# Three-Dimensional Science Tasks—Analysis and Development

## Facilitator's Guide

Summer 2019

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# Module Overview:

The *Three-Dimensional Science Tasks—Analysis and Development* Module contains the materials and resources to be used in work sessions at the district, school or department level. These sessions are intended to provide guidance in the identification and development of three dimensional (3D) tasks that meet the intent and expectations of the *Kentucky Academic Standards* for Science.

The duration and scope of the sections may be customized to accommodate local needs and conditions. While the two sessions may be viewed as standalone, it is recommended that components of Session A be used before Session B in order to gain insight into the criteria for 3D tasks.

## Materials:

The following materials are part of this module:

- *Three-Dimensional Science Tasks—Analysis and Development* Facilitator's Guide
- *Three-Dimensional Science Tasks—Analysis and Development* slide presentation

All materials are available on the KDE website at Kystandards.org

Other documents that will be required are identified within the appropriate session.

## Goals:

The goals of the *Three-Dimensional Science Tasks—Analysis and Development* Module are for educators to:

- Build a shared understanding of criteria for three-dimensional tasks.
- Experience how the development of tasks is dependent upon identified learning goals explicitly *connected* to the *Kentucky Academic Standards for Science.*
- Understand the connection between the criteria for three-dimensional tasks and their development.

## Intended Audiences:

**Participants**

Module participants include, but are not limited to, classroom teachers and preservice teachers, special educators, instructional specialists/coaches, intervention specialists, department chairs.

Participants should have familiarity with the three dimensions of science. If not, it is recommended that they review *The Kentucky Academic Standards for Science: An Overview* Module. There are many references made to phenomena within this module. For a more in-depth look as to the role of phenomena in science instruction and assessment, see the *Selecting Anchoring Phenomena for Equitable Three-Dimensional Teaching* Module.

**Facilitators**

Module session facilitators may include, but are not limited to, district leadership, instructional specialists/coaches, intervention specialists, department chairs, special educators, classroom teachers and pre-service faculty.

# Using This Facilitator's Guide:

This facilitator's guide provides suggestions for structuring each session within this module. This includes recommended learning experiences to prompt thinking and meaningful discussions as well as guidance on talking points to use with the provided slides. Also included are background notes for facilitators to assist in guiding discussions among participants.

**Abbreviations Used**

A number of science-specific abbreviations are used within this module.

- PE: Performance Expectation. These are the standards defined by Kentucky Department of Education
- 3D: three-dimension(al). We speak of the science standards in terms of dimensionality. Each dimension is further defined below.
- DCI: Disciplinary Core Idea. This dimension of science is commonly referred to as the content of science.
- SEP: Science and Engineering Practices. Also called "the practices", this dimension of science defines the skills, and their specific knowledge, that scientist use to investigate and understand the DCI.
- CCC: Crosscutting Concepts: This dimension provides a lens through which sense-making across science disciplines occurs.

## Planning Ahead:

- Determine who to invite as participants.
- Reserve adequate space and equipment. Tables should be set up to support small group discussion.
- If you choose to decide to break up each session into smaller "chunks", consider how you may wish to handle participants who may have missed earlier learning.

## Preparation:

**Participant Documents Needed:**

- Access to the *Kentucky Academic Standards for Science* (electronic or hard-copy)
- Access to Appendix F Science and Engineering Practices and Appendix G Crosscutting Concepts (https://www.nextgenscience.org/resources/ngss-appendices).

**Facilitator Session Supplies Needed:**

These items will be needed consistently throughout each session of this module. Supplies needed for specific sections of the module will be listed prior to the facilitator's notes for that section.

- Computer with access to the *Three-Dimensional Science Tasks—Analysis and Development* slide presentation
- Technology with projection capability
- Copies of Participant Guides and Handouts needed for the session
- Issues Bin

  The Issues bin can be used by the participants to note ideas, questions, or concerns while the group continues to focus on the learning. This may be a poster or a digital parking lot (i.e., a Google document) where participants can post these issues. The purpose of the Issues Bin is to provide participants with a safe way of asking questions or suggesting ideas. Participants should feel free to add to the Issues Bin throughout the module.
- Chart paper
- Post-It Notes (optional unless otherwise indicated)
- Colored markers

## Work Session Consideration:

**Building a Community**

Building a community is important for any group that will work together, especially if participants have not worked together before. The concept is the same as building a safe, respectful, productive classroom climate. Incorporating community-building into each session builds trust, shows participants that they are valuable as individuals and engages them in the learning process. It is also useful for creating a professional learning network where participants can be supported in their work. Community-building can be as simple as allowing participants to introduce themselves and their role in the school/district, developing or refining group norms, allowing for questions and/or the sharing of answers to reflection questions or individual discovery task items that are included in the Module 1 sections. Again, time allotted for community-building will allow participants to have a voice and be engaged as active contributors and learners in the sessions.

**Note:**

Session A of this resource has been modified from a professional learning workshop developed by Achieve for the Task Annotation Project in Science (https://www.achieve.org/our-initiatives/equip/tools-subject/science/task-annotation-project-science).

Session B of this resource has been modified from ACESSE Resource D and is provided through OER (Open Educational Resources) Commons Platform and provided through a Creative Commons license (CC BY-SA). The Advancing Coherent and Equitable Systems of Science Education (ACESSE, or "access") project brings together partners for educational research and practice to tackle a pressing problem in education: how to make state systems of science education more equitable and coherent. The project is based on deep collaboration between the University of Colorado Boulder, University of Washington and the Council of State Science Supervisors (CSSS). It is funded by the National Science Foundation (NSF) through Award DRL-156 1300.

## Preparation for Session A: Using Task Evaluation to Understand Dimensionality

If time is an issue, this session may be divided into two separate sessions. The first session would focus upon identifying what drives educator thinking in regards to three-dimensional tasks (slides 1-23). The second session would focus on the use of screening tools in the evaluation of tasks (slides 24-36).

**Posters to Make Ahead of Time:**

- Issues Bin Poster:
    - Poster can just be labeled "Issues Bin". The Issues Bin can be used by the participants to note ideas, questions, or concerns while the group continues to focus on the learning. This may be a poster or a digital parking lot (i.e., a Google document) where participants can post these issues. The purpose of the Issues Bin is to provide participants with a safe way of asking questions or suggesting ideas. Participants should feel free to add to the Issues Bin throughout the module.

- Thought Experiments Chart
    - A chart labelled "thought experiments" will be used to capture the consensus findings from the Thought Experiment learning experience. The information in the consensus column could be from the highlighted phrases. The sample chart shows what your chart may look like. *Note: This is only a sample and does signify the "correct" responses.*

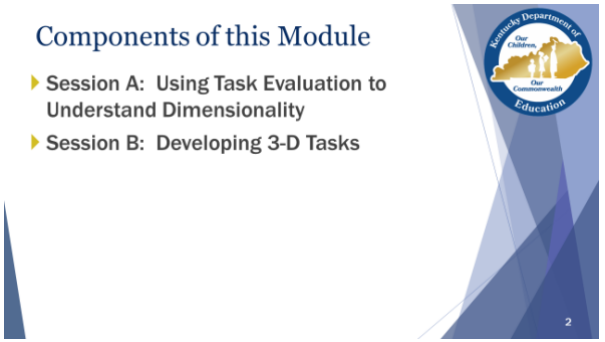
      Sample Chart:

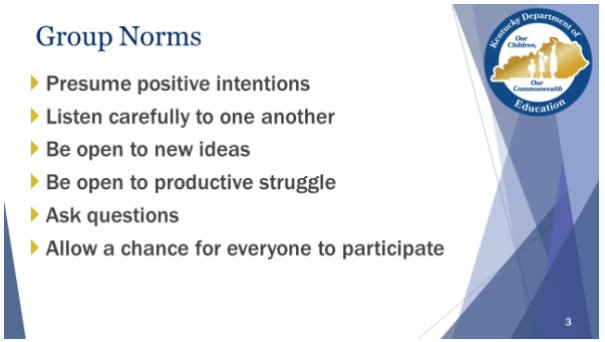
| | Criteria | Consensus |
|---|---|---|
| *#1* | *Phenomenon* | *Not necessary* |
| *#2* | *Standards* | *Direct with standards* |
| *#3* | *Intentionality* | *Specific CCC, DCI and SEP* |
| *#4* | *Student Agency* | *Important* |
| *#5* | *DCIs* | *Must include core idea* |
| *#6* | *Grade appropriate* | *Only the DCI must be grade appropriate* |

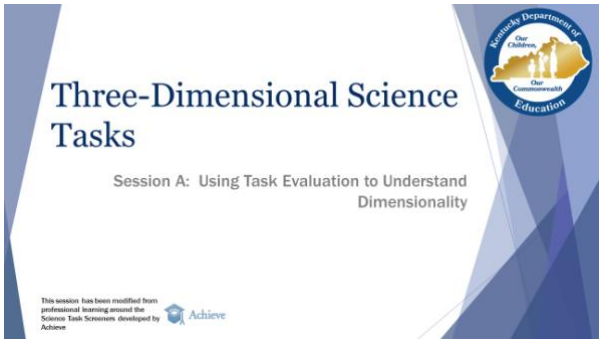
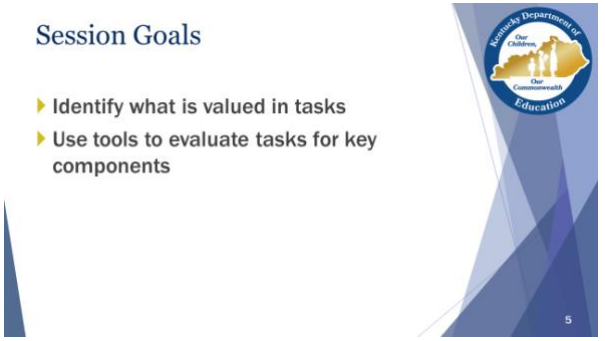
- Copies of the following documents
    - Tasks used with slide 21 (1 set per person)
        - Movement of Matter (https://education.ky.gov/curriculum/standards/kyacadstand/Documents/Modeling_Rabbits_Movement_of_Matter.pdf)
        - Evolution of Swallows (https://education.ky.gov/curriculum/standards/kyacadstand/Documents/Evolution_of_Swallows.pdf)

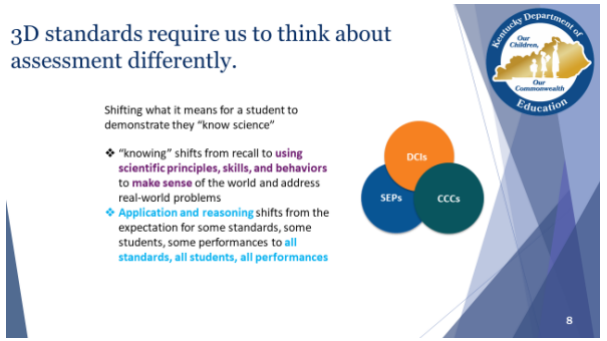
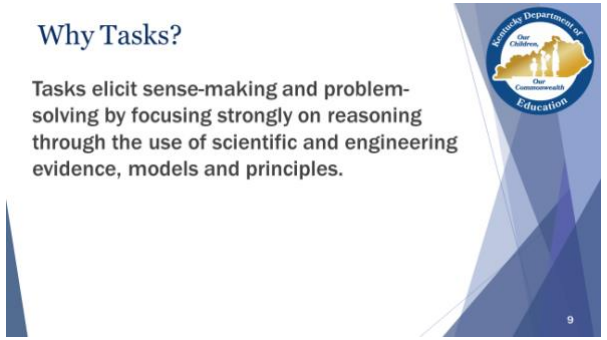
        - John's Heating Sand (https://education.ky.gov/curriculum/standards/kyacadstand/Documents/John's_Experiment_Heating_Sand.pdf)
    - Task Pre-Screener—1 per person (https://www.nextgenscience.org/sites/default/files/resource/files/Achieve%20Task%20PreScreener_Final_9.21.18.pdf)
    - Task Screener—1 per person (https://www.nextgenscience.org/sites/default/files/resource/files/Achieve%20Task%20Screener_Final_9.21.18.pdf)
    - "Natural Hazards" Task and accompanying rubric (https://drive.google.com/file/d/0B7wHekJxyLeyTGVRay1jeWYtd3M/view and https://drive.google.com/file/d/1RzEKOGrszs84IJa0iEYHTouB2wqcwQ47/view)

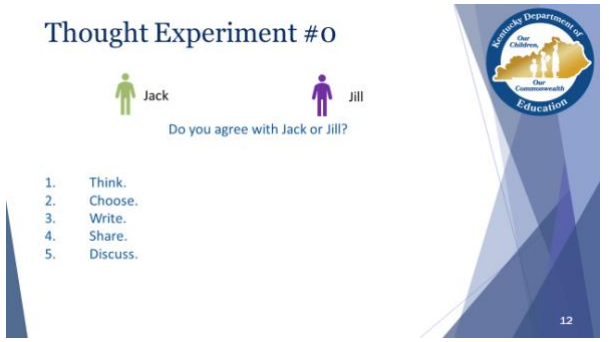
## Session A: Using Task Evaluation to Understand Dimensionality

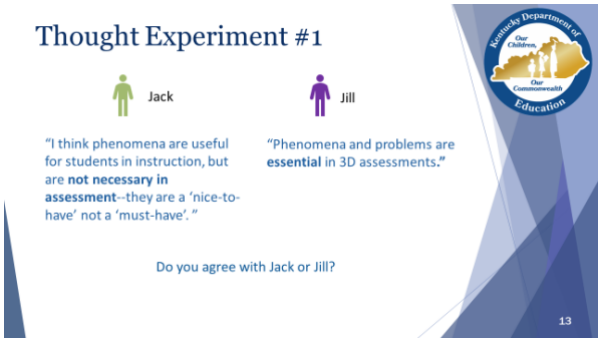
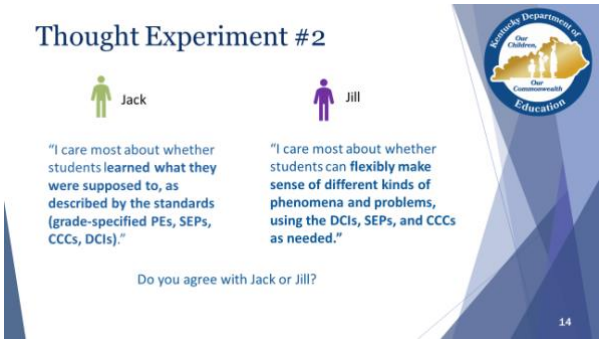
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Officially welcome the participants. If necessary, introduce yourself.*<br><br>**Explain:**<br>"This module is designed to provide you with some tools that will help you analyze science tasks as well as experience in crafting your own multi-dimensional tasks." |  |
| *Facilitator Notes:*<br>*Use the information on this slide to share the components of this module. If you are focusing on a single session of this module, you may wish to delete this slide.* |  |

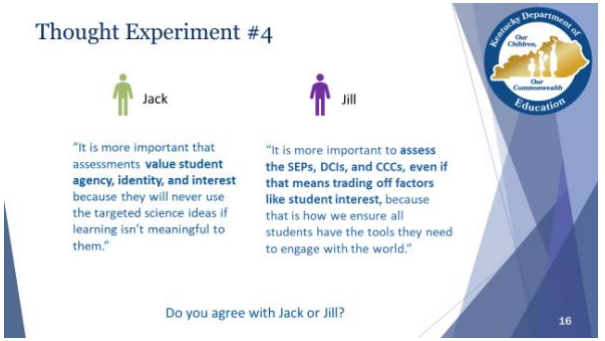
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Group norms can help to create a safe space where participants feel comfortable sharing their ideas and experiences. This slide is a starter. Take a moment to read the norms."<br><br>*After people are finished, ask if anyone would like to revise, edit or add any norms to the list. If so, make changes on the slide; if not, move on to your discussion of the Issues Bin.*<br><br>**Explain:**<br>"I realize you may not want to pose every question to the whole group, or we may not have time in the session to get to every question. Therefore, I want us to have a place for to capture those issues."<br><br>*Introduce participants to the Issues Bin. The Issues bin can be used by the participant to note ideas, questions, or issues constructively while the other attendees continue to focus on an activity or lesson. This may be a poster or you may prefer to have a digital parking lot where participants can access a Google document, for example, to post questions and that you can modify as the participants work through the sections of the module. The purpose of the Issues Bin is to provide participants with a safe way of asking questions or suggesting ideas. Participants should feel free to add to the Issues Bin throughout the module.*<br><br>*Remember that you may not know all of the answers to the questions, and that is okay. Some issues may be addressed in future sessions of this module. If the question is pressing and doesn't appear to be addressed in this module, talk to your district team and determine who would be the best person to contact at the KDE. You may also e-mail questions or feedback to KDEScience@education.ky.gov* |  |

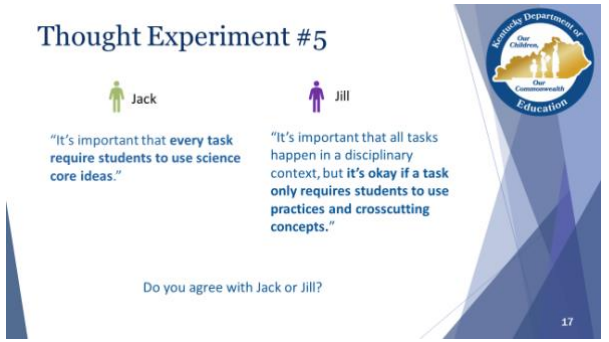
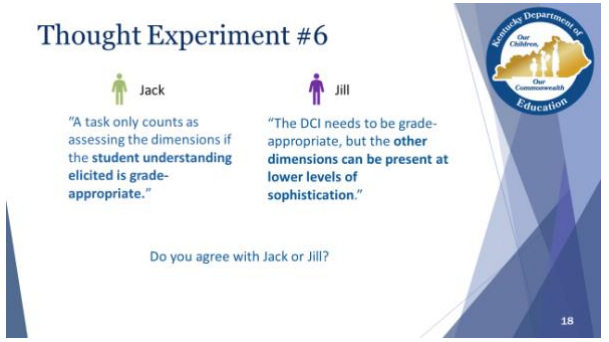
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"In this session we will utilize some tools that will help us in evaluating science tasks." |  |
| *Facilitator Notes:*<br>*Use the information on this slide to share the learning goals for this session.* |  |
| **Explain:**<br>"When thinking about three-dimensional science assessment, we no longer talk about questions, but tasks. Why tasks? What is the difference?" |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"The vision of the *Framework for K-12 Science Education* is that 'students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of each field's disciplinary core idea.' (NRC, pg. 25) Because of this vision, the way we assess must also be thought about differently." |  |
| *Facilitator Notes:*<br>*Read the information presented on this slide.* |  |
| **Explain:**<br>"Tasks allow students to demonstrate their understanding of core ideas by using the practices through the lens of a crosscutting concept. This is the vision of the *Framework*. Because of this complexity, individual questions will not easily allow students to show this kind of depth of understanding—or make their thinking visible." |  |

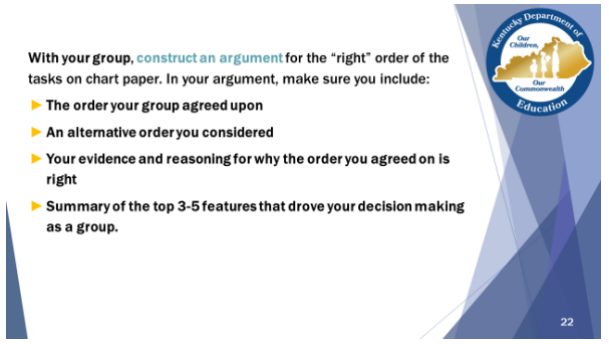
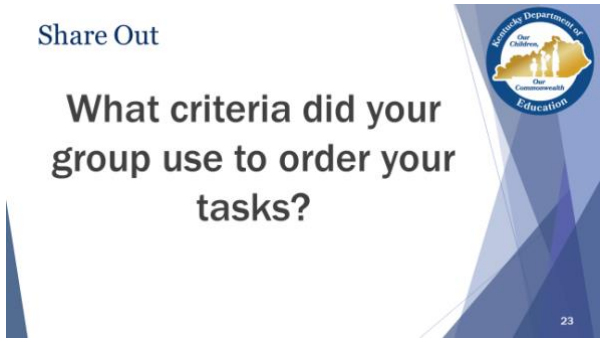
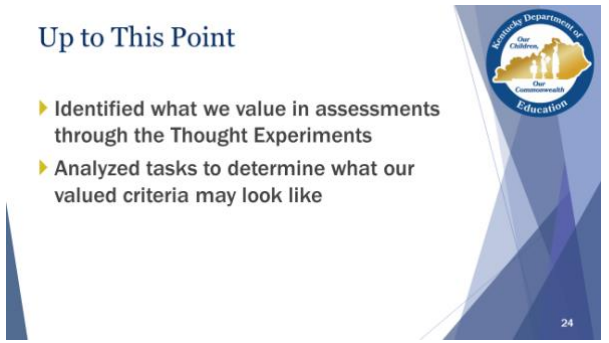
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Now that we have a sense as to why use tasks, what characteristics should we be looking for?" |  |
| *Use the information on the slide to set the stage for the learning experience.*<br><br>*Slides 13-18 contain six "thought experiments." The purpose of this learning experience is for participants to come to a consensus as to what they value when looking at, or analyzing, science tasks. There are no right or wrong answers. You may not wish to use all six "thought experiments". It is recommended, however, that you use the first four as this will allow participants to think deeply about their own values in regards to science education. This section may take up to 30 minutes. During the consensus discussion for each thought experiment, you may wish to refer back to the vision stated in the* Framework *and the reason we use tasks.* |  |
| **Explain:**<br>"This is the process we will be using during our thought experiments."<br><br>*Facilitator Notes:*<br>*It is important that this process takes place, especially the think/choose/write. Allowing participants to determine their own values before discussion is key. During the discussions, participants should explain why they feel one way or the other. If possible, the group should come to consensus as these ideas will be used to frame the discussion about tasks participants will be analyzing. The Facilitator Notes for each thought experiment are there to help you frame/lead discussions about decisions. You should record on chart paper the consensus idea for each* |  |

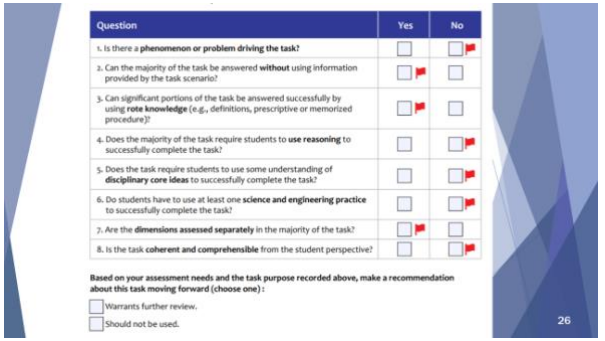
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *thought experiment.* | |
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*Participants who choose Jack are suggesting that the dimensions can be "pulled apart" or assessed separate from one another without a purpose (they're not used with meaning). The science standards should lead to students becoming scientifically literate, which is the "knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity….[it] means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences." (National Science Education Standards, National Research Council, pg. 2)*<br><br>*Participants who choose Jill are suggesting that phenomena or problems allow students to use the three dimensions to demonstrate their understanding and that the dimensions work together.* |  |
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*Participants who choose Jack suggest that the role of an assessment is to certify that students learned what was taught.*<br><br>*Participants who choose Jill suggest that an assessment allows students to apply their learning to unique situations.*<br><br>**Note: Standards define what students should know and be able to do at the end of <u>all</u> instruction. Students should have experience utilizing <u>all</u> of the SEPs and CCCs throughout their* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *learning; not just those identified within the performance expectations.* | |
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*The two ideas presented here are dependent on the purpose of the assessment. Are we looking to understand how students make sense of the world or do we wish to see <u>how</u> knowledgeable and skillful they are in using specific dimensions? Even if a task is written to explicitly elicit evidence of selected dimensions, evidence for a different dimension may arise. For example, students may be asked to use data from an investigation to construct an explanation for a given phenomenon. While the targeted dimensions may be the DCI and the SEP, you may also get evidence of CCC (for instance, students may need to look at <u>patterns</u> in the data in order to determine a <u>cause/effect</u> relationship that would explain the phenomenon).* |  |
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*Participants who choose Jack suggest that equity is important in task development. In other words, tasks designed around student interests (i.e., a community problem) are more likely to authentically engage with the task.*<br><br>*Participants who choose Jill suggest that, while student interest does have value, it is more important to assess students' knowledge and use of the dimensions as these skills are necessary to be scientifically literate.* |  |

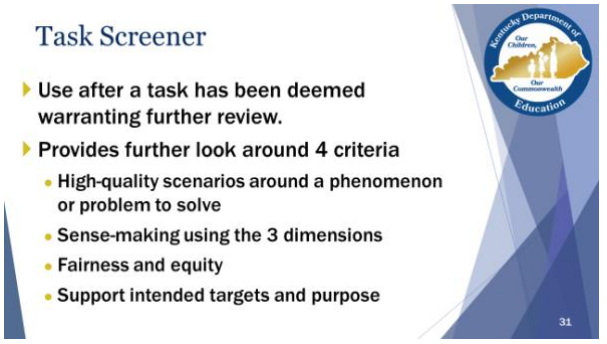
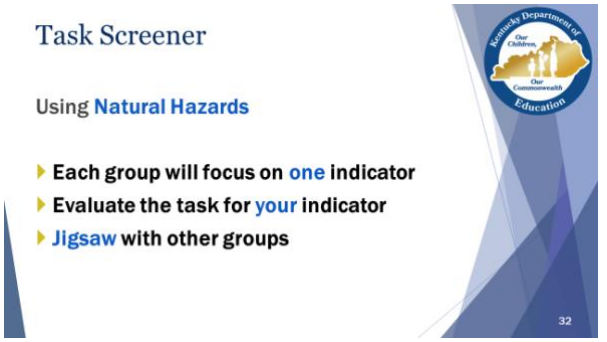
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*Participants who choose Jack suggest that tasks must use targeted core ideas. There is no mention, however, of the other two dimensions (SEPs and CCCs).*<br><br>*Participants who choose Jill suggest that the purpose of the task is to determine if students are able to use the targeted SEPs and CCCs, regardless of the context.* |  |
| *Facilitator Notes:*<br>*You may or may not wish to read the two viewpoints. Remember to give participants an opportunity to think/choose/write before leading a consensus discussion.*<br><br>*These ideas get at sophistication of the task. The level of sophistication should be grade appropriate and what is necessary for making sense of the phenomenon within the task. What teachers need to be aware of, however, is how often lower levels of sophistication (or lower grade level expectations) are utilized within tasks.* |  |
| *Facilitator Notes:*<br>*Use the points on this slide to bring together the consensus criteria from the though experiments. It is important to reiterate that there were no right or wrong answers—that each participant's choice is based upon their perspectives.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"When choosing or designing assessments, we should know what it is we deem important. We will now look at some tasks to determine their characteristics. From there, we will further clarify what we think is important." |  |
| *Facilitator Notes:*<br>*Use the information on this slide to set up this learning experience. Participants should work individually as they work through the tasks. This will provide greater insight into what the expected outcomes are for the tasks. Have them write down the characteristics of each task. Use the characteristics, in conjunction with the Jack/Jill consensus, to order in terms of alignment to the belief system. Ordering is generally "worst" to "best." Allow approximately 15 minutes for this learning experience.*<br><br>**Note: Teachers who are not accustomed to analyzing tasks often choose the more simplistic, traditional tasks as "the best" with the more complex being "the worst." Rationales given are generally in line with student ability vs what students are expected to do. As a facilitator you should be aware of this so that you may guide learning within this and subsequent learning experiences within this session.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Facilitator Notes:*<br>*Use the points on this slide to lead this learning experience. Each group should have no more than four participants. Stress that the key to this argument is the features, as these are the evidence that will support their claims as to the order of the tasks. Allow up to 20 minutes for this experience.*<br><br>*Charts can be posted around the room.* |  |
| **Explain:**<br>"I'd like each group to share the 3-5 key criteria that they used to order the tasks."<br><br>*Facilitator Notes:*<br>*Chart these key criteria as they are shared. Add to the list new ideas that are shared. Star, or identify in some other way, each time the same criterion is mentioned. When all groups have shared out, identify the most common features and compare with the Thought Experiments values. There are often many overlaps between these two lists.* |  |
| *Facilitator Notes:*<br>*Use the points on this slide to review the learning up to this point. As you move into the next part of this session, you may wish to continue referring to the two lists of key features/criteria of tasks the participants deem will lead to scientifically literate students.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"We will now look at a tool that will help us quickly analyze a task to determine if it is viable for what we wish to accomplish."<br><br>*Facilitator Notes:*<br>*The Pre-Screening Task Tool, developed by Achieve, is centered on these three big ideas. It is likely that these same big ideas surfaced during the previous two learning experiences. At this point, all participants should have a copy of the pre-screener.* |  |
| **Explain:**<br>"This is pre-screening task tool." |  |
| **Explain:**<br>"There are a few things you should be aware of before using this tool.<br>1. This tool is used to look at tasks, not instructional units.<br>2. We won't worry about grade-appropriateness. At this point we're trying to determine if the task is worthy of use and/or a deeper review. That is when we will look at grade appropriateness.<br>3. Watch for the red flags. These tell us that we should be aware of potential short comings of the task. A red flag or two doesn't mean that the task is not useable. Remember that we have to keep in mind the purpose of the task and what we wish to accomplish. Many red flags, though, suggest that we should probably not use this task."<br><br>*Facilitator Notes:* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *You may need to remind participants that the purpose of this tool to pre-screen the tasks; do a relatively quick look at a potential task to determine its viability as an assessment.* | |
| **Explain:**<br>"We will now use the pre-screen tool to do a quick evaluation of this task."<br><br>*Facilitator Notes:*<br>*Allow participants a few moments to analyze this task using the pre-screen tool.* |  |
| *Facilitator Notes:*<br>*Lead a discussion about the findings from the group. Some questions you may ask include:*<br>• *Would you use this task? Why or why not?*<br>• *What are some of the characteristics of this task (referring back to the previous charts)?*<br>• *Is there a phenomenon or problem? If so, what is it? (There may be much disagreement about this question. A general consensus is that it may be dependent as to when this task is introduced. The later into a unit this is used, the less likely it would be considered a phenomenon).*<br>*This task is generally determined to be considered to not be used.* |  |
| **Explain:**<br>"After we have pre-screened a task, what can we do next?" |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"If a task that has been pre-screened warrants further review, you can use the Task Screener. This is a more-detailed look into the task itself. It takes these four criteria and allows for a deeper analysis of each."<br><br>*Facilitator Notes:*<br>*Participants should have copies of the both the Task Screener and the task "Natural Hazards."* |  |
| **Explain:**<br>"In order to give you a sense of how this screener is used, each of you will look at a single indicator. We will then jigsaw with other groups so that all information within the tool can be shared."<br><br>*Facilitator Notes:*<br>*Four groups, each with the same number of people, will focus on a single indicator. After 10 to 15 minutes of analysis, individuals will jigsaw to share the findings from their indicator. Allow approximately 10 minutes for sharing of their findings.* |  |
| *Facilitator Notes:*<br>*Lead a discussion about the findings from the group. Some questions you may ask include:*<br>• *Would you use this task?*<br>• *What adjustments would you make?*<br>• *How could you see this tool being used?*<br><br>*At this point, you may wish to share the annotated version of this task, as analyzed by a group of experts (*https://www.achieve.org/natural-hazards).<br><br>**Note: We know that an in-depth analysis takes time. It may be helpful for teachers to use this tool to analyze common tasks as a starting point. As they become more comfortable with its use,* |  |

| Facilitator Notes | Accompanying Slide(s) |
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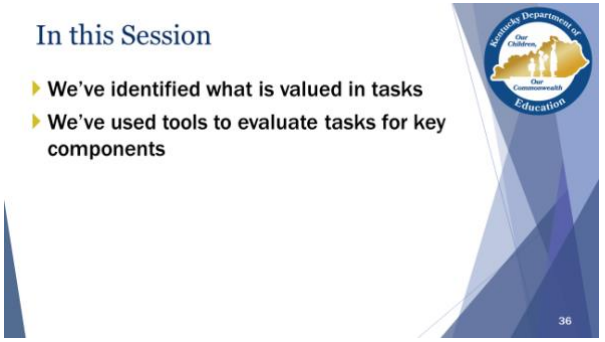
| *and familiar with the criteria, they may then wish to look at individual tasks. In any case, it should be emphasized that these tools are available to use so that teachers are assured that any task, especially those that are freely available on-line, meet the rigor and expectations of the science standards.* | |
| **Explain:**<br>"The tools we used in this session may be found here." |  |
| **Explain:**<br>"Here you can find other tasks that have been analyzed and annotated using the Task Screener. In addition, you can find resources that explain in more detail the "lessons learned" around each of the criteria." |  |
| *Facilitator Notes:*<br>*Use this slide to remind participants of the learning experiences presented within this session. You may wish to reiterate the connections between the valued criteria identified earlier with the criteria and expectations seen with the screening tools.*<br><br>*At this point, you may wish to share that the topic of the next session, Developing 3-Dimensional Tasks, will build on what was experienced in this session.* |  |

## Preparation for Session B: Developing 3-Dimensional Tasks

Task development is very complex and time-consuming. It does, however, provide educators the opportunity to delve deep into the standards. The goal of this session is to introduce a process for development. Teachers will need opportunities to continue practicing this skill so that, over time, they will find the process becomes much easier. For this session, facilitators may prefer that participants bring existing tasks (those that they use in class) and work towards revising them.

**Pre-Read**

It is recommended that participants read STEM Teaching Tool # 29 *Steps to Designing a Three-Dimensional Task (*http://stemteachingtools.org/brief/29) before the start of the session. This will provide a grounding in the learning that participants will experience.

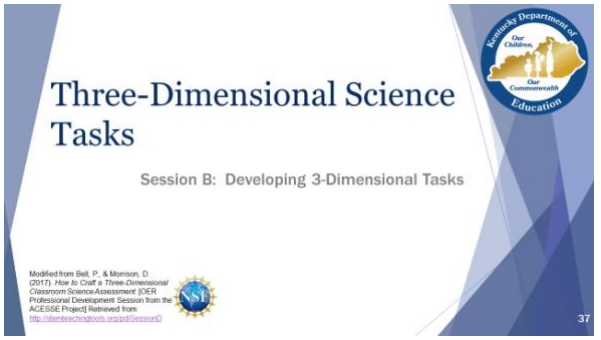
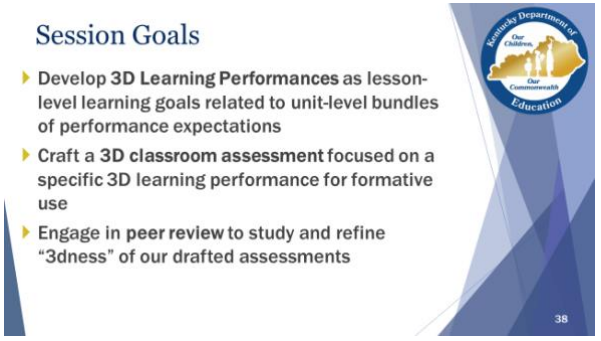
**Participant Documents Needed:**

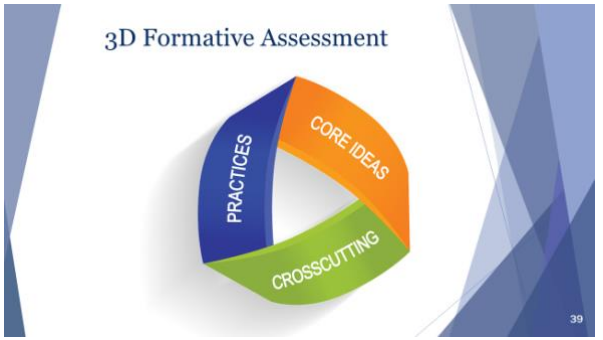
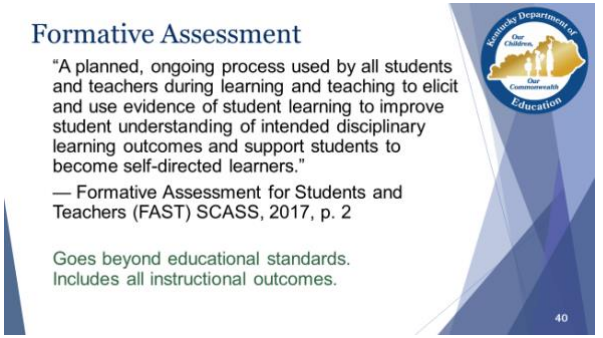
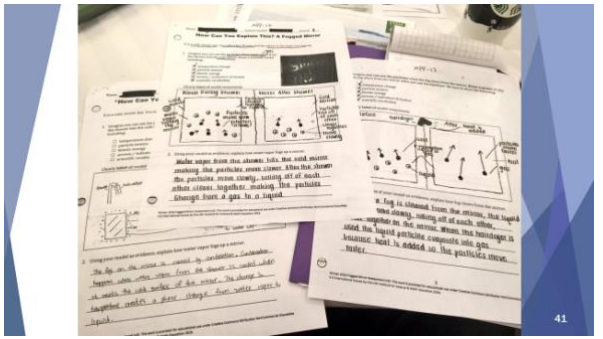
- Access to the *Kentucky Academic Standards for Science* (electronic or hard copy)
- Fogged Mirror Task (https://drive.google.com/file/d/1KuPze0nqcgitXgrPWa0l-QGdMqDuC_Q3/view) and Student Work (https://drive.google.com/file/d/0B1rvxYW3BEHWS3dTdlp0TS02WmM/view)
- Crafting a 3D Classroom Task Worksheet – 1 copy/person (https://education.ky.gov/curriculum/standards/kyacadstand/Documents/3D_Task_Design_Worksheet.docx)
- STEM Teaching Tool #30 *Integrating Science Practices into Assessment Tasks (*http://stemteachingtools.org/brief/30) – 1 copy/person
- STEM Teaching Tool # 41 *Prompts for Integrating Crosscutting Concepts into Assessment and Instruction (*http://stemteachingtools.org/brief/41) – 1 copy/person
- *Optional: What have we learned about improving assessment for learning? (*http://researchandpractice.org/resource/synthesis-paper-formative-assessment/).

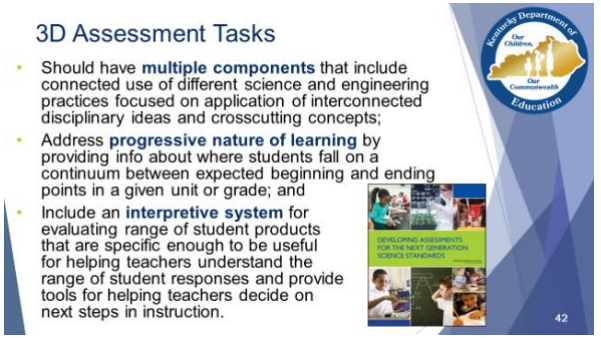
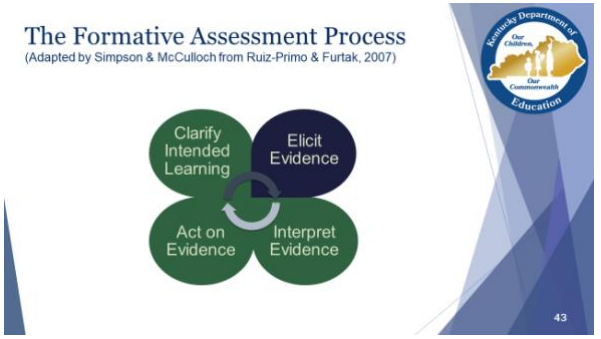
This session has been modified from Bell, P., & Morrison, D. (2017). *How to Craft a Three-Dimensional Classroom Science Assessment*. [OER Professional Development Session from the ACESSE Project] Retrieved from http://stemteachingtools.org/pd/SessionD.

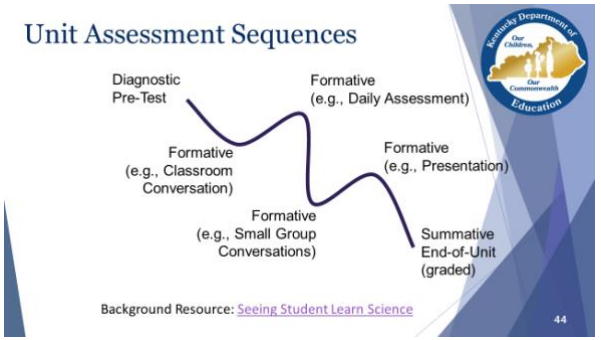
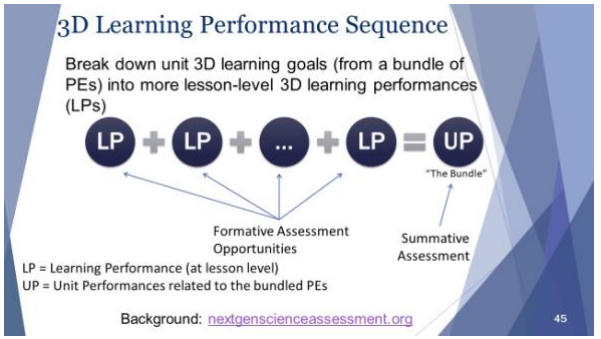
You may access other resources from the ACESSE Project (http://stemteachingtools.org/pd) that support the implementation of the *Framework for K-12 Science Education*, which is the foundation for the *Kentucky Academic Standards for Science*. All tools and resources have been developed as Open Education Resources (OER).

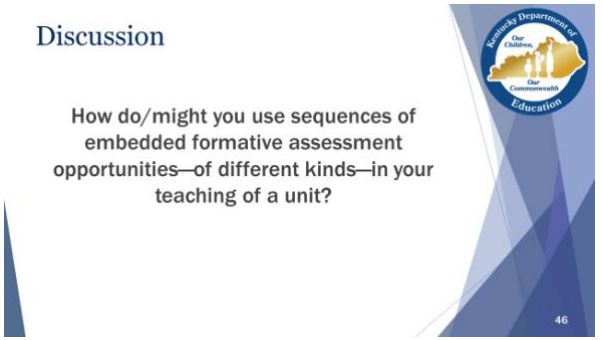
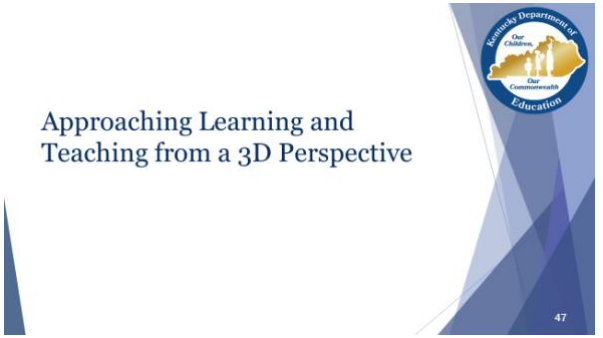
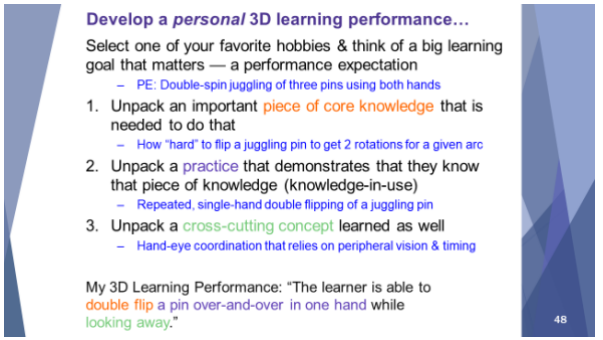
## Session B: Three-Dimensional Science Tasks: Developing 3-Dimensional Tasks

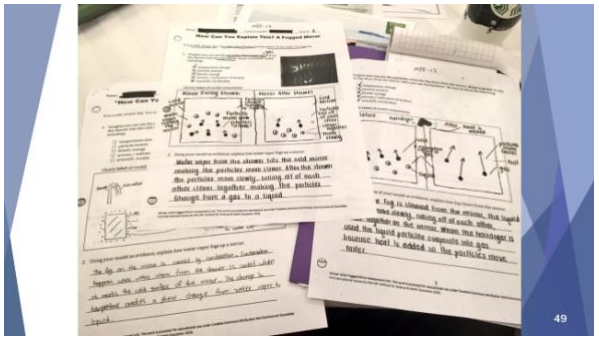
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"In this session we will go through a process that will help in developing 3-dimensional tasks. This same process may also be used to refine any existing tasks."<br><br>*Facilitator Notes:*<br>*The above message should be modified if you have asked participants to bring existing tasks to be modified.*<br><br>*This session has been modified from the ACESSE D Professional Learning Module, How to Craft 3D Science Assessments. This resource was refined through a 13-state collaboration to make this resource useful across a broad spectrum. Funding for this work was provided by the National Science Foundation (NSF).* |  |
| **Explain:**<br>"These are the three goals for this session." *Share goals*<br><br>*Facilitator Notes:*<br>*One thing to note explicitly is that this session is not about a product so much as it is about capacity building around a process of creating a product. Therefore, encourage reflection and questioning throughout this session.* |  |

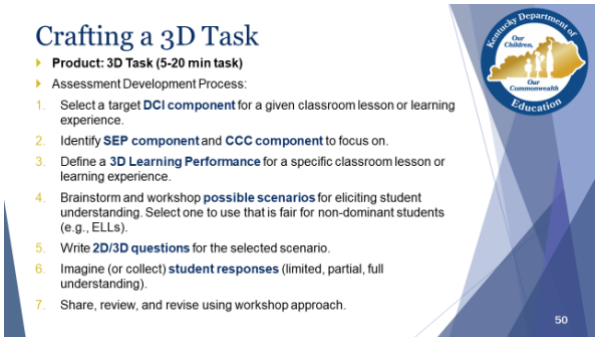
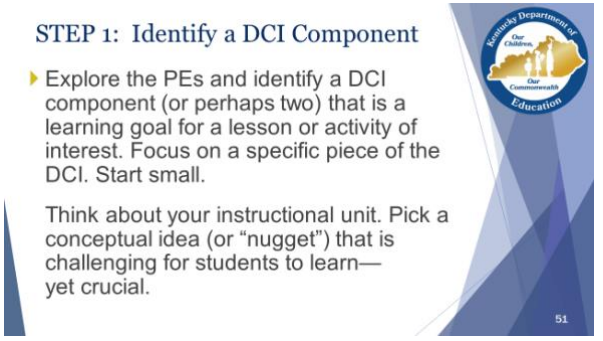
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"All three dimensions described in the Framework for K-12 Science Education need to be taken into account for horizontal coherence across curriculum, instruction, assessment and professional learning." |  |
| **Explain:**<br>"This is the definition for formative assessment we will use today to guide our work. This comes from an effort initiated by the Council for Chief State School Officers (CCSSO)."<br><br>*Facilitator Notes:*<br>*Point out that formative assessment is a process. The tasks that are developed/refined as a result of this session are a part of this process, not the formative assessment (thing). Information about the CCSSSO Formative Assessment group made be found at* https://ccsso.org/resource-library/formative-assessment-students-and-teachers-fast. |  |
| **Explain:**<br>"Instruction should include a sequence of different kinds of assessments. There are cognitive assessments, focused on gauging student's conceptual understanding, and cultural assessments focused on guiding instruction based on student's interests, experiences and goals.<br><br>Cognitive assessments are likely somewhat similar to what you're used to seeing or developing. This is a picture of just such as assessment from a project between the University of Washington's Institute for Science and Math Education, the Seattle Public Schools and Renton School District. Today's session is focused on supporting the designing of 3D cognitive formative tasks.<br><br>*Facilitator Notes:* |  |

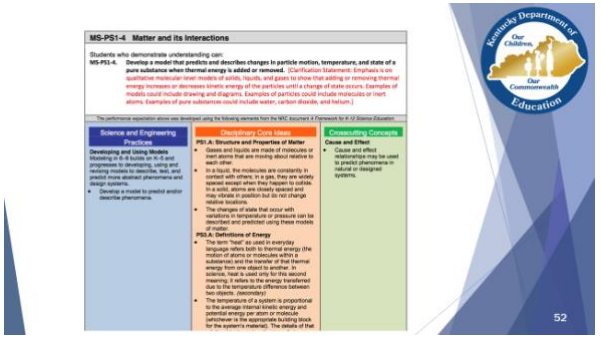
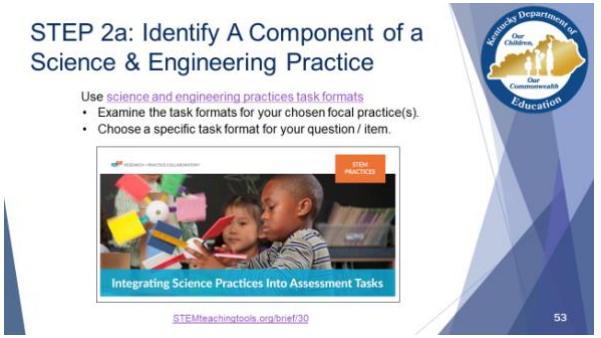
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *More information about cognitive and cultural formative assessment can be found in the research synthesis paper "what have we learned about improving assessment for learning" linked as an optional resource.* | |
| **Explain:**<br>"According to *Developing Assessment for the Next Generation Science Standards*, 3D assessment tasks should have these characteristics." *Read these*<br><br>*Facilitator Notes:*<br>*If participants have completed Session A of this module, you may wish to ask how the task screener may, or may not, be used to meet these characteristics.* |  |
| **Explain:**<br>"One model of the formative assessment process can be understood as involving four basic steps. Today we are focused on designing a written cognitive assessment that elicits evidence of how students understand the learning goals associated with the performance expectations. We will have to also spend some time clarifying the intended learning goals that are the focus of the assessment task we will craft."<br><br>*Facilitator Notes:*<br>*Dylan Wiliam, a leading expert in formative assessment, suggest five steps which includes explicit student engagement (feedback and activating students) (*https://www.dylanwiliamcenter.com/webinars/*). In addition, the CCSSO FAST-SCASS definition includes the role of students within the formative assessment process.* |  |

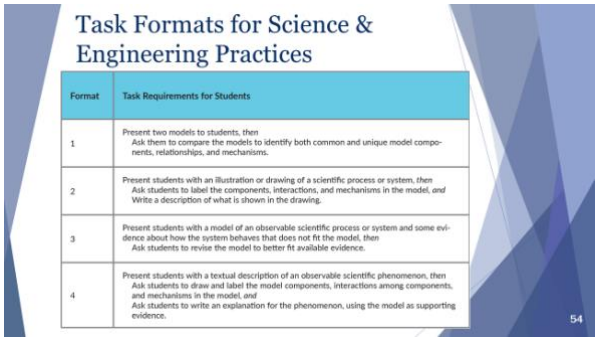
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"A sequence of formative assessment opportunities should be embedded throughout a unit in order to guide student sense-making and learning in response to their progress on the intended learning goals. You may want to start the unit with a pre-assessment that you use to gauge where students are starting. The formative assessment opportunities take many different forms. Today we are focused on designing a 3D classroom-embedded task.<br><br>Remember—formative assessment is a verb (an action), not a noun (a thing). To guide instruction, we *do* formative assessment—not give them." |  |
| **Explain:**<br>"We will be going through a process in developing/refining a 3D learning performance. Learning performances link together across a unit to represent the learning described within unit performances related to the bundled performance expectations. These connections also parallel instructional learning in lessons that collectively form the unit as well as sequences form formative assessment experiences that allow educators and students to check for understanding and adjust learning.<br><br>At each stage within a unit there is a 3D learning performance followed by some kind of learning experience that is assessed through a 3D formative task. Collectively these practices form the unit and reflect the complex 3D unit learning goals associated with the selected performance expectations.<br><br>*Facilitator Notes:*<br>*It should be noted that the process that participants will engage with for developing lesson-level learning performances can be used to develop unit level learning performances. The difference is in the grain-size of the learning performance.* |  |

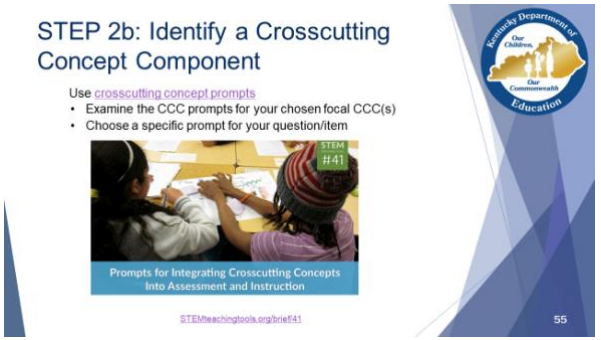
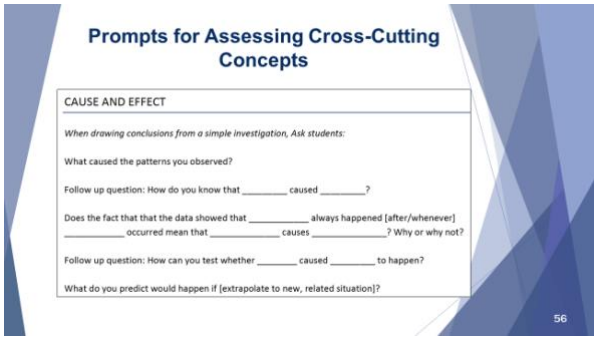
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Facilitator Notes:*<br>*Use this question to guide discussion, related to the information previously presented. Possible questions to initiate the discussion include:*<br>• *How do you involve students in the formative assessment process?*<br>• *How intentional are you in connecting the formative assessment opportunities to your identified learning goals?* |  |
| **Explain:**<br>"Now let's do some thinking about the design of 3D cognitive assessment tasks." |  |
| **Explain:**<br>"Before eliciting evidence of student thinking it is important to clarify the intended learning. At the scale of lesson planning, this process is sometimes called establishing specific learning goals or learning. These will help us identify 3D assessment claims, as you read in your pre-read *(You may wish to briefly review this reading)*. To make firm connections to the *Framework* we use the term 3D learning performances, sometimes called lesson-level performance expectations.<br><br>We first create our 3D learning performance. Then we will construct our 3D assessment task. However, some of you may already have clearly laid out 3D learning performances across your unit of instruction. This could be your opportunity to check these before moving forward with assessment development/revision. *(You may wish to change "construct" to "revise" if participants are revising existing tasks.)* |  |

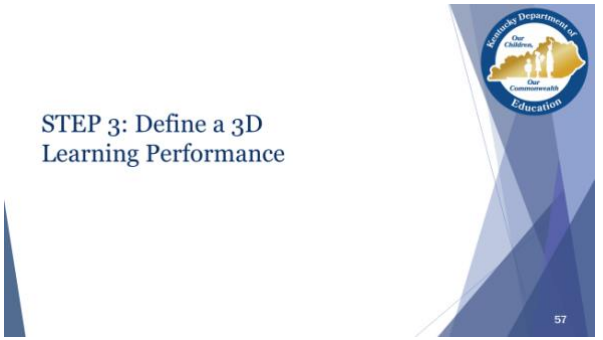
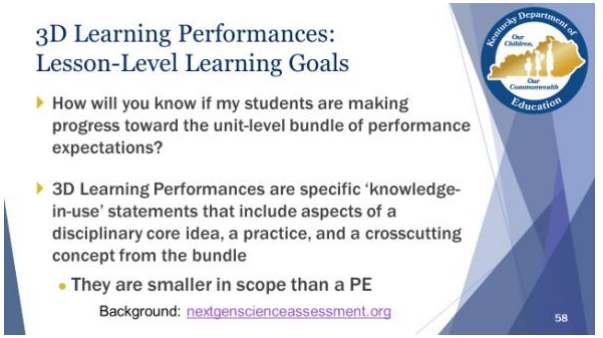
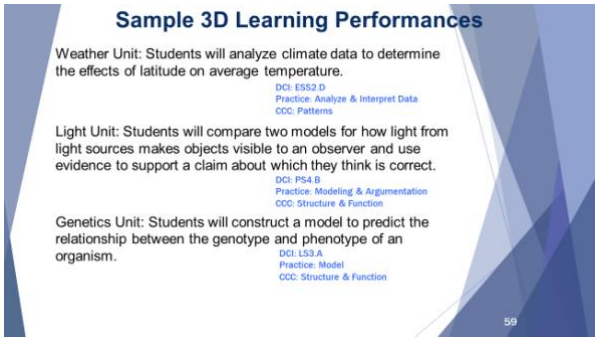
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| We'll think about lesson-level 3D learning performances by first thinking about a personal area of learning. *(Talk through the slide to demonstrate the unpacking of each dimension. You can customize the slide to be about a domain that you are an expert in by swapping out the blue text and the final 3D learning performance. Elementary teachers seem to appreciate talking about a non-science example; secondary teachers prefer to discuss a science example.)*<br><br>*Facilitator Notes:*<br>*The term "learning performance" may be new to many participants. A learning performance is synonymous with learning goals. We use the term "performance" because we wish for students to demonstrate, or "perform," their learning using the 3 dimensions of science.* | |
| **Explain:**<br>"Let's explore a sample task. You have a sample student response for the Fogged Mirror middle school classroom assessment example I showed earlier. Please take note of some specific features: 1) the scenario description, 2) learner scaffolds, 3) a sequence of 2D and 3D questions, and 4) spaces for students' multi-modal expression (diagram, text, questions). This is the kind of task we will be working towards developing."<br><br>*Facilitator Notes:*<br>*Participants should have access to the task at this time. Share that the developed task is at the end of the process.* |  |

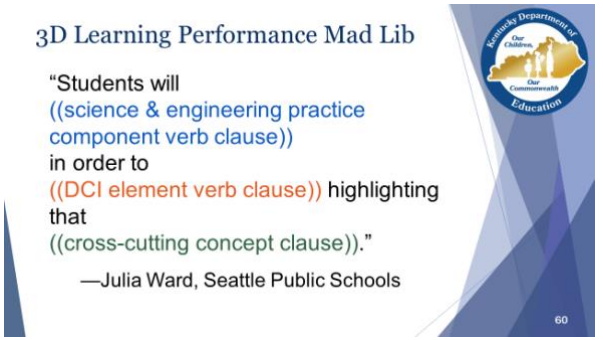
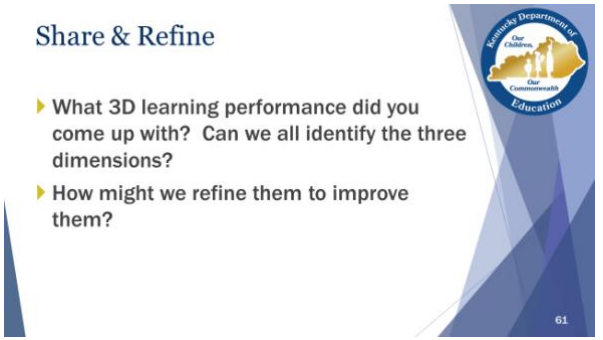
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"This is a 7 step process we will use to design 3D formative tasks at the lesson level. We are going to move through each of these steps as we design a 3D formative task for a particular lesson within a unit of study. Take a minute to look over the process and the worksheet we will be using to capture our work."<br><br>*Facilitator Notes:*<br>*The worksheet is used to record ideas and thoughts during this process. Point that the pre-reading contained 5 steps in the development process, whereas the process they will be engaging with contains 7 steps. The 2 steps that have been added are steps #3 and #4. It is important that task development is very intentional to the learning; hence the explicit development of learning performances and identification of the appropriate SEPS and CCCs.*<br><br>*If possible, have participants organize into groups by grade level, curriculum units, specific lessons and/or content domains. Teacher discourse during this development helps deepen understanding.*<br><br>*Emphasize that this is just one method by which educators may follow in developing 3D tasks. The important point, however, is that a learning performance/goal/objective be identified first, with tasks designed to provide evidence of student attainment towards that goal.* |  |
| **Explain:**<br>"We want to focus on designing/revising a task that is useable and 'gets at' a component of the standard."<br><br>*Facilitator Notes:*<br>*Participants should identify a standard, or bundle of standards, that drive their unit of study. Once those are identified, participants review the DCI components for each of those standards in order to determine a specific concept or conceptual relationship they wish to focus upon.* |  |

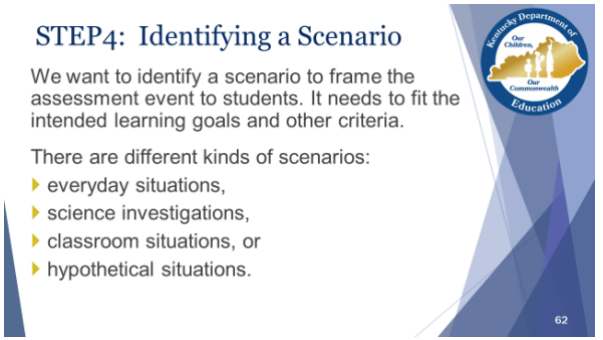
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *You may wish to use the next slide as an example and then come back to this slide. Allow approximately 5-10 minutes of work time.* | |
| **Explain:**<br>"Here's one of the middle school performance expectations for physical science that is part of the bundle driving a unit of study. The "Fogged Mirror" task we previously looked at was developed with the desired conceptual understanding in mind. Looking at the task, which DCI component was the focus?"<br><br>*Facilitator Notes:*<br>*The main focus of this task is the 3rd bullet of PS1.A along with the secondary DCI PS3.A, as it is related to PS1.A.* |  |
| **Explain:**<br>"The science and engineering practices are a central element of the 3D learning model. They are the foundation on which conceptual knowledge is developed and applied. They are the means by which students make sense of natural phenomena, or build solutions to problems, through sustained investigations.<br><br>*Facilitator Notes:*<br>*Participants should have access to STEM Teaching Tool #30 Integrating Science Practices into Assessment Tasks.* |  |

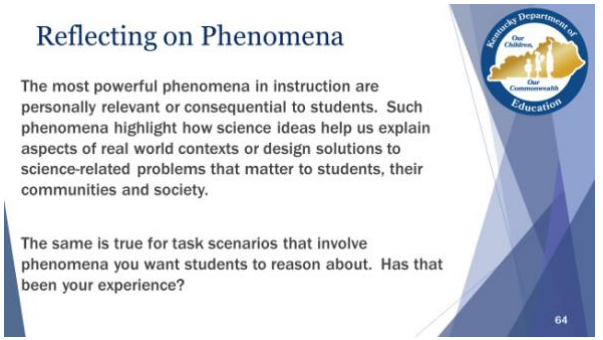
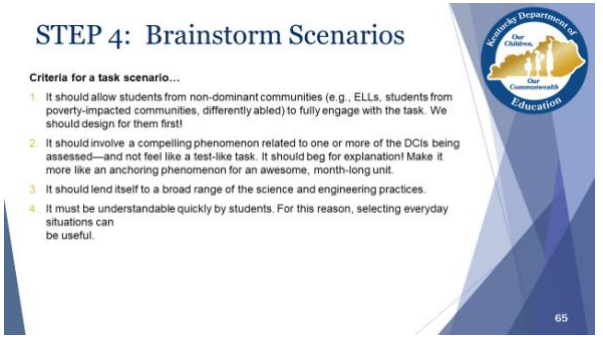
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"This tool offers between four and eight possible task formats for each of the science and engineering practices listed in the *Framework*. The task formats can give you specific ideas about how to craft questions that engage students in the practice in question. The task formats are roughly ordered from less to more cognitively complex. Think of them as blueprints for developing tasks that require students to engage in a practice to show what they know.<br><br>You may want to focus on finding a task format for the practice included in your performance expectation, but that is not necessarily the case as students can express their understanding of concepts through other practices. **The SEP you focus on should be the one that makes the most sense for your task.** *(Emphasize this statement)*<br><br>Find the page that is for your specific SEP. *Point out the titles of the different practices at the top of the task formats and describe how they go from lower to higher cognitive complexity from the top to the bottom of the page.* Now take a few minutes to go through your practice and select a particular task format that you want to use in building your 3D task. This is typically the starting point for you as you begin to frame a cluster of questions. As you identify a sequence of assessment questions you will likely flow across a range of practices that are coherent in terms of student sense-making."<br><br>*Facilitator Notes:*<br>*Participants will likely prefer to choose the SEP associated with one of the PEs within their bundle. While there is nothing incorrect about this, you may wish to encourage them to think more strategically in regards as to which SEP would make the most sense for the task. Many PEs are associated with "culminating" practices, such as constructing an explanation. The task being developed, however, may be better associated with a practice that will lead to a culminating performance (i.e., asking a question).* |  |

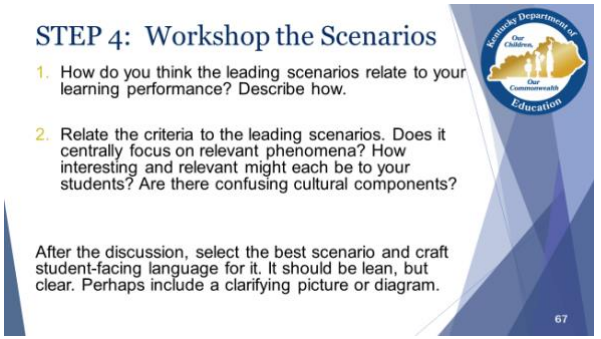
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Crosscutting concepts link the different disciplinary core ideas in science. These concepts are often in the explorations we engage students in but are not always explicitly identified or assessed."<br><br>*Facilitator Notes:*<br>*Participants should have access to STEM Teaching Tool #42 Prompts for Integrating Crosscutting Concepts Into Assessment and Instruction.* |  |
| **Explain:**<br>"This tool highlights prompts that can be used in assessments or in classroom conversation to support the learning and application of these crosscutting concepts that show up across the disciplines of science and engineering. These are some prompts for Cause and Effect." *Point these out in the screen shot.*<br><br>"Find the page that is for your selected CCC. Read through these and select particular prompt styles that might work for your 3D task."<br><br>*Facilitator Notes:*<br>*Like the SEPs, participants will likely prefer to choose a CCC associated with one of the PEs within their bundle. While there is nothing incorrect about this, you may wish to encourage them to think more strategically in regards as to which CCC would make the most sense for the task.* |  |

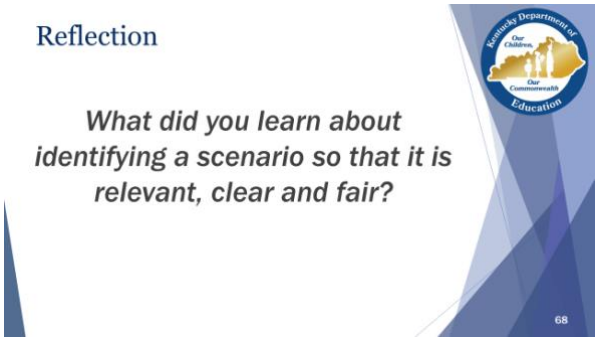
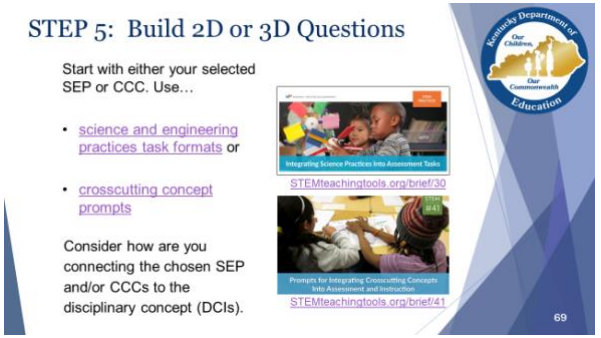
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Now we are going to pull together the work so far and formalize our 3D learning performance. Remember here that learning performances are the way in which we clarify intended learning. Learning performances are at the scale of lesson planning. This practice is sometimes called establishing learning targets, learning claims (STEM Teaching Tool #29), learning goals or learning objectives." |  |
| *Facilitator Notes:*<br>*Read the information on this slide to clarify 3D learning performances. You may wish to refer participants back to the learning performance examples shared at the beginning of this session.* |  |
| **Explain:**<br>"Here are some middle school examples of 3D learning performances and their associated DCI, SEP and CCC. See how they make direct use of the science and engineering practice task formats."<br><br>*Facilitator Notes:*<br>*Allow participants to read through these sample learning performances. You may wish to point out the CCC, some of which are implied, in each of these.* |  |

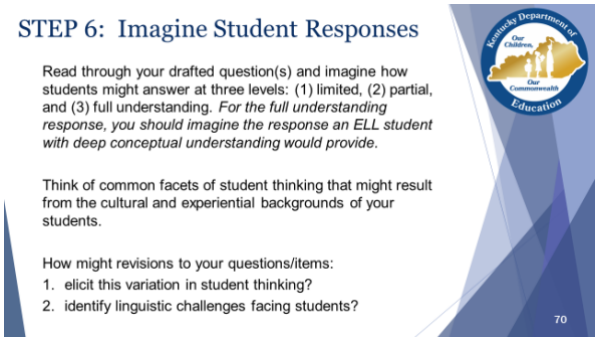
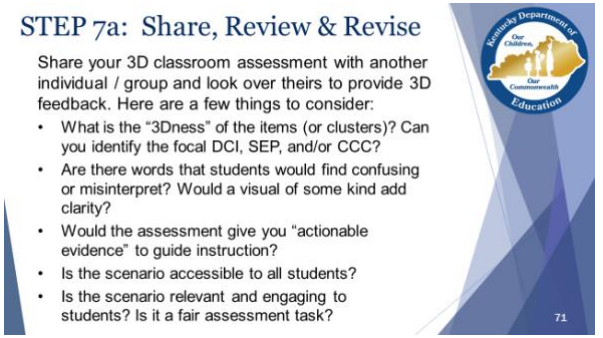
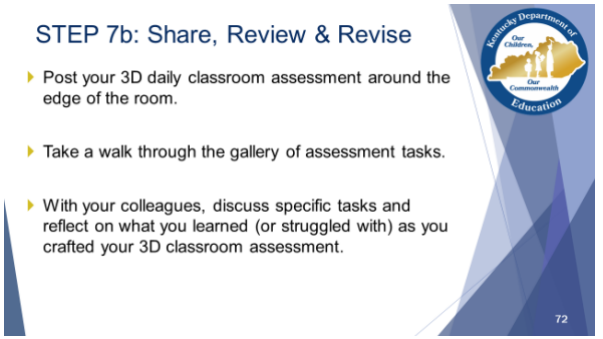
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"This mad lib strategy was developed by a middle school teacher in Seattle to help in constructing a 3D learning performance. Now it is your turn to draft a 3D learning performance you would expect students to have mastered during the instructional unit. Try to attend to all 3 dimensions."<br><br>*Facilitator Notes:*<br>*Allow participants 5 to 10 minutes to draft their learning performances, making sure they can*<br>• *Identify all 3 dimensions*<br>• *Explain how the 3 dimensions they have chosen make sense for the task they plan to develop or are revising*<br>*Remind them about the resources they have available that could help in framing their learning performances.* |  |
| *Facilitator Notes:*<br>*After participants have developed some examples, have them share in order to help refine them. This share out may be in pairs, small groups, grade/course alike groups or large group, depending on the size and makeup of your participants.* |  |

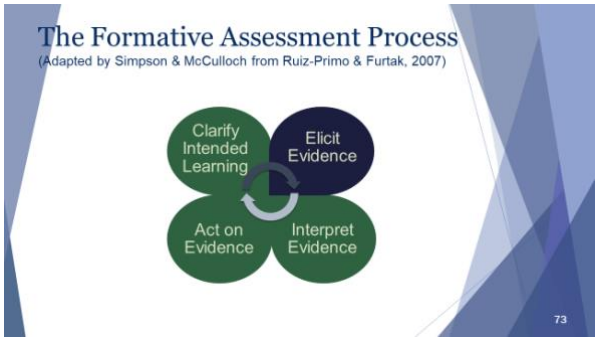
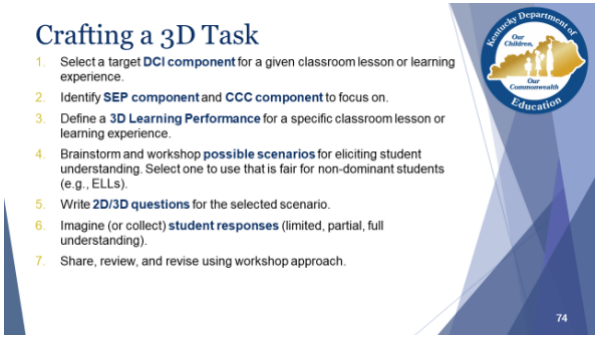
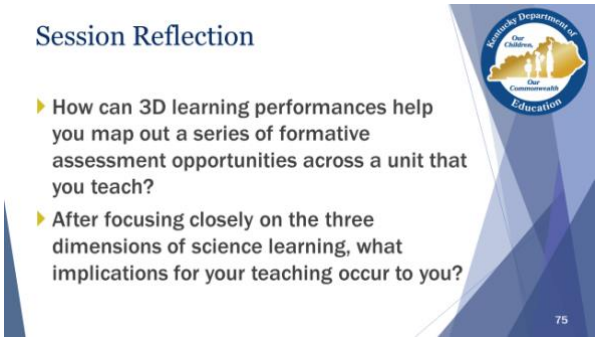
| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Task scenarios are what are commonly known as the stimulus. They become the context that students reason about."<br><br>*Facilitator Notes:*<br>*Background on different kinds of scenarios:*<br>• *Everyday Situation—invokes a common everyday situation for students to think about*<br>• *Science Investigations—describes a science study (with or without quantitative data) for students to think about.*<br>• *Classroom Situations—describes a classroom science investigation moment (or shared experience) for students to think about.*<br>• *Hypothetical Situation—describes a "what if" kind of situation for students to think about. These can be far-fetched, but need to be concrete enough to surface students' thinking.* |  |
| **Explain:**<br>"Scenarios need to relate to phenomena that are explained or predicted by the conceptual component of the DCI you are focused on.<br><br>Phenomena come in a variety of different kinds: 1) rich, anchoring phenomena that can drive unit investigations, 2) investigative phenomena that students can inquire into directly, and 3) everyday phenomena where the ideas relate to events and situations in the world. It can be useful to brainstorm phenomena related to the standard, or bundle of standards, being focused on as a way to then frame a scenario for the assessment task."<br><br>*Facilitator Notes:*<br>*Participants may find identifying quality phenomena for tasks difficult. Two resources that provide a good overview are STEM Teaching Toole #28 and STEM Teaching Tool # 42. For a more in-depth look at phenomena, and choosing them for tasks, see the Selecting Anchoring Phenomena for Equitable three-Dimensional Teaching Module.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Facilitator Notes:*<br>*Use this idea and question to lead a discussion about the use of phenomena for tasks as well as in instruction. This is an opportunity for participants to share their experiences with one another. If no one has used phenomena, you may wish to change the question to "What are your thoughts on this idea?"* |  |
| **Explain:**<br>Task scenarios can be a major source of inequity. They need to be quickly understandable by as many students as possible. Often specific scenarios from everyday life are culturally unfamiliar to some students.<br><br>It is ideal to test out scenarios with your actual students. Keep in mind these criteria as you brainstorm possible scenarios. As you continue to refine your ideas, you may also want to adjust it to make it fairer."<br><br>*Facilitator Notes:*<br>*You may wish to have a copy of these criteria available for participants as they continue with the task development. Go to the next slide in order to show them an example of how the process in identifying a scenario evolves.*<br><br>*Allow participants 7-10 minutes to brainstorm possible scenarios related to the identified DCI(s). These should be recorded on their working document.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"This is the brainstorm of possible scenario contexts that the Seattle & Renton project generated for their learning performance before they settled on the "Fogged Mirror" scenario. They used the criteria for a task scenario to settle in on it. Note the initial framing (in red) in comparison with the final description of the scenario on the student sample."<br><br>*Facilitator Notes:*<br>*After sharing this sample, go back to the previous slide so that participants will have access to the criteria during their brainstorming.* |  |
| **Explain:**<br>"Now we will share our top scenario ideas to help identify which may be best for the task you will develop. When sharing your ideas, use the questions to guide your discussions. Our goal is to help one another identify the "best" (relevant, workable, fair) scenario that should be worked on."<br><br>*Facilitator Notes:*<br>*In smaller groups, participants share out leading (2-3) scenario ideas from individual or paired work, using the questions and criteria. After groups or individuals have identified their task scenario, they should write a student-facing description (that is, the "stimulus" for the task). This work may take up to 20 minutes. Student-facing means that the student will read and engage with the information. You may think of this as "student friendly"; however, this does not imply language that is overly simplified or lacks appropriate rigor.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| *Facilitator Notes:*<br>*Ask participants to individually reflect on this question, perhaps jotting down their thoughts. Ask for volunteers to share.* |  |
| **Explain:**<br>"Now that you have your 3D learning performance and the beginnings of a scenario, use the specific task format for your SEP and the specific prompt structures from your CCC you selected in step 2 in order to write out possible questions that go with the task. You can start with either the SEP or the CCC and then build it together with the other.<br><br>Remember: student responses should give you evidence that you can use to guide your instructional choices. You are steering students toward deeper understanding through sense-making by engaging in formative assessment. You are not simply trying to see if they have the "right idea" or not. You are trying to make their thinking visible."<br>*Facilitator Notes:*<br>*As educators the thought is often "what is the correct answer." We are trying to move, however, to a questioning that will allow teachers to look at student responses and determine "what understanding does this student have?" Therefore, this part of the process may take some time as participants will need to be very intentional in their questioning.* |  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Now that you have crafted your task and questions, what response(s) would you expect?"<br><br>*Facilitator Notes:*<br>*Give participants time to craft student responses. If your context allows it is more powerful to pilot the task with students and get their responses.* |  |
| *Facilitator Notes:*<br>*Give time for participants to share and review their work thus far. You may wish to provide the Pre-Screener, used in Session A of this module, as a tool to help guide feedback.*<br><br>*There are two possible ways in which this may be accomplished.*<br>1. *7a has participants work in pairs or small groups to share and review their work. This small group share is described on this slide.*<br>2. *7b describes a whole group review process. This gallery walk sharing has participants use Post-It notes to mark suggested revisions to the task and questions.*<br><br>*Use the appropriate slide to meet the expectations of your group.* |  <br>  |

| Facilitator Notes | Accompanying Slide(s) |
|---|---|
| **Explain:**<br>"Today we have focused on clarifying intended learning goals-our 3D learning performances—and how to design fair cognitive assessments to elicit evidence." |  |
| *Facilitator Notes:*<br>*Use the information on this slide to remind participants of the process they followed in the development/revision of their tasks.* |  |
| *Facilitator Notes:*<br>*Use this slide to guide reflection. Allow participants to individually reflect, through writing, on this questions. After a few moments, facilitate a group reflection on the core learning goals of this session. If you are in a position to provide support, make note specifically on how participants respond to the 2nd question.*<br><br>*This resource was modified from the NSF ACESSE Project grant. The developers would like feedback to help them improve this resource. Please ask participants to complete this 5 minute survey. Clarify that this is information for the ACESSE team to refine the module and not about you as the facilitator.*<br><br>*http://tinyurl.com/ACESSE-D* |  |