TASK OVERVIEW

HIGH SCHOOL CHEMISTRY: TURF TASK

Three-Dimensional Claim

In this task, students are asked to apply an understanding of the quantitative and qualitative properties of energy and energy transfer through modeling, critically reading scientific literature, analyzing data, and constructing an explanation to describe how patterns in data and energy flow can help explain why artificial turf is hotter and more dangerous to athletes than natural grass.

Disciplinary Core Ideas Crosscutting Concepts Science and Engineering Practices

Tennessee Academic Standards for Science

This task is intended to elicit student learning of the following Tennessee Science Standard:

CHEM1.PS3: Draw and interpret heating and cooling curves and phase diagrams. Analyze the energy changes involved in calorimetry by using the law of conservation of energy quantitatively (use of q = mcΔT) and qualitatively. *This stan-dard is not completely measured in this assessment as it is included in multiple units in chemistry. This assessment focuses on specific heat and its relationship to heat transfer.*

Next Generation Science Standards

This task is intended to elicit student learning of the following NGSS elements for each of the three dimensions:

Science and Engineering Practices

Using Mathematics and Computational Thinking

- *High School Element*: Use mathematical, computational, and/or algorithmic representations of phenomena or design solutions to describe and/or support claims and/or explanations.

Engaging in Argument from Evidence

- *High School Element*: Construct, use, and/or present an oral and written argument or counter arguments based on data and evidence.

Developing and Using Models

- *Middle School Element*: Develop and/or revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena. *Note: This middle school element is used to develop/ scaffold skills students may find difficult.*

Disciplinary Core Ideas

PS3.A Definitions of Energy

- *High School Element*: Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. *Note: The entire DCI is not measured in this assessment. The focus of this assessment is specific heat and its relation to heat transfer.*

Crosscutting Concepts

Patterns

- *High School Element*: Mathematical representations are needed to identify some patterns.

Energy and Matter: Flows, Cycles, and Conservation

- *High School Element*: Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.

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	STRENGTHS	OPPORTUNITIES FOR IMPROVEMENT
SCENARIO	A specific real-world example is used in the scenario. Also, the scenario is likely relevant to the students due to the love of football in Tennessee and number of artificial football fields being installed.	The initial scenario establishes that artificial turf is a hotter surface than a natural grass field. Throughout the task, students engage in a series of questions confirming that it is hotter, but they are not figuring out and explaining something new. The task may be more compelling if students know what they are trying to figure out (collecting evidence to construct an argument) from the onset.
SENSE-MAKING	Students are able to make their thinking visible in various ways: through explanations, mathematical calculations, and oral or written arguments.	Due to the lack of initial uncertainty established in the task scenario, it is unclear if students are actually making sense of anything. They do a fair amount of confirming that the artificial turf is hotter than natural turf, but the sense-making opportunities in the task would be strengthened if students are expected to make sense of why.
INTEGRATED DIMENSIONS	Students have several opportunities to show understanding of the targeted part of the disciplinary core idea element related to energy transfer.	Students do not have opportunities to show an understanding of several of the targeted science and engineering practice or crosscutting concept elements at a grade-appropriate level. Providing students with sufficient evidence for both sides of the argument can help to elicit the constructing arguments of science and engineering practice element understanding.
EQUITY	Scaffolds are provided for each question to help clearly elicit student understanding. There is choice in how students respond in Question #4, potentially increasing the feeling of student agency.	Students may feel that the questions keep focusing on the same concept. In the task, students are gathering limited evidence to construct an argument at the end, but they are not aware that they are doing this until the end. Coherence could be improved if students are told they will be constructing an argument at the beginning and if students are given opportunities to gather and make sense of substantial evidence for both sides of the argument throughout the task.
FEEDBACK SUPPORT	Each question within the task has a rubric and guidance. Examples of feedback that could be provided to students are also included.	Guidance for interpreting student responses for each of the targeted elements could be improved. Consider separating or color coding the scoring components so they show exactly what is needed in an answer to show disciplinary core idea understanding, vs. crosscutting concept understanding, vs. science and engineering practice understanding.

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Suggestions for Use

This task could be used as a formative assessment to reveal students' progress towards portions of the targeted disciplinary core idea element that involve understanding of energy transfer and specific heat. Teachers using this task should make sure students are given additional opportunities to demonstrate that they can use the targeted science and engineering practice and crosscutting concept elements to make sense of phenomena or problems before making any claims about student proficiency of those targets.

What Are The Major Takeaways?

SUMMARY POINTS

This task has a real-world scenario about the material used for the grounds of athletic fields that is relevant and engaging to students. It also includes multiple modes for students to respond to the task, and one of the questions offers student choice. The task's prompts and directions provide sufficient guidance for students to complete the task successfully and for teachers to administer it effectively.

SUGGESTIONS FOR IMPROVEMENT

Students could be given opportunities to do more than confirm that artificial turf fields are hotter than grass. There may be opportunities to dig deeper into structure and function of matter or to investigate new technologies that can elicit deeper understanding of the targeted elements and provides students with opportunities to engage in sense-making. *Note: Users may also want to correct or remove the inaccurate use of criteria and constraints in the task's brainstorming section.*

What Should I Do Before Using This Task?

Users should review the provided guidance to familiarize themselves with instructions and disclosures before using these tasks.

How Were These Tasks Developed?

The tasks were developed and revised by teacher work groups from participating districts in the Tennessee District Science Network (TDSciN), which was launched in early 2019 and managed by NextGenScience. Tasks were evaluated using an adapted version of the Science Task Screener. Teachers worked collaboratively across districts to develop and revise these tasks after attending multiple professional learning sessions. Find out more about the development process here.

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