Science Assessment System Through Course Task

Systems Thinking

Grade Level:
3

Phenomena:
Bees in Ecosystems

Science & Engineering Practices:
Developing and Using Models
Constructing Explanations and Designing Solutions

Crosscutting Concepts:
Systems and System Models

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.

Systems Thinking Task Annotation

After analyzing diagrams that model *the interactions of various components within given systems,* **modify a model to indicate the** *types of interactions bees have* within the system, **and construct an explanation for the** *impact of removing bees* from the system.

Overall intent of the task

Students will analyze models to explore how the parts of a system work together to achieve a particular function. Students will also discover that if each part of the system doesn't do its job, then the entire system will not function, or the system function will change. Students will modify a model to illustrate the types of interactions between organisms within a garden ecosystem, and construct an explanation to describe how each part works together for the benefit of the system. They will collaboratively study what happens if the bee were to be removed from the system. How would plant and animals work without the bees, or can they?

Phenomenon within the task

Any ecosystem contains interacting components that are interdependent. The removal of any component of an ecosystem will cause the system to change. In this task, students explore the impact bees have on a defined ecosystem.

> ***Albert Einstein once said, "If the bee disappeared off the surface of the globe, then man would have only four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man."***

How the phenomenon relates to DCI

Organisms have basic needs and these basic needs are met through interdependent relationships within their habitats. This concept threads across the grade bands in multiple disciplinary core ideas beginning in kindergarten when students begin to think about basic needs of organisms and how these needs are met.

- LS1A (1) All organisms have external parts that help them survive.
- LS1C (K) All animals need food in order to survive. They obtain their food from plants of form other animals.
- LS2A (2) Animals depend on plants or other animals for food. They use their senses to find food and water, and they use their body parts to gather, catch, eat, and chew the food.
- LS4D (3) Populations of organisms live in a variety of habitats, and change in those habitats affect the organisms living there.

As well as reinforcing scientific concepts at K-2, this task helps lay the groundwork for future grade level content where students utilize these basic concepts to make seen of more sophisticated phenomena.

What information/data will students use within this task?

Prior knowledge/experiences:

- Stating claims and supporting them with evidence
- Using, modifying and developing models
- Synthesizing information
- Use of t-charts

Information in task:

- Diagram of bicycle
- Diagram of bee
- Diagram of a garden ecosystem

Ideas for setting up the task with students

Consider providing students opportunities to engage with various garden ecosystem through videos, photographs or in person as well as an actual bicycle. This promotes equal access to the content of the task for all students. Some students may not have experiences with a garden of any type, a pond or a bike.

Students should be encouraged to engage in a conversation related to the following topics:

- What is a system? An ecosystem?
- What are the boundaries of a system and why are they important to consider?
- Why are all the parts found within a system important?
- How are bees and other living things found within a backyard ecosystem interrelated?

This task has multiple components that provide opportunities to gain insight into your students' ability to engage in systems thinking and use of models. The task can be facilitated in a collaborative manner up until the actual student task pages. The level of scaffolding will be dependent on the needs of your students and your expertise.

The following is a suggested plan for facilitation:

Bicycle as a system:

- Students share experiences with bikes and any troubles they have had with them. They look at a diagram of a bike, identify the components and discuss how each component of a bicycle has a specific function or role within the bicycle system. The parts of a system work together to carry out a function that cannot be done by one single component. Students can select a component of the bicycle that might malfunction and share how this impacts the entire system. If a bike is available, have kids test out their thinking but remember, SAFETY FIRST! Consider discussing the boundaries of the bike system (the actual bike, not the ground or rider, as they are not part of the given system) and why scientist take boundaries into consideration with studying a system.

The bee as a system:

- Next, students are asked to think about a honey bee as a system. They identify the components of a honey bee (only the external parts) and the function of each part. Collaboratively list components of a honeybee (stinger, abdomen, thorax, antenna, eyes (5!), legs, head, proboscis, wings). How do parts function??
- Again they are asked to think about how the removal of one component would impact the rest of the system. Note the boundary is the actual bee and not its interaction with a flower, human or other interdependent objects.

The components of an ecosystem around a garden ecosystem:

- Students brainstorm a list the components they might see in a backyard ecosystem area PRIOR to seeing the diagram and discuss their function within the given system. Focus should be on living and nonliving things but try to steer students away from man made objects. This will give you some insight as to what experiences your students have had and whether or not they need further support, e.g., video clips, etc.
- Next, students check out the provided backyard diagram to see if the components the students brainstormed are present in the model. Emphasize this system has many parts that are dependent on each other – they work together to ensure that all organisms' needs are met. One misconception held by most young children is that all bees live in hives that hang from the branch of a tree. It may be of interest to share that honeybees usually make their hives in the bark of trees, not in a hanging hive. This is a misconception held not only by children but by adults as well. A discussion as to whether or

not the tree and the bee are dependent on each other for survival would promote deep thinking and provide an opportunity for further inquiry.

Systems Thinking Student Task:

- This is the actual student task (3 pages- Parts A, B and C) that should be completed independently (although you may need to go over the directions with students). Students will complete a model to show interactions between the bee and other component of the given system (only that in the diagram). Students will need colored pencils or crayons to complete the model as designed. To complete the task, students explain how the removal of the bee would impact the other components of the system and give examples to support their explanation.

Intent of the Task for Assessment

This task is designed to elicit evidence of a student's ability to identify components of a system and their functions within a system. Students modify a model to shows how the components of a system interact then explain how removal of one component within the system (the bee) affects other components in that system and use evidence from the model to support their explanation.

Although the graphic organizers, diagrams and discussion questions are wonderful tools to formatively assess, they are more intended to help scaffold and support students as they prepare to create an explanation. It is here, teachers will be able to gather evidence related to student ability to successfully use information from a model to support and explanation.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Developing and Using Models

- Develop and/or use models to describe and or predict phenomenon.

Constructing explanations (for science) and designing solutions (for engineering)

- Construct an explanation of observed relationships

Systems and System Models

- A system can be described in terms of its components and their interactions.

Success Criteria

Students modify a model to show interactions between the bee and other components of the system. They then use the information from the model as evidence to support an explanation about how the removal of one component of the system (the bee) affects other components within the same system.

Possible Student Responses

- Student models with the color coded arrows should demonstrate an understanding that many things are co-dependent (e.g., the bee needs the flowers and sun, the flowers need the bee for pollination and the humans need the bee to pollinate plants/fruits/vegetables.)
- The explanation should list and explain how 3 things that they circled in the model would be affected if the bees were removed entirely.

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

Some considerations for preparing to use this task would be to decide how you want to present this task to students. Teachers may use a variety of teaching strategies including whole-group, pairs, small group or a combination. Teachers could also choose to begin the lesson with a QFT (Question Formulation Technique) by presenting students with a picture of the bee/pond ecosystem and allow students time to compose open-ended and closed questions to engage their curiosity.

You will find that there is a great deal of information on backyard ecosystems online. Much of the information shared states that a backyard consists of many ecosystems within a larger ecosystem. If students need further help understanding a backyard is actually and ecosystem, we suggest visiting such sites as Easy Science for Kids and Kids Discover as well as many YouTube videos.

Although system boundaries does not come into play at this grade band, you might want to lay groundwork or future grades by introducing students to this concept. Consider the system boundary of a bike then the bike with a child riding on it. What is the system boundary of a bee if only discussing the external body structures? How does the system boundary change when the bee is interacting with plants in a garden? Etc.

Extensions and/or other uses after the task is implemented

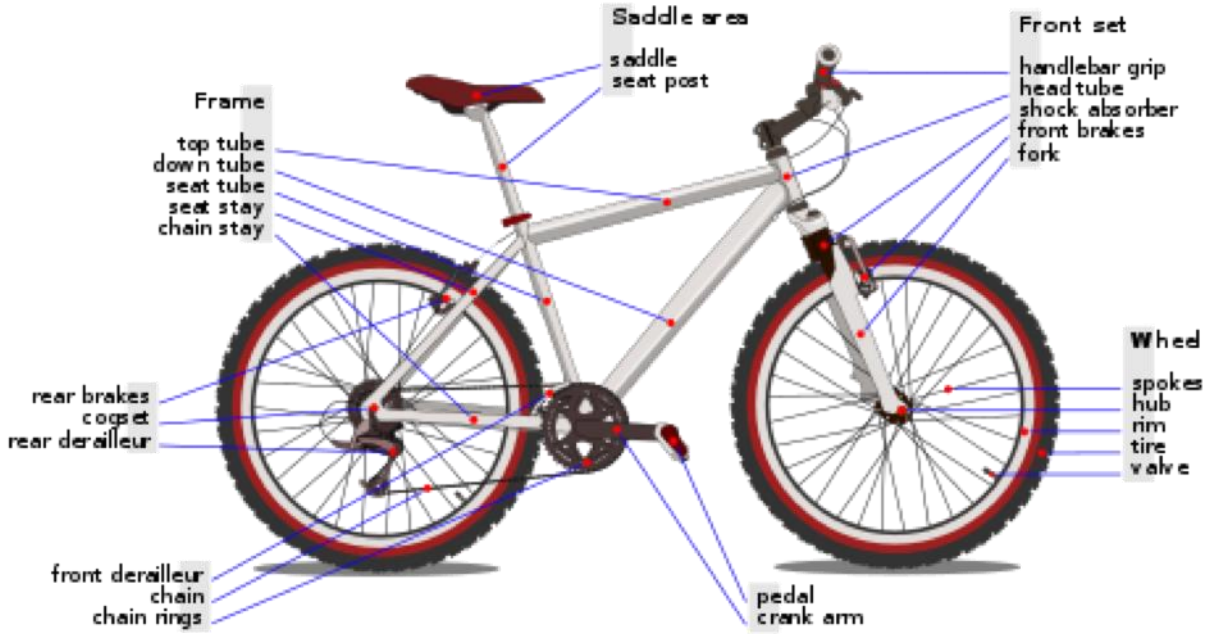
If time and resources are available, students may choose to watch a Magic School Bus on honey bees and complete extension activities such as building bee gardens/boxes.

Through Course Task – Systems Thinking

Name_____ Date_____

People use bikes to get from place to place every day. Do they realize that what they are riding is actually a well-designed system? A system is made up of parts that work together to perform a specific function. Study the following diagram of a bicycle. All the parts work together in order for the bike to function properly.

Parts of a Bicycle



Consider what would happen if one component of the bike system failed or broke. Choose one component of the bike and share how removing this part would impact the system.

How would it change the overall function of the bike? If I removed the _____, the results would be _____

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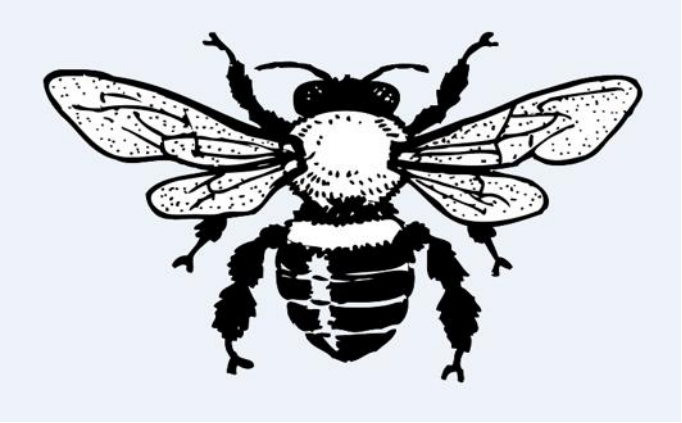
A bike is one example of a system. We use systems thinking when we look at how things work together to perform a task or function.

For example, consider a honeybee. It has many parts that work together that enable it to do amazing things. The honey bee is an example of a system. If the focus is only on the bee's external parts as a system, what would be the system boundary?

The Honeybee



Observe all the external parts of the bee. Complete the following t-chart by listing the structures, or body parts, of a honeybee and their function. In other words, describe the role of each component in the system.

Body Part	Job/Function

Select one component of the bee system and explain how the removal of the component would affect the system.

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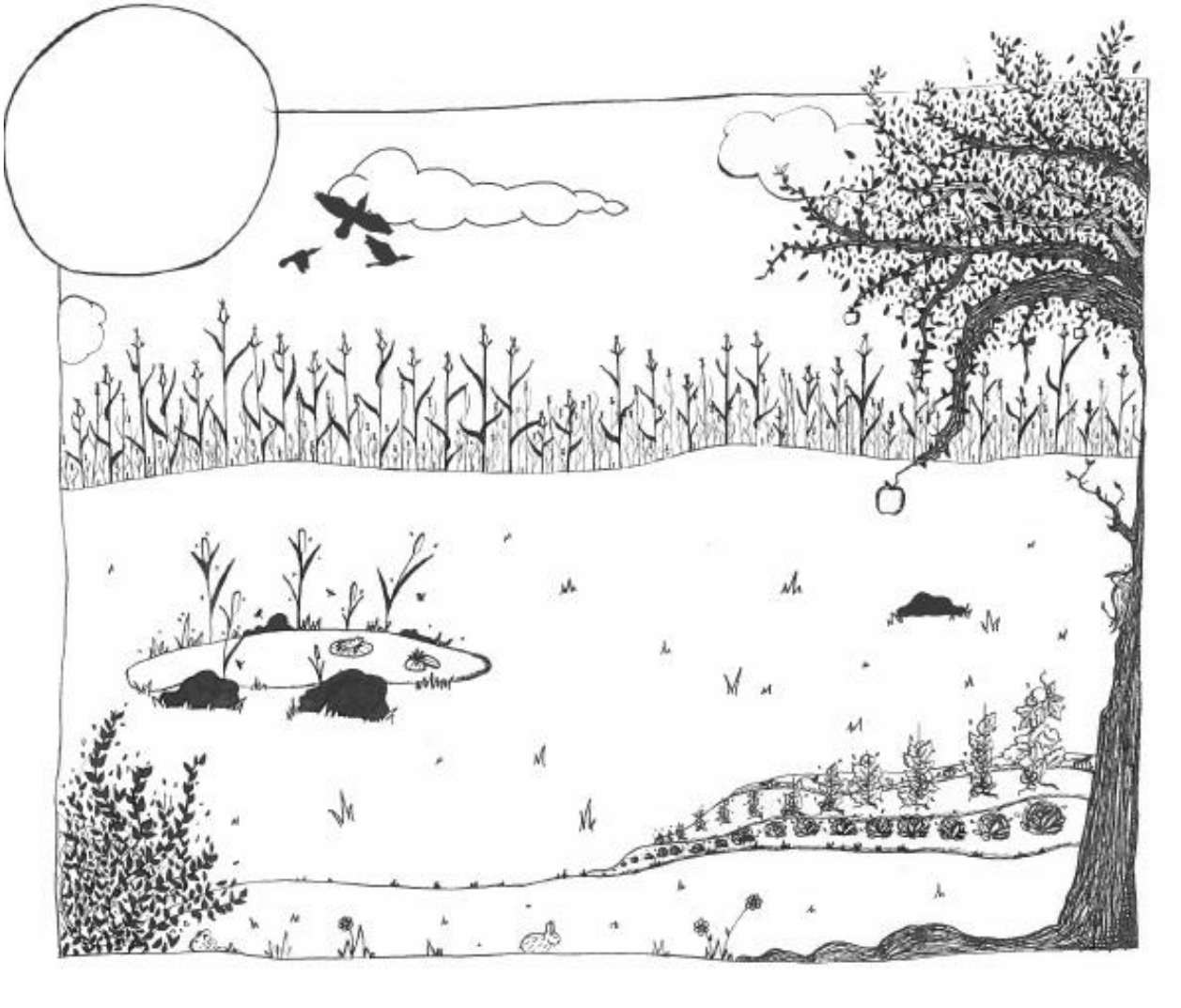
We have explored a honeybee and learned that it has many parts that must function together for the honeybee to survive. Although the honeybee is very small, it is part of much bigger systems that include you and me! Bees do many wonderful things, like pollinate flowers and make tasty honey. However, they also are known to cause a little bit of pain to humans. I remember that as a little kid I did not like bees at all! When helping Grandma with her gardening, bees would buzz from flower to flower. I felt like they were all around me and feared I would get stung. At the time, no one could convince me how important bees were to the garden, and to me as well.

Picture all the living and nonliving things you might find in an area near a garden. Make a list of plants, animals and some nonliving things (not man made) that might exist in this ecosystem.

Complete the table explaining how the bee **is helping** or is **being helped** from the system component.

Components that make up a garden system	How does a bee interact with this component of the system?

All the components listed work together as a system. The bee is one of those important parts. Look at a model that represents an area near a garden. Does the model include several of the components you identified? Think about how all the components of the system work together.



Systems Thinking Student Task

Name_____ Date_____

Use the given diagram of a garden ecosystem and the information you gathered in the table to complete this task. Think about how the honeybee interacts with the components previously identified in this system then complete the following directions:

- **Part A Directions:** Add arrows to the diagram to show the following interactions between the bee and other components in the ecosystem.

	Bee depends on this component of the system for survival.
	This component of the system depends on the bee for survival.
	The bee and a component depend on each other for survival.

There has been much concern about the honey bee population decreasing. Consider how the system would be affected if all honey bees no longer existed?

- **Part B directions:** Circle the components of this system that would be affected if all the bees left or died.
- **Part C Directions:** Explain how the things you circled would happen to animals/plants if the bees left the area or died. Give at least **3** specific examples to support your explanation.

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Systems Thinking Garden Area with Bee Diagram

Name _____ Date_____