Science Assessment System Through Course Task

Lion Trouble

Grade Level:
4

Phenomena:
Engineering Design/Lions Eating Livestock in Africa

Science & Engineering Practices:
Engaging in Argument from Evidence
Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts:
Cause and Effect

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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.

Lion Trouble Task Annotation

After **analyzing multiple sources of data** to identify *constraints posed by life in Kenya*, **state a claim supported by evidence** as to which of four *proposed design solutions best takes into account the identified constraints and success criteria*.

Note: Typically, any PE that relates to an ETS DCI doesn't have a CCC connected to it. See the Engineering Design page for Grade 3-5 in the standards. You will see that there are 3 PEs, none of which have a CCC connected in the foundation boxes (the green area). There is only a reference to the influence of Science, Engineering and Technology on Society and the Natural World. Therefore, students are asked to process the information through the lens of the needs and wants of people. However, it can be argued that causal thinking is present in tasks where students are evaluating design solutions, such as this task. What causes one design solution to be a better choice over others? *While this is not the intended use cause and effect as a CCC in scientific sense-making as to the intent of the standards (what causes a phenomenon?), being intentional about causal thinking in any classroom experience is beneficial to building understanding for cause and effect.*

Phenomenon within the task

This is an engineering design task. The context for the task is a real world problem occurring in many villages in Africa. Lions are killing livestock. Although it is natural for lions to hunt for food, these carnivores are eating the cattle that is the basis for food and the livelihood of the Maasai people, a nomadic African community. Due to a scarcity of water, herds of game are traveling to areas where they can find water. Unfortunately, the people of Africa establish their villages near the same water sources. Because lions follow the wild game to the areas near water, they often kill the nearby cattle as well as the wild game.

This grade 4 task builds on K-2 grade level engineering design expectations, especially the engineering component related to defining and delimiting engineering problems. Overall, this component involves stating the problem to be solved as clearly as possible in terms of criteria for success and the constraints or limits. At K-2, students focus on understanding the problem, gathering information related to the problem and considering how the problem can be solved through engineering. At 3-5, students begin to realize that the solution to a problem is limited to available resources and that solutions are often compared based on how well each one takes into account the success criteria and the identified constraints. This task incorporates all the grade level expectations of both K-2 and 3-5. Through engagement in the Lion Troubles task, students are building foundational understanding that will be

useful when addressing more sophisticated engineering core ideas at the middle school level (taking in to consideration scientific principles and other relevant information when addressing constraints).

How the phenomenon relates to DCI

ETS1.A: Defining and Delimiting Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account.

Students will analyze different design solutions based on given constraints (cost, effectiveness and need for human resources, etc.). To add to the real world context, students will learn about the process engineers use to gather relevant information about their clients. Students may not realize that engineers conduct research and interviews and spend time making observations prior to developing a possible solution to a problem. The suggested pre-task activities support engagement with the ELA standards making this task interdisciplinary. Taking into consideration student ability and schema, teachers will need to determine whether or not engagement in the suggested pre task activities is beneficial.

What information/data will students use within this task?

Students will obtain information necessary to support a claim from provided charts and text.

- Ted Talk presentation (only a portion of the talk)
- Two optional videos are provided that support understanding of the context of the task. One video provides insight on what life is like for the Maasai through the lens of a child. The second video provides information on lions. Please preview prior to determining use. Both are listed in the task resource area below.

Background information:

- Students will need to have had experiences related to:
- Establishing criteria for a successful design solution.
- Opportunities to learn about how constraints impact design solutions.
- Use of criteria to evaluate design solutions
- Locating relevant information in text.

Content:

- Problem identification, criteria, constraints

Ideas for setting up the task with students

Before beginning this task, it would be helpful if the students have had experiences related to establishing criteria for a successful design solution as well as opportunities to learn about how constraints impact design solutions.

Suggested Pre-Task: Engagement with text/videos that support development of background information related to the Maasai people is recommended. An vast array of resources are available online through a Google search should you choose to deepen student understanding of the Maasai people and their way of life. It is also recommended that students learn about lions, their needs, habits and behaviors. Having greater awareness of the importance of cattle to the Maasai and to lions will help students comprehend the magnitude of the problem.

Task: The task begins with an adapted version of a Ted Talk given by Richard Terure, a 13- year old, Kenyan boy. Viewing this video promotes understanding of the "lion troubles" addressed in the task. As students view the video clip (**Minute Mark 1:50**), consider having students write their observations related to the life of the Maasai and share the problem (Lion Troubles). Promote discourse about Richard's life, the trouble his village is dealing with, the differences between the life of the Maasai and their own lives and other topics that help students conceptualize the problem. You might also consider using the corresponding text from the Ted Talk as a means for gathering information that may have been overlooked while watching the video clip (also promotes access to different learning styles). Whether you choose to show the video clip, provide the text, or both, document student observations on a chart to serve as a resource for students to reference as they complete the task.

After having rich discussion about the life of the Maasai and the problem shared by Richard, students are to define the problem as presented in the text and in the Ted Talk. This part of the task can be done individually, in pairs, or as a whole class but students are to record their responses individually on the task document. As with any design task, students need a clear understanding of the problem being addressed. Although the problem is presented clearly in the video, it is important that students think about how the loss of cattle impacts the people of the village. Again, discourse is encouraged.

Next, students will analyze information presented in the chart about life of the Maasai in order to develop a list of possible constraints that should be taken into consideration when selecting one of the proposed design solutions. Students may struggle with this component of the task as it requires them to synthesize data to determine limitations that will impact a design solution. There are no "right there" answers so students might need more support. Because it is critical that they uncover constraints presented by life in the Maasai village in order to engage in the task, be sure that students are able to identify the constraints. A space is provided in the task for documenting identified constraints. See text box PART A. The following are some possible prompts to consider if students struggle with this piece of the task:

- *What problems are the people of the Maasai facing, based on the texts you've read so far?*
- *What resources are available?*
- *What resources are not available?*
- *What financial issues are the people of Maasai facing?*
- *Are there any geographic barriers?*

After identifying constraints, students read the "Proposed Design Solutions for the Maasai's Lion Problem" chart. Students can engage with the information provided in this chart in small groups, individually or with a partner. The intent is for students to understand each of the proposed design solutions rather than to think deeply about how they meet the identified criteria and constraints. Again, this promotes equal access to the data. It may serve students well to discuss their ideas with a partner. **However, students should work independently to evaluate the proposed design solutions based on the identified constraints (PART B). PART B of the task provides a tool for students to use when thinking deeply about how a solution meets or does not meet the identified constraints. The thinking that students capture in this tool will serve as a resource as they independently develop a claim supported with evidence and reasoning consistent with information provided throughout the task.**

Intent of the Task for Assessment

The intent of this task is to get evidence of a student's ability to develop a reasoned argument for competing designs. In order to do this, students must access the provided data. Components of this task are completed collaboratively in order to facilitate engagement with unfamiliar topics (life of the Maasai people, development of criteria and identification of constraints). Through collaboration, the experience is more equitable thus allowing for better evidence of the intended student learning. Teachers will need to be very intentional in how they gather evidence of student ability when analyzing the data and synthesizing multiple pieces of information (video clip, text, charts) as these skills are essential for successful engagement in the task. Preplanning for gathering

anecdotal information as students work collaboratively is necessary. Consider developing check sheets with specific "look fors" identified to use as you listen in on conversations and ask probing questions to elicit student thinking.
Scaffolding the task up to PART B where students evaluate each proposed design solution against the identified constraints is acceptable. This is section should be done independently as well as the final question.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Note: Because of the structure of this task, evidence of student learning related to the SEP in bold is gathered as students engage collaboratively. Therefore, these components of the task are not included in the success criteria or in the sample student response but are essential to engagement in the task. It is suggested that teachers plan effectively for gathering formative information on all students.

Obtain, evaluate and communicate information?
Combine information in written text with that contained in corresponding tables, diagrams and/or charts to support engagement in other science and engineering practices.

Engaging in Argument from Evidence
Make a claim about the merit of a solution to a problem by citing relevant evidence about how it meets the criteria and constraints of the problem.

Success Criteria
Students state a claim as to which one of the proposed design solutions they feel best solves the identified problem of the Maasai based on:

- Criteria and constraints accurately applied when evaluating design solutions.
- Use of reasoning consistent with information provided in the task (Maasai life, problem to be solved).

Possible Student Responses
Look fors:

- Relation of constraints and criteria of success to solution chosen

- Supported claim with evidence found in the provided data (text and charts)
- Reasoning as to why the solution they choose is the best choice

Sample Student Response: I think the electronic flashing light system would be the best option for this community. I think this because it does not require the use of resources which this community does not have a lot of. This option does require a battery which could be expensive since they do not have a lot of money, but the good thing is that it will not have to be replaced because it can be recharged with solar power. This community does not have electricity.

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

When we facilitated the task, we found that our students were shocked at the comparison between a child's life in Kenya and their own. Children had a difficult time wrapping their head around why killing all lions was not a feasible option. After that was resolved, students engaged with the task, but it was very difficult. It is imperative that you, as the teacher, are prepared to help them identifying the problem, criteria and constraints. It would help to be explicit that there is a difference between criteria and constraints. We suggest reviewing these terms and giving examples to students as you work through this task. The final question/claim should be done only by the students; probing questions may be used, but you, the teacher, need to know if they can make a claim and justify it independently.

Remember TCTs are a learning experience for you and the students. You gain information from them and they show you how they process the information.

Extensions and/or other uses after the task is implemented

Students could potentially propose a solution of their own if they have enough background information about the Maasai people. They might develop a design solution that includes a description and a materials list that takes into consideration the available resources then engage in the evaluation of proposed solution based on constraints and success criteria.
Students could improve upon available solutions and explain how these newly revamped options meet constraints and would be successful in solving the identified problem.

Pre-Task: African Lions

What specific behaviors do lions show when they get hungry?

Possible responses:

- *Lions steal from hyenas or wild dogs.*
- *Cubs start hunting at one year old.*
- *Females work together to hunt their prey.*
- *Lions roar.*
- *They chase their prey.*
- *Lions prey on zebras, cows and other large animals*

Pre-Task: A Child's life in Kenya

What is the difference about a child's life in Kenya compared to your own?

Possible responses:

- *They don't have a lot of money.*
- *They work on a farm/help animals.*
- *They earn money for their family.*
- *Abandoned children /orphans have to live on the street- no public or government system to take care of them.*

Why may children in Kenya not go to school?

- *They must end to cattle or crops.*
- *They are pulled out of school because their family needs money because a parent lost their job.*
- *They are homeless.*
- *They're trying to survive.*
- *Working interferes with school.*

Through Course Task – Lion Trouble

The following is a true story of a young Kenyan boy named Richard Turere. Richard is 13 years old who lives in a rural community of Maasai. As you read the first part of his story, look for the problem that exists in Richard's village.

Richard Turere: 13 year old Kenyan Boy

Story adapted from TedTalk:

"This is where I live. I live in Kenya, at the south parts of the Nairobi National Park. Those are my dad's cows at the back, and behind the cows, that's the Nairobi National Park. Nairobi National Park is not fenced in the south widely, which means wild animals like zebras migrate out of the park freely. So predators like lions follow them, and this is what they do. They kill our livestock. This is one of the cows which was killed at night, and I just woke up in the morning and I found it dead, and I felt so bad, because it was the only bull we had. My community, the Maasai, we believe that we came from heaven with all our animals and all the land for herding them, and that's why we value them so much. So I grew up hating lions so much. The Morans are the warriors who protect our community and the livestock, and they're also upset about this problem.

So a boy, from six to nine years old, in my community is responsible for his dad's cows, and that's the same thing which happened to me. So I had to find a way of solving this problem."

According to the text, what is the problem that Richard addresses?

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How might this problem affect the people of Richard's village?

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Once a problem is identified, people like Richard Turere, attempt to find solutions. These solutions require that people understand the needs of those who have a problem, as well as the **criteria** (*the goal or desired outcome*) and **constraints** (*the conditions under which a problem must be solved/limited to available material and resources*) associated with the problem. Consider how the Maasai people will know how if a design solution is successful. What would be the identified criteria for a successful design solution related to their problem?

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It is important to gather more information to better ensure that a design solution can be successful. Below is a chart with information related to Richard and his village. Carefully read the information provided in this chart.

Maasai people	Life of the Maasai	Animals of the area	Biome- savannah	Lions of Africa
● Herders ● Young boys in are responsible for tending the cattle.	● No running water or indoor plumbing ● No electricity/only battery operated tools ● Many people are farmers. They rely on their crops and cattle for food. These items are also sold at common market. ● Wood stoves are used for cooking. ● Children sometimes get to go to school.	**Wild animals:** • lions • cheetahs • zebras • wildebeests • gazelle **Farm animals:** • cows • sheep • chicken	● Primarily open grassland ● Few trees and bushes ● Flat land with rolling hills ● Scarce water supply for people and animals	● Man - greatest enemy ● Carnivores - eat meat ● Tend to fear moving lights ● Ambush hunters - sneak up on prey ● Follow natural prey but sometimes kill cattle and livestock ● Avoid humans unless afraid or threatened or hungry. ● Avoid people carrying torches.

Based on the information provided in the chart, list constraints (availability of materials and resources) that need to be taken into consideration based on the Maasai people, their environment and the lions when designing a solution to the lion problem?

Part A: Identify constraints that need to be considered when designing possible solutions to the Maasai's lion problem?

When solving a problem, once constraints are identified that should be taken into consideration and solutions are proposed, it is important to evaluate the solutions based on how well each one takes the constraints into account.

The “Proposed Design Solution for the Maasai Lion Problem” chart provides information about possible solutions that were designed to solve the lion problems experienced by the Maasai people, one of which is Richard’s design solution. Read through the provided information closely.

Proposed Design Solution for the Maasai Lion Problem

Design Solution	Description	Materials	Human resource
Electronic Flashing Lights	● An automated solar powered system that creates blinking lights ● Positioned around cattle shed	● Solar charged battery ● Indicator light ● Light bulb ● Switch ● Materials not available locally	Construction, installation, and maintenance of device
Living walls/Boma	● Plant a wall of trees and cover them with chain link fence – predators can’t squeeze through and cattle can’t roam.	● Chain link fencing (not available locally) ● Trees ● Estimated cost is $500 ● Rainfall is important for growth of trees that make up the wall.	Construct and maintain the walls
icow	● Eye like pictures are painted on the cow’s backside	● Paint (not available locally)	People will need to paint all cows, young and old.
Relocate herbivores	● Round-up zebras and wildebeests by helicopter to areas where lions are killing the most cattle so lions can eat animals other than livestock.	● Use of helicopter ● Fuel and pilot fees	Round up animals and harnessing them for transport

Use this tool to help you evaluate each of the solutions.

Part B: Evaluation of Proposed Solutions based on identified constraints:

Proposed Design Solution	**Identify how the design solution MEETS the constraints**	**Identify how the design solution DOES NOT meet constraints.**
Electronic Flashing Light System		
Living Walls/Boma		
iCow		
Relocation of Herbivores		

After carefully evaluating each proposed design solutions, make a claim about which design solution best meets the **constraints you previously identified and would most likely be successful in solving the Maasai's lion problem**? Support your answer with evidence found throughout this task. Be sure to address how the design solution solves the problem and the constraints posed by the life of the Maasai people.