument for the investigation the student chooses.
- Students will need experience in designing investigations in which variables are controlled. The goal in this TCT is for students to see the value of having a controlled investigation and to develop awareness that variables can affect the outcome of investigations. By developing a controlled experiment where as many variables as possible are the same, students can better see the impact of the variable that is not controlled. As you conduct investigations throughout the year, discuss the significance of the design of the investigation. In particular, the term variable should be discussed as related to investigations.
- Students will need experience in developing appropriate methods of collecting information. The goal of an investigation is to

gather data that can be analyzed for results which can then be communicated. Students need experience collecting and analyzing data so that they can recognize the importance of having a clear idea of the information they are looking for.

- Students will need experience in evaluating a proposed investigation. In this TCT, students will evaluate two investigation proposals using a criteria. Students will need experience in using a criteria to better understand potential problems in the investigation.
- Students will need experience in making a claim about the merits of an investigation and supporting that claim with reasoned judgment. In this TCT, students will need to make a claim and provide evidence of their thinking in which they interact with two different proposals using a criteria. Students will need to use evidence from the criteria to support their thinking.
- The Crosscutting Concept most prevalent in this task is Cause and Effect. Any prior student experience with identifying the causes of events or identifying causal relationships will better prepare students for this task.

Task Facilitation

In piloting the task, we noticed some tendencies among our students that could shape the way you use this TCT. We recommend having students complete the variable chart and investigation criteria sections in heterogeneous groups of three to four and completing the final selection/explanation section independently to assess student understanding. We found student engagement and performance stronger in the cooperative group format, but could better formatively assess our students if the last section was completed independently. We also found that using a time frame of at least two hours (depending on student understanding of variables) was needed to complete the task.

Secondly, students will need an understanding of variables to complete the task. We found this concept as the most significant area to build on with our students as they struggled to identify and understand the need control variables in a test. The goal is for students to select an investigation design that will show whether or not earthworms make a difference in the decomposition. For the design to be successful, the variables (container, type of soil, decomposing matter, etc.) will all need to be the controlled, except that one container will contain earthworms and one container will not contain earthworms. Students may need preliminary work in understanding the nature of variables in an investigation and in particular, students may need guidance in identifying the variables in this investigation. There is one scaffolded question that asks students to identify three variables in the investigation (based on the available materials) and to explain the impact of those variables on the investigation. **This portion of the task proved very challenging for students with limited knowledge of the nature of variables in an investigation and might require teacher interventions such as direct instruction or demonstration**. However, taking the time to build this understanding proved important

to understanding and completing this task. After the piloting process, one class conducted Group A's investigations proposed from the TCT. Students showed considerable growth in their understanding of controlling variables when actually physically setting up the investigation.

Thirdly, we found the criteria for evaluating the investigations to be both a benefit and an area of improvement. Our students have not had much opportunity to use criteria in this format. Therefore, we had to teach using this criteria during the actual implementation of the TCT. It would have been so helpful if they would have had experience beforehand. We have used this criteria with investigations since developing this TCT and have found our students are more metacognitive about the investigation design. The criteria can also serve as evidence for developing their argument in stating a claim about which investigation would better answer the research question. We found that the components of the criteria elicited positive discourse in evaluating the investigation proposals.

Finally, we found that our students tended to select the better investigation proposal (Group A), but struggled to support their decision using evidence from the criteria. They tended to identify reasons not directly connected to the investigation to support their answer rather than actual issues with the investigation design. These insights informed our next steps of instruction.

Modifications: Since piloting this TCT, we have modified the task to eliminate some elements that may have been confusing for students and added elements that would focus student efforts on the SEPs and CCC. When you review the annotated samples of student work, you will notice a few slight variations in the answer samples submitted versus the task as it presently reads.

Intent of the Task for Assessment

The intent of this task is to elicit student's ability to provide a reasoned explanation for selecting one investigation design over another based on their ability to critique the design of the investigations. Students are given the goal of the investigation, a list of materials available to use in the investigation, and two investigation proposals. They are asked to identify variables that would influence the outcome of the investigation. This is not an assessed component of the task, rather it is intended to promote student engagement with the investigation design. Student should conclude that there are multiple variables that can influence an investigation (size of tank, type of soil, amount and type of materials to decompose, etc.)

Next, students interact with two investigation proposals. Students read the proposals and are given a criteria to evaluate different

components of the investigation design. Students provide evidence of their selection by explaining their reasoning for one choice over another. By evaluating the design of the two investigation proposals, students are more likely to be able to identify which of the two investigations would yield data better suited to detect the influence of earthworms on decomposing matter. The written explanation will provide evidence of their ability to critique an investigation and gauge the impact of variables in an investigation. Having students use a criteria and support a claim with evidence demonstrates student ability to evaluate an investigation design and present a claim supported with reasoned judgment.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Planning and Carrying Out Investigations

- Test two different models of the same proposed process to determine which best meets the criteria for success. (Appendix F)

Engaging in Argumentation from Evidence:

Scientists and engineers use argumentation to listen to, compare and evaluate competing ideas and methods based on merits.

- Construct or support an argument with evidence, data and/or models.
- Students will respectfully provide a critique from peers about a proposed procedure, by citing relevant evidence and proposing specific questions. (Appendix F)

Cause and Effect:

- Cause and effect relationships are routinely identified, tested and used to explain change. (Appendix G)

Success Criteria

Students will construct a claim about which of two proposed investigation, if implemented as suggested, will result in data that can be used as evidence to answer the question being investigated using:

- analysis of the proposed investigation designs based on success criteria,
- understanding of the intent of the investigation,
- and identification of cause and effect relationships.

Possible Student Responses

Group A has a better investigation proposal than Group B. Since the variables are controlled, except for the earthworms, we will know it was the earthworms that made the difference. Group A also has a more accurate way of collecting data in that pictures are clearer than a drawing.

Group B does not control the variables as well in the investigation. They use different kinds of matter to decompose. Since both sections have earthworms, you will not know if the earthworms or another variable cause the matter to decompose. Group B's data collection is not as clear as Group A because a drawing is not as clear as a picture.

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

As mentioned before, the two biggest challenges we discovered when using this TCT was our students' lack of understanding the importance of controlling variables in an investigation and using the criteria for success. However, we would found that the time invested in building student understanding with these concepts has proved foundational for future learning.

Extensions and/or other uses after the task is implemented

There are a variety of tasks and extensions from the work performed in this TCT.

- Supporting reason with evidence is a cross-curricular theme. Students can build skills in this experience to enhance their ability to justify their thinking in ELA and Mathematics tasks.
- Students can perform a similar investigation in the classroom to measure for themselves the influence of earthworms on decomposition. How would they design the experiment? How would they collect data? How would they control the other variables in the experiment? Conducting the investigation after completing this task could illustrate the influence of variables, the importance of investigation design, the effect of decomposers and build student experience with how to measure change over time. The research question could also be changed to illustrate how the investigation design would need to change to provide information to answer the question. For example, students could test how long it takes different materials to decompose or whether the type of soil affects the rate at which materials decompose.
- Students could explore the diversity of decomposers in an ecosystem. The study of earthworms offers fifth grade students the opportunity to learn about decomposers on the macroscopic level. However, most decomposers exist on the microscopic levels and are introduced in the sixth grade. This task provides the opportunity for students to research and identify both macroscopic and microscopic decomposers, thereby introducing students to concepts they will learn in future grade levels.

- Students could explore the function of decomposers in an ecosystem. Decomposers have a vital role in the matter cycle, but are often viewed as “gross” or “disgusting” by humans. Students could write a fiction piece predicting what could happen if the decomposers disappeared or what would happen to matter on a planet that did not have decomposers. Understanding the role of decomposers will only build an appreciation for their role in the environment.

Through Course Task – Worms, the Dirty Work

Name:_____ Date:_____

Scenario:

While observing the soil on the playground of the school, a student found an earthworm. After showing the worm to the other classmates, the students began asking questions about the worm. How does it move? Where is the head? How do earthworms survive? The class studied worms and learned that earthworms provide many benefits to the ecosystem. They learned that worms are **decomposers**, which means that the worms recycle dead materials, such as fallen leaves, fruit and wood, back into the soil. A student said, "I thought that most decomposers were very small and hard to see, like bacteria. How do we know that worms are decomposers since they live underground?" The class decided to design an investigation that would show the influence of earthworms in decomposing matter back into the soil.

Before designing the investigation, the teacher reminded the students that the purpose of the investigation was to **measure the effect of the earthworms on decomposition**. They wanted to be able to see if the earthworms caused the matter to decompose or if a **variable** caused the decomposition.

The teacher told the students that there are many variables in an investigation that must be **controlled** or kept the same in order for an investigation to be considered a fair test. They were eager to design their investigation. With the help of their teacher, they generated a list of available materials that might be useful. The students could pick any of the materials from the list to use in their investigation, but did not have to use them all. Review the items listed below:

Containers	Types of soil	Matter to decompose	Classroom Supplies	
1 large aquarium	potting soil	leaves	rulers	scissors
6 small aquariums	sand	apples	cardboard	pencils
4 large bowls (same size)	clay	tomatoes	notebooks	markers
		bananas		
		sticks		

Before designing the investigation, the teacher reminded the students that the purpose of the investigation was to see if earthworms affected the decomposition of matter. They wanted to be able to see if the earthworms caused the matter to decompose or if a **variable** other than the earthworms caused the decomposition.

The teacher told the students that there are many variables in an investigation that must be controlled or kept the same in order for an investigation to be considered a fair test.

1. Imagine that you are designing this investigation. What are some variables in this investigation that will need to be controlled? Work with your group to complete the chart below.

Identify at least 3 possible variables that need to be controlled.	How could this variable affect the outcome of the investigation if not controlled?

The students designed an investigation proposal to share with the class. This is the work of real scientists. Scientists use feedback from other scientists to make sure that the investigation they are designing will provide the needed data to answer their question.

The students were divided into two groups (Group A and Group B). Each group designed an investigation proposal for peer review. Students listened to each other's investigation proposal to determine if the investigation would answer the research

question. When scientists review an investigation proposal and identify potential problems in the way the investigation is designed, this is called **evaluating** or **critiquing an investigation**. Students used a criteria to compare the two investigations. This criteria aided the students in determining which investigation design would better answer the research question.

Research Question: Do earthworms cause matter to decompose?

Group A Investigation Proposal	Group B Investigation Proposal
For the investigation, our group believes that we should: ● Use two equal bowls and label them A and B. ● Put an equal amount of potting soil in each bowl. ● Put 6 earthworms in Bowl A and no earthworms in Bowl B. ● Put one tomato, leaf, apple, banana and stick in Bowl A and Bowl B. Try to make the materials the same size. ● Observe the bowls every 5 days and take a digital picture of the decomposing materials to add to a virtual notebook.	For the investigation, our group believes that we should: ● Take the aquarium and divide in half with cardboard to make two equal sections. Label them A and B. ● Put an equal amount of potting soil in Section A and Section B. ● Put 6 earthworms in Section A and Section B. ● Put one tomato and leaf in Section A and one apple and one banana in Section B. ● Use the notebook and draw a picture of the materials every 5 days in each container and describe what it looks like.

Student Task Name_____ Date: _____

Imagine that you are a student in the class. It is your task to evaluate each of the proposed investigation plans.
Read each investigation proposal carefully and use the student created criteria tool to evaluate each group's investigation proposal.

Research Question: Do earthworms cause matter to decompose?

Group A Investigation Proposal	Group B Investigation Proposal
For the investigation, our group believes that we should: ● Use two equal size bowls and label them A and B. ● Put an equal amount of potting soil in each bowl. ● Put 6 earthworms in Bowl A and no earthworms in Bowl B. ● Put one tomato, leaf, apple, banana and stick in Bowl A and Bowl B. Try to make the materials the same size. ● Observe the bowls every 5 days and take a digital picture of the decomposing materials to add to a virtual notebook.	For the investigation, our group believes that we should: ● Take the aquarium and divide in half with cardboard to make two equal sections. Label them A and B. ● Put an equal amount of potting soil in Section A and Section B. ● Put 6 earthworms in Section A and in Section B. ● Put one tomato and leaf in Section A and one apple and one banana in Section B. ● Use the notebook and draw a picture of the materials every 5 days in each container and describe what it looks like.

The variables are controlled in a way that will show if earthworms cause the matter to decompose.

Does the plan meet this criteria?	Yes	No	Provide evidence to support your decision.
Group A			
Group B			

The steps of the investigation are clearly stated and easy to follow.

Does the plan meet this criteria?	Yes	No	Provide evidence to support your decision.
Group A			
Group B			

The collection method will provide clear data of the effect of the earthworms on the decomposing matter.

Does the plan meet this criteria	Yes	No	Provide evidence to support your decision.
Group A			
Group B			

After critiquing each group's investigation proposal, which of the two investigation proposal do you feel best met the criteria to produce the evidence needed to answer the research question?

Circle one: Group A Group B

Support your choice by citing relevant evidence for how the proposal you chose met the criteria in order to measure the effect of the earthworms better than the other proposal.

_____

_____

_____

_____

Research Question: Do earthworms cause matter to decompose?

GROUP A Investigation Proposal	GROUP B Investigation Proposal
For the investigation, our group believes that we should: • Use two equal size bowls and label them A and B. • Put an equal amount of potting soil in each bowl. • Put 6 earthworms in Bowl A and no earthworms in Bowl B. • Put one tomato, leaf, apple, banana and stick in Bowl A and Bowl B- try to make the materials the same size. • Observe the bowls every 5 days and take a digital picture of the decomposing materials to add to a virtual notebook.	For the investigation, our group believes that we should: • Take the aquarium and divide in half with cardboard to make two equal sections. Label them A and B. • Put an equal amount of potting soil in Section A and Section B • Put 6 earthworms in Section A and in Section B. • Put one tomato and leaf in Section A and one apple and one banana in Section B • Use the notebook and draw a picture of the materials every 5 days in each container and describe what it looks like.