



Science Assessment System Through Course Task

Chillin' on the Beach

Grade Level:

7

Phenomena:

Ice Melts at Different Rates Depending on
Environmental Conditions

Science & Engineering Practices:

Planning Carrying Out Investigations

Crosscutting Concepts:

Cause and Effect

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).

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.

Chillin' on the Beach Task Annotation

After **critiquing Ted's procedure for evaluating the impact** of *burying a cup in the sand to reduce thermal energy transfer*, **evaluate and revise Ted's experimental design to better ensure that it results in a fair test.**

Phenomenon within the task

Ice melts at different rates depending on the conditions surrounding the ice.

In this task, two different types of cups that contain unspecified amounts of ice and water are left on a beach. One of the cups is partially buried in sand. After a period of time, one cup still has ice but in the other cup the ice has melted. Because the conditions for the ice in the two cups varies in more than one way, it is unclear which variable has the greatest impact on the ice melting/not melting..

Possible misconceptions - direction of heat transfer from ice cube into the drink. Water warms the ice cube, the ice cube does not add cold to the water. Heat travels from the object with the higher temperature to the object with the lower temperature. Hence, heat from the drink goes into the ice.

How the phenomenon relates to DCI

PS3.B

- Energy is spontaneously transferred out of hotter regions or objects and into colder ones.
- The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

What information/data will students use within this task?

A color projection of the beach set up, Ted's claim and the task instructions. You could provide students with a copy of the table to complete if needed.

While Ted's "procedure" is not given, it is implied through the information given and set-up shown in the photo.

Prior knowledge needed

Understanding of energy flow and thermal energy transfer. For example, thermal energy flows from hot to cold. Thermal energy transfer can be affected by different environmental conditions. Materials have different heat transfer properties. Students are not necessarily expected to know the details of these ideas/content, but they need to be able to explore "what matters" to affect ice melting. That is, know enough about heat and that conditions affect heat transfer, but maybe not know exactly how or why. If they can isolate what matters most in affecting ice melting, then maybe they can explore "why" in a different hypothetical experience.

Prior exposure to the concept of fair testing, variables and planning investigations. Students should be able to recognize that Ted's experiment is "unfair" due to the many different conditions in each cup: different insulation materials, different amounts of liquid, different number of ice cubes AND one is buried in the sand. All of these variables could affect the transfer of heat within the cup. Students should be able to explain to Ted that he should only test one variable at a time, while keeping the others the same, to make the test fair. Students should then be able to suggest a plan for Ted to carry out the investigation.

Ideas for setting up the task with students

The teacher could set up a simulation of the TCT in the classroom with two cups, sand, an umbrella and a heat lamp. The teacher could provide a time-lapse video of the set up over the course of one school day.

To make sure everyone was clear, after students read the task, I began by asking students what variable Ted was testing.

Other exemplar questions could include, "Do we know for sure that Ted's drink stayed colder because it was buried in the sand?" (answer should be "no"), then ask "why not?" You are looking for students to recognize the differences between the 2 cups - materials, insulation, volume of liquid, number of ice cubes etc. (I asked students to think about the answer to this rather than sharing with the class).

It is recommended that the teacher lead a discussion to provide an example of one variable that would affect the flow of energy into the containers so that students have a clear understanding of what is expected. Using one variable identified by the students, e.g., volume of liquid, ask a question such as, "How is the transfer of energy different within each volume of water?" You are looking for students to identify that more liquid takes longer to warm up in the sun than less liquid. So, Ted's cup with a greater volume of liquid will absorb heat from the environment slower than the smaller volume of liquid.

Students need to have prior experiences in planning investigations and in identifying variables that need to be controlled to produce valid data. (These tasks do not have to be related to thermal energy, e.g., the effect of changes in mass or height for cars going down a ramp.)

Be prepared to talk to individual students as they record their ideas about variables that need to be controlled. You may need to scaffold student thinking so that it moves towards variables that affect the transfer of energy in the scenario. For example, both cups should contain the same amount of liquid because a small volume of liquid absorbs heat from the environment faster than a larger volume of liquid.

**If you choose to do this TCT after your study of thermal energy, this task can provide evidence of student understanding of the flow of thermal energy as well as the intended SEPs and CCC. However, this is not necessary. Students can complete the task before completing a unit on thermal energy transfer and you can still evaluate their use of the SEPs and CCC.

Intent of the Task for Assessment

This task was designed to elicit evidence of a student's ability to evaluate and revise an experimental design to better ensure that a fair test will result. Part A asks students to identify variables as potential "causes" that could "affect" ice melting. Students are asked to explain why each identified variable *might affect* the experimental outcome. While this does provide information about a student's content understanding about energy transfer, that is not the intent of the task for assessment. A student could do well with the task (redesigning an experiment to better ensure a fair test) and have flawed understanding of the content that would be evidenced in Part A (and the flawed thinking could be addressed subsequent to the TCT). But what this does do is ask for mental engagement and reduce the likelihood that a student will suggest variables that might clearly have very little impact on ice melting. A teacher could explain that they do not have to be certain of the impact of the variable, but they should capture their thinking at this point in their understanding. This would reduce stress for a student and allow getting better evidence of their ability to revise the experimental design to better result in a fair test - the primary intent of the task for assessment.

Can students then transfer information from Part A to recommended revisions in Part B? Can students identify the variable being tested? Are clear, precise, practical revisions suggested for the other variables? Can students explain why their revisions now make it a fair test? Do students actually understand the concept of fair testing and how it could be achieved?

Some evidence of the student's understanding of the CCC, cause and effect, is gathered in the identification of potential variables in Part A, but perhaps evidence of understanding of causality is stronger in Part B, where the student ***explains why*** the modified experimental design will result in a fair test - essentially, what ***causes*** the experimental design to be "fair."

Components of the task / resources used with the task

- Chillin' on the Beach task

- Optional Demo:
 - Tray of sand
 - 1 x insulated cup (like a yeti)
 - 1 x smaller plastic cup
 - Ice cubes
 - Water

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Engaging in argument from evidence

- Respectfully provide [and receive] critiques about one's explanations, procedures, models and questions by citing relevant evidence and posing and responding to questions that elicit pertinent elaboration and detail. (Appendix F)

Planning Investigations

- Evaluate and revise the experimental design to produce data to serve as the basis for evidence that meets the goals of the investigation. (Appendix F)

Cause & Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (Appendix G) In the context of this task, the cause and effect relationship is not only between the factors affecting ice melting, but more importantly the cause and effect relationship between the *experimental design* and the *resulting fair test*. What causes the design to result in a fair test?

Success Criteria

- Student identifies 4 variables that were not controlled in the original experiment (examples include color of cups, size of cups, amount of liquid in cups, initial temperature, type of liquid, composition of cups, amount of ice initially in cups, etc.). These 4 variables do not have to be visible in the picture.
- Student defines how to control at least 4 variables identified in the preceding step. (For example, both cups need to start with 5 ice cubes that are the same size and temperature.) This does not have to be a step by step procedure, however the suggestions made should be clear and result in a fair test.
- Student explains why the revisions suggested to control the 4 variables identified will result in a fair test.

Possible Student Responses

Student Sample 5:

1. Ted's cup has more water. The more water that there is the faster the ice melts, because there is more heat energy in a bigger mass of water.
2. They are different cups; Ted's cup is insulated and when something is insulated that keeps things hot or cold. So the heat would be kept out of Ted's cup.
3. Ted has more ice; Ice helps to cool drinks by the heat being used to melt the ice. His sister's cup only has 1-2 ice cubes, so it would not be as cool to start.
4. Ted's sister's drink could have been warmer than Teds. We don't know if the temperatures were the same. If his sister's drink was warmer at the start, then the ice would have melted faster.

Student Sample 1:

Step 1: Buy the same cups.

Step 2: Same amount/temp. of water in it

Step 3: Same amount of ice

Step 4: Test it.

Student Sample 5:

To get a fair test in this investigation... Ted would have needed to get the exact same cup for both him and his sister. Then, Ted will need to get the same type of drink at the same starting temperature. After that, Ted will need to get the same amount of ice cubes

for each cup. Now Ted will need to pour the same amount of liquid in each cup. Lastly, place one cup partially in the sand and the other on top. For more reliable answers, do the test multiple times to see if you get near the same results. He could also use a thermometer to track how much temperature each one has.

Student Sample 4.

A fair test would be the same kind of beverage, the same size cup, the same amount of ice, the cup should have the same material as the other one... *(everything is the same, except the one variable being tested.)*

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

- I chose to facilitate this task after students had been exposed to energy transfer, and had practiced fair testing through investigation planning.
- I found it helpful to have the scenario set up at the front of the room. My colleague did not set up the scenario and his students did struggle a little more with identifying the variables. The scenario made it clearer to students that the 2 cups were different sizes, contained different amounts of water and had different amounts of ice. I began by reading through the task with students, referring to the scenario set up as we went through. I then asked students, “Is this a fair test?” Several students wanted to answer why it was not fair, but I told them they would be able to write their thoughts in the table rather than sharing out loud.
- I added the task to Google classroom and gave each student the task as a template, so each student received a copy to complete online.

Extensions and/or other uses after the task is implemented

**Be sure to look for the specific next steps included with each student sample response.

If most of your students write actual procedures, students could carry out procedures written by other students.

The teacher can demonstrate following the procedure written by an anonymous student.

After a classroom discussion about the issue at hand, students can work in groups to provide evidence to Ted to support or refute his claim (i.e. students carry out variations of the experiment paying careful attention to controlled variables).

Students can produce their own claims about keeping a drink cool and then test those claims making sure to attend to controlled variables.

In reviewing Part A, students could be given examples of misconceptions raised in the right hand column. Then ask them to identify the “flawed” ideas and provide some suggestions for helping that student to understand why they are not correct.

As you review data, look for patterns.

- What can the data tell you about specific students? Are there specific students who need more practice on planning and carrying out investigations?
- What can the data tell you about instructional strategies? Did another teacher in your building get “better” results? What has that teacher done instructionally this year that might support those results?
- What can the data tell you about the science program at your school? Are students getting enough opportunities to design and plan investigations? Are they missing opportunities to control variables?
- Samples of student work could be used to identify various misconceptions that students have about the particle nature of matter, including the effect of temperature on particle motion. These samples (names removed) could be used in various ways. For example, students in small groups could review different samples and identify flawed or incomplete thinking, or develop an argument for which piece of student work among a collection is the most accurate and why, among various other strategies. Revisiting student work could occur later in the school year to review and assess their understanding of the particle nature of matter.

Through Course Task – Chillin’ on the Beach



CUP A

CUP B

Ted and his sister Stephanie are enjoying a day on the beach. They each have a cold drink. Before they go for a swim they both place their drinks under the umbrella, so both cups are in the shade. Ted partially buries his drink in the sand (cup A). Stephanie leaves her drink on the surface (cup B).

After their swim, Ted notices that the ice cubes in Stephanie’s drink have all melted and his have not.

Ted claims “I told you that burying your drink in the sand would keep it cooler.”

Part A: In this situation Ted would not have reliable results because there were a lot of differences between the 2 cups.

In the chart below, list 4 variables (differences between the cups) that could have affected Ted’s results. Then explain how you think each variable you have chosen would affect the melting of ice.

Variable (possible differences between the two cups)	Explain how you think this difference/variable would affect the melting of ice.
1.	
2.	
3.	
4.	

Part B. Ted realized that he has made mistakes in his investigation. What would you specifically tell Ted to do so that he can carry out a fair test, and get accurate and reliable evidence to support his claim? Explain why your recommendations will result in a fair test.

Ted claimed “burying the drink in the sand would keep it cooler.”

Be sure to address the issues you listed in the table above.