Lesson 26 Part 1: Introduction

Understand Statistical Questions

CCLS 6.SP.1

Why ask statistical questions?

When you want to find out more about something, one thing you can do is ask questions. Some questions have exact answers, such as, "How many people are in your class right now?" Other questions can have many answers, such as asking some sixth graders, "What is your favorite kind of music?"

When you want to find out what kind of music all sixth graders like most, there are likely too many people to ask. By asking 20 sixth graders, "What is your favorite kind of music?," you can get a good sense of the type of music all sixth graders like. If you asked another class of sixth graders the same question, your results would probably be similar but not exactly the same.

When you ask a question to make a prediction about a larger group, you are asking a statistical question. **Statistical questions** do not have an exact answer; you expect to get a variety of answers. So answers to statistical questions have variability. Non-statistical questions have exact answers.

Think What does it mean for a question to be statistical?

Circle a statistical question where you might expect many different answers.

Sasha wants to collect statistical information about the different sports sixth graders at her school like to watch. She writes 3 questions to ask 50 sixth grade
rs and will use the results to make an estimate about all sixth graders. Which questions are statistical and which are not?

- When is the next home basketball game?
- What is your favorite sport to watch?
- What was the last sports game you watched at this school?

The first question is not statistical because the date of the next home game is the same for no matter whom or how many people Sasha asks.

The next two questions are statistical because you would expect some variability in the answers. Sasha could use the responses to think about the different sports that sixth graders like to watch.

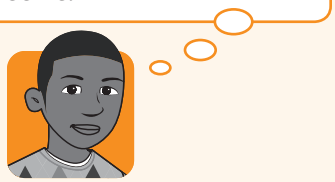
Think How do I write statistical questions?

What statistical question could Sasha ask if she was interested in knowing what school sport sixth graders like to watch the most?

Look at the questions Sasha wrote. "What is your favorite sport to watch?" is too general. Someone's favorite sport to watch might not be a school sport. There may be too many varying answers.

"What was the last sports game you watched at this school?" is too specific. Depending on the time of year or what home game was most recent, there may not be enough variability.

What are possible answers to this question? Are the answers too general? Too specific?



To collect data on what school sport sixth graders like to watch the most, Sasha could ask:

"Which school sport are you most interested in watching? Circle one from the list below."

Then Sasha could list all the school sports at her school.

Possible responses would be one of the listed sports. The varying answers would help Sasha draw conclusions about which sports sixth graders at her school most like to watch.

Now you'll have a chance to think more about statistical questions and the data they help collect.

Reflect

1 Explain the difference between a question that is statistical and one that is not.

Explore It

Determine whether each question is *statistical* or *non-statistical*. Then, explain your answer.

2 A political group asked voters waiting in line to vote: Who are the 2 major candidates running for president this year?

3 The journalism club surveyed students in the library and asked: About how much time do you spend reading each day?

4 To decide if a new movie should be shown this Friday, a movie theatre invited 50 people to view the movie and answer the question: Did you enjoy the movie?

5 A sixth grader asks her guidance counselor: How many clubs and sports are open to sixth graders at this school?

Write statistical questions.

6 Write both a statistical and a non-statistical question you could ask some classmates to make a prediction about teenagers and text messaging.

Talk About It

Solve the problem below as a group.

7 Use an example from the previous page to explain what it means for a question to have statistical variability.

8 Look at problems 2–5. How could you change one of the non-statistical questions so that it is statistical? Explain.

9 Look at the questions you wrote in problem 6. Explain why the answers do or don't have variability.

Try It Another Way

Look at these survey results and think about a possible statistical question.

10 Mia surveyed her classmates to make a prediction about kids her age.

Hours	0	0.5	1	1.5	2
Number of students	2	8	5	3	1

Which could be a question Mia asked? Explain.

- How many people do not watch TV?
- How many TV shows do you watch regularly?
- About how long do you spend watching TV everyday?

Connect It

Talk through these problems as a class. Then write your answers below.

11 **Compare.** Which question is statistical and which is not? Explain how you know.

- What is your favorite Olympic sport to watch?
- When are the next Olympic games?

12 **Analyze.** Which is a better statistical question to ask your classmates if you are interested in finding out movies sixth graders enjoy watching? Explain.

- What is the most recent movie you saw?
- What are three of your favorite movies?

13 **Predict.** Which statistical question would result in more variability? Explain.

- Do you own a scooter and/or bicycle?
- About how many hours per week do sixth graders participate in sports?

Put It Together

Use what you have learned to complete this task.

14 Write statistical questions and analyze the variability in the answers.

A Write two statistical questions that you are interested in asking the students at your school.

B Choose one question to ask your classmates and record the answers in a line plot.

C Explain how your classmates' answers showed variability.

D Explain why you expect variability in the answers if you asked a different group of students the same question.

Lesson 26 (Student Book pages 266–271)

Understand Statistical Questions

LESSON OBJECTIVES

- Understand that data generated from statistical questions will vary.
- Recognize that responses to statistical questions have variations that can be used to draw conclusions about the data set.
- Identify the difference between a statistical and non-statistical question.
- Write simple statistical questions.
- Create models that represent the anticipated data from statistical questions such as charts and tables.

PREREQUISITE SKILLS

- Know the difference between a statement and a question.
- Be able to formulate a question.
- Know how to set up and use charts and tables for representing data.

VOCABULARY

statistical questions: questions with answers involving a mass of numerical data

THE LEARNING PROGRESSION

Understanding of statistical variability is fundamental to future studies in statistics and to everyday decision-making based on data. This lesson teaches students that statistical investigations begin with a question and that answers to such questions always involve variability in the data collected to answer them. Students are guided to distinguish statistical questions from non-statistical questions and to compare the variability of different statistical questions.

In Grade 6, students build on the knowledge and experiences developed in earlier grades. They develop a deeper understanding of variability and more precise descriptions of data distributions using numerical measures of center and spread and terms such as cluster, peak, gap, symmetry, skew, and outlier.

In Grade 7, students move from concentrating on analysis of data to production of data, understanding that good answers to statistical questions depend upon a good plan for collecting data relevant to the questions of interest.

Ready Toolbox — Teacher-Toolbox.com

	Prerequisite Skills	*6.SP.1*
Ready Lessons		✓
Tools for Instruction		✓
Interactive Tutorials		

CCLS Focus

6.SP.1 Recognize a statistical question as one that anticipates variability in the data related to the question and accounts for it in the answers. *For example, "How old am I?" is not a statistical question, but "How old are the students in my school?" is a statistical question because one anticipates variability in students' ages.*

STANDARDS FOR MATHEMATICAL PRACTICE: ***SMP 1, 3, 6*** *(see page A9 for full text)*

AT A GLANCE

Students explore the difference between statistical and non-statistical questions. Students learn that statistical questions have variability. i.e., a variety of answers, while non-statistical questions have exact answers.

STEP BY STEP

- Introduce the question at the top of the page.
- Explain to students that one of the ways we can find out more about something is to ask the same statistical question to a group of people and use the answers to make a prediction or draw a conclusion about a larger group to which these people belong.
- Explain that when we ask a statistical question we expect to get a variety of answers instead of the exact same answers.
- Reinforce the idea that this variety of answers, called variability, is the difference between statistical and non-statistical questions.
- Read Think with students. Remind students that they should circle only the questions where there could be different answers from different people or at different times. Only those questions solicit data with some degree of variability.
- Have two or three students answer the second and third questions as a way to demonstrate how those questions solicit a variety of answers. Such variety is what makes these questions statistical questions.

ELL Support

Have students do a cloze activity using the following terms: *variability*, *variety*, *vary*, and *variable*.

- A _____ is a symbol usually represented by a letter that stands for a value that may vary. [variable]
- What makes a statistical question different from a non-statistical question is _____. [variability]
- Non-statistical questions have answers that do not _____. [vary]
- When we ask a statistical question we expect to get a _____ of answers. [variety]

Focus on Math Concepts

Lesson 26 Part 1: Introduction

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CCLS 6.SP.1

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Mathematical Discourse

- *Can you think of a career you would like to be in some day where you would ask a statistical question to learn more about something?*

  Examples: People do research in the sciences and medicine; athletes use statistics for performance measures (e.g., earned run averages in baseball); market research to design products. Accept other reasonable responses.

- *What is one statistical question you could ask to help you in the career you described?*

  Answers will vary. Encourage students to think about what information or data they would work with in such a career. Ask students what questions they can ask to learn that information.

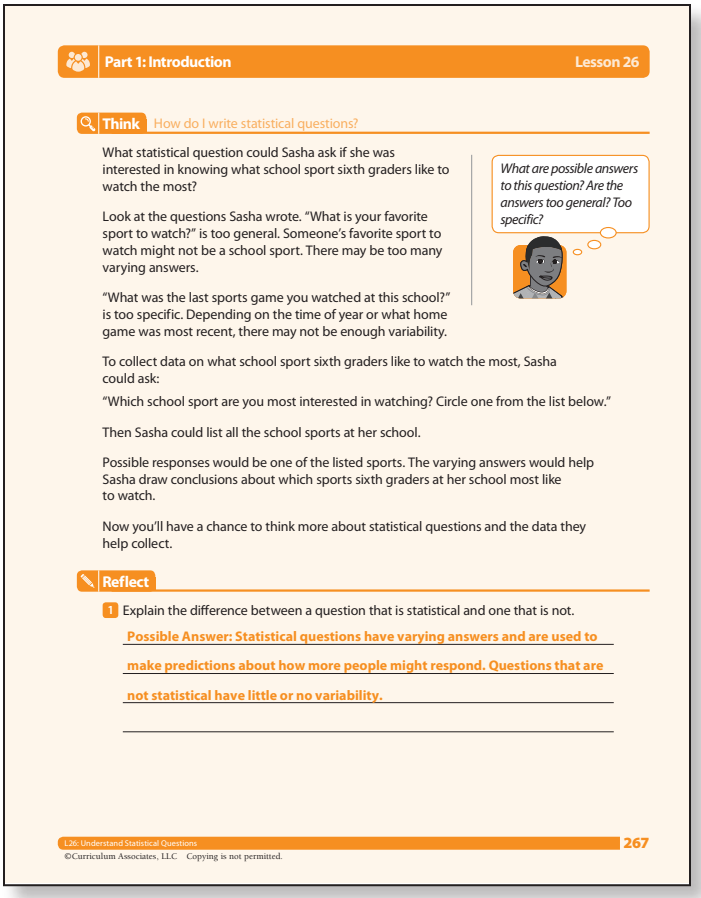
AT A GLANCE

Students explore how to write an effective statistical question. Students identify statistical questions that are too general or too specific.

STEP BY STEP

- Read Think with students.
- Emphasize to students that Sasha is interested in knowing what *school* sports sixth graders like to watch the most.
- Tell students that they will consider the effectiveness of Sasha's questions from page 266, given what she is interested in learning about sixth graders.
- Point out that Sasha can phrase her statistical question in more than one way, but that questions need to be carefully worded so that they are neither too general nor too specific. Tell students that one goal in devising a statistical question is to produce varying answers.
- Have students read and respond to the Reflect directive.

SMP Tip: When students identify questions as too general or too specific, they attend to precision by relating statistical questions to anticipated variability in the data (*SMP 6*).


Part 1: Introduction Lesson 26

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Now you'll have a chance to think more about statistical questions and the data they help collect.

Reflect

1 Explain the difference between a question that is statistical and one that is not.

Possible Answer: Statistical questions have varying answers and are used to make predictions about how more people might respond. Questions that are not statistical have little or no variability.

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Concept Extension

Rank questions in order of variability.

- Present to students three statistical questions that could be asked of a group of sixth graders. You can make up your own or use the following:

  How many brothers and sisters do you have?
  How many books did you read last school year?
  How many extracurricular activities do you do (sports, music, dance, and theater)?

- Have students rank the questions in order of greatest to least variability (i.e., which question would solicit the greatest variety of responses? The least?) [There is no single correct answer. Have students explain the rationale for their order, which will likely be based on their own personal experience or observations.]

Mathematical Discourse

- *Describe in your own words how a statistical question can affect how accurately you can describe or predict something.*

  Listen for students to explain that a good question that allows for variability in the responses helps the questioner understand or predict something about a group. If the question is too specific or too general, that quality affects how accurate the prediction is.

- *In the real world, what are some effects of making a bad prediction? What are some effects of bad predictions in science, medicine, business?*

  Answers will vary. Bad predictions lead to an inaccurate understanding of a situation. Such lack of understanding can lead to incorrect courses of action.

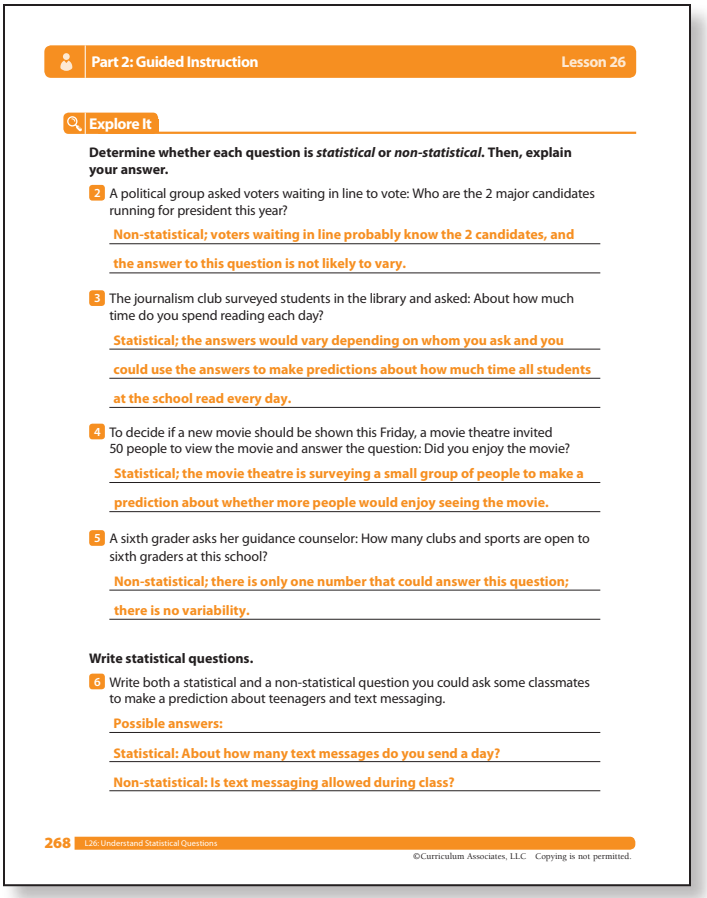
AT A GLANCE

Students determine whether questions are statistical or non-statistical and explain their reasoning. Students write a statistical and a non-statistical question.

STEP BY STEP

- Tell students that they will have time to work individually on the Explore It problems on this page and then share their responses in groups. You may choose to work through problem 2 as a class.
- Encourage students to read the questions and ask themselves, *Is there an exact answer to this question, or will answers vary?* [If there is an exact answer, the question is not a statistical question. If answers to the question can vary, then the question is a statistical question.]
- As students work individually, circulate among them. This is an opportunity to assess student understanding and address student misconceptions. Use the Mathematical Discourse questions to engage student thinking.
- Guide students to distinguish between statistical and non-statistical questions for the problems. Ask students to volunteer their answers and encourage them to think aloud and explain their reasoning to the class.
- Reinforce the idea that if the answer to the question varies, it is a statistical question. Answers to statistical questions let the questioner make predictions about the larger group to which the responders belong.
- Take note of students who are still having difficulty. Wait to see if their understanding progresses as they work in their groups during the next part of the lesson.

STUDENT MISCONCEPTION ALERT: Suppose you ask a group of sixth graders, *How many U.S. senators are there?* You might get a variety of answers because students don't know the exact answer. Students may confuse this sort of variety with statistical variety.



Part 2: Guided Instruction Lesson 26

Explore It

Determine whether each question is *statistical* or *non-statistical*. Then, explain your answer.

2 A political group asked voters waiting in line to vote: Who are the 2 major candidates running for president this year?

Non-statistical; voters waiting in line probably know the 2 candidates, and the answer to this question is not likely to vary.

3 The journalism club surveyed students in the library and asked: About how much time do you spend reading each day?

Statistical; the answers would vary depending on whom you ask and you could use the answers to make predictions about how much time all students at the school read every day.

4 To decide if a new movie should be shown this Friday, a movie theatre invited 50 people to view the movie and answer the question: Did you enjoy the movie?

Statistical; the movie theatre is surveying a small group of people to make a prediction about whether more people would enjoy seeing the movie.

5 A sixth grader asks her guidance counselor: How many clubs and sports are open to sixth graders at this school?

Non-statistical; there is only one number that could answer this question; there is no variability.

Write statistical questions.

6 Write both a statistical and a non-statistical question you could ask some classmates to make a prediction about teenagers and text messaging.

Possible answers:

Statistical: About how many text messages do you send a day?

Non-statistical: Is text messaging allowed during class?

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Mathematical Discourse

- *When our answer to a math problem is not a number that we can plug back into an equation to check, how do we "check" our answer?*

  Listen for students to explain how they judge whether an answer is correct or incorrect when they can't plug a number back into an equation. Listen for students to explain how they reason, use logic, reread the question, and so on as ways to check the reasonableness of an answer.

- *What are the ways you have checked some of your answers in this lesson so far?*

  Listen for students to explain how they decide whether a question is statistical or non-statistical. Encourage students to break down their reasoning into steps such as (1) recall the definition of a statistical question, (2) reread the question, and (3) evaluate the question against our definition.

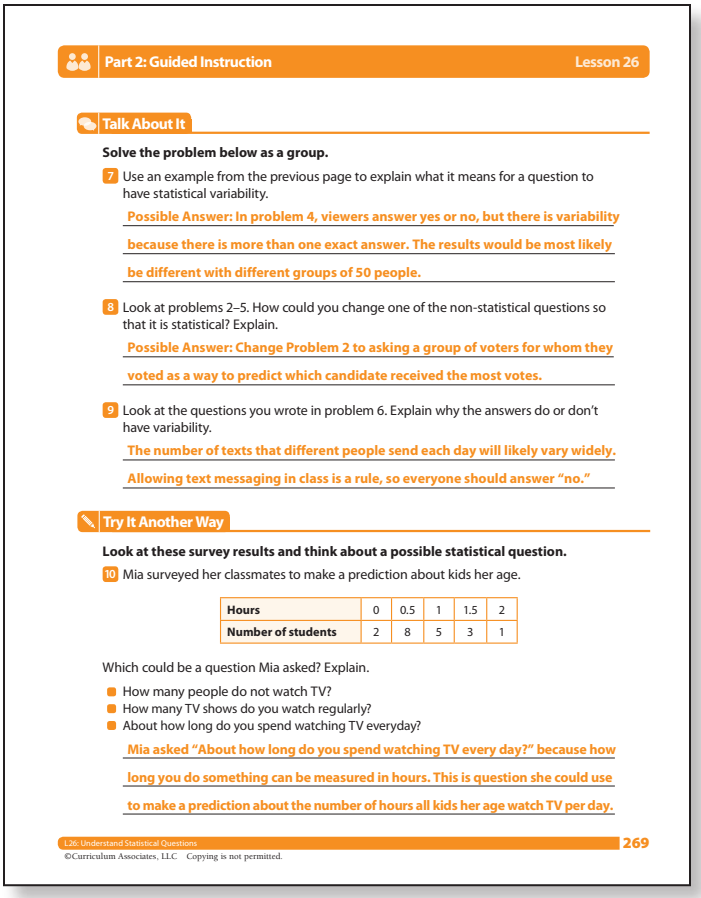
AT A GLANCE

Students revisit the problems from page 268 and give examples of how statistical questions have variability. Students make changes to the wording of non-statistical questions to make them statistical questions.

STEP BY STEP

- Organize students into pairs or groups. Work through problem 7 as a class. Remind students that problem 7 refers to page 268.
- Encourage students to explain how the statistical questions from page 268 have variability. Also have students explain the ways in which the non-statistical questions lack variability.
- Have student groups work through Try It Another Way.

SMP Tip: When students give examples that show how the statistical questions have variability and the non-statistical questions lack variability, they demonstrate they understand and can use stated assumptions, definitions, and previously established results in constructing arguments (*SMP 3*).



Part 2: Guided Instruction Lesson 26

Talk About It

Solve the problem below as a group.

7 Use an example from the previous page to explain what it means for a question to have statistical variability.

Possible Answer: In problem 4, viewers answer yes or no, but there is variability because there is more than one exact answer. The results would be most likely be different with different groups of 50 people.

8 Look at problems 2–5. How could you change one of the non-statistical questions so that it is statistical? Explain.

Possible Answer: Change Problem 2 to asking a group of voters for whom they voted as a way to predict which candidate received the most votes.

9 Look at the questions you wrote in problem 6. Explain why the answers do or don't have variability.

The number of texts that different people send each day will likely vary widely. Allowing text messaging in class is a rule, so everyone should answer "no."

Try It Another Way

Look at these survey results and think about a possible statistical question.

10 Mia surveyed her classmates to make a prediction about kids her age.

Hours	0	0.5	1	1.5	2
Number of students	2	8	5	3	1

Which could be a question Mia asked? Explain.

- How many people do not watch TV?
- How many TV shows do you watch regularly?
- About how long do you spend watching TV everyday?

Mia asked "About how long do you spend watching TV every day?" because how long you do something can be measured in hours. This is question she could use to make a prediction about the number of hours all kids her age watch TV per day.

L26: Understand Statistical Questions 269

Hands-On Activity

Materials: strips of paper, scissors, markers

- Put students into pairs or small groups. Tell them that they will write down each of the following question stems on two strips of paper.

  What are . . . , How many . . ., When do . . .

- Next, for each question stem, they are to write an ending that will create a statistical question and a non-statistical question. (You may want to give them examples such as *How many books are on the book shelf in this classroom? How many books have you read this year?*)
- Discuss each question stem as a class. Have one person from each group read the group's questions for that stem. Discuss why each question is or is not a statistical question.

AT A GLANCE

Students demonstrate their understanding of how variability distinguishes a statistical question from a non-statistical question by answering a series of questions. Students compare the variability of statistical questions.

STEP BY STEP

- Discuss each Connect It problem as a class using the discussion points outlined below.

Compare:

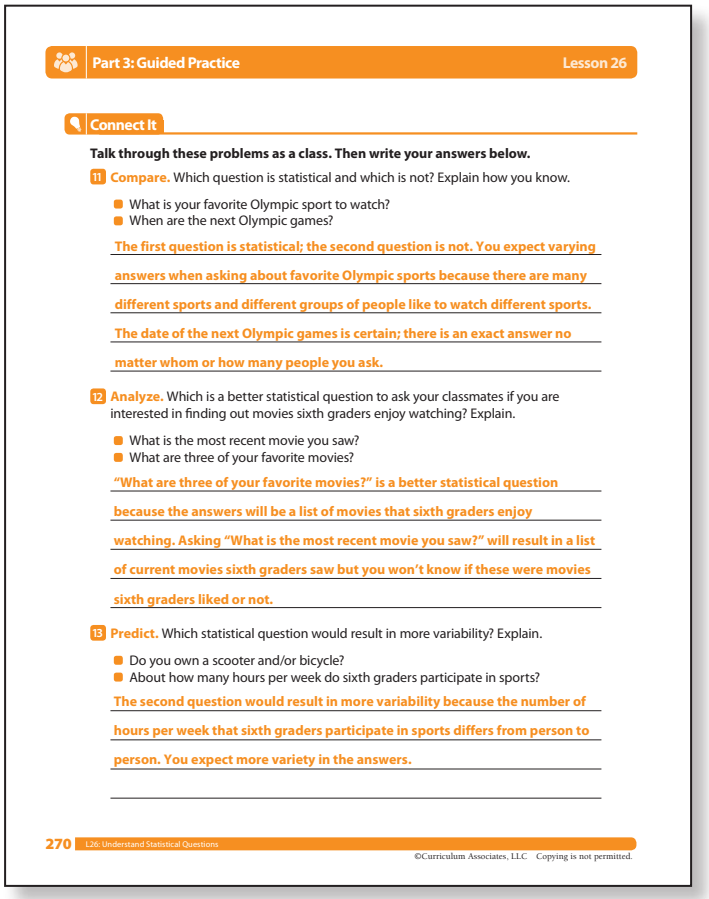
- You may choose to have students work in pairs to encourage sharing ideas and justifications.
- For quick assessment, you can read the first question and ask for a show of hands—statistical question or non-statistical question. Do the same for the second question.
- Ask a student to volunteer to explain how he/she knew that the first question is statistical and the second is non-statistical.

Analyze:

- The second problem focuses on the idea that certain statistical questions are better than others because they solicit answers that help you make better predictions or draw conclusions based on your original question.
- Read the problem together as a class. Ask students to continue to work in pairs to discuss and write their responses to the question.
- Begin the discussion by asking: *What does the problem tell us that we are trying to learn about by asking a question? Be specific.*

Predict:

- This discussion gives students an opportunity to predict which question will produce a greater variety of answers.
- Discuss the possible answers for the first question. [Answers will be yes or no.]
- Discuss the possible answers to the second question. Emphasize the variety of answers to this question versus the first one.



Part 3: Guided Practice Lesson 26

Connect It

Talk through these problems as a class. Then write your answers below.

11 **Compare.** Which question is statistical and which is not? Explain how you know.

- What is your favorite Olympic sport to watch?
- When are the next Olympic games?

The first question is statistical; the second question is not. You expect varying answers when asking about favorite Olympic sports because there are many different sports and different groups of people like to watch different sports. The date of the next Olympic games is certain; there is an exact answer no matter whom or how many people you ask.

12 **Analyze.** Which is a better statistical question to ask your classmates if you are interested in finding out movies sixth graders enjoy watching? Explain.

- What is the most recent movie you saw?
- What are three of your favorite movies?

"What are three of your favorite movies?" is a better statistical question because the answers will be a list of movies that sixth graders enjoy watching. Asking "What is the most recent movie you saw?" will result in a list of current movies sixth graders saw but you won't know if these were movies sixth graders liked or not.

13 **Predict.** Which statistical question would result in more variability? Explain.

- Do you own a scooter and/or bicycle?
- About how many hours per week do sixth graders participate in sports?

The second question would result in more variability because the number of hours per week that sixth graders participate in sports differs from person to person. You expect more variety in the answers.

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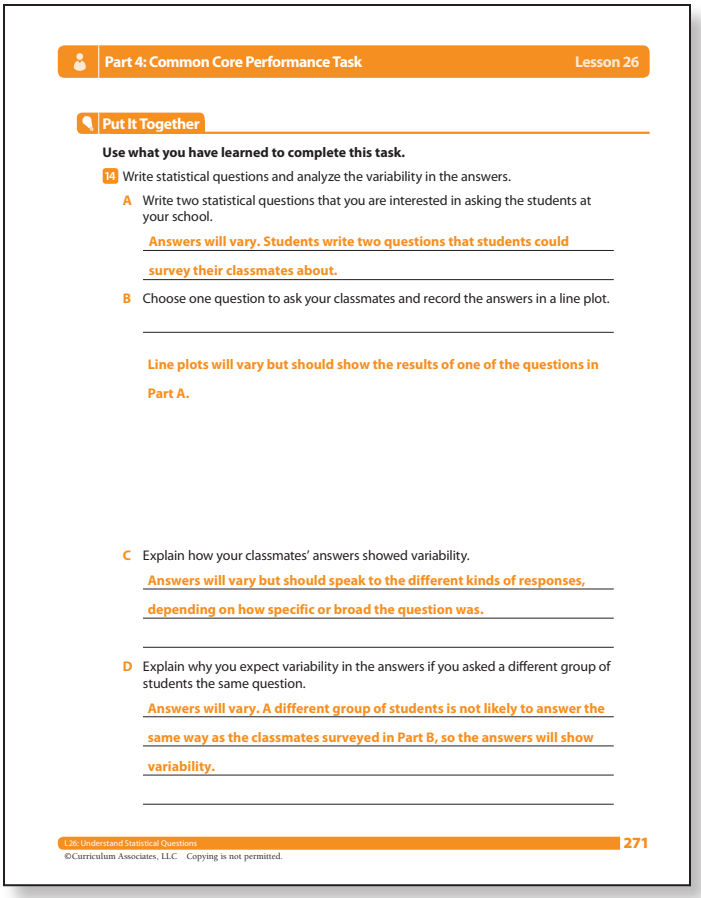
SMP Tip: As students advance through a series of increasingly difficult questions relating statistical questions to variability, they are making sense of problems and persevering in solving them (*SMP 1*).

AT A GLANCE

Students write two statistical questions and analyze variability in the answers. Students ask a question, record the answers in a line plot, and explain variability of answers.

STEP BY STEP

- Direct students to complete the Put It Together task on their own.
- Explain to students that their questions should be carefully worded to get a variety of responses. Allow them to make predictions or draw conclusions based on what they are interested in learning about their classmates.
- As students work on their own, give additional support, if needed.
- Have students ask classmates one of their questions and record the answers on a line plot.
- Have students write down their responses to the questions about the variability of given responses and predicted variability.



Part 4: Common Core Performance Task Lesson 26

Put It Together

Use what you have learned to complete this task.

14 Write statistical questions and analyze the variability in the answers.

A Write two statistical questions that you are interested in asking the students at your school.

Answers will vary. Students write two questions that students could survey their classmates about.

B Choose one question to ask your classmates and record the answers in a line plot.

Line plots will vary but should show the results of one of the questions in Part A.

C Explain how your classmates' answers showed variability.

Answers will vary but should speak to the different kinds of responses, depending on how specific or broad the question was.

D Explain why you expect variability in the answers if you asked a different group of students the same question.

Answers will vary. A different group of students is not likely to answer the same way as the classmates surveyed in Part B, so the answers will show variability.

L26: Understand Statistical Questions 271

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SCORING RUBRICS

See student facsimile page for possible student answers.

A

Points	Expectations
2	The question demonstrates the student's mathematical understanding of how to devise a good statistical question that has variability.
1	One or both questions lacked variability or were too general or specific based on what the student wanted to learn about classmates.
0	Student did not write the questions or showed little effort or understanding of variability.

B

Points	Expectations
2	Student records answers in an organized line plot.
1	Student records answers but line plot is incorrectly drawn.
0	There is no line plot or plot does not represent data collected.

C

Points	Expectations
2	Student's explanation about answers is clear, correct, and demonstrates a good understanding of the concept of variability.
1	Student attempts to explain answers but lacks clarity understanding about the concept of variability.
0	Student does not respond to the question or does not address the key point about variability.

D

Points	Expectations
2	Student's response demonstrates a good understanding of how asking different groups increases variability.
1	Student's response shows minimal understanding of how variability is affected by asking additional groups.
0	Student does not respond or shows a lack of understanding of the concept of variability.

Intervention Activity

Write statistical and non-statistical questions.

Display the table below. On the left are examples of statistical questions. On the right are examples of how these questions might read if they were non-statistical. The first row shows the statistical and its corresponding non-statistical question. Have students complete the table. After they complete the table, have them explain why they wrote the question as they did.

Statistical Question	Non-Statistical Question
How old are the students in my school?	How old am I?
How many pets do students in my school own?	
	What is my math test score?
When do sixth graders go to bed?	
	What is my best friend's favorite ice cream flavor?
What is the height of the girls in my grade?	
	What is my favorite type of music?

On-Level Activity

Write and analyze questions with variability.

Tell students that they will write three different questions—one non-statistical and two statistical. Then tell students that one statistical question should produce data with more variability than the other statistical question.

Tell students the following:

1. Write a non-statistical question.
2. Explain why this question does not have variability.
3. Write your first statistical question.
4. Explain how this question has variability.
5. Write your second statistical question.
6. Explain how this question has variability.
7. Explain how one statistical question has more variability than the other statistical question.

Challenge Activity

Create problems to match data.

At the right is a line plot for data that were collected in response to a statistical question. Answer the following questions related to the line plot.

1. Write two statistical questions that could have been asked to produce the data.
2. How many people responded to the question?
3. Pick a question from problem 1 (above) to answer these questions: Why would someone be interested in asking this question? What could that person do with the data they collect from that question?

		x		
		x	x	
	x	x	x	
	x	x	x	x
x	x	x	x	x
x	x	x	x	x
Below 65	66–69	70–79	80–89	90–100