Science Assessment System Through Course Task

Tennis Ball Bounce

Grade Levels:
6, 7, 8

Phenomena:
Height of Ball Bounce Differs with Conditions

Science & Engineering Practices:
Analyzing and Interpreting Data
Developing and Using Models

Crosscutting Concepts:
Energy and Matter
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.

Tennis Ball Bounce Task Annotation

Task Template: After **analyzing and interpreting the data** *about the varying conditions in which the tennis ball has different amounts of gravitational potential energy*, **develop a model (drawing or diagram) that describes** the conditions needed to increase the gravitational potential energy of an object.

Phenomenon within the task:
Data are often provided from an investigation without background describing the experimental set-up. In this task, students are asked to read a scenario about a student's, Connor's, experiment using a tennis ball under varying conditions. The experiment in the scenario is vague and includes minimal information on how the experiment was conducted. A data table is provided for the students to analyze and interpret the results of the experiment. Through data analysis, students are asked to create a model (diagram or drawing) to show how the components of the system would interact resulting in the collected data, which would relate to an increase in the gravitational potential energy of an object.

Students in 7th grade are asked to develop models to describe how the potential energy of a system of objects (stored energy) is affected depending on their relative positions. The emphasis is on the *relative* amounts of potential energy, not on *calculations* of potential energy.

How the phenomenon relates to DCI:
PS3.A Definitions of Energy

- A system of objects may also contain stored (potential) energy, depending on their relative positions

PS3.C Relationship Between Energy and Forces

- When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from an object.

Students should use idea of interaction of objects transferring energy and experimental results to inform their model and annotation of the possible experimental design.

What information/data will students use within this task? Students are provided with a vague scenario about an experiment using a tennis ball under some unknown condition. The data from this experiment is provided for students to interpret in order to develop

a model of the experimental design. This model will demonstrate how the components of the system interact. Students will use their understanding of gravitational potential energy to help in data interpretation.

Ideas for setting up the task with students: Students should have experience with the concept of gravitational potential energy through labs, simulations and/or demonstrations. Students should have had experience with analyzing data. To assist students in interpreting the data, some "things to consider" are provided in the student task.

Intent of the Task for Assessment: This task was designed to determine if students can analyze and interpret data in order to create a model that describes the effects of relative position on an object's gravitational potential energy. Student models should show how the vertical position or height of an object changes the amount of gravitational potential energy (i.e. the higher the tennis ball the greater the gravitational potential energy). The models developed and the accompanying summary should be supported by the data and clearly demonstrate the transfer of energy.

List components of the task / resources used with the task:

All component needed for this task are included.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Analyzing and Interpreting Data

- Analyze and interpret data to provide evidence for phenomena.

Developing and Using Models

- Develop a model, based on evidence, to match what happens if a variable or component of a system is changed.

Energy and Matter: Flows Cycles and Conservation

- The transfer of energy can be tracked as energy flows through a system.

Success Criteria

Students create a model (drawing or diagram) that describes the conditions needed to increase the gravitational potential energy of the tennis ball in the scenario. The model and accompanying annotation should demonstrate how the components of the system interact that would result in the data provided (i.e., the higher or harder the ball is dropped, the higher the resulting bounce) and how energy moves through a system.

Possible Student Responses

Students may associate the higher the bounce of the tennis ball, the higher the shelf was placed on the wall and that means the tennis ball had a higher amount of gravitational potential energy.

Other information teacher teams might find useful when preparing to use this task in the TCT process: Student developed models should include only one object. Teacher teams may wish to determine if this is something that should be explicitly stated to students or if this is additional evidence of student understanding of experimental design and/or understanding of effects of mass on an object's motion. Students are provided the opportunity to summarize their developed model. Teacher teams may determine if students will complete this summary or if it would be optional. As teacher teams prepare for use of this task, they may determine at this time if this is something they would wish for students to complete.

Extensions and/or other uses after the task is implemented: As an extension, students could design an experiment that would test their models. If their data from these tests differ substantially from the data provided, students may engage in discussions regarding how the models may be modified. In addition, the teacher may facilitate discussions into the limitations of data analysis.

Through Course Task – Tennis Ball Bounce

Ms. Travis asked Connor to conduct an experiment showing the conditions in which an object has more gravitational potential energy. Connor conducted an experiment with a tennis ball under three different conditions. He conducted five (5) trials and his results are shown in the table below.

The results show the height of the tennis ball bounce after a transfer of energy.

Connor's Data Table

	Bounce of ball under Condition A	**Bounce of ball under Condition B**	**Bounce of ball under Condition C**
Trial 1	20 cm	9 cm	37 cm
Trial 2	20 cm	8 cm	35 cm
Trial 3	19 cm	9 cm	36 cm
Trial 4	20 cm	8 cm	35 cm
Trial 5	19 cm	8 cm	37 cm

Student Task:

Create a model (drawing or diagram) showing the experimental set-up that could produce the results in Connor's table. Annotate your model to show the transfer of energy that resulted in the tennis ball bounce for each configuration.

To help you in thinking about your model, here is a list of questions to consider.

- What are the averages for each "Bounce of ball under Condition"?
- Where does the tennis ball have the most gravitational potential energy? The least?
- What does the bounce of the tennis ball show?

Model (Drawing or diagram):

Title of Model: _____

Written summary of model