How do you know if an assessment is measuring three-dimensional reasoning?

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Stanford NGSS Assessment Project

National Science Teacher's Association
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SCALE
Stanford Center for Assessment, Learning, & Equity
Understanding Language

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An NGSS Warm-Up:
Small Group to Whole Group

In pairs or triads at your tables, each of you respond to the following:

1. A Benefit

Share something you find beneficial about NGSS and assessment.

2. A Challenge

Share something you find challenging about NGSS and assessment.

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Session Focus: How do you know if an assessment is measuring three-dimensional reasoning?

In this session, we will use SNAP performance assessments to:

1

Examine how we evaluate multidimensional reasoning, and

2

Practice evaluating multidimensional reasoning using student data.

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Guiding Questions for Framing this Session: The So What

1. How can evidence of the multiple dimensions of NGSS support our work?

2. How can we elicit evidence of the multiple dimensions of NGSS?

3. How does examining student responses to NGSS performance assessments help us reflect upon or rethink our instruction or assessment practices?

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Evaluating multidimensional reasoning

A Brief overview:
Moving from assessing one dimension to assessing multiple dimensions

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Moving from assessing one dimension to multiple dimensions

NSES: Internal and external processes of the earth system cause natural hazards... Natural hazards include earthquakes, landslides, wildfires...

Do students know what process causes an earthquake?

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Moving from assessing one dimension to multiple dimensions

NSES: Internal and external processes of the earth system cause natural hazards... Natural hazards include earthquakes, landslides, wildfires...

Do students know what process causes an earthquake? — **Content**

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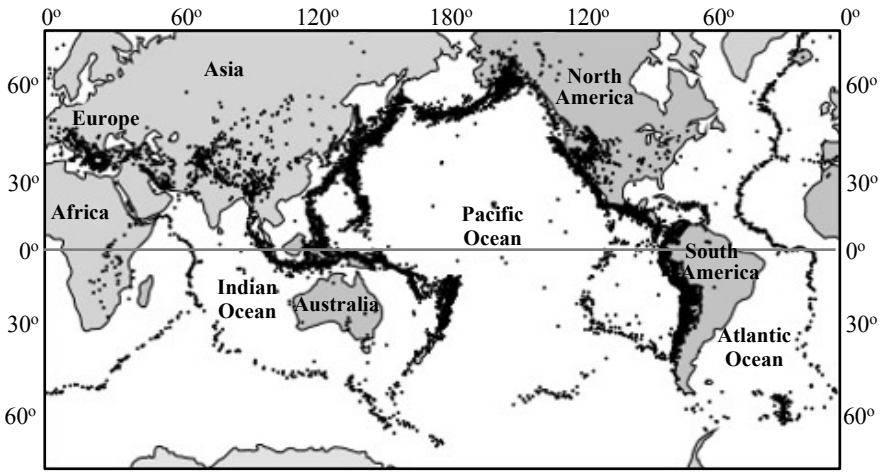
Moving from assessing one dimension to multiple dimensions



What is responsible for the pattern of earthquake activity shown on the map?

A. Volcanic eruptions

B. The weight of ocean water pressing on the land

C. Hurricanes and cyclones

D. The movement of tectonic plates

NAEP Question ID: 1994-8G6 #4 G017602

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Moving from assessing one dimension to multiple dimensions

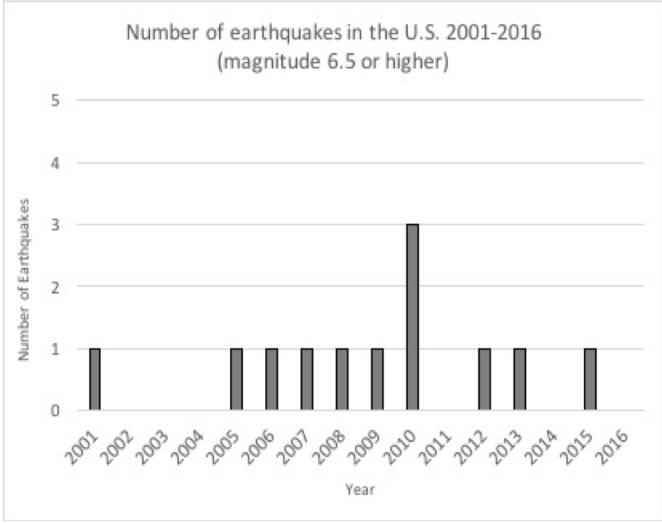
Review the SPA and consider these reflective questions:

1. What are some of the differences in what students are being asked to do?

2. What are some of the differences in information provided to teachers from these two assessments?

3. What are some of the differences in challenges that students might encounter?

5. One of the city leaders has claimed that the graphs showed that it was not necessary to plan for earthquakes.



Data source: earthquake.usgs.gov

The graph above shows additional data on earthquakes in the U.S. Use the data **and** what you know about earthquakes to explain why you agree or disagree with this claim.

I ___agree/___disagree **because**

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NGSS brings a new era for assessment

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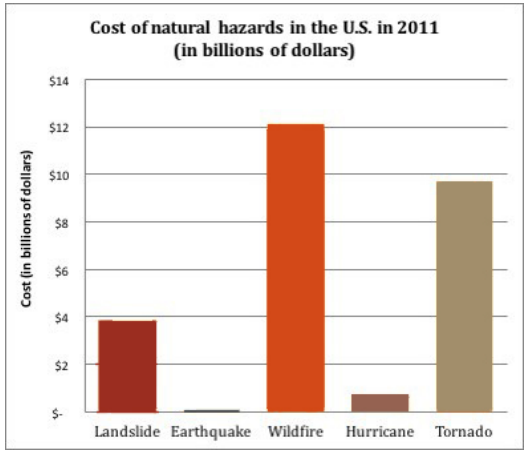
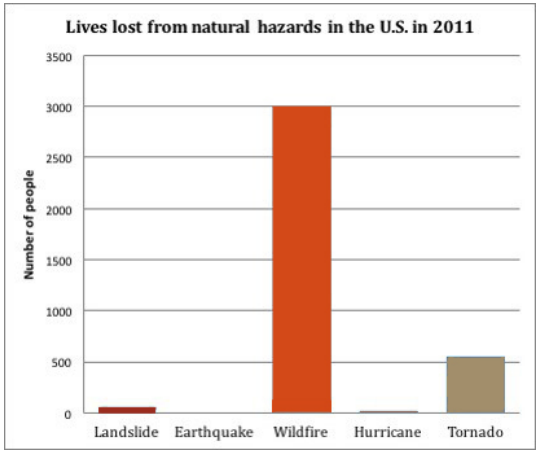
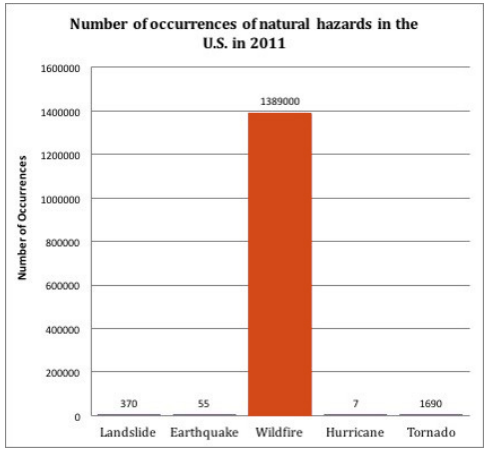
Evaluating Multidimensional Reasoning







4. You have found that you need to know a lot more about the data than what is shown in the three graphs.

Describe additional information about the data in the graphs that city leaders would need before they could use the data to make decisions. Explain why leaders would need that information.

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Evaluating multidimensional reasoning

Step 1: Review what is being assessed.

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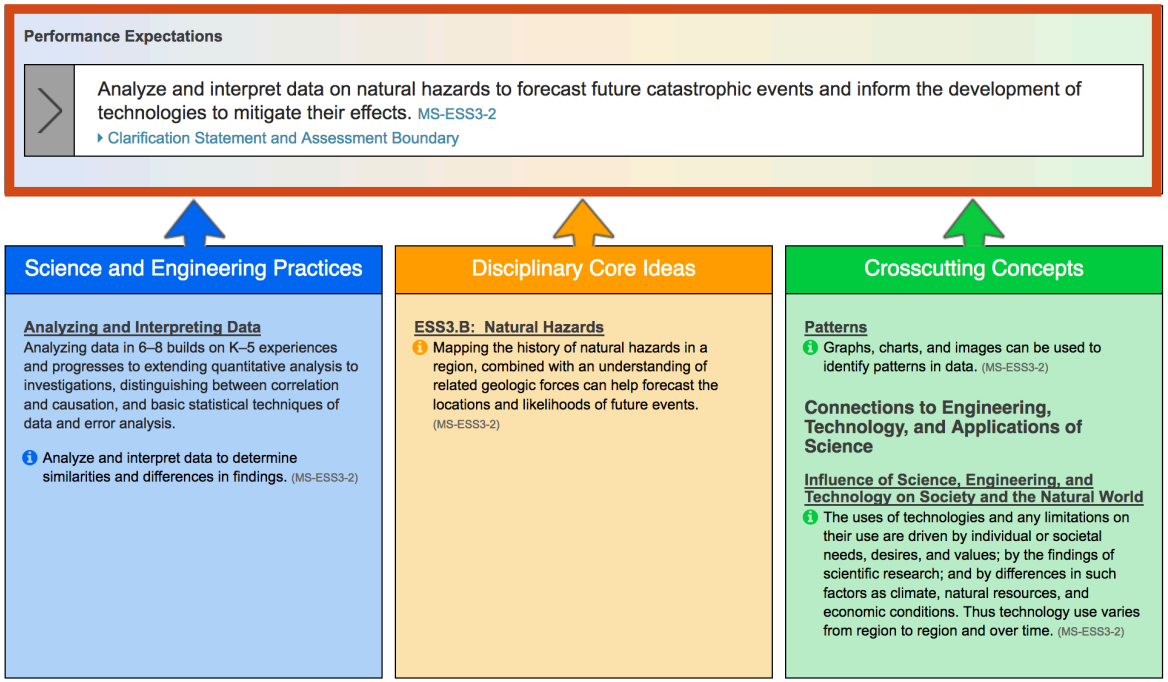
Students who demonstrate understanding can:



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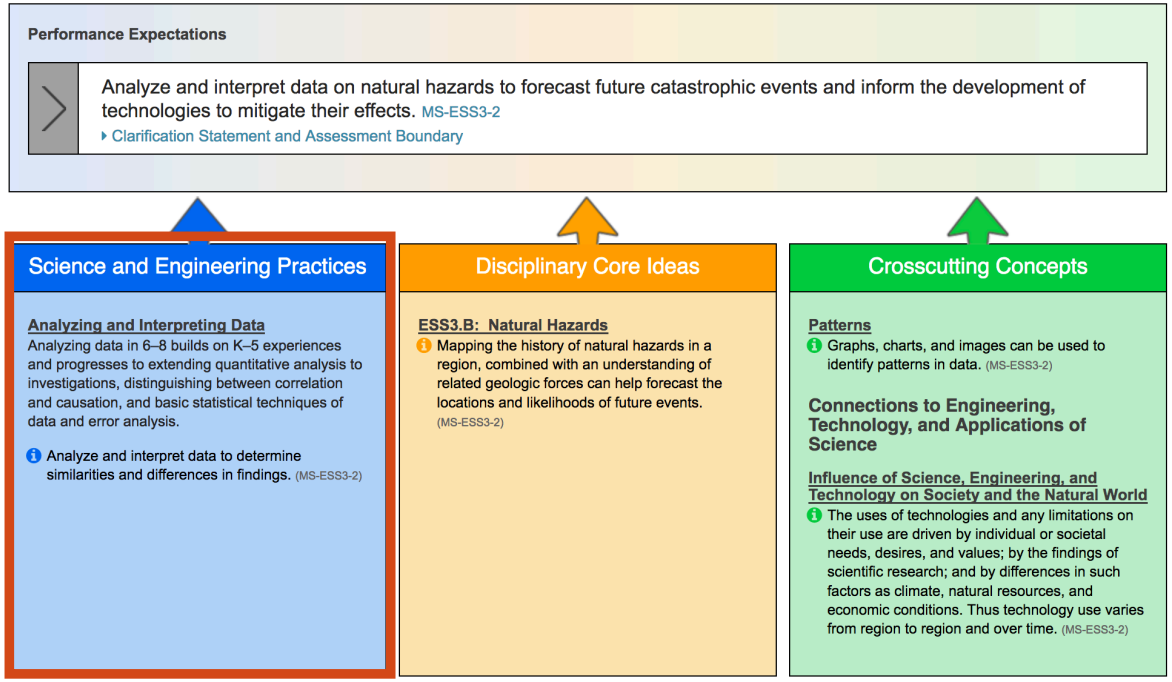

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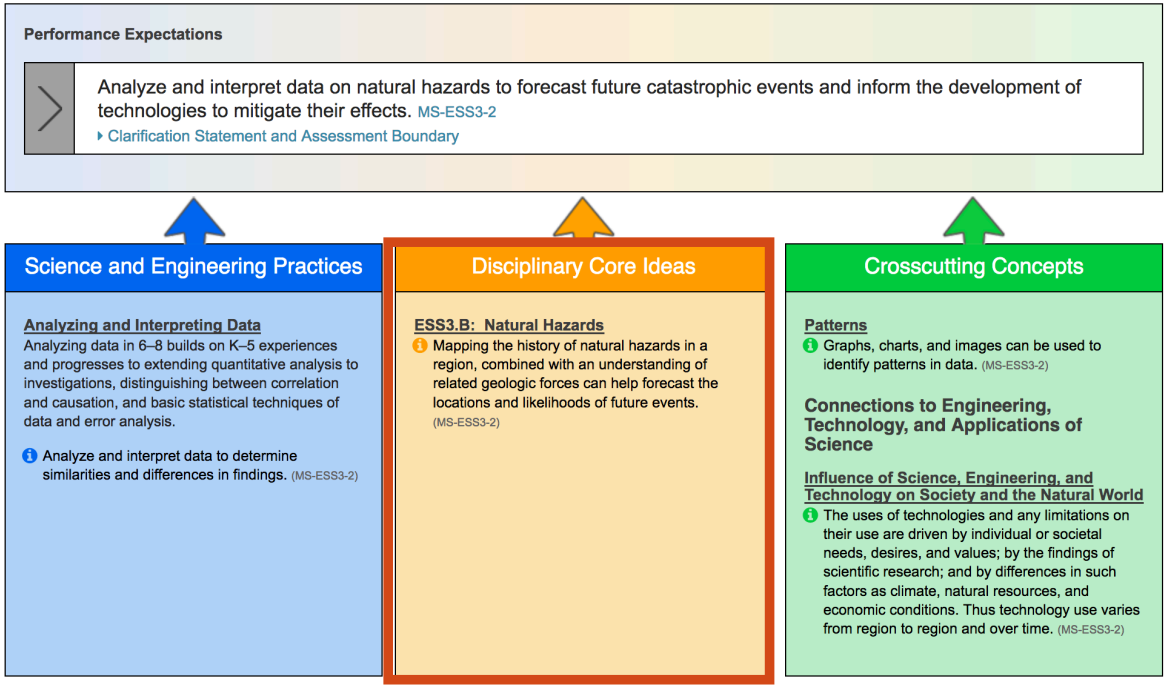

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Evaluating multidimensional reasoning

Step 2: Describe what evidence of each dimension could look like.

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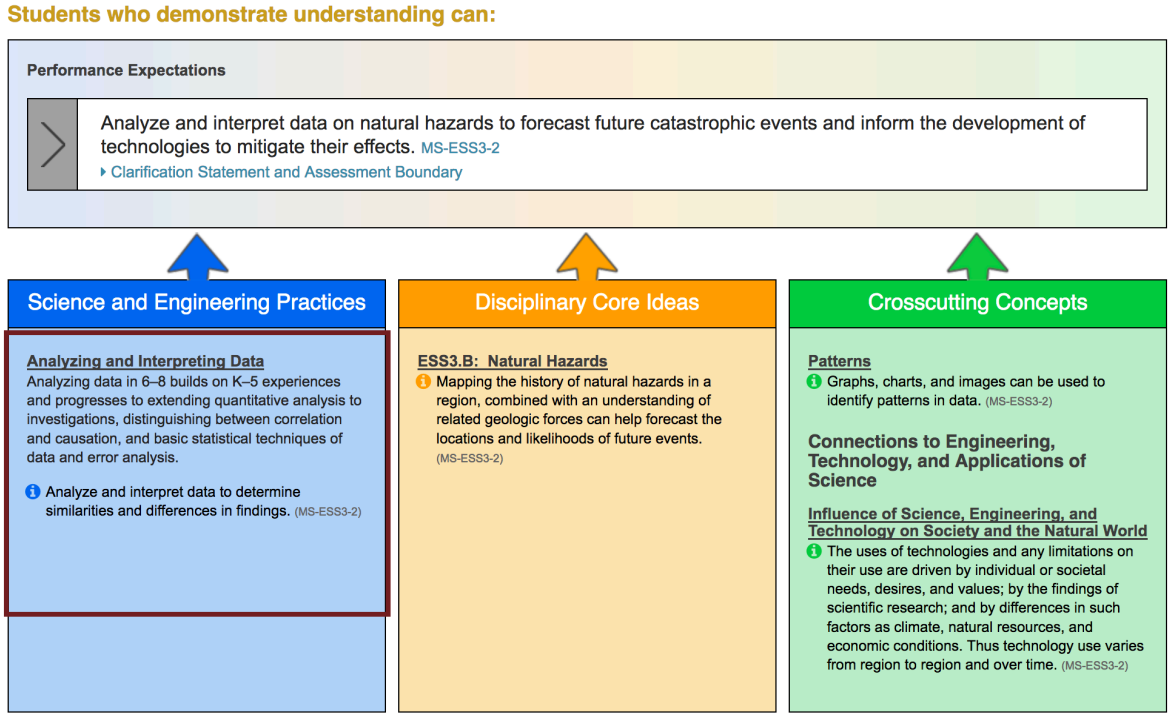

Question 4:

Analyzing biases or limitations of data for addressing a problem

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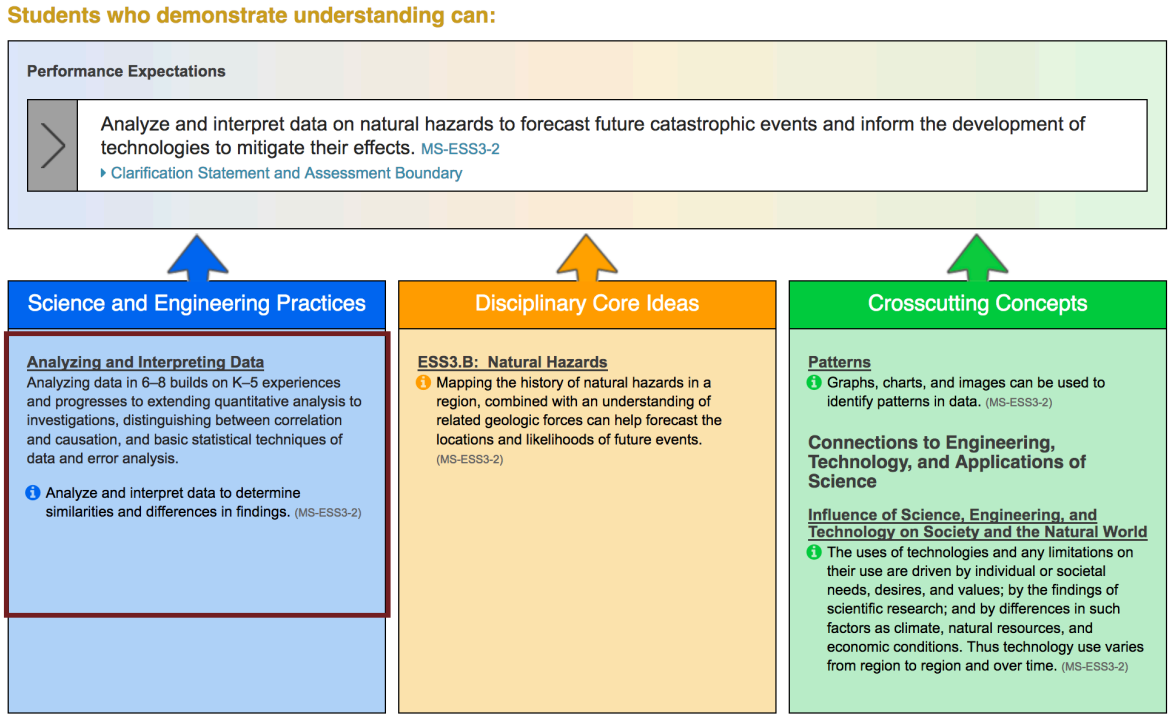

Question 4:

Analyzing biases or limitations of data for addressing a problem

Practice: Student describes relevant information not provided by the data

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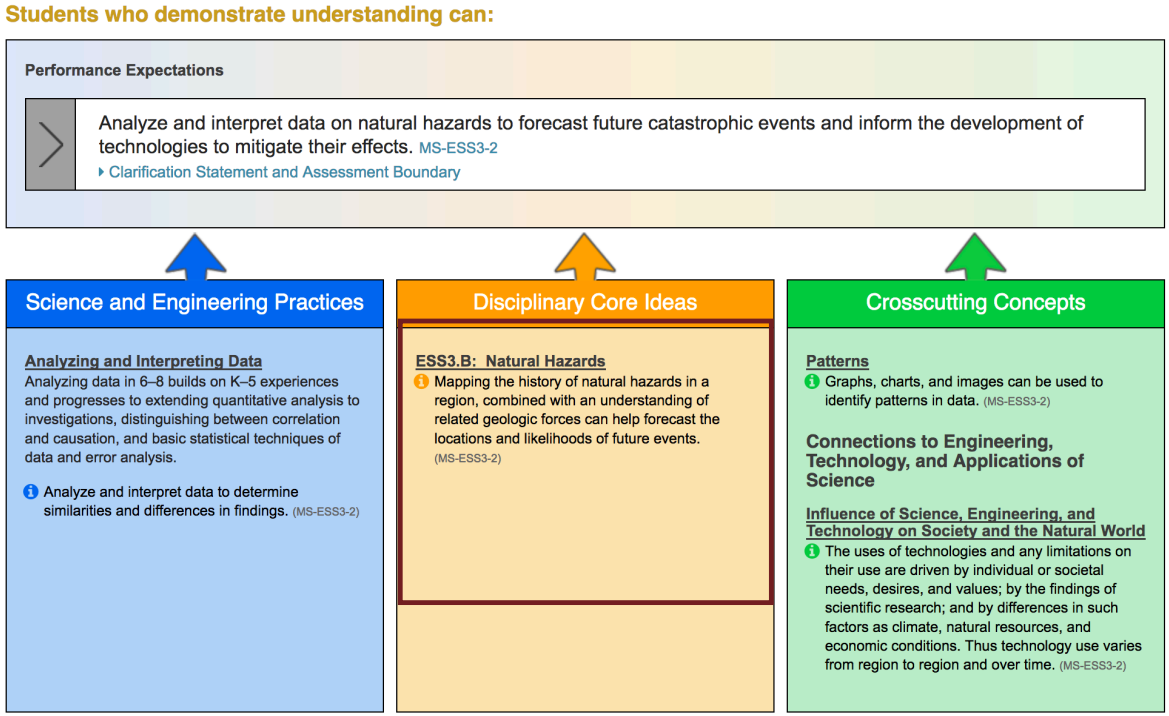

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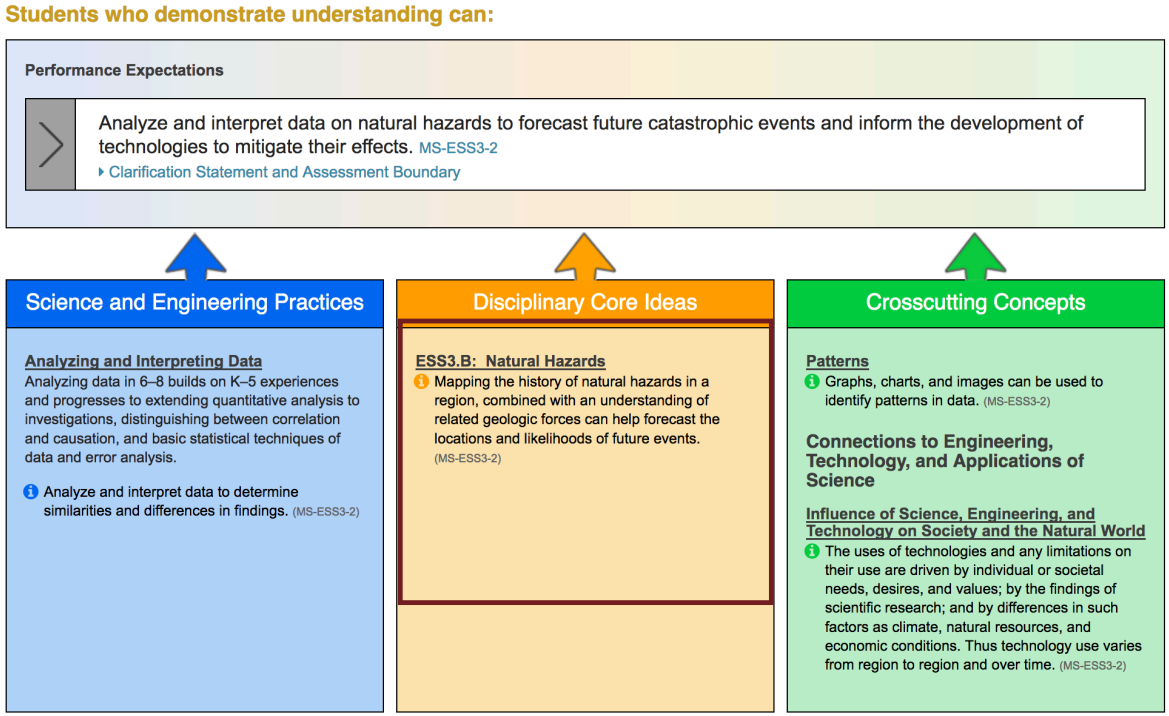

Question 4:

Analyzing biases or limitations of data for addressing a problem

DCI: Students use content knowledge to support reasoning about how or why the data could help address the problem.

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Evaluating multidimensional reasoning

Step 3: Identify evidence of each dimension being measured

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Activity – Analyzing Student Responses for Multiple Dimensions

1. Pairs: Analyze Student Sample 1 find evidence of the two dimensions being assessed
2. Whole Group: Debrief
3. Pairs: Analyze Student Samples 2 and/or 3

Dimensions:

Practice: Student describes relevant information not provided by the data

DCI: Students use content knowledge to support reasoning about how or why the data could help address the problem.

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Evaluating Multidimensional Reasoning

Sample Student Response 1

Where did these wildfires take place, and if it repeated in a general area? This would help leaders because it would give them a better idea as to where to focus on.

Evaluating Multidimensional Reasoning

Sample Student Response 1

SEP

Identifying information not provided by the data

Where did these wildfires take place, and if it repeated in a general area? This would help leaders because it would give them a better idea as to where to focus on.

Evaluating Multidimensional Reasoning

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DCI

Reasoning uses knowledge of how data inform mitigation of future hazards

Evaluating Multidimensional Reasoning

Sample Student Response 2

For earthquakes specifically, I would like to know the magnitude of the earthquakes. I know that there are always small earthquakes happening EVERYWHERE and EVERY TIME but they are not dangerous, so if we know that only a couple of earthquakes were high magnitude then we might not worry about earthquakes as much since lower magnitude ones aren't dangerous.

Evaluating Multidimensional Reasoning

Sample Student Response 1

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DCI

Reasoning uses knowledge of how data inform mitigation of future hazards

Evaluating Multidimensional Reasoning

Sample Student Response 3

How many people were injured? If many people were injured, then they should force on that disaster because the cost for the hospital fees could be high and if they lost their house, it is a lot of money to pay.

Evaluating Multidimensional Reasoning

Sample Student Response 3

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Evaluating Multidimensional Reasoning

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Reasoning uses knowledge of how data inform mitigation of future hazards

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Evaluating multidimensional reasoning

Step 3: Identify evidence of each dimension being measured

*** for analysis of the assessment ***

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Step 2: Describe what evidence of each dimension could look like: implications for assessment

Version 1 of Question 5 originally looked like this:

A newspaper article claimed that these graphs show that planning for earthquakes in the United States is not necessary. Use what you know about earthquakes and the information in the graphs to decide if you agree or disagree with this claim and **explain why you agree or disagree**.

I ___agree/___disagree because

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Step 2: Describe what evidence of each dimension could look like: implications for assessment

Dimensions being evaluated

SEP: Analyze and interpret data to find similarities and differences in findings

DCI: …the history of natural hazards in a region, combined with an understanding of geologic forces can help forecast the locations and likelihoods of future events

CCC: Graphs…can be used to identify patterns in data

What is being assessed (construct)

Interpret pattern in graphs on natural hazards to forecast likelihood of future events

Sample student response

-[I disagree because] though earthquakes do not cause a lot of damage or kill a lot of people, they are still dangerous. The worst part about earthquakes is that they happen hundreds of times a year and are hard to detect until they already happen. This is a big issue because an earthquake can happen at any time and people must know what to do in the event of one

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DCI

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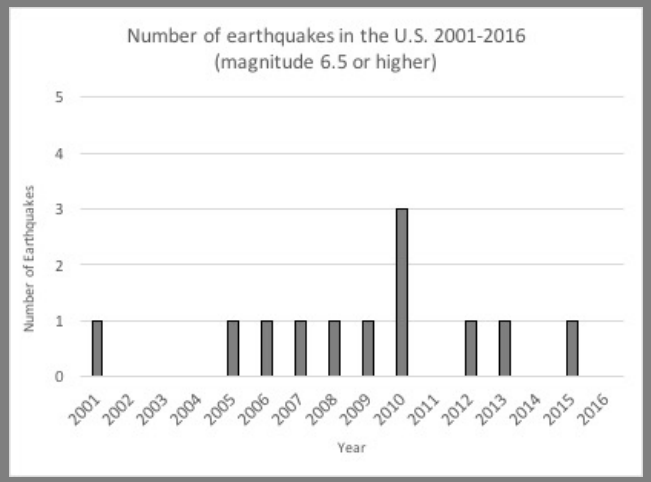
Step 2: Describe what evidence of each dimension could look like.

Version 2 of Question 5 now looks like this:

One of the city leaders has claimed that the graphs showed that it was not necessary to plan for earthquakes.



Do you agree or disagree with the city leader's claim? Explain why you agree or disagree using data from the graphs (Figures 1-4) **and what you know about earthquakes.**

I ____agree/____disagree **because**…

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Step 2: Describe what evidence of each dimension could look like.

Dimensions being evaluated
SEP: Analyze and interpret data to find similarities and differences in findings
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What is being assessed (construct)
Interpret pattern in graphs on natural hazards to forecast likelihood of future events

NEW Sample student response
I disagree, because earthquakes happen randomly. It's hard to predict when an earthquake is coming. Using the graph from the official, there was at least one earthquake every year. But, did all those earthquakes happen at the same time? In 2010, there was 3 earthquakes, which I doubt people were expecting until it happened. We can't predict earthquakes so we should plan ahead just in case one does happen.

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Step 2: Describe what evidence of each dimension could look like.

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Step 4: Characterize student responses using a rubric

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Reviewing SNAP Rubric - Performance Levels and NGSS Multiple Dimensions

Level 1	Level 2	Level 3	Level 4
Attempting the Standard	Approaching the Standard	Achieving the Standard	Exceeding the Standard
Analysis identifies information that is **not relevant** to the data **AND** explanation **is missing or does not address** the problem.	Analysis identifies information that is **relevant** to data AND explanation is missing or does not address the problem.	Analysis identifies information that is relevant to the data AND explanation **minimally** addresses the problem.	Analysis identifies information needed that is relevant to the data AND explanation **coherently** addresses the problem.

Reviewing RUBRIC Performance Levels for NGSS Multiple Dimensions

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		Multidimensional Language	
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Reviewing RUBRIC Performance Levels for Multiple Dimensions

Level 1	Level 2
Attempting the Standard	Approaching the Standard
Analysis identifies information that is **not relevant** to the data **AND** explanation **is missing or does not address** the problem.	Analysis identifies information that is **relevant** to data AND explanation is missing or does not address the problem.

Activity – Use the SNAP Rubric to Evaluate Student Response 1

Level 1	Level 2	Level 3	Level 4
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Student Response 1

Where did these wildfires take place, and if it repeated in a general area? This would help leaders because it would give them a better idea as to where to focus on.

Evaluate Student Response 1 Using the SNAP Rubric

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Student Response 1

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Activity – Use SNAP Rubric to Analyze Student Response 2

Level 1	Level 2	Level 3	Level 4
Analysis identifies information that is **not relevant** to the data **AND** explanation **is missing or does not address** the problem.	Analysis identifies information that is **relevant** to data AND explanation is missing or does not address the problem.	Analysis identifies information that is relevant to the data AND explanation **minimally** addresses the problem.	Analysis identifies information needed that is relevant to the data AND explanation **coherently** addresses the problem.

Student Response 2

For earthquakes specifically, I would like to know the magnitude of the earthquakes. I know that there are always small earthquakes happening EVERYWHERE and EVERY TIME but they are not dangerous, so if we know that only a couple of earthquakes were high magnitude then we might not worry about earthquakes as much since lower magnitude ones aren't dangerous.

Using the SNAP Rubric to Analyze Student Response 2

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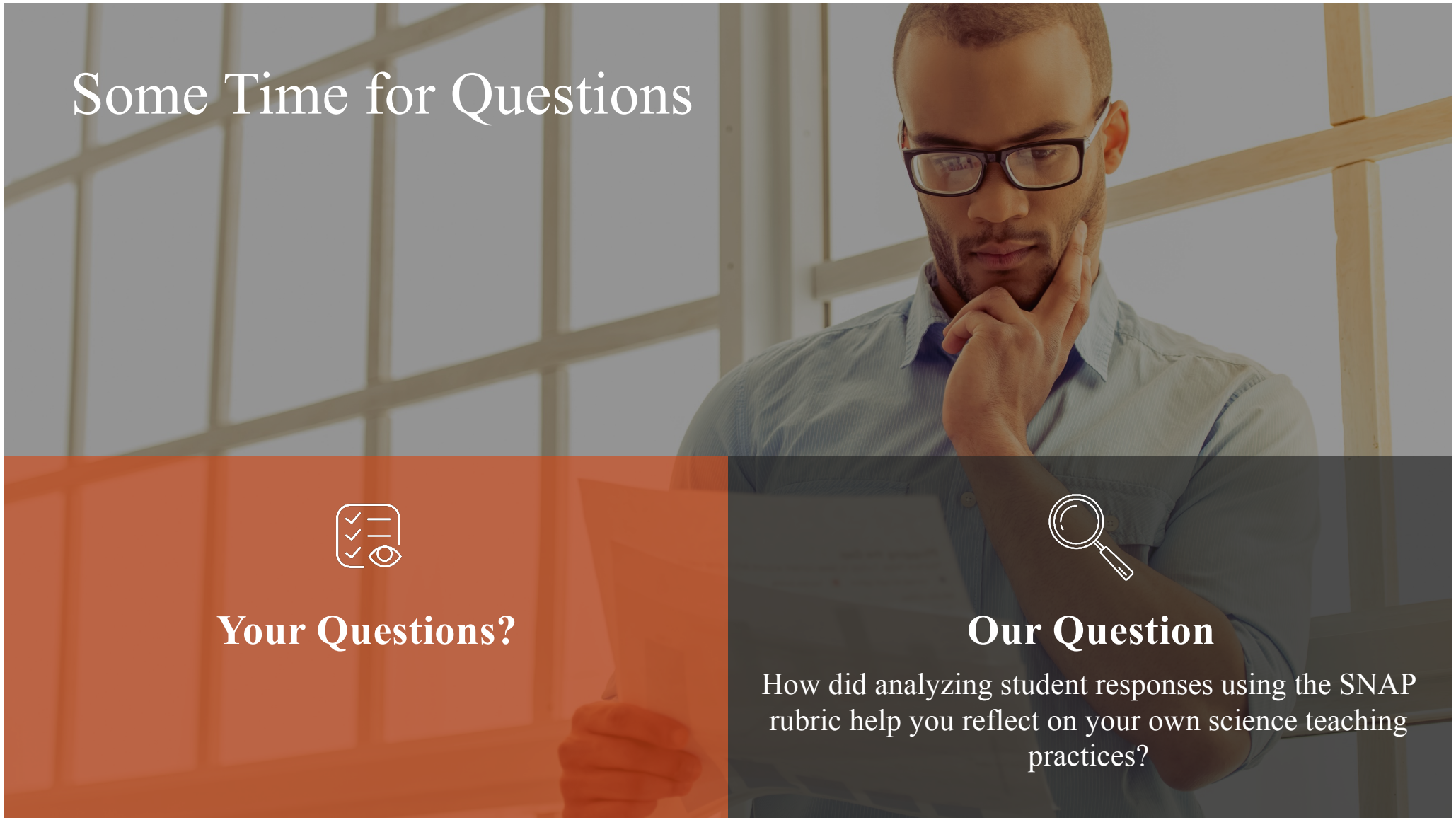
Some Time for Questions

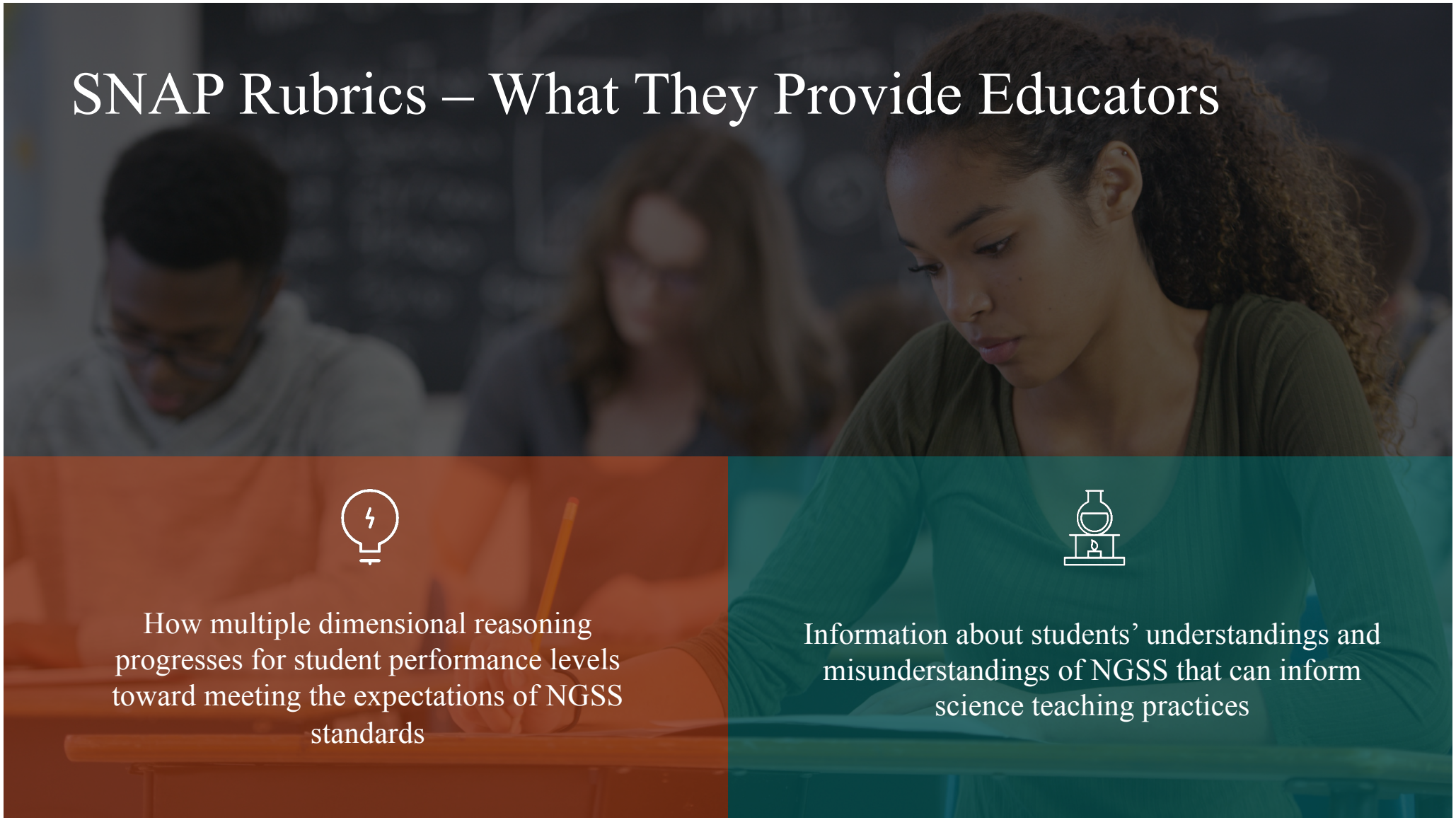


Your Questions?

Our Question

How did analyzing student responses using the SNAP rubric help you reflect on your own science teaching practices?

SNAP Rubrics – What They Provide Educators



How multiple dimensional reasoning progresses for student performance levels toward meeting the expectations of NGSS standards

Information about students' understandings and misunderstandings of NGSS that can inform science teaching practices

Returning to Our Guiding Questions : The So What

1. How can evidence of the multiple dimensions of NGSS support our work?

1. How can we elicit evidence of the multiple dimensions of NGSS?

2. How does examining student responses to NGSS performance assessments help us reflect upon or rethink our instruction or assessment practices?

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Next step: using analysis of student responses to make instructional decisions

If you are interested in learning more, please respond to our survey:

snapgse.stanford.edu

Contact Jill for more info.: jwerthei@stanford.edu

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