Science Assessment System Through Course Task

Dissolving Chocolate Covered Candies

Grade Levels:
6, 7

Phenomena:
Climate Differences at Equivalent Latitude

Science & Engineering Practices:
Asking Questions and Defining Problems
Analyzing and Interpreting Data

Crosscutting Concepts:
Patterns

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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.

Dissolving Chocolate Covered Candies Task Annotation

After **making observations** about the *effects of temperature on dissolving rate*, **construct an explanation** that describes the cause for these differences based on your knowledge of the *particle motion of matter/energy transfer*.

Overall Intent

This task was developed with the intention of evaluating students' ability to use their understanding of the particle nature of matter and the cause and effect relationship with temperature in order to make sense of their observations of M&Ms dissolving in varying temperature water. (The focus should be on the changes to the candy coating.) As students explore the particle nature of matter, it is important for them to understand the role of energy transfer. The intended grade level for the task is 6.

Phenomenon within the task

The observation that soluble substances (chocolate covered candies) dissolve at different rates in water at different temperatures is the phenomenon. Soluble substances dissolve faster in higher temperature water because the water molecules have higher energy/particle motion, which is transferred to the solute. The task has students observing three different cups. One cup is at room temperature, one cup is cold water, and one cup is hot water. A candy of the same color is placed in each cup. The students are aware that the only difference is the 3 temperatures, but they are not told the temperature of each cup. Their observations of what happens to the candy coating will give students a basis to connect prior knowledge about the energy transfer/particle motion of matter to temperature and dissolving rates.

Ideas for setting up the task with students

Students need to have experience with the concept that all matter is made up of particles too small to be seen (5^{th} grade) and that the particles move faster as the temperature of the substance is increased (6^{th} grade) prior to using this task. Students are asked to transfer this understanding of higher energy/faster moving particles to the impact on dissolving rate, so it is important not to over-scaffold the relationship of particle motion (hotter solvents) with the rate of dissolving of solute.

During development of the task, the task was facilitated as a class demonstration so that the students were not aware of which cup had which water temperature. It is helpful if you use a blue or green candy since they don't look like chocolate when the coating dissolves and show up bright. The students can see better if you project it on the screen while it is happening. Prior to this activity,

energy levels and particle motion with varying states of matter and temperature were discussed. Once the candy is in the water, the cups should remain still with no stirring or motion.

You may want to video this ahead of time and show the students the recording. This will allow for quick changes between classes and remove the chance that students see differences in the water.

Intent of the Task for Assessment

This task has three parts and it is important to understand the role of each. Part A and question #1 of Part B are part of the process. Part A asks students to create a table and record observations. This allows teachers to get evidence of these skills. In some learning experiences, a data table is provided and students simply fill it in. However, the cognitive load and skills developed by organizing data in a way that supports making meaning is developmentally useful for students, and provides useful information for both students and teacher when areas of struggle are revealed. Question 1 of Part B provides a snapshot of synthesis, and allows students to connect their observations to prior knowledge about the particle nature of matter and the effect of temperature on the particles. These two parts provide much information about where students are on the Science and Engineering Practices progression.

Question #2 of Part B is the product. This is the part that shows a student's scientific understanding and ability to use cause and effect relationships to write an explanation.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Constructing Explanations and Designing Solutions

- Construct an explanation that includes qualitative relationships between variables that describe phenomena --
- Construct a scientific explanation based on valid and reliable evidence obtained from an observed experiment and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.
- Apply scientific ideas and evidence to construct an explanation for real world phenomena.

Planning and Carrying Out Investigations

- Collect data to serve as the basis for evidence to answer scientific questions.

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Success Criteria

- Students create a data table that is effective in organizing their observations of what is taking place in each of the three cups. (Qualitative data)
- Constructing a data table is a skill that is the expectation by the end of the 6-8 band. Constructing a data table will provide feedback to teachers and students but is not a key component of this task. The goal is for students to organize their observations into a usable form.
- Students predict the relative temperatures of the water in the 3 cups based on their observations about the rate of dissolving and provide rationale for their predictions by:
    - Using their observations/data as evidence to describe the phenomenon, and support their rationale.
    - Using their understanding of the particle nature of matter and the relationship between thermal energy and particle motion to describe the causal mechanism that could explain their observations.

Possible Student Responses (these are not "look fors")

Part A: Observations of all three cups organized in usable form.

- Observations will vary.

Part B Section A:

- Cup A - The candy color spread faster than all other cups. Prediction: this is the hot water.
- Cup B - The candy color spread faster than cup C but not as much as cup A. Prediction this is the room temperature water
- Cup C the candy color spread the slowest of all three cups. Prediction: This is the cold water.

Part B Section B

- Cup C had the slowest particle motion and coldest temperature. We know this because the candy was least dissolved. This is evident by the minimal color change in the water color. Due to the fact that the water molecules have the least amount of energy, there is less energy to transfer to the candy, causing the candy to dissolve slower than the other cups.
- Cup A had the fastest particle motion and hottest temperature. We know this because the candy was the most dissolved. This is evident by the complete change in water color and exposing of the chocolate. Due to the fact that the water molecules have the most amount of energy, there is more energy to transfer to the candy, causing the candy to dissolve faster than the other cups.

- Cup B had less particle motion than Cup A, but more than Cup C. We know this because the candy was dissolved, but not to the level of the candy in cup A. This is evident by the change in water color and the partial exposure of the chocolate. Due to the fact that the water molecules have less energy than cup A and more than cup C to transfer to the candy causing the candy to dissolve at a rate in between the other cups.

Extensions and/or other uses after the task is implemented

- Students generate questions based on their observations.
- Record quantitative differences and have students display data in a graph.
- Dissolving chocolate covered candies is not something that students would experience in their everyday life. It would be important to have students discuss what situations this would apply to. Making sweet tea or Kool-Aid and powdered laundry detergent are just a couple of examples.
- Discussing solubility and why some materials dissolve while others do not.
- 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 – Dissolving Chocolate Covered Candies

Name_____ Date_____ Period_____

Part A: Making Observations

Your teacher has three different cups. In each cup is 30 mL of water and an chocolate covered candies of the same color. There are three different temperatures of water. Create a data table to record qualitative data about what is happening in each cup. Look carefully for differences!

Data Table:

Part B: Constructing Explanations --

A. Analyze your data to predict which cup had hot water, which had cold water and which had room temperature water.

b. Based on your knowledge of particle motion and temperature, use your data to explain the cause for the different rates of dissolving. Diagrams or drawings may be included to help with your explanation.