Achieve

SCIENCE TASK ANNOTATION

ANNOTATION KEY

EQUITY
Supporting a wide range of diverse students.

SCENARIOS
Information provided to elicit performances.

SEPs
Opportunities to demonstrate science and engineering practices.

DCIs
Opportunities to demonstrate understanding of disciplinary core ideas.

CCCs
Opportunities to demonstrate understanding of crosscutting concepts.

SENSE-MAKING
Opportunities for reasoning about phenomena and problems.

ASSESSMENT PURPOSE
Highlights how the task features connect to intended assessment use.

SEET

Student Electronic Exit Ticket: A short assessment at the conclusion of a lesson in a storyline unit. These examples come from the evolution unit, "Why Don't Antibiotics Work Like They Used To?"

SEET QUESTIONS

LESSON 5

Develop and use a (mathematical) model generate data to support explanations of *how the spots of bacteria appeared so quickly in the Petri dishes to predict the scale and quantity of population size of bacteria on our Petri dishes.*

What we figure out:

- Bacteria are microscopic; an individual bacterium is made of one cell
- There is variation in what different types of bacteria look like.
- A bacteria colony is actually made of many individual bacteria.
- When the colony grows, it is due to one old bacterium growing in size and then splitting in half producing two bacteria, so the two new bacteria are the same size as the original old bacterium (reproduction: 1 bacterium becomes 2 total bacteria, not 3 total bacteria).
- When we plotted the numbers on a graph, we got an exponential growth curve.
- But this raised a new question: Will the bacteria on our petri dishes continue to grow this quickly forever?

This information is provided to the teacher and supports the interpretation of student responses throughout the SEET.

CONNECTION TO ASSESSMENT PURPOSE

SEET (CONTINUED)

Proposed SEET Questions

The population of a bacteria culture doubles every 2 minutes.

Approximately how many minutes will it take for the population to grow from 1,000 to 500,000 bacteria?

a. 10

b. 12

c. 18

(Overall) These questions are closely-tied to the curriculum unit, surfacing whether students understand and can use specific ideas developed in the lesson, rather than revealing proficiency on PE, SEP, DCI, or CCC-level targets. This is appropriate for the purpose of the assessment.

CONNECTION TO ASSESSMENT PURPOSE

This question is not situated around a specific phenomenon or problem, but rather a general rate. It is unlikely that this can support sense-making using the three dimensions; rather, it will be able to support a very specific, targeted understanding.

SCENARIOS **SENSE-MAKING**

Successfully responding to this question requires that students have the necessary math skills—while the math is an important skill associated with the SEP "Using mathematics and computational thinking", this question does not reach the level of asking students to demonstrate the SEP because they do not use mathematical thinking to support a scientific understanding (DCI or phenomenon).

SCENARIOS **SEPs**

If bacteria are much too small to see, why can we see colonies in the petri dishes after only a few days?

a. Because when bacteria split, each new bacterium is twice as big as the old.

b Because of the speed with which bacteria grow.

c. Because the conditions in the petri dish are favorable to bacteria growth.

Successfully answering this question requires that students understand that the reason we can see colonies is because of how quickly the bacteria reproduce, rather than individual bacteria growing larger. This is an example of students developing an understanding of the concepts related to scale, proportion, and quantity.

CCCs

SEET (CONTINUED)

A pond has algae (an aquatic plant) growing on the surface of the water. On day 1, it covers 1/4 of the area of an 800 m^2 pond, about 200 m^2. The area it covers doubles in size every day. After 6 days, how much of the area of the pond will be covered?

a. 800 m^2, because that is as big as an area that can be covered.

b. 12,000 m^2, because that is equal to 200 m^2 x 6 days.

c. 64,000 m^2, because that is $(200\ m2)^6$.

This question distinguishes between students who can do the math and those who 1) read the whole question and all the answers, and 2) understand that the whole pond would be covered, once it hits 800 m2. Its not clear that this is surfacing ideas connected to any specific DCIs, SEPs, or CCCs, but rather revealing logical reasoning that is important to developing the three dimensions.

SENSE-MAKING

LESSON 7

Use mathematical thinking to develop mathematical representations *(tables and graphs) of phenomena (changes in population size over time) to support claims of why it takes multiple doses of antibiotic to wipe out a large bacterial population.*

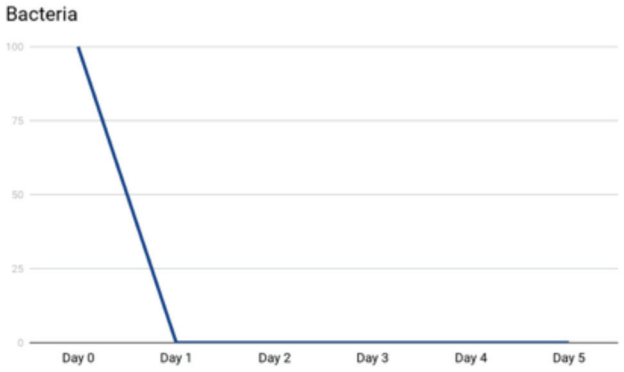
What we figure out (related to this PE):

- Antibiotics don't kill 100% of the bacteria after the first dose. It takes multiple doses to kill 100% of the bacteria.
- Some antibiotic particles might get used up as they kill bacteria.
- Antibiotic particles don't remain in our bloodstream forever. The body breaks them down and excretes them at a certain rate (about 50% are removed daily).
- Some bacteria might actually be different from the others; even though one antibiotic particle interacts with these bacteria, it doesn't kill them. Maybe it takes more than one antibiotic particle to destroy them. Or maybe some don't get killed by any number of antibiotic particles that interact with them.
- We are wondering if there is some way we could test the interaction between bacteria reproducing in a Petri dish and the addition of antibiotics to that dish.

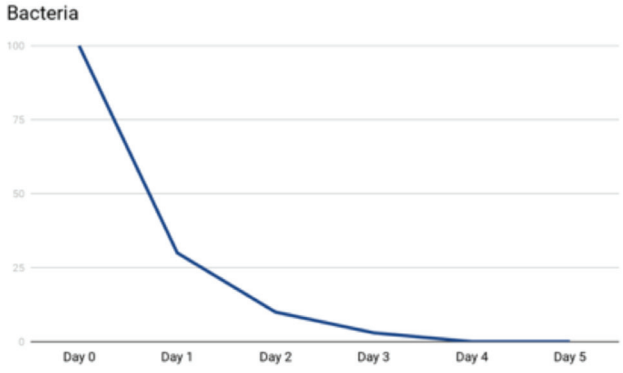
SEET (CONTINUED)

Which graph below shows the population of harmful bacteria after a person completes a successful course of antibiotics (that is, they get better)?

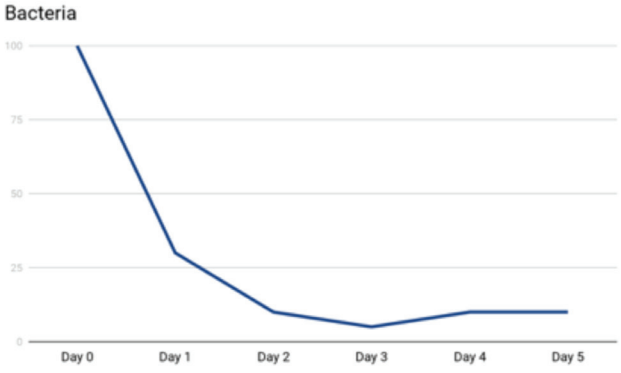
a. Graph A (draw – shows all being killed at once)



b. Graph B (draw going down after multiple doses and eventually all die)



c. Graph C (draw going down after multiple doses, but staying at a low level)



Successfully responding to this question requires that students 1) understand what they figured out about how antibiotics work, and 2) apply that to analyze and interpret graphs that would reflect that idea.

SEPs **DCIs** **SENSE-MAKING**

SEET (CONTINUED)

What causes the pattern in the graph shown above?

a. **The antibiotics kill all of the bacteria after multiple doses.**

b. The antibiotics kill all the bacteria immediately when someone takes them.

c. The antibiotics kill most of the bacteria after multiple doses.

Students have to connect their understanding of the idea to a simple understanding of cause and effect.

CCCs

How can we test whether antibiotics will kill bacteria in a petri dish in the same way it works in people?

a. Put a single dose of antibiotics in one dish, and make observations for 1 day.

b. Put a dose of antibiotics in a dish every day for a week. Make observations each day.

c. **Put a dose of antibiotics in a dish every day for a week. Make observations each day. Have one petri dish nearby that you observe and compare the size of the colonies in each dish each day.**

Successfully answering this question requires students to use their understanding of both the science ideas they are learning as well as how to plan and carry out investigations to propose a mechanism. This requires some aspects of all three dimensions to sense-make.

SENSE-MAKING | SEPs | DCIs | CCCs

SEET (CONTINUED)

Today we used the Driving Questions Board to remind ourselves of what questions we had that we've answered in previous classes.

a. Yes

b. No

c. I don't know

With the help of our teacher, our class used the Driving Questions Board to guide what we did in class today.

a. Yes

b. No

c. I don't know

I feel like I understand how today's class ties to the bigger picture for what we're studying in this unit.

a. Yes

b. No

c. I don't know

What we did in class today matters to me because (select the option that best describes your feelings).

a. I think this material is interesting

b. I think what we did today is important.

c. I care about this because it will help me get a good grade

d. What we did today doesn't matter to me.

e. Other: _____

From this point onward, the questions in the SEET attend to affective components of students' learning experiences, highlighting a unique and important way exit tickets can be used to 1) ask students to reflect on how their classroom experiences are supporting their learning, 2) show students that their thinking and experiences are important and valued, and 3) provide information to teachers that can be used to grow more supporting classroom culture, rather than only information about content learning targets.

EQUITY

CONNECTION TO ASSESSMENT PURPOSE

Questions about the driving question board and how the class ties into the bigger picture for the unit:

1) provide information to teachers about whether the learning experiences are coherent for students, and
2) prompt students to be reflective and metacognitive about their learning sequence.

EQUITY

CONNECTION TO ASSESSMENT PURPOSE

Questions about why students care about the material (both for themselves and their community):

1) provide feedback to teachers about whether their students find the learning experiences relevant, authentic, and engaging;
2) provide teachers with information, across the class and over time, about what motivates students in their classrooms.
3) prompt students to be reflective and metacognitive about their learning sequence; and
4) show students that their ideas and experiences matter.

EQUITY

CONNECTION TO ASSESSMENT PURPOSE

SEET (CONTINUED)

What we did in class today matters to my community because (select the option that best describes your feelings):

a. This material is important for my community

b. People in my community should know about this material

c. This material is important because it could affect our everyday lives.

d. What we did today doesn't matter to my community.

e. Other: _____

I contributed out loud in today's class either to the whole class or a smaller group of students.

a. Yes

b. No

If you answered yes to the question above, did you feel like others respected your contribution?

a. Yes

b. No

Questions about how students engaged in discourse during the class

1) provide feedback to teachers about whether all students had the opportunity to speak, providing insight into whether students had chances to make their thinking and ideas visible.
2) provides feedback to teachers about whether students felt comfortable and confident enough to speak, providing insight into how students perceive the classroom culture.
3) prompts students to be reflective about their interactions with their peers; and
4) show students that their ideas and experiences matter.

EQUITY

CONNECTION TO ASSESSMENT PURPOSE