Science Assessment System Through Course Task

Johnny's Pendulum

Grade Level:
3

Phenomena:
Pendulum Period/Experimental Design

Science & Engineering Practices:
Asking Questions and Defining Problems
Planning Carrying Out Investigations
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.

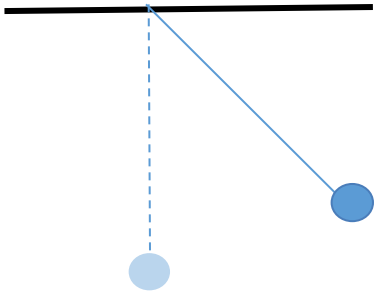
    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Johnny's Pendulum Task Annotation

After **analyzing experimental set-ups** *for various pendulum investigations*, **create scientific questions that** identify the causal relationship *each experimental set-up is intended to explore*. **Construct an explanation for why** *one of the experimental set-ups will not provide clear evidence of a* causal relationship **due to errors in the experimental design (more than one variable is changed).**

Phenomenon within the task

Although the task is centered on the phenomenon of pendulums, where the only thing that affects the pendulum swing period (the time it takes to swing back and forth) is the length of the pendulum, this phenomenon is simply the context to explore experimental design. It is not intuitive to most observers that weight of the pendulum "bob," or release position of the pendulum "bob," do not affect the pendulum swing period. For this reason, pendulums are frequently used in classrooms to explore and practice experimental design principles.



How the phenomenon relates to DCI

Although the intent of this task is to explore students' understanding of some experimental design principles, the periodic motion of pendulums can support PS2.A at the third grade level. However, understanding **why** the length of the pendulum is the only thing that affects the pendulum swing period is not appropriate for third grade (or typically even before high school). Third graders could evaluate the increase in period as pendulum length increases, and then make a prediction about the period of a pendulum of a different length. That is not the intent of this task.

3.PS2.A: The patterns of an object's motion in various situations can be observed and measured; when the past motion exhibits a regular pattern, future motion can be predicted from it.

What information/data will students use within this task?

Page 1 of the task sets up the scenario of a hypothetical classroom that is going to explore pendulum motion. There is a lot of information contained in this text: what a pendulum is, aspects of conducting investigations, as well as specific variables of pendulums that this class might explore. Teachers should intentionally plan for the best way for students to access this information.

Each experimental set-up is represented graphically in the task; students will need to interpret these graphical representations. Students will need to have some practice with asking questions, although the task naturally scaffolds (significantly) the development of the experimental questions. Students are asked to identify what is changed and what is not changed in an experimental set-up, and then asked to develop the question the investigation would be trying to answer.

Ideas for setting up the task with students

We discovered that most of our 3rd graders did not have any idea of what a pendulum was; therefore, we had them engage in several experiences as described below.

Books:

- Grandpa's Clock by Rachna Gilmore

YouTube videos:

- https://www.youtube.com/watch?v=Bpe1z1KIpE0
- https://www.youtube.com/watch?v=yVkdfJ9PkRQ
- https://www.youtube.com/watch?v=7_AiV12XBbI

Videos from PBS LearningMedia:
https://ket.pbslearningmedia.org/resource/phy03.sci.phys.mfw.zpendulum/experimenting-with-a-pendulum/#.WbGHprKGPIU
https://ket.pbslearningmedia.org/resource/65508e65-74cc-40eb-aac9-6192b13a899a/65508e65-74cc-40eb-aac9-6192b13a899a/#.WbGH_rKGPIU

Before engaging with the task groups of students were given teacher created questions about pendulums. They created their own pendulums and tested the questions.

We also found it helpful to demonstrate pendulums as presented in each section the task for students to observe the motion. We made one set and demonstrated in front of the class, but next time we will make one set for each table so that they can investigate on their own.

Intent of the Task for Assessment

This task is intended to provide evidence of a student's understanding of 2 key aspects of experimental design as appropriate for third grade:

1. Can the student create an experimental question that explores the relationship between 2 variables?
2. Can the student recognize and explain that an experimental set-up is faulty/will not provide meaningful results because more than one variable is changed?

Parts A-F of the task support idea #1 above. The task naturally scaffolds (significantly) the development of the experimental questions. Students are asked to identify what is changed and what is not changed in an experimental set-up, and then asked to develop the question the investigation would be trying to answer. It is important not to give too much support beyond what is given in the task so that accurate evidence of a student's ability to make sense of the information is obtained.

That said, a teacher might decide to have a class discussion before proceeding to Parts G-J, coming to consensus about good experimental questions for the first two experimental setups in order to get better evidence for item #2 above. Students could be allowed to change their papers for answers A-F if they wanted to (students could use a different color pen), and the teacher should note any student's particular struggles with this portion of the task.

Students may struggle with Part I because two variables have changed in this experimental set-up. If that occurs, encourage students to proceed to Part J. A major purpose for this task is to evaluate where a student struggles with articulating that changing more than one variable in an experiment affects getting useful results, because any experimental outcome could not be attributed to a specific variable.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Planning Investigations

- Analyze an experimental set-up to determine what is being investigated. (This is not a specific bullet for Appendix F but provides evidence of understanding investigations.)

Ask Questions

- Ask questions about what would happen if a variable is changed.

Cause and Effect

- Cause and effect relationships are routinely identified and tested.

Constructing explanations

- Construct explanations that specify variables that describe and predict phenomena. (This statement is in the heading in Appendix F for this SEP, rather than a discreet bullet.)

Success Criteria

- Student creates a question that explores the causal relationship that is described by the experimental set-up. (Part C and F)
- Student explains that the experimental set-up will not provide meaningful evidence (about a causal relationship) because more than one variable changed. (Part J)

Possible Student Responses

- What happens when you change the string length?
- How many swings do you get if you only change the length of the string?
- How many times does it swing back and forth when you drop it from different starting positions?
- Johnny will not get a clear answer because he changed the string and the number of washers and you won't know which is which.

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

- Before this task it would be useful to practice asking scientific questions with students. Teach them that in an investigation you only change one variable at a time.
- It was helpful to allow students to create and test pendulums prior to the TCT.
- Emphasize that these questions need to lead to an investigation not just a recall question.

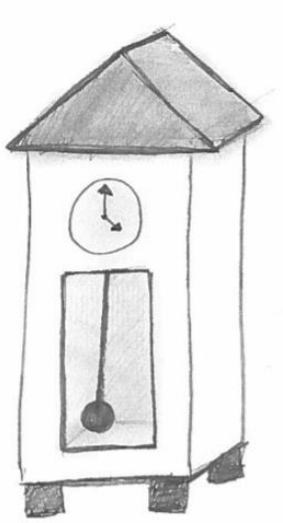
Extensions and/or other uses after the task is implemented

If you want lesson ideas on variables, FOSS has a Variable Kit*. This includes lesson using the pendulum. Here is a video to help with the Foss: Variables Swinger Activity Part 1. https://www.youtube.com/watch?v=-rlR4Uk6jbU

**KDE does not endorse any particular products.*

Through Course Task – Johnny's Pendulum

Johnny's class has been learning about how some things move in a predictable pattern. Johnny's teacher held up a string with a washer attached to the end and told them it was called a pendulum. The teacher pulled back the washer to one side and held the end of the string. Johnny and his class watched as it swung back and forth. Jane said her grandma has a big clock with a pendulum that makes a loud ticking noise.



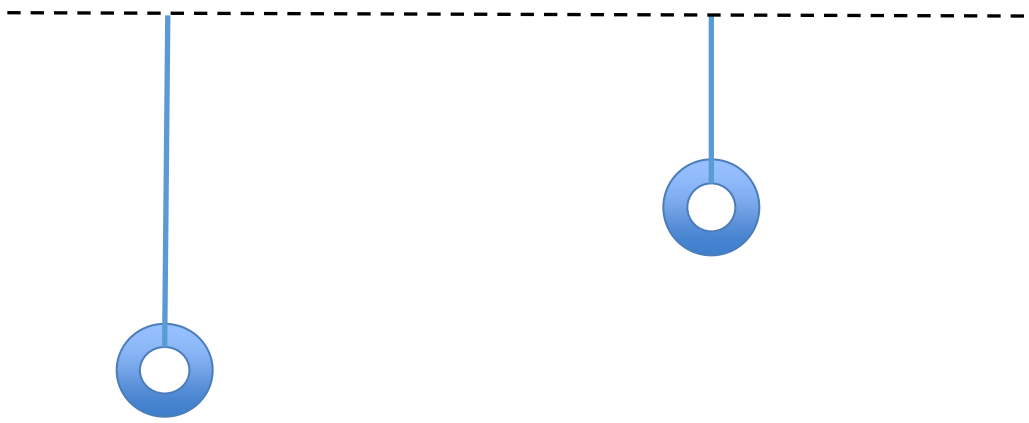
The class decided they wanted to know more about how the pendulum works. They wanted to investigate for themselves. The teacher explained that when they conduct an investigation, it is important to change only one thing at a time and to try to keep other things the same. That way, they could tell how the thing that is changed affects the thing being tested.

Johnny's class came up with a list of things (variables) they could change that they thought might affect how a pendulum swings:

- length of string
- the number of washers at the end of the pendulum
- at what level they released the washer
- the type of string

Johnny's class decided to try to investigate some of these choices.

First, his class made two pendulums. One pendulum was long and the other was short.



Refer to the list of things that the class wanted to explore from the previous page.

A. What did the class change in this investigation?

_____

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_____

B. What did they keep the same?

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C. What question would this investigation answer about the pendulum?

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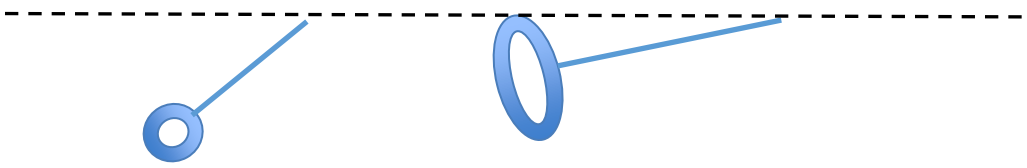
Next, the class made two new pendulums. This time they started one pendulum with a higher start position than the other.



D. What did the class change in this investigation?

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E. What did they keep the same?

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F. What question would this investigation answer about the pendulum?

_____

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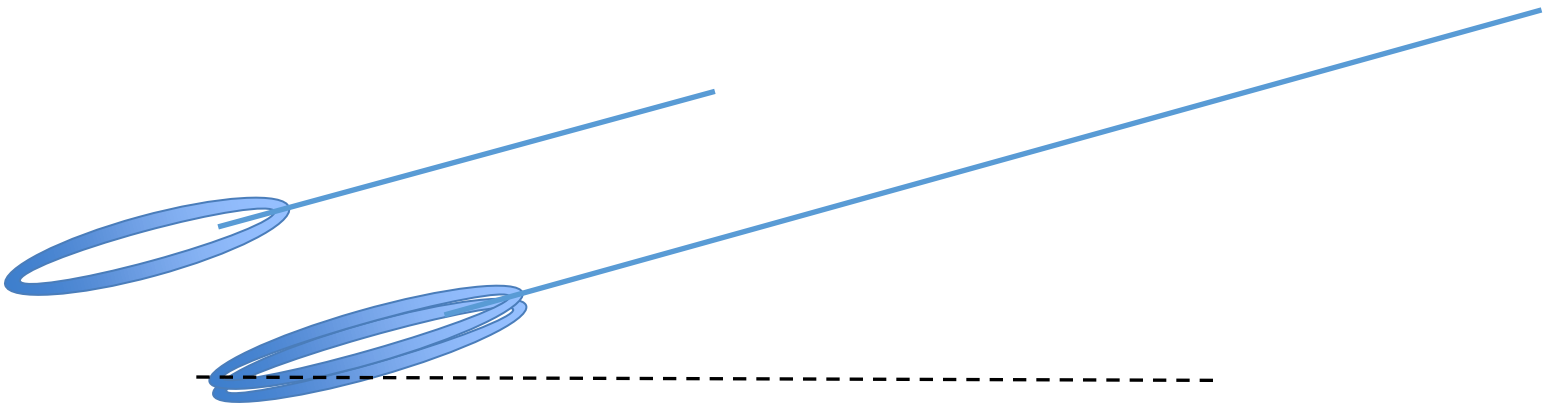
Johnny realized that the class didn't investigate all of the variables they had identified that might affect how the pendulum swings. He decided to do more at home. This is what he did:

1. Johnny cut a short string and tied 1 washer on the end to make pendulum A.
2. He cut long string and tied 2 washers on the end to make pendulum B.



Pendulum A

Pendulum B

G. What did Johnny change in this investigation?

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_____

_____

H. What did he keep the same?

_____

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_____

I. What question do you think Johnny is trying to answer with this investigation?

_____

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_____

J. Can Johnny use this investigation to find a clear answer to his question? Explain why he will or will not find an answer.

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