Science Assessment System
Through Course Task

Matter Models

Grade Level:
5

Phenomena:
Evaporation of Water

Science & Engineering Practices:
Developing and Using Models
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.

Matter Models Task Annotation

After comparing similarities and differences between 2 models that represent *what happens to liquid water after it evaporates*, select one of the models and explain what causes this **model to be useful** in understanding *what happens to water after it evaporates*.

Phenomenon within the task

When water evaporates it changes from a liquid to a gas and seems to disappear. The same water molecules that are present in liquid form are now not visible, but are still present as a gas in the air surrounding the liquid.
One common misconception held by students related to evaporation is that water must "boil" in order to evaporate. It is important that this be addressed within the context of everyday situation (water in a glass left outside does not boil nor does the water in a puddle or the ocean). Another misconception is that the visible water above a boiling pot is water vapor (it is not). The visible "steam cloud" we see is actually condensing water vapor – liquid water droplets. True steam is actually a gas (water vapor) and not visible. What frequently called steam (as from a tea kettle) is sometimes called wet steam, and is actually condensed water vapor that you can see in the air.

How the phenomenon relates to DCI

Through the course of 5th grade, students should develop an understanding that matter is made out of particles too small to be seen, and that matter is conserved – both of these ideas are important to understand what happens to liquid water when it evaporates (where it goes), but it is not all that is needed to understand the process of evaporation (why it happens). In this task, students are told that heat is needed for evaporation to occur simply because it is part of the context for the task, but it is not a 5th grade DCI (thus, it is provided).

Students prior to grade 5 have had experience with different types matter and their observable properties. Students at this level many times can recite the 3 states of matter but have difficulty explaining and/or demonstrating that air takes up space and has mass. Student struggle with understanding that matter is there even though they cannot see it. For example, students may have a misconception that air, when released from a balloon, no longer exists.

During second grade, students learn that heating or cooling a substance may cause changes that can be observed (PS1.B). Fifth grade students are expected to have an understanding that matter of any type can be subdivided into particles that are too small to seen, but even then the matter still exists and can be detected by other means. Students also learn that the amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish (PS1.A). Both of which are foundational for conservation of matter for middle school.

What information/data will students use within this task?

Conceptual understanding:

- **Heat is necessary for evaporation.** (Understanding why or how is not important; a heat source is identified in provided models.)
- **Matter is made of particles too small to be seen.**
- **Matter is conserved when it changes form, even when it seems to vanish.**
- Models are used to explain science concepts or as a resource to better understand science concepts.
- In effective models, each component should be relevant and support the model's purpose. If models include things that are not relevant to the purpose, it can make understanding the concept more difficult.
- Sometimes in a science classroom the focus is the creation of a model (a product) rather than developing understanding that a model's usefulness is directly related to the purpose for the model (developing capacity for the practice of modeling). A particular model might be very useful for one purpose and not useful at all for another purpose. Depending on the use, the same model could be judged as good or bad (effective or ineffective).

Ideas for setting up the task with students

Students have experiences with water evaporating in their daily lives. It is important to engage students in discussion related to their personal experience to active personal schema. Experiences prior to the task could have students identify various situations where they know water is evaporating, and describe those experiences. Some questions to prompt student thinking might include: Why does the water in the pool need to be topped off? Where does the water is a bathroom towel go?

Student Task:

Part A: A storyline is provided that prompts students to consider what happens to water when heat is added (evaporation happens faster with higher heat). Students are given two different models to explore. They are asked to look for similarities and differences between the components of the models and how the models help explain what happens to the liquid water. This portion of the task can be completed whole/small group based on the needs of your students. Students analyze a model from a notebook and complete a table by identifying 3 features/components and then explaining how each helps them understand what happens to liquid water. This table could be recreated for the second model to support your students as they engage with the puddle model. Students are asked to think about how the removal of any of the identified components would impact the usefulness of the model when explaining evaporation. A guided classroom discussion will uncover areas of need and misconception as well as help solidify student understanding of why it is important to think deeply about the purpose, characteristics and usefulness of a model.

Part B: (Independent Student work aligned with success criteria)
Next, students select which of the two models they feel would be best to use when explaining the process of evaporation based on the specific features/components that make up the model.

Intent of the Task for Assessment
This task is intended to provide evidence of a student's ability to explain why a model is useful for its intended purpose. (What about the model causes it to be effective?) The content information is provided (heat is necessary for evaporation, matter is made of particles too small to be seen and matter is conserved when it changes form even when it seems to vanish), and the models use that content information in order to support the model's purpose. Thus, a student must show they understand the purpose and explain how the model is useful in meeting that purpose. Essentially, the students are provided everything in the task (the content, the models and the purpose for the models) and they are asked to explain why the model is useful for the purpose. Students are not asked to explain evaporation or what happens to the liquid water, they are asked to explain how or why the model is effective for that purpose.

In the scenario for this task, children are wanting to understand where liquid water goes when it evaporates. Thus, that is the purpose of the models in this task – to help someone understand where the liquid water goes.

Initially, students are asked to think about the components (features) of provided models and how these help serve the purpose of the model – what happens to liquid water after it evaporates. They are asked to process how each model supports the purpose by finding similarities and differences in the components of the two models. This provides an opportunity to collect evidence that each student has meaningfully engaged with the models. It is suggested that students compare their findings related to the models in groups and the teacher orchestrate a discussion about the similarities and differences between the models to ensure that all students can access information needed to complete the actual task.

The individual work in the task is for the students to select one of the models and construct an explanation for why (what causes) the model to be useful in understanding what happens to liquid water after it evaporates. This explanation should only include things that are present in the model and not ideas they have about evaporation and water that are not in the model.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Developing and Using Models

- Use models to describe and/or predict phenomena.

Constructing Explanations:

- Identify the evidence that supports particular points in an explanation.

Cause and Effect:

- Cause and effect relationships are routinely identified tested and used to explain.

Success Criteria

Students provide a reasoned explanation for which of two models they feel is best to use when explaining what happens to water when it evaporates. Student supports explanations by identifying specific model components as well as their usefulness of the components.

Possible Student Responses

- Includes features of the model and identifies how the selected feature is useful in explaining what happens to the water when it evaporates such as:
    - Heat source
    - Change in the number of molecules
    - Upward movement of molecules
    - Amount of time that passes

    - Change in water level
- Explanation includes reasoning related to what causes identified features of the model to be useful when conveying the concept.

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

- Video Playlist on Physical Science- Properties of Matter by Crash Course Kids (16 videos): https://www.youtube.com/playlist?list=PLhz12vamHOnaY7nvpgtQ0SIbuJdC4HA5O
- Does air have mass? Sample balloon scale demonstration of: https://youtu.be/Bv_tS6-qCJ4?t=24s
- Does air have mass? Teacher does the beach ball demonstration:
    - Part 1 (5 min): https://www.youtube.com/watch?v=GuiDxpv-mEE
    - Part 2 (6 min) https://youtu.be/Otizr3Guclw?t=11s

Extensions and/or other uses after the task is implemented

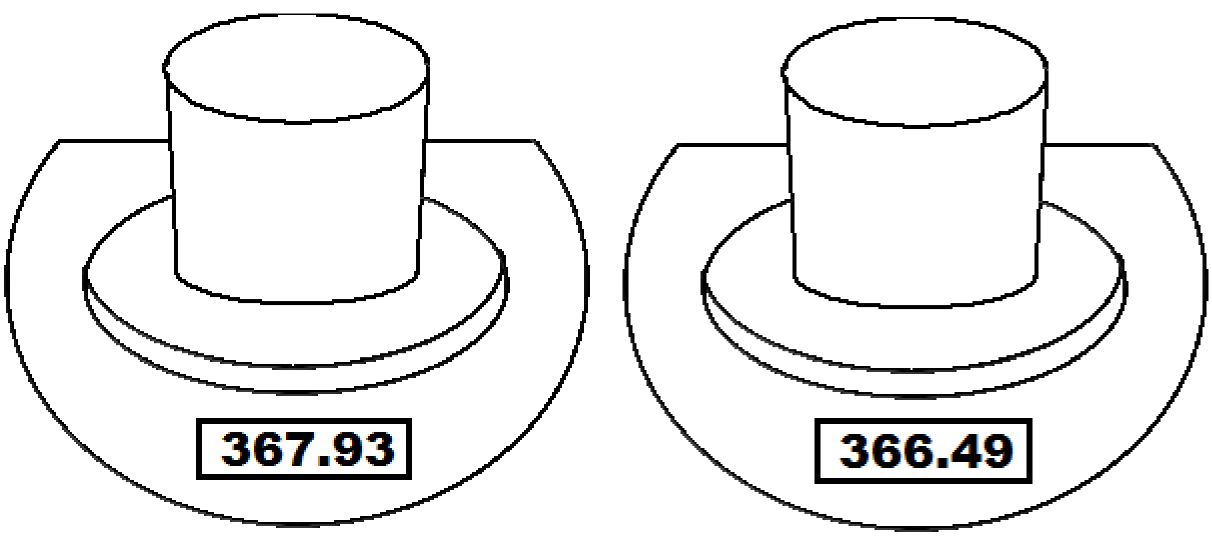
- After completion of the part B, share responses and then have students revise the model to be more effective for the stated purpose.
- Use a model of a closed system that represents condensation.
- Participate in or watch a lab that mixes vinegar and baking soda in a beaker with balloon over the neck.
- Participate in or watch a lab that separates the salt from salt water.

Student Pre-Task – Matter Models

Storyline:

Early in the morning, students Malik and Sophie began setting up the science lab by reading the instructions that their teacher left them. Sophie opened the lab book and read the materials list, "We will need one 12 ounce can of lemon-lime flavored soda, one digital scale, one clear plastic cup and a timer. It also says we can't drink ANY of the soda from the can." Malik put the empty cup on the digital scale, and then he made sure the scale measured zero with the cup on the scale. Sophie opened the 12-ounce can of lemon-lime flavored soda and poured all of it into the clear plastic cup. They both immediately observed the sound the soda can made when she opened it, and the bubbles that began moving to the top of the cup. Malik set the timer for 3 hours, and then read the scale, he said, "At 10:00AM the digital scale reads 367.93 grams." They both recorded the weight and time on a chart in the lab book. Three hours later, the timer beeped at 1:00PM, the lab partners returned to the digital scale. Sophie said, "The scale reads 366.49 grams."

Soda at 10:00AM (0 hrs passed)	Soda at 1:00PM (3 hrs passed)
367.93 grams	366.49 grams



What’s the Matter? Pre-Task

1. What are the features of the model that are currently present that would help explain or represents the concept that particles are too small to be seen?

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2. What are some features that are **NOT** present in the model that would be helpful when representing this concept?

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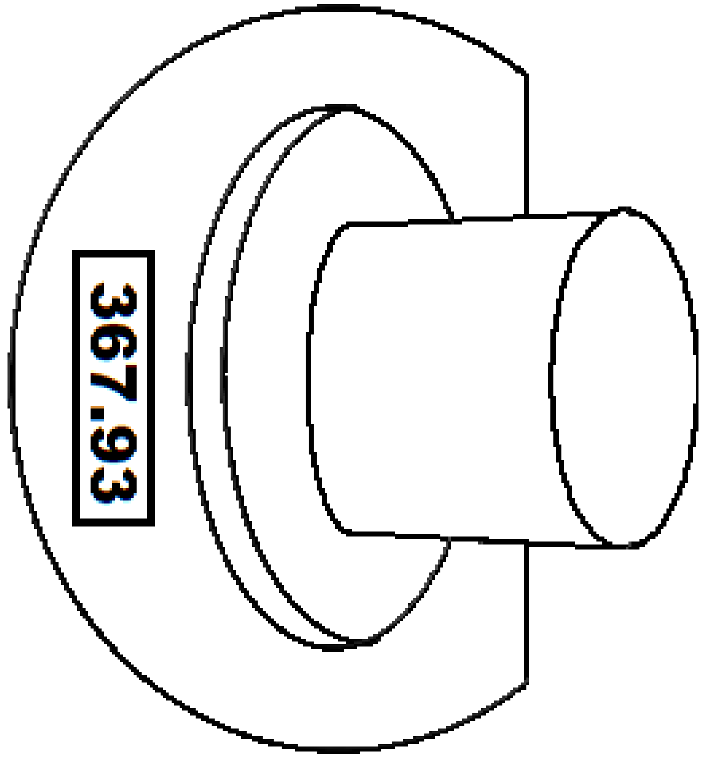
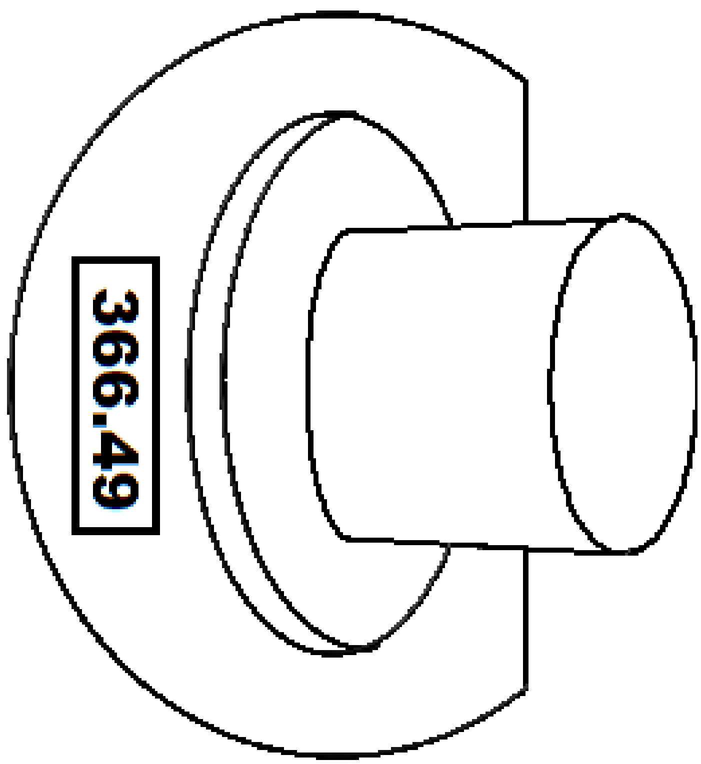
3. Collaborate with another student to revise the model on the next page in order to better illustrate the student's soda pop investigation.


367.93


366.49

Through Course Task – Matter Models

Part A: Complete collaboratively

One day after school, Kariah decided to make some Jell-O to have as a dessert after dinner. She got out the Jell-O mix and carefully read the directions on the box. The directions called for 1-cup boiling water. Kariah took a measuring cup and measured out 1 cup of water. Next, she poured the water in a pan, placed it on the stove and turned the burner on high. Kariah left the kitchen to answer the door and when she came back she realized that the water had been boiling for a while. Kariah noticed a change in the amount of water in the pan. Since the recipe called for 1 cup of boiling water, she decided to measure the water again to make sure she had enough to make the Jell-O. She no longer had a full cup of water.

Kariah's sister**,** Olivia, came into the kitchen and asked, "Have you finished making the Jell-O?" Kariah said, "No, I need more hot water because some of the water in the pan evaporated while I was talking to the salesperson who was at the door. Olivia gave her sister a puzzled face. Kariah went on to say the heat from the burner made the water in the pot boil which caused the water to turn into a gas. Olivia said she did not understand and walked away. Kariah thought about how she could help Olivia make sense of the "missing water."

Kariah got out her school notebook and turned to the model she had drawn earlier in the school year. She read through her notes about the basic information needed to understand the concept of evaporation.

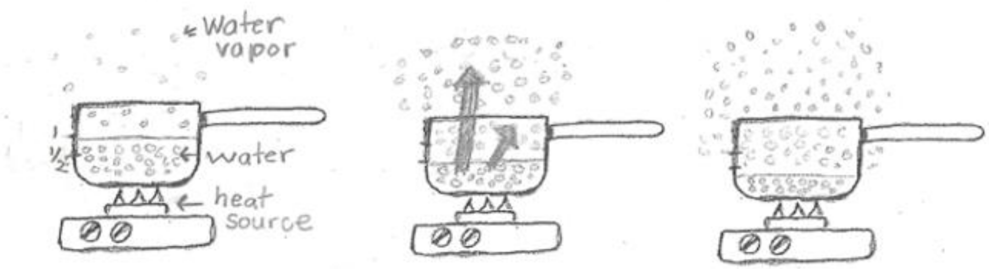
Heat is necessary for evaporation to occur.

Matter is made of particles too small to be seen.

Matter is conserved when it changes form, even when it seems to have vanished

Kariah knew that this information was important to convey in her model. The following is the model that Kariah had previously drawn in her notebook.

Evaporation model from notebook



Before heat was added	Boiling	Heat turned off
Figure 1	**Figure 2**	**Figure 3**

Consider how the components of the model cause you to think about what happens to the liquid water in the pot.

Complete the chart.

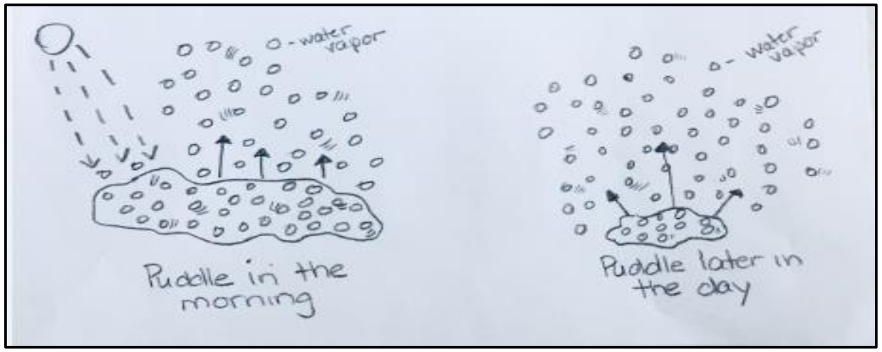
Identify 3 components of the model.	Explain why each components of the model helps you understand what happens to the liquid water?

**Share your thinking with a partner: Think about how the removal of any of these components impact the effectiveness of the model when helping others understand what happens to liquid water when it evaporates.*

The next day Kariah and Olivia went outside to play. The first thing Olivia noticed was a big puddle that she played in the day before was almost gone. She said to Kariah, “What happened to the puddle?” Kariah explained that the water in the puddle evaporated much like the water for the Jell-O evaporated. Olivia exclaimed, “I don’t get it. Will you help me understand what you are talking about?”

Kariah drew the following model to show Olivia what happened to the water in the puddle.

Puddle Model



Next, consider how the components of the model cause you to think about what happens to the liquid water in the puddle.

Complete the chart.

Identify 3 components of the model.	Explain why each components of the model helps you understand what happens to the liquid water?

Reflect on the components you identified for each model. Do the models help you understand some/all of the basic information about what happens to water when it evaporates that Kariah provided from her notes?

- *Heat is necessary for evaporation to occur.*
- *Matter is made of particles too small to be seen.*
- *Matter is conserved when it changes form, even when it seems to have vanished.*

Compare the two models in the table below.

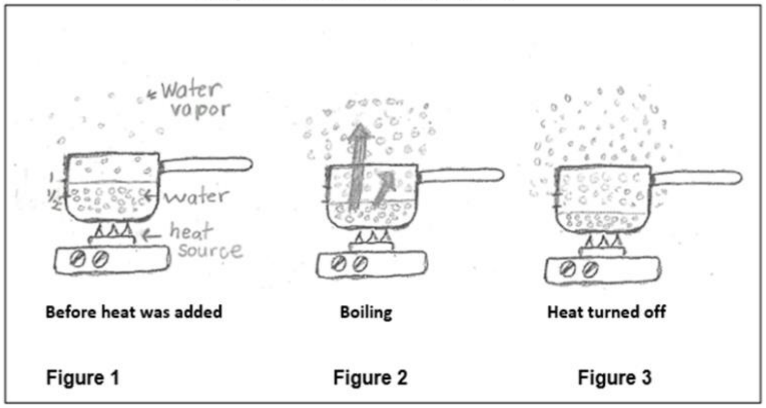
What similar information do the models convey?	**What different information do the models convey?**

Name________________________ **Matter Models TCT** **Date________________**

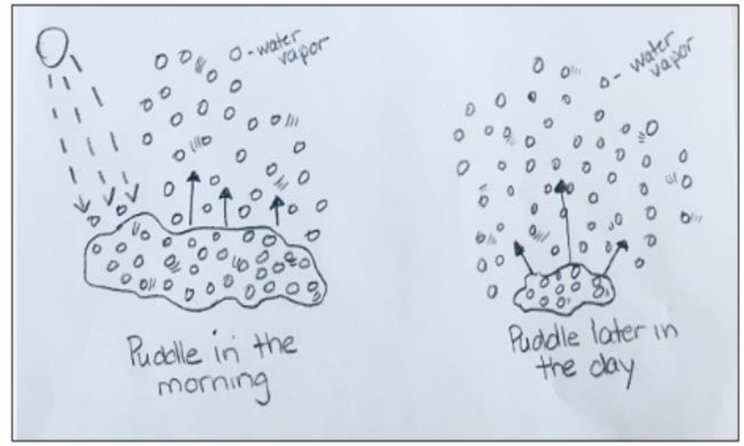
Part B: Independent work

Kariah drew two different models to demonstrate her understanding about what happens to water when it evaporates.

Evaporation model from notebook



Puddle Model



1. Which of these models is best to use by Kariah to help explain to her sister what happened to the liquid water on the stove and the water in the puddle. Circle the one you choose.

Evaporation Model or Puddle Model

2. Explain what it is about the model you chose that **makes it useful** to help people understand what happens to liquid water when it evaporates. **Your explanation should only include components that are present in the model you choose to support your choice.**

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