Lesson 1

Organizing Data

Goals

- Comprehend that a "scatter plot" represents data with two variables and does not represent a function.
- Coordinate (orally and in writing) representations of data in scatter plots and tables.
- Describe (orally and in writing) patterns in representations of data in scatter plots and tables, and use these representations to make predictions.

Learning Target

I can organize data to see patterns more clearly.

Lesson Narrative

In this lesson, students are given data from 2 variables in a table and asked to consider ways to organize it to look for any patterns. They are shown that one way to organize the data is to visualize it graphically using **scatter plots**. Students must reason abstractly and quantitatively to match data to given scatter plots and use the structure of the scatter plot to label the axes.

Student Learning Goal

Let's find ways to show patterns in data

Access for Students with Diverse Abilities

- Action and Expression (Activity 2)

Access for Multilingual Learners

- MLR8: Discussion Supports (Activity 1)

Instructional Routines

- Notice and Wonder

Required Materials

Materials to Gather

- Copies of blackline masters: Activity 2

Materials To Copy

- Tables and Their Scatter Plots Handout (1 copy for every 2 students): Activity 2

Required Preparation

Lesson:
Provide 1 copy of the blackline master from the activity "Tables and Their Scatter Plots" for each student.

Lesson Timeline

Warm-up	Activity 1	Activity 2	Lesson Synthesis	Assessment
5 min	10 min	15 min	10 min	5 min
				Cool-down

Instructional Routines

Notice and Wonder

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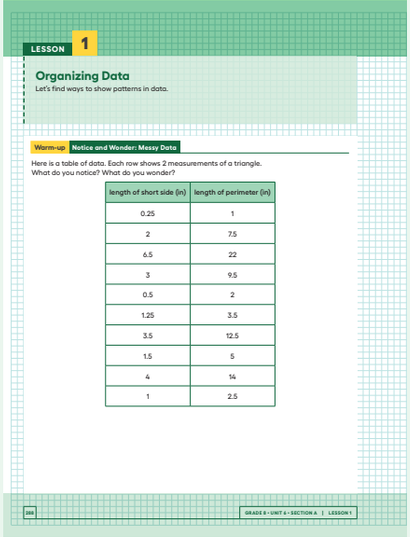
Please log in to the site before using the QR code or URL.

Student Workbook


LESSON 1

Organizing Data

Let's find ways to show patterns in data.

Warm-up Notice and Wonder: Messy Data

Here is a table of data. Each row shows 2 measurements of a triangle. What do you notice? What do you wonder?

length of short side (in)	length of perimeter (in)
0.25	1
2	7.5
6.5	22
3	9.5
0.5	2
1.25	3.5
3.5	12.5
1.5	5
4	14
1	2.5

Warm-up

Notice and Wonder: Messy Data

5 min

Activity Narrative

The purpose of this *Warm-up* is to elicit the idea that organizing data is helpful for recognizing patterns, which will be useful when students work with ways or organizing data in a later activity. While students may notice and wonder many things about this table, working towards recognizing any patterns and associations are the important discussion points.

This *Warm-up* prompts students to familiarize themselves with the context and mathematics that might be involved by making sense of data before organizing it.

Launch

Arrange students in groups of 2. Display the table for all to see. Ask students to think of at least 1 thing they notice and at least 1 thing they wonder. Give students 1 minute of quiet think time, and then 1 minute to discuss the things they notice and wonder with their partner.

Student Task Statement

Here is a table of data. Each row shows 2 measurements of a triangle. What do you notice? What do you wonder?

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6.5	22
3	9.5
0.5	2
1.25	3.5
3.5	12.5
1.5	5
4	14
1	2.5

Students may notice:

- The perimeters increase when the side lengths increase.
- The perimeters may be rounded to the nearest half unit.
- The data are not in any obvious order.

Students may wonder:

- Are the measurements exact?
- Is there a pattern in the data?
- Why measure these triangles?

Activity Synthesis

Ask students to share the things they noticed and wondered. Record and display their responses without editing or commentary for all to see. If possible, record the relevant reasoning on or near the table.
Next, ask students,

💬 *"Is there anything on this list that you are wondering about now?"*

Encourage students to observe what is on display and respectfully ask for clarification, point out contradicting information, or voice any disagreement.

If the pattern that both values increase together does not come up during the conversation, ask students to discuss this idea.

Activity 1
Seeing the Data

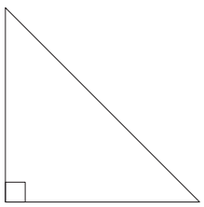
10 min

Activity Narrative

In this activity, students continue to look for patterns and associations for variables by sorting the values in a table. They use the table to make predictions about data that is not included in the table. In the discussion following the activity, students are asked to consider other methods of finding patterns within the data and see a graphical representation that more clearly shows the strong relationship between the variables. The graphical representation can also help improve predictions over those made with only the tables.

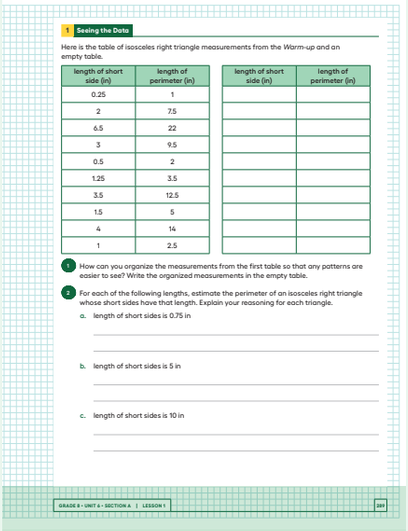
Launch

Keep students in the same groups of 2 from the *Warm-up*. Explain that the data in the *Warm-up* came from fourth grade students who were practicing drawing isosceles right triangles and measuring their perimeters. Display an example of an isosceles right triangle.



Ask students to recall what it means for a triangle to be isosceles and right as well as how to measure the perimeter of a triangle. Ask students if they think there should be a relationship between the length of the 2 short sides and the entire perimeter. Remind students that specifying 2 sides and the angle between them does determine a unique triangle, so we might expect that knowing the 2 side lengths and the right angle would be closely related to the length of the perimeter.

Student Workbook



1 Seeing the Data

Here is the table of isosceles right triangle measurements from the *Warm-up* and an empty table.

length of short side (in)	length of perimeter (in)	length of short side (in)	length of perimeter (in)
0.25	1		
2	7.5		
6.5	22		
3	9.5		
0.5	2		
1.25	3.5		
3.5	12.5		
1.5	5		
4	14		
1	2.5		

1. How can you organize the measurements from the first table so that any patterns are easier to see? Write the organized measurements in the empty table.
2. For each of the following lengths, estimate the perimeter of an isosceles right triangle whose short sides have that length. Explain your reasoning for each triangle.
   a. length of short sides is 0.75 in
   b. length of short sides is 5 in
   c. length of short sides is 10 in

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Student Task Statement

Here is the table of isosceles right triangle measurements from the *Warm-up* and an empty table.

1. How can you organize the measurements from the first table so that any patterns are easier to see? Write the organized measurements in the empty table.

Sample responses:

length of short side (in)	length of perimeter (in)
0.25	1
2	7.5
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0.25	1
0.5	2
1	2.5
1.25	3.5
1.5	5
2	7.5
3	9.5
3.5	12.5
4	14
6.5	22

2. For each of the following lengths, estimate the perimeter of an isosceles right triangle whose short sides have that length. Explain your reasoning for each triangle.

a. length of short sides is 0.75 in

2.25 in

It is between the perimeters for the triangles with lengths of short sides 0.5 in and 1 in.

b. length of short sides is 5 in

17 in

As the length of the short sides increases, so does the perimeter. 17 in is a little less than halfway between 14 in and 22 in, the perimeters for triangles with lengths of short sides 4 in and 6.5 in.

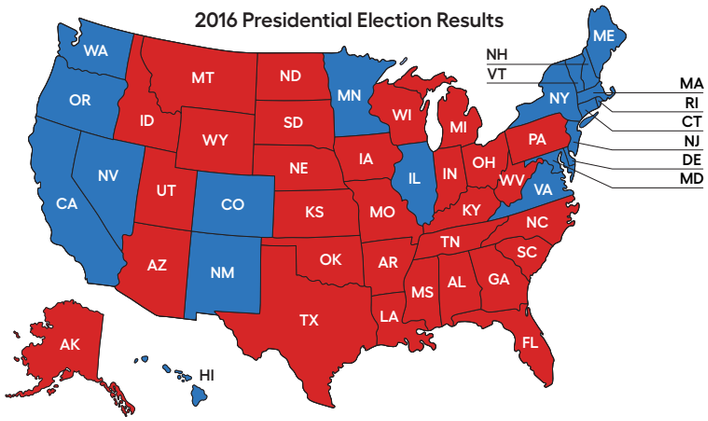
c. length of short sides is 10 in

30 in

Each time the length of the short side goes up 1 in, the perimeter goes up about 3 in, so when the short length is 10 in, the perimeter should be about 30 in.

Are You Ready for More?

In addition to the graphic representations of data you have learned, there are others that make sense in other situations. Examine the maps showing the results of the elections for United States president for 2012 and 2016. In red are the states where a majority of electorate votes were cast for the Republican nominee. In blue are the states where a majority of the electorate votes were cast for the Democratic nominee.



1. What information can you see in these maps that would be more difficult to see in a bar graph showing the number of electorate votes for the 2 main candidates?

   Sample response: The maps show that many of the votes for candidates happen in regions. For example, in the Northeast, they tend to vote for the Democratic nominee, while in the Southeast, they vote for the Republican nominee.

2. Why are these representations appropriate for the data that is shown?

   Sample response: Since electorate votes are cast by state, it makes sense to show the data using a map of the states.

Access for Multilingual Learners (Activity 1, Synthesis)

MLR8: Discussion Supports. Revoice student ideas to demonstrate and amplify mathematical language use. For example, revoice the student statement "The number is between the other values" as "Because the short side length is about halfway between these other 2 side lengths, the perimeter should also be about halfway between the other 2 perimeters."

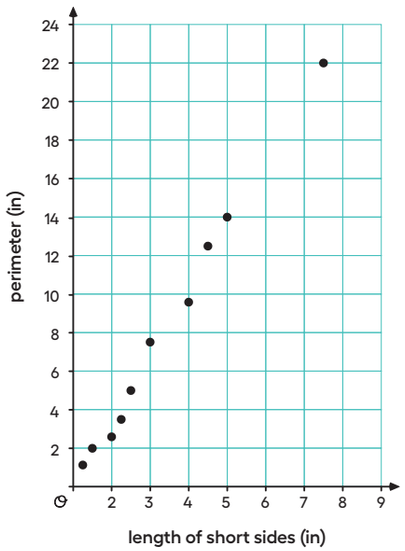
Advances: Speaking, Representing

Activity Synthesis

Select students to share their arrangements of the data, the patterns they noticed, and their predictions for the triangles with short side lengths. Display the predictions for all to see.

Ask students to share ideas for other ways to look at the data that might lead to better predictions.

Display a graph of the data for all to see.



To highlight features of the graph, ask:

- *"What patterns do you see in the data when it is graphed?"*

  It is close to linear.

- *"How could you use the graph to estimate the perimeter for the isosceles right triangles with a short side length of 0.75 in, 5 in, or 10 in?"*

  It is okay for students to not be precise in their answer at this point. Future lessons will give more instruction in how to do this.

Tell students that this graphical representation of data is called a **scatter plot**. A scatter plot is when two numerical variables are graphed by using one variable as the x-coordinate and the other as the y-coordinate. Data pairs are represented as plotted points.

Note that there is a difference between *time series* graphs and *scatter plots*. In time series graphs, a single variable is recorded at multiple time points and plotted on a graph. In a scatter plot, 2 variables are measured and plotted on a graph. For scatter plots, time may be one of the variables, but it should be possible to have more than one measurement for the second variable for the same time measurement. For example, when comparing the price of a car to its model year uses the year as one of the variables, but 2 cars made in the same year could have 2 different prices. The price for a single car throughout different years would be represented in a time series graph since it only has one price at any given time.

Activity 2
Tables and Their Scatter Plots

15 min

Activity Narrative

An essential part of creating and understanding scatter plots is interpreting the meaning of the points. In this activity, students match tables of data with scatter plots representing the same information. After matching appropriately, students are asked to include titles for the axes of the scatter plots. Following the activity, the importance of the axis labels is discussed.

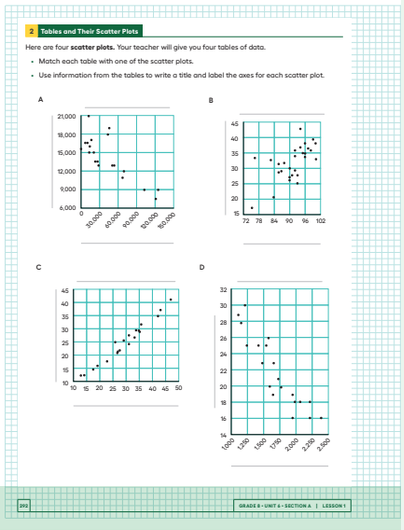
Launch

Arrange students in groups of 2. Distribute 1 copy of the tables from the blackline master to each group and resolve any clarifying questions about the data in the tables. In particular, students may wish to know about particular terminology. For example, “kilowatt hours” are a unit of electrical energy that most electricity companies use to measure how much electricity a customer consumes to determine how much to charge them. Another example is “battery life,” which is how long a device can run before its battery dies.

Access for Students with Diverse Abilities (Activity 2, Student Task)

Action and Expression: Internalize Executive Functions.
To support development of organizational skills in problem-solving, chunk this task into more manageable parts. For example, check in with students within the first 2–3 minutes of work time.
Supports accessibility for: Organization, Attention

Student Workbook



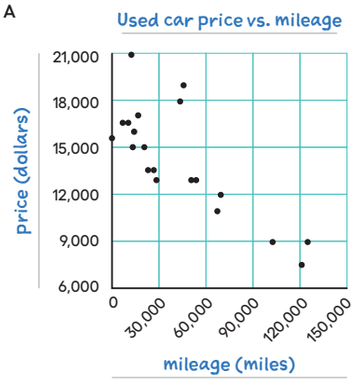
Student Task Statement

Here are four **scatter plots**. Your teacher will give you four tables of data.

- Match each table with one of the scatter plots.
- Use information from the tables to write a title and label the axes for each scatter plot.

1. Match each table with one of the scatter plots, then write a title and label the axes for each.

A



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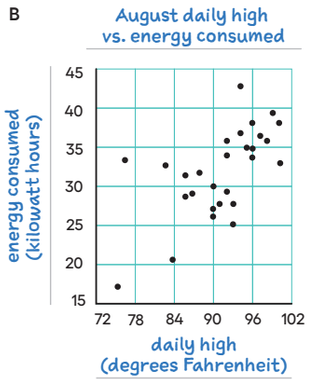

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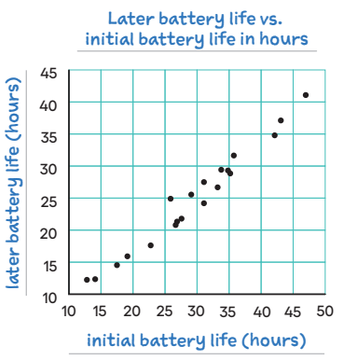

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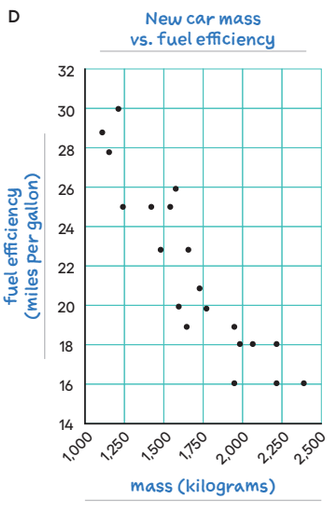


2. Why do you think some of the scatter plots do not include the origin?

In many of these cases, the data is not very close to the origin, so it might make sense to focus on the region where there is data.

3. Why do you think the values on the grid lines differ by numbers other than 1?

There would be too many lines if they went up by 1, so a different number is good to keep the scale reasonable.

Activity Synthesis

The goal of this discussion is for students to develop strategies for relating different representations of data.

Select 1–2 groups to share their responses to the questions about axis numbering with the class.

Tell students that they should think about the maximum and minimum values as well as the range (the distance between the maximum and minimum values) when setting the scale for the different axes. For the graphs in this unit, it is not usually essential to include the point (0, 0) in the graph, so that makes the axis labels even more important.

To conclude the discussion, consider asking some of these questions:

- *"How did you match the tables to the scatter plots?"*

  I looked at the scale of the values and tried to match them to the data in the tables. For example, the used car data had both variables in the thousands, which matches the scatter plot on the top left.

- *"Why is it important to include labels for the axes on scatter plots?"*

  so that any patterns that are found can be recognized from the scatter plot without having to go back to the table

- *"Why is it important to include units in the axis labels?"*

  so that the patterns found can be understood easily

- *"The same data is presented in the tables as in the scatter plots. Which is easier to understand? Explain your reasoning."*

  I think the scatter plots are easier to understand. I can more easily see how the data are related to one another.

Lesson Synthesis

To highlight the progression of representations seen today (unorganized table, ordered table, scatter plot) that help to highlight any patterns that may be present in data, ask:

- *"Why would sorting the information in the table be helpful?"*

  It makes it easier to see the minimum and maximum values.

- *"When looking for relationships between 2 variables, what are some graphic representations that might be helpful to use?"*

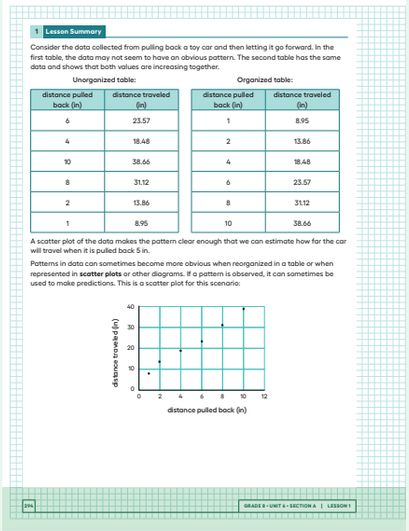
  An organized table helps show trends of one variable while another goes from smallest to largest. A scatter plot also shows how one variable changes in relation to the other.

- *"What is a scatter plot and how is it different from plotting points for a function?"*

  For a function, every input has a single output, but a scatter plot uses data that does not have an input or output, and a single value for one variable could have multiple values in the second variable.

Remind students that, when reorganizing data, it is important to continue to label what the information represents. A table without titles or a scatter plot without labels may show some relationship between numbers, but is meaningless outside of the context.

Student Workbook



1 Lesson Summary

Consider the data collected from pulling back a toy car and then letting it go forward. In the first table, the data may not seem to have an obvious pattern. The second table has the same data and shows that both values are increasing together.

Unorganized table:

distance pulled back (in)	distance traveled (in)
6	23.57
4	18.48
10	38.66
8	31.12
2	13.86
1	8.95

Organized table:

distance pulled back (in)	distance traveled (in)
1	8.95
2	13.86
4	18.48
6	23.57
8	31.12
10	38.66

A scatter plot of the data makes the pattern clear enough that we can estimate how far the car will travel when it is pulled back 5 in.

Patterns in data can sometimes become more obvious when reorganized in a table or when represented in **scatter plots** or other diagrams. If a pattern is observed, it can sometimes be used to make predictions. This is a scatter plot for this scenario:

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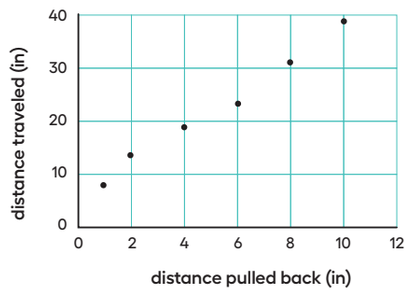


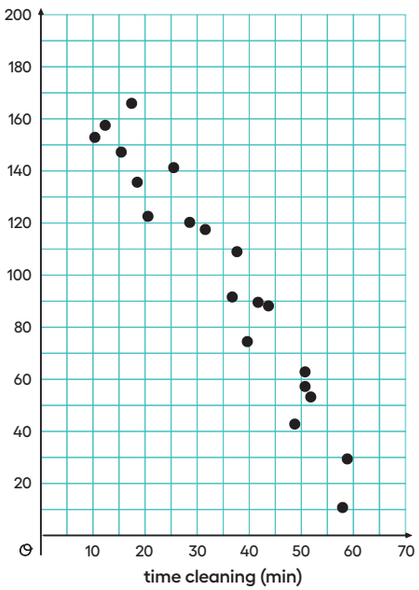
Cool-down

Beach Cleaning

5 min

Student Task Statement

20 volunteers are cleaning the litter from a beach. The number of minutes each volunteer has worked and the number of meters left to clean on their section are recorded. Here is a scatter plot that shows the data for each volunteer.



1. Label the vertical axis of the scatter plot.

   Sample response: beach left to clean (meters)

2. If a volunteer has worked 45 minutes, should they have closer to 60 meters or 120 meters of beach left to clean? Explain your reasoning.

   60 meters

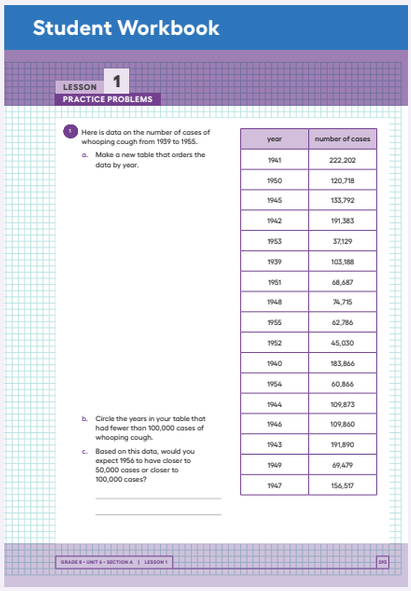
   Sample reasoning: When the time spent cleaning increases, the amount of beach left to clean tends to decrease. To keep in line with the rest of the data, the length left to clean should be closer to 60 meters than 120 meters.

Responding To Student Thinking

More Chances
Students will have more opportunities to understand the mathematical ideas addressed here. There is no need to slow down or add additional work to the next lessons.

Practice Problems

3 Problems


Student Workbook

LESSON 1
PRACTICE PROBLEMS

1 Here is data on the number of cases of whooping cough from 1939 to 1955.

a. Make a new table that orders the data by year.

year	number of cases
1941	222,202
1950	120,718
1945	133,792
1942	191,383
1953	37,129
1939	103,188
1951	68,687
1948	74,715
1955	62,786
1952	45,030
1940	183,866
1954	60,866
1944	109,873
1946	109,860
1943	191,890
1949	69,479
1947	156,517

b. Circle the years in your table that had fewer than 100,000 cases of whooping cough.

c. Based on this data, would you expect 1956 to have closer to 50,000 cases or closer to 100,000 cases?

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Problem 1

Here is data on the number of cases of whooping cough from 1939 to 1955.

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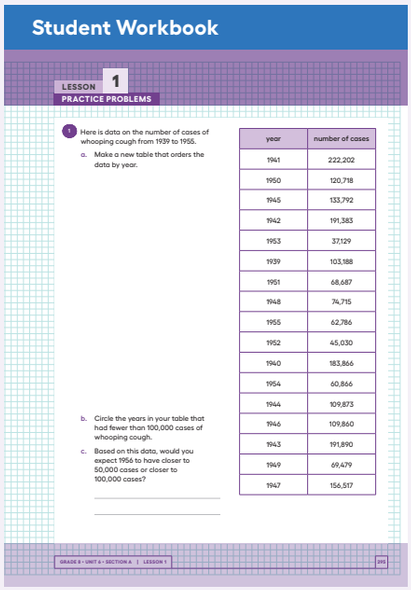
1946	109,860
1947	156,517
1948	74,715
1949	69,479
1950	120,718
1951	68,687
1952	45,030
1953	37,129
1954	60,886
1955	62,786

c. Based on this data, would you expect 1956 to have closer to 50,000 cases or closer to 100,000 cases?

Sample response: This data seems to show the number of cases decreasing over time, so I would expect 1956 to have closer to 50,000 cases than 100,000.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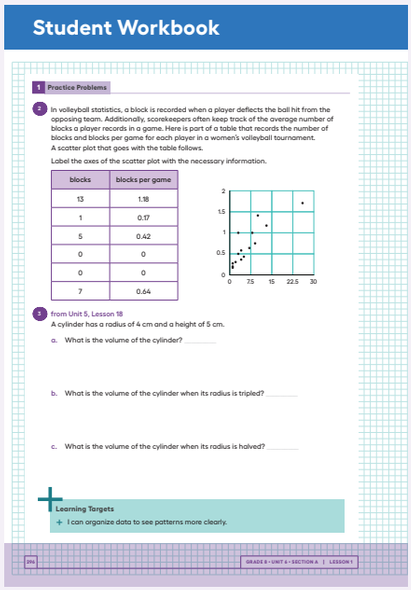
Student Workbook

1 Practice Problems

2 In volleyball statistics, a block is recorded when a player deflects the ball hit from the opposing team. Additionally, scorekeepers often keep track of the average number of blocks a player records in a game. Here is part of a table that records the number of blocks and blocks per game for each player in a women's volleyball tournament. A scatter plot that goes with the table follows.

Label the axes of the scatter plot with the necessary information.

blocks	blocks per game
13	1.18
1	0.17
5	0.42
0	0
0	0
7	0.64

3 from Unit 5, Lesson 18

A cylinder has a radius of 4 cm and a height of 5 cm.

a. What is the volume of the cylinder?

b. What is the volume of the cylinder when its radius is tripled?

c. What is the volume of the cylinder when its radius is halved?

Learning Targets

+ I can organize data to see patterns more clearly.

Problem 2

In volleyball statistics, a block is recorded when a player deflects the ball hit from the opposing team. Additionally, scorekeepers often keep track of the average number of blocks a player records in a game. Here is part of a table that records the number of blocks and blocks per game for each player in a women's volleyball tournament. A scatter plot that goes with the table follows.

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13	1.18
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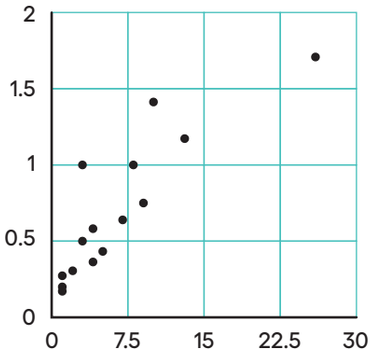

Label the axes of the scatter plot with the necessary information.

The horizontal axis should be labeled "blocks," and the vertical axis should be labeled "blocks per game."

Problem 3

from Unit 5, Lesson 18

A cylinder has a radius of 4 cm and a height of 5 cm.

a. What is the volume of the cylinder?

80π cm^3

b. What is the volume of the cylinder when its radius is tripled?

720π cm^3

c. What is the volume of the cylinder when its radius is halved?

20π cm^3