NGSS Tool 3
Using the 5E Instructional Model to Develop a Conceptual Flow

Introduction

Tool 1 focused on using information from a NGSS page to develop a Unit Blueprint and Tool 2 involved developing evidence of learning specifications to inform classroom assessment. Tool 3 introduces an instructional model that is grounded in the research on learning and will be used in Tool 4 to design integrated instructional sequences.

The purpose of Tool 3 is to introduce and deepen teachers’ understanding of the BSCS 5E Instructional Model, a research-based approach to designing instructional sequences within a unit. Consistent with a constructivist view of learning, the 5E model offers an approach that surfaces and challenges students’ current conceptions or misconceptions, and provides activities and time for reflection to facilitate the reconstruction of ideas and abilities. The Tool 3 process asks teachers to analyze two classroom scenarios: one involves instruction that is aligned with the 5Es and the other is not. Teachers gain a deeper understanding of the 5E model and how it incorporates three-dimensional learning. Using the 5E instructional model and the Unit Blueprint from Tool 1, teachers develop a storyline that focuses on anchor phenomena. They use Tool 3 to develop guiding questions for each phase of the 5Es. Teachers also develop a conceptual flow of the science content in Tool 3 that aligns with the 5E model, all of which lay the groundwork for the design of three-dimensional learning sequences in Tool 4.

Goals and Outcomes:
- Develop understanding of the BSCS 5E Instructional Model to support planning for instruction and assessment aligned with the NGSS
- Develop a coherent storyline about phenomena and conceptual flow aligned with the NGSS

Prerequisite: Participants should have experience using Tools 1 and 2

Time and Purpose

Part 1 Introduction (Slides 1-4) [10 min]
Purpose: Provide an opportunity for participants to connect to one another and to the content of the day.

Part 2 Science Teaching and Learning (Slides 5-10) [70 min]
Purpose: Explore ideas about science teaching and learning.
Summary: Participants read and analyze two teacher scenarios.

Part 3 BSCS 5E Instructional Model (Slides 11-15) [50 min]
Purpose: Introduce the BSCS 5E Instructional Model
Summary: Participants learn about the BSCS 5E Instructional Model and revisit the Teacher B scenario to identify the “E” for each lesson.

Part 4 Tool 3 Process (Slide 16-21) [95 min]
Purpose: Learn how to develop a storyline about a phenomenon and a conceptual flow aligned with the three dimensions of the NGSS
Summary: Participants develop an understanding of anchor phenomena
during a concept attainment activity. They use sentence strips to identify the anchor phenomena and concepts from the lessons in the Teacher B scenario. They review a Tool 3 Template Example aligned with the Teacher B scenario to deepen their understanding of coherence in storyline and conceptual flow.

**Part 5** Developing a Storyline and Conceptual Flow (Slide 22-24) [135 min]

**Purpose:** Use Tool 3 to develop a storyline and conceptual flow for a 5E sequence

**Summary:** Participants review the Guide for Developing a Storyline and Conceptual Flow about a Phenomenon and apply the Tool 3 process to one of their sequences from their Tool 1 Unit Blueprint

**Total Time = 360 min (6 hours)**

**Materials:**
- Tool 3 Electronic Template (each team will need to revise the number of rows as needed)
- yellow and pink highlighters (one of each color/participant)
- Phenomena concept attainment cards (one set, printed on 11x17)
- blank sentence strips
- markers
- yellow sticky-notes

**Handouts**
- HO 1 Teacher Scenario A
- HO 2 Teacher Scenario B
- HO 3 BSCS 5E Instructional Model – Summary
- HO 4 NSTA Article by Rodger Bybee
- HO 5 Coherent Instructional Sequences Based on Anchor Phenomena
- HO 6 Tool 3 Template Example
- HO 7 Guide to Developing a Conceptual Flow and Phenomena-based Storyline

**Resources (Optional for this session)**
- R 2 *Next Generation Science Standards For States, By States Volume 1: The Standards* (2013) by NGSS Lead States
- R 3 *Next Generation Science Standards For States, By States Volume 2: The Appendices* (2013) by NGSS Lead States
Slides

Slide 1  Five Tools & Processes for NGSS
Slide 2  Planning for Teaching and Learning
Slide 3  Five Tools and Processes Graphic
Slide 4  Goals and Outcomes
Slide 5  Science Teaching and Learning (Teacher A)
Slide 6  Science Teaching and Learning (Teacher B)
Slide 7  Thinking Beyond a Lesson
Slide 8  NGSS Instructional Design
Slide 9  Research-Based Instructional Model
Slide 10  BSCS 5E Instructional Model
Slide 11  Summary of BSCS 5E Instructional Model
Slide 12  Selected Reading (article by Rodger Bybee)
Slide 13  Revisit the Scenarios
Slide 14  Science Teaching and Learning
Slide 15  Science Teaching and Learning
Slide 16  Concept Attainment
Slide 17  Phenomena and Concepts
Slide 18  Ms. Rivera’s Phenomena and Conceptual Flow
Slide 19  Tool 3 Example
Slide 20  Coherence means...
Slide 21  Coherence and Storyline
Slide 22  Your Turn
Slide 23  Sharing
Slide 24  Reflection

PD Leader Resources (NOT used by participants)

- How Students Learn Science in the Classroom (2005), The National Academies Press, Washington, D.C.
- The BSCS 5E Instructional Model: Origins and Effectiveness (pp. 113-184) in Measuring Our Success: The First 50 Years of BSCS http://www.bscs.org/estore/bscs-measuring-our-success-first-50-years
- Tool 4 HO 1 – The BSCS 5E Instructional Model

Advance Preparation:

- Communicate with participants prior to the session. Suggest that they bring a computer to complete the electronic Tool 3 Template.
- Print and copy handouts, and one set of Phenomena Concept Attainment cards
- Ensure adequate space for reading, charting, and other work in groups of 3-4. Remember to have yellow and pink highlighters (one of each color/participant) for reading the Teacher Scenarios.

Note: After the session be sure to collect the Teacher B Scenario Charts for use with Tool 4
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| **Slide 1 (1 min)** | **Display Slide 1 (Five Tools & Processes for NGSS)**  
Set the stage for the session by linking to the group’s work with Tools 1 and 2. They’ve done some planning for what students will learn, but haven’t really planned for how students will learn.  
Transition: we want to give you a chance to think individually and then together about what informs your decisions when you plan for instruction and while in the classroom. |
| **Slide 2 (6 min)** | **Display Slide 2 (Planning for Teaching and Learning)**  
Provide the quick-write prompts and give time for each participant to record a response.  
Invite participants to share their ideas with an elbow partner.  
As partners are sharing listen for words and phrases that provide insights into what participants believe about teaching and learning.  
If time permits, provide an opportunity for a whole group conversation. |
| **Slide 3 (1 min)** | **Display Slide 3 (Five Tools and Processes Graphic)**  
Briefly reorient participants to the Five Tools and Processes. Introduce Tool 3 as the focus of the session today. |
Part 2  
Science Teaching and Learning (Slides 5-10)  
70 minutes

PD Leader Note: You need to form small groups for the next activity. Count off with everyone from one to seven to form “expert groups” (seven different groups). Each “expert group” should have 3-4 participants, assuming your whole group is more than 20 participants total. Each group will read, highlight, and chart one of the lessons in Teacher Scenario A and the same number lesson in Teacher Scenario B. These “expert groups” will be used to form “home groups” in Part 4. Participants will also work in these “expert groups” during the Tool 4 session.

5. Display Slide 5 (Science Teaching and Learning: Teacher A)

Share with participants that they’ll be reading two scenarios that highlight different approaches to science instruction. Distribute HO1 (Teacher Scenario A).

Provide instructions for individuals to mark up the text for their assigned lesson as they read and for each table to create a chart.

Once each group has charted, provide instructions for a Gallery Walk to look for similarities and differences in how different groups thought about the Teacher Scenario A.

Provide a few minutes for table groups to share their findings and then invite them to record their responses to the question for individual reflection. Note that they will not be sharing their ideas now, but will later.

Goals and Outcomes
- Deepen understanding of the BSCS SE Instructional Model to support planning for instruction and assessment aligned with the NGSS
- Develop a coherent storyline about phenomena and a conceptual flow aligned with the NGSS

4. Display Slide 4 (Goals and Outcomes)

Share the goal for the day and connect to ideas shared by participants in response to the quick-write prompt.
6. Display Slide 6 (Science Teaching and Learning: Teacher B)

Share with participants that now they’ll read the Teacher Scenario B and follow the same process. Distribute HO2 (Teacher Scenario B).

Once each group has charted, provide instructions for a Gallery Walk to look for similarities and differences in how different groups thought about Teacher Scenario B. You may want to facilitate the gallery walk, depending on the size of your group.

Provide a few minutes for table groups to share their findings and then invite them to record their responses to the question for individual reflection. Note that they will now share their ideas about both scenario A and B.

Expect to hear table groups talk about how each scenario represents a different approach to instruction. Scenario A is a more teacher-centered approach to learning and teaching science. Mr. Coles does most of the meaning-making during his lessons. Scenario B represents a more student-centered approach to learning and teaching science. Ms. Rivera provides more opportunities for her students to make meaning from their experiences. Although Mr. Coles would score high using Danielson’s Framework for Teaching, Ms. Rivera’s approach to instruction is more consistent with inquiry-based teaching and constructivist learning.

Transition: Note that the purpose of the two scenarios was for us to have a common experience to help us explore our thinking about instruction that is aligned with the goals and vision of the NGSS. Link to ideas generated by the groups as they consider how they would describe each classroom. If they mention student-centered, integrated or coherent instruction, highlight this comment and use these types of statements to transition to a discussion about NGSS aligned instruction.

7. Display Slide 7 (Thinking beyond a Lesson)

The NGSS requires that we expand conceptions about instruction from “the lesson” to an integrated instructional sequence in order to translate these new standards to classroom instruction. Based on a synthesis of research findings about the role of laboratory experiences, the NRC found these types of experiences, when integrated with other instruction, produce more effective learning sequences for students and enhance student achievement of learning goals.

The slide provides the NRC’s definition of integrated instructional
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<td><strong>NGSS Instructional Design</strong>&lt;br&gt;1. Instructional materials are designed with clear performance expectations in mind&lt;br&gt;2. Learning experiences are thoughtfully sequenced into the flow of classroom science instruction&lt;br&gt;3. Learning experiences are designed to integrate learning of science concepts (DCI and CCC) with learning about the SEP&lt;br&gt;4. Students have opportunities for ongoing reflection, discussion, discourse, &amp; argumentation&lt;br&gt;Ryhee, 2014</td>
<td>8. Display <em>Slide 8 (Principles of Instructional Design)</em>&lt;br&gt;The three dimensions of the NGSS compliment the NRC’s conclusion for integrated instructional sequences. The slide provides four principles of instructional design that contribute to attaining learning goals as stated in the NGSS according to Rodger Bybee (2014).&lt;br&gt;The BSCS 5E Instructional Model serves as an understandable and manageable application of an integrated instructional sequence.</td>
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<td><strong>Research-Based Instructional Model</strong>&lt;br&gt;NRC’s How People Learn&lt;br&gt;Meta-analysis of 30 years of research&lt;br&gt;BSCS 5E Instructional Model&lt;br&gt;Developed by BSCS for a Curriculum project&lt;br&gt;NRC’s Curriculum Framework: Framework for the NGSS</td>
<td>9. Display <em>Slide 9 (Research-Based Instructional Model)</em>&lt;br&gt;Share with participants that the BSCS 5E Instructional model supports the vision of the Framework and it’s grounded in the research on how people learn.</td>
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<td><strong>BSCS 5E Instructional Model</strong>&lt;br&gt;Is a specific example of the general architecture for an Integrated Instructional Sequence&lt;br&gt;An Engage Lesson&lt;br&gt;Exploration Lesson(s)&lt;br&gt;Explanation Lesson(s)&lt;br&gt;Elaboration Lesson(s)&lt;br&gt;Evaluation Lesson(s)&lt;br&gt;Ryhee, 2014</td>
<td>10. Display <em>Slide 10 (BSCS 5E Instructional Model)</em>&lt;br&gt;The BSCS 5E Instructional Model provides a specific example of the general architecture for an integrated instructional sequence.&lt;br&gt;Use an integrated instructional sequence as the basis for a curriculum unit.&lt;br&gt;While lessons serve as daily activities, design the sequence of lessons using a variety of learning experiences that contribute to the learning outcomes described using the three dimensions of the NGSS.&lt;br&gt;Transition: Note that we want to learn more about the BSCS 5E Instructional Model can help us translate the NGSS into the classroom in ways that are student-centered, coherent, and incorporate all three dimensions as well as the PEs.</td>
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<td>Slide 11 (5 min)</td>
<td>11. Display <strong>Slide 11 (5E Instructional Model)</strong> and distribute <strong>HO3 (BSCS 5E Instructional Model – Summary)</strong>. Share with participants that we have incorporated the three dimensions into this summary description of the BSCS 5E Instructional Model. Note the references to the DCIs, SEPs, and CCCs in the descriptions of certain phases of the model. While the DCIs and SEPs are in the foreground in the <em>Explore</em> and <em>Explain</em> phases, the CCCs are in the foreground of the <em>Elaborate</em> phase.</td>
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<td>Slide 12 (20 min)</td>
<td>12. Display <strong>Slide 12 (Selected Reading)</strong> Provide instructions for the reading and distribute <strong>HO4 (NSTA Article by Rodger Bybee)</strong>. Remind participants that the room will be silent for reading. Offer time for participants to discuss the reading in their small group. Capture key ideas from the whole group. Focus energy on the characteristics of the 5E Instructional Model including descriptors of the phases and overall purpose of the Model.</td>
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| Slide 13 (15 min) | 13. Display **Slide 13 (Revisit the Scenarios)** Display the first question. Everyone should agree that Teacher B is using the 5Es. Next, groups will make sense of the 5Es as they apply their thinking to their charts developed from the reading by labeling each E on a sticky-note with a marker or sharpie. They should find many examples of actions consistent with each phase, but potentially a few inconsistencies. Most groups will easily identify Lesson 1 as the Engage and Lessons 6 and 7 as the Elaborate and the Evaluate. Suggest the options below if groups are struggling to identify the middle lessons (2 – 5):  
- Explore Explore Explain Explain  
- Explore Explain Explore Explain (this is the correct answer!)  
- Explore Explore Explore Explain  
- Explore Explain Explain Explain  
- Explore Explain Explain Explain |
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| **Slide 14 (5 min)** | **14. Display Slide 14 (Science Teaching and Learning)**  
Think back to the research on *How People Learn* and *How Students Learn Science in the Classroom*  
- How does the BSCS 5E Instructional Model reflect the themes from this research?  
Discuss the question on the slide. |
| **Slide 15 (5 min)** | **15. Display Slide 15 (Science Teaching and Learning).** Ask one participant to read the quote to the whole group.  
Discuss the question the slide. Help participants to make connections between the BSCS 5E Instructional Model and how it may help teachers achieve the vision of science education set forth in the Framework. |

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**Part 4  Tool 3 Process (Slides 16-21)  95 minutes**

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| **Slide 16 (30 min)** | **16. Display Slide 16 (Concept Attainment)**  
Describe what is going to happen and why. Link to goals for the day.  
Start out silently and have people focused on thumbs up/down/side based on the question: *Do you think you can predict “yes” or “no.”* Place each statement on the wall under yes or no. Do the first 4 cards, then ask for thumbs. Highlight that the question will change over time!  
Once quite a few participants feel pretty confident in their ability to predict yes or no, change the question and have them use their thumbs based on the new question: *Is this statement a “yes” or “no.”* Still no talking!  
By card 7 (hopefully), ask participants to share why they are thinking what they are thinking. Might have them talk with a |
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<td>neighbor for another few. By about card 10, have them use their thumbs for the following question: <em>Can explain which place it goes and why?</em> At some point, start to chart their criteria for saying a statement is a yes and it’s usually during this time when someone understands that you are sorting based on phenomena. Use the statements for discussion carefully so you keep moving the group forward in their shared understanding. A good follow-up question is: What would make this a more clear phenomenon?</td>
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<th>Phenomena and Concepts</th>
<th>17. Display Slide 17 (Phenomena and Concepts). Distribute HO5 (Coherent Instructional Sequences Based on Anchor Phenomena) and have participants read, then discuss with an elbow partner. Group discussion about what is similar between their rules and the ideas on the handout. Discuss the questions on the slide with participants. If participants are still struggling, brainstorm other examples of anchor phenomena to help participants clarify their understanding. Emphasize key points about phenomena, such as they relevant to the particular students, they need an explanation, and they have data to engage students. Concepts are complete sentences that show relationships. Need information about what students should know or learn.</th>
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<td>17. Display Slide 17 (Phenomena and Concepts). Distribute HO5 (Coherent Instructional Sequences Based on Anchor Phenomena) and have participants read, then discuss with an elbow partner. Group discussion about what is similar between their rules and the ideas on the handout. Discuss the questions on the slide with participants. If participants are still struggling, brainstorm other examples of anchor phenomena to help participants clarify their understanding. Emphasize key points about phenomena, such as they relevant to the particular students, they need an explanation, and they have data to engage students. Concepts are complete sentences that show relationships. Need information about what students should know or learn.</td>
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<th>Ms. Rivera’s Phenomena and Conceptual Flow</th>
<th>18. Display Slide 18 (Ms. Rivera’s Phenomena and Conceptual Flow). Follow the directions on the slide to form two or three bigger “home groups” comprised of 1-2 participants from each lesson “expert group.” New groups work together to identify the phenomenon and concepts in Ms. Rivera’s sequence – participants should record these, and post them in order to compare their storyline to the other larger group’s storyline. Debrief the experience with participants after. What was challenging, what “aha” moments did they experience, etc.</th>
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<td>Form a larger group comprised of an “expert” or two from each of the seven Ms. Rivera lessons. With your new group, use sentence strips to identify: The phenomenon of the instruction sequence The concept for each of the 7 lessons</td>
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| Slide 19 (10 min) | 19. Display **Slide 19 (Tool 3 Example)** and distribute **HO6 (Tool 3 Template Example)**  
Give participants a few minutes to compare their storyline to Ms. Rivera’s – where are they similar, where do they differ.  
Ask participants to look at the conceptual flow – point out that on the tool, the concepts are written as statements that use text from the DCIs and CCCs while the SEPs have their own column.  
Give participants a few minutes to read over the conceptual flow – ask them to share examples of ideas and phrases that come directly from language in the NGSS. |
| Slide 20 | 20. Display **Slide 20 (Coherence means...)** and **Slide 21 (Coherence and Storyline)**  
Allow participants to read the text on each slide silently. Give them a moment to think to themselves about how the Tool 3 process helps provide support to help them accomplish instructional coherence.  
Do a quick turn & talk and ask for any lingering questions. |
| Slide 21 (5 min) | **Coherence and Storyline**  
A storyline is situated in a context that drives student engagement and motivation about a phenomenon or problem.  
In a coherent storyline, students engage in making sense of phenomena or designing solutions to problems. |

**Part 5**  
**Developing a Storyline and Conceptual Flow (Slide 22-24)**  
(135 min)
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| Slide 22 (120 min) | **Your Turn**  
- Read the Guide to Developing a Conceptual Flow and Phenomena-based Storyline  
- Review the three dimensions and PEs from the instructional sequence you worked with in Tool 2 to develop your EoLS.  
- Follow the steps in the Guide and work with your group to develop a coherent SE sequence  
- Transfer your work to the electronic Tool 3 Template.  

21. Display Slide 22 (Your Turn) and distribute HO7 (Guide to Developing a Conceptual Flow and Phenomena-based Storyline)  
Give participants a few minutes to read through the Guide and answer any initial question they have.  
They should have about 2 hours to develop their storyline and conceptual flow for one sequence from their Tool 1 Unit Blueprint – this should be the same sequence they developed their EoLS for in Tool 2.  
Participants should work make their thinking and their work public so encourage them to use chart paper and sentence strips. Save some time at the end for groups to transfer their work into the electronic Tool 3 Template.  
Share with participants that the process is iterative, they may work on storyline, then conceptual flow and then go back and revise parts of their storyline, etc. as they work. This will continue in Tool 4 – they may continue to revised and refine their Tool 3 during the Tool 4 process as well. |
| Slide 23 (10 min) | **Sharing**  
- Share your storyline and conceptual flow with another team!  

22. Display Slide 23 (Sharing)  
Partner up teams with each other and have one group share their storyline and conceptual flow with another group, then switch.  
NOTE: If teams are struggling, you may prefer to have one group that has been successful share their Tool 3 with the entire room. |
| Slide 24 (5 min) | **Reflection**  
- Talk with a new partner  
  - What do you think will be your greatest challenges in planning lessons using the BSCS SE Instructional Model?  
  - What are the similarities and differences between using the BSCS SE Instructional Model to guide classroom practice and what you are doing now?  

23. Display Slide 24 (Reflection).  
Summarize the conversation of the group as one possible closing. If you have more time, use a more formal closing.  
Be sure to collect the Scenario B charts developed by table groups. This information will be used in the session focused on Tool 4. |
Evolution
1. Evolution
No - what do you want kids to know about evolution? This is a topic and does not say what you want them to know or understand.
Long distance runners have more mitochondria than non-athletes.
2. Long distance runners have more mitochondria than non-athletes.

Organisms interact with their environments and other organisms.
3. Organisms interact with their environments and other organisms.

No - concept
When wolves were reintroduced to Yellowstone in 1995, they had a number of different effects on the ecosystem.
4. When wolves were reintroduced to Yellowstone in 1995, they had a number of different effects on the ecosystem. Phenomenon. Makes me wonder about the effects & causal mechanism.
The Irish potato famine showed why asexual reproduction can be problematic.
5. The Irish potato famine showed why asexual reproduction can be problematic.

No - this is something that can be explained pretty easily in a short time period and does not involve multiple concepts. It is not complex enough to be a phenomenon for MS LS.
Chloroplasts contain chlorophyll, which causes plants to appear green. Other pigments cause other colors.
6. Chloroplasts contain chlorophyll, which causes plants to appear green. Other pigments cause other colors.

No - not complex, not generalizable, and it would not take much time to learn. Implies the causal mechanism.
There are fewer carnivores than herbivores and fewer herbivores than producers in a food web.
7. There are fewer carnivores than herbivores and fewer herbivores than producers in a food web.

Phenomenon. Might be more interesting if it were more specific. Makes me wonder about THIS pattern.
A person from the coast is breathing hard and has a fast heart rate while hiking in the mountains of Colorado.
8. A person from the coast is breathing hard and has a fast heart rate while hiking in the mountains of Colorado.

Phenomenon. Wonder why!
Some important parts of the circulatory system are the heart, blood vessels, and blood while some important parts of the respiratory system are the lungs, bronchi, and alveoli.
9. Some important parts of the circulatory system are the heart, blood vessels, and blood while some important parts of the respiratory system are the lungs, bronchi, and alveoli.

No (does not involve multiple dimensions or concepts that students have to link); just information
Cells have parts, called organelles, that carry out specific functions to help the cells work properly within the body.
10. Cells have parts, called organelles, that carry out specific functions to help the cells work properly within the body.

No - concept; no real link to causal mechanisms or wondering why...nothing to figure out.
Two parents with A type blood wonder why their child has O type blood.
11. Two parents with A type blood wonder why their child has O type blood.

Phenomenon; goes beyond a single lesson; makes me wonder why
A drought in the Galapagos led to birds that had larger beaks than those in generations before.
12. A drought in the Galapagos led to birds that had larger beaks than those in generations before.

Phenomenon
Jaguars can be black or spotted.
13. Jaguars can be black or spotted.

No (could be phenomenon, but I feel like it is not specific enough about the context, why this happens is pretty easily searchable online, and students do not necessarily have to link many ideas to explain the it); not enough of a puzzle; not compelling enough.
A 10-year-old has been having diarrhea, fatigue, and anemia.
14. A 10-year-old has been having diarrhea, fatigue, and anemia.

Phenomenon; Relatable & observable; wonder why
The immune system has several lines of defense that interact with other body systems to protect the body.
15. The immune system has several lines of defense that interact with other body systems to protect the body.

No - concept; could be turned into a phenomenon
The life expectancy of people with cystic fibrosis has increased greatly over the last twenty years.
16. The life expectancy of people with cystic fibrosis has increased greatly over the last twenty years.

**DISCUSSION STATEMENT**

This one very much depends on the context. Could be a “no” because it is more of a fact. Could be a phenomenon because it is something that students could use data to explain and link a number of concepts. Phenomena; could be surrounded by data/readings; multiple causal mechanisms.
All muscle cells contain mitochondria.
17. All muscle cells contain mitochondria.

**DISCUSSION STATEMENT**

No, because it is too narrow, does not require understanding of multiple concepts. But, could be presented as a phenomenon if is done so that students are comparing mitochondria in muscle cells compared to other kinds of cells and explaining why there would be differences.
If a person uses more energy than they take in, they lose weight.
18. If a person uses more energy than they take in, they lose weight.

**DISCUSSION STATEMENT**

Phenomenon because it is relevant to lives, data that students can study, complex ideas about using and taking in energy. But, could be presented as a simple fact or math problem in which case it would not be a phenomenon.; GIVES us too much...what’s to figure out?
Pilobolus is a fungus that is less than 1 cm tall and can shoot a spore 2 meters. This involves acceleration from 0 to 20 km/h in only 2 µs, subjecting it to over 20 000 G, equivalent to a human being launched at 100 times the speed of sound.
19. Pilobolus is a fungus that is less than 1 cm tall and can shoot a spore 2 meters. This involves acceleration from 0 to 20 km/h in only 2 µs, subjecting it to over 20,000 G, equivalent to a human being launched at 100 times the speed of sound.

**DISCUSSION STATEMENT**

No - what are you trying to explain? Although this is interesting--which is what participants may be basing their ideas about phenomena on at this point--there is not anything that you need to explain based on the statement that is there. It could easily be changed to make it more about how shooting the spore represents a reproductive strategy and then it would be more phenomenon-like.
The circulatory and respiratory systems work together to provide the body with oxygen and remove waste.
20. The circulatory and respiratory systems work together to provide the body with oxygen and remove waste.

No - concept
A pond in a community has unexpectedly turned green and it is affecting tourism in the area.
21. A pond in a community has unexpectedly turned green and it is affecting tourism in the area.

Phenomenon
A small change in a DNA sequence can lead to a life threatening disease.
22. A small change in a DNA sequence can lead to a life threatening disease.

No - concept. It’s telling us a “weak” causal mechanism; could be better presented better.
Neighboring farmers disagree about whether a certain type of seed or breeding specific plants will lead to tomatoes that stay fresh longer.
23. Neighboring farmers disagree about whether a certain type of seed or breeding specific plants will lead to tomatoes that stay fresh longer.

Phenomenon
Male peacock spiders have colorful backs and perform a dance in a way that makes them unlike any other animal in the world.
24. Male peacock spiders have colorful backs and perform a dance in a way that makes them unlike any other animal in the world.

Phenomenon