LESSON 33: Histograms

[Objective]
The student will use and interpret numerical data to create histograms.

[Prerequisite Skills]
dot plots, median, mean

[Materials]
Student pages **S409 – S419**
Colored pencils
Ruler (1 per student pair)

[Essential Questions]
1. How can I compare a dot plot and a histogram?
2. When is it best to use a histogram?
3. How can I determine the intervals to use when creating a histogram?

[Words For Word Wall]
dot plot, histogram, scale, data, intervals, frequency table, range

[Grouping]
Cooperative Pairs (CP), Whole Group (WG), Individual (I)
*For Cooperative Pairs (CP) activities, assign the roles of Partner A and Partner B to students. This allows each student to be responsible for designated tasks within the lesson.

[Levels of Teacher Support]
Modeling (M), Guided Practice (GP), Independent Practice (IP)

[Multiple Representations]
SOLVE, Graph, Verbal Description, Graphic Organizer, Pictorial Representation, Concrete Representation

[Warm-Up] (IP, I, WG) S409 (Answers are on T789.)

- Have students turn to S409 in their books to begin the Warm-Up. Students will work with a data set to determine the mean and median. Monitor students to see if any of them need help during the Warm-Up. Have students complete the problems and then review the answers as a class. **{Verbal Description}**

[Homework]
Take time to go over the homework from the previous night.

[Lesson] [2 days (1 day = 80 minutes) - (M, GP, IP, WG, CP)]

SOLVE Problem (IP, CP, WG) S410 (Answers on T790.)

Have students turn to S410 in their books. The first problem is a SOLVE problem. Students are going to complete all steps of the SOLVE problem because plotting data with a dot plot is prior knowledge. Have students complete the SOLVE problem in student pairs and then review the answers as a whole group. **{SOLVE, Verbal Description, Graph, Graphic Organizer}**

Discovery Activity - Histograms - Extend the SOLVE Problem

(M, GP, WG, CP) S411, S412, S413, S414, S415, S416) (Answers on T791, T792, T793, T794 ,T795, T796.)

WG, M, CP, GP Have students turn to page S411 in their books. Assign the roles of Partner A and Partner B. Students will be applying their knowledge of dot plots to create and interpret data with histograms. **{SOLVE, Verbal Description, Graph, Graphic Organizer}**

MODELING

Discovery Activity – Histograms- Extend the SOLVE Problem

Step 1: Have students turn to S411 in their books.

- Have students discuss how this SOLVE problem is different from the SOLVE problem on S410. (The problem on S410 asks students to display data in a **dot plot**, and the SOLVE problem on S411 asks students to display data in a histogram.)
- Partner A, what does this mean? (The same data can be displayed using different graphs.)

Step 2: Students will work in student pairs to read the SOLVE problem and complete the S and O steps.

- Give students a few minutes to complete S and O steps and then go over the answers as a whole group before moving on to the L step.
- Partner A, what is the problem asking me to find? (the number of days that 66 or more lunches were sold and to create a histogram) Record.
- Partner B, identify the necessary facts. (data in the **frequency table**) Record.

***Teacher Note:** Students will be completing the same solve problem on S411 – S412 and S413 – S414 using two different strategies.

Step 3: Have student pairs look at the information that is done for them in the V step on S412.

- Partner A, discuss what has been given. [a dot plot and another graph (**histogram**)]
- Partner B, describe what is not complete in the V step. (frequency chart)

Step 4: Have students explain how this SOLVE problem is different. (The L step requires fill-in answers.)

***Teacher Note:** Students will be using the information given in L and V to discover and compare the differences in dot plots and histograms while making the connection between the two graphs.

- Have students look at the V Step on S412 and identify how the dot plot and histogram display the **data** differently. (Dot plots show all values, while histograms show data in groups; dot plots use a dot for each value, while histograms show groups of data with a bar; histograms have an *x*- and *y*-axis, while dot plots have only an *x*-axis.)

Step 5: Work with students on filling in the L step of the plan. Partner B, what is the first step for our plan? (Create a dot plot using the data in the table.) Record.

- Partner A, how could we divide the data in the dot plot into sections? (Look at the difference in the low and high values to determine the **range** and create the sections or **intervals**.)
- Partner B, if we want to display the data in intervals, what could we do to the data in the dot plot? (Use the **scale** from the dot plot to divide the number of data points on the horizontal axis into even groups.) Record.
- Partner A, what would be the third step of our plan? (Create a frequency table with the intervals and frequencies for each interval.) Record.
- Partner B, what is the next step? (Construct a histogram with a title. Label and scale the *x*-axis. Label and scale the *y*-axis. Then shade the columns to represent the different intervals.) Record.
- Partner A, what is the final step? (Use the information in the histogram to determine what we are looking for.) Record.

Step 6: Using the steps from L, walk through how to complete the V Step. (Take time at this point to fill in the frequency table showing the relationships between the dot plot and histogram.)

- Have student pairs complete the E Step of SOLVE and review the answers as a whole group.

***Teacher Note:** You could take time here to also show the students what the histogram would look like if you divided the intervals differently. A "Think Aloud" would be a good idea. Discuss how many intervals to use in different situations. Help students realize that if the data spreads over a small range of values, then they will want as many intervals as possible to identify clusters. When data ranges over a large range of values, it is better to identify larger intervals (6-8).

Step 7: Have students turn to S413 in their books. This is the same SOLVE problem as the one they just completed on S411 and S412.

- Students will work in student pairs to read the SOLVE problem and complete the S and O steps.
- Give students a few minutes to complete S and O steps and then go over the answers as a whole group before moving on to the L step.
- Partner A, what is the problem asking me to find (the number of days that 66 or more lunches were sold and to create a histogram) Record.
- Partner B, identify the necessary facts.(data in the frequency table) Record.

***Teacher Note:** Students will be completing the same SOLVE problem using two different strategies. This one will be listing the frequency values from lowest to highest and then making the intervals to create the histogram.

Step 8: Have student pairs discuss possible ways to describe how to line up a plan that will include everything you will need to do.

***Teacher Note:** You will have to help the students fill in the plan using the L step.

- Partner B, what would be the first step for our plan? (List the data from the table in order from lowest to highest.) Record.
- Partner A, if we want to display the data in intervals, what could we do to the data? (Use the number of different data points and divide them into equal groups. 60 – 71 is a total of 12 values, so we can divide it into 4 groups of 3 data points.)
- Partner B, what is the second step of the plan? (Count the total number of data points and determine the number of intervals based on divisibility.) Record.
- Partner A, identify the next step in the plan. (Create a frequency table with the intervals determined.) Record.
- Partner B, explain the next step. (Construct a histogram with a title, label and scale the *x*-axis, label and scale the *y*-axis, and then shade the columns to represent the different intervals.)
- Partner A, what is the next step for our plan. (Use the information in the histogram to determine what we are looking for.) Record.
- Partner B, what would our operation or operations be? (We will not be using a specific operation.)

Step 9: Direct students to page S414 and then follow the plan to complete the V Step.

- Partner A, explain how the histogram is different from the dot plot. (The histogram displays the data in sections in intervals, and the dot plot displays each individual data point. The histogram has an *x*- and *y*-axis with a label and scale.)
- Have student pairs complete the E Step of SOLVE and review the answers as a whole group.
- Partner B, did both SOLVE problems give us the same answer? (Yes)
- Partner A, explain what that means. (There is more than one plan - L Step - to create the histogram.)

IP, CP, WG: Have students work with their partners to complete the problems on S415 and S416 using the information on the dot plot to create a histogram. Monitor closely to make sure students are using the appropriate vocabulary. Then come back together as a class and share their results.
{Verbal Description, Graphic Organizer, Graph}

Creating a Histogram Using Student Data

(CP, WG, M, GP, IP)
S417 (Answers on T797.)

M, WG, GP, CP: Have students turn to S417 in their books. Make sure students know their designation as Partner A or Partner B.
{Verbal Description, Graphic Organizer, Graph}

MODELING

Create a Histogram Using Student Data

Step 1: Direct students' attention to S417.

- Have student pairs measure each other's height and list them on the board.
- Review the steps on S417 for creating the histogram and group students in fours to create the histogram to present to the class.
- Have students look at the sample class data on S417 as an example.
- Students may choose to create a dot plot or list the values from least to greatest.

***Teacher Note:** Creating and presenting the histograms will take more than the allotted time. Below are some discussion questions for students to reflect on during and after the presentations. Possible answers are given in parentheses.

1. Did all the histograms have the same number of intervals? (No, different groups may have used different divisibility values.)
2. Were all the intervals grouped the same? (No, again this depends on how the data was divided.)
3. What was different about the histograms? (Different scales or different shadings may be used.)

IP, CP, WG: Have students work with their partners to complete S417. Monitor closely to make sure students are using the appropriate vocabulary. Then come back together as a class and share their results. **{Verbal Description, Graphic Organizer, Graph}**

If time permits… **(IP, CP) S418 (Answers on T798.)**
Have students complete S418.

[Closure]
To wrap up the lesson, go back to the essential questions and discuss them with students.

- How can I compare a dot plot and a histogram? *(A dot plot uses dots placed on a horizontal line to show the spread of data. A histogram uses vertical bars to show specific intervals of data.)*
- When is it best to use a histogram? *(It is best to use a histogram when showing data that falls into specific ranges or intervals.)*
- How can I determine the intervals to use when creating a histogram? *(Examine the data, find the range, and determine a value that will divide evenly into the range.)*

[Homework] Assign S419 for homework. (Answers on T799.)

[Quiz Answers] T800 –T801

1. **D** 2. **B** 3. **D** 4. **C** 5. **D** 6. **B** 7. **B** 8. **B** 9. **D** 10. **B**

The quiz can be used at any time as extra homework or to assess how students progress on understanding how to display numerical data using histograms.

Here is the key to **S409**.

Warm–Up

Directions: Find the median and mean for Questions 1 and 2.

1. Mrs. Thompson is having a reading contest in her classroom. Each student writes the number of pages read per day on a chart in the classroom. On Thursday, only 14 students had read the night before.

The number of pages read by 14 students:

10, 11, 15, 17, 16, 11, 15, 12, 13, 13, 15, 13, 11, 13

What is the median? **13**

What is the mean? **13.2**

2. Marc has taken 5 quizzes in math this quarter. His quiz grades are 80, 85, 95, 90, and 85.

What is the median quiz grade? **85**

What is the mean quiz grade? **87**

Here is the key to **S410**.

Directions: Complete this page with your partner.

~~Mr. Henderson's 6th grade math class had an assignment for data and graphing.~~| One group of students compiled data for 30 days about how many lunches were served to sixth-grade students.| The data they collected is shown in the frequency table below.|

Number of lunches	60	61	62	63	64	65	66	67	68	69	70	71
Frequency	2	3	3	1	1	2	5	4	3	2	2	2

Create a dot plot to display the data and determine the median of the data set.

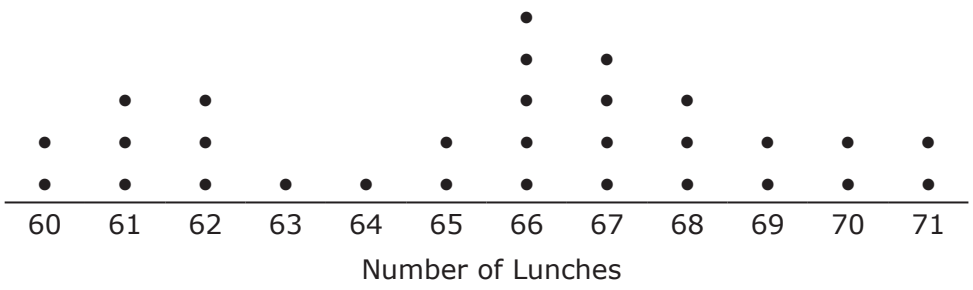
S Underline the question.
This problem is asking me to find **the median of the data set and to create a dot plot.**

O Identify the facts.
Eliminate the unnecessary facts.
List the necessary facts. **data in the frequency table**

L Write in words what your plan of action will be.
Create a dot plot using the data in the frequency table. Determine the median by finding the middle value in the dot plot.
Choose an operation or operations. **N/A**

V Estimate your answer. **Median: about 66 lunches**
Carry out your plan.

Number of Lunches Served in Sixth Grade in 30 Days



The median of the data set is 66 lunches.

E Does your answer make sense? (Compare your answer to the question.) **Yes, because I was looking for the median of the data set.**
Is your answer reasonable? (Compare your answer to the estimate.) **Yes, because it matches my estimate of about 66 lunches.**
Is your answer accurate? (Check your work.) **Yes**
Write your answer in a complete sentence. **The median number of lunches in the data set is 66.**

Here is the key to **S411**.

Directions: Complete this page with your teacher and partner.

~~Mr. Henderson's 6th grade math class had an assignment for data and graphing.~~ | ~~One group of students compiled data for 30 days about how many lunches were served to sixth-grade students.~~ | The data they collected is shown in the frequency table below.|

Number of lunches	60	61	62	63	64	65	66	67	68	69	70	71
Frequency	2	3	3	1	1	2	5	4	3	2	2	2

Create a histogram to represent the data set and determine how many days the number of lunches sold was 66 or greater.

S Underline the question.

This problem is asking me to find **the number of days that 66 or more lunches were sold and to create a histogram to display the data.**

O Identify the facts.

Eliminate the unnecessary facts.

List the necessary facts. **data in the frequency table**

L Write in words what your plan of action will be.

1. Create a **dot plot** using the data in the **table**.
2. Use the **scale of the dot plot** to **divide the number** of data points on the horizontal axis into even groups.
3. Create a **frequency table** with the **intervals** and frequencies for each interval.
4. Construct a **histogram** with a **title**. Label and scale the *x*-axis. Label and scale the *y*-axis, then **shade the columns** to represent the different intervals.
5. Use the information in the **histogram** to determine what you are looking for.

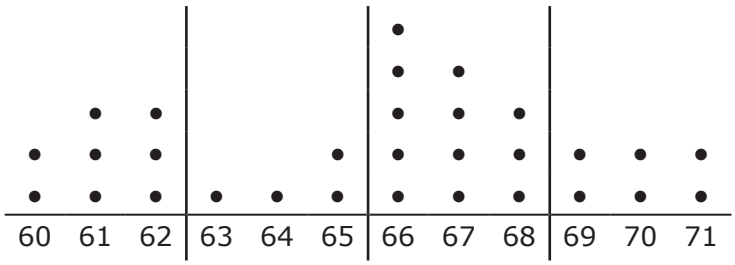
Choose an operation or operations. **N/A**

Here is the key to **S412**.

Directions: Complete this page with your teacher and partner.

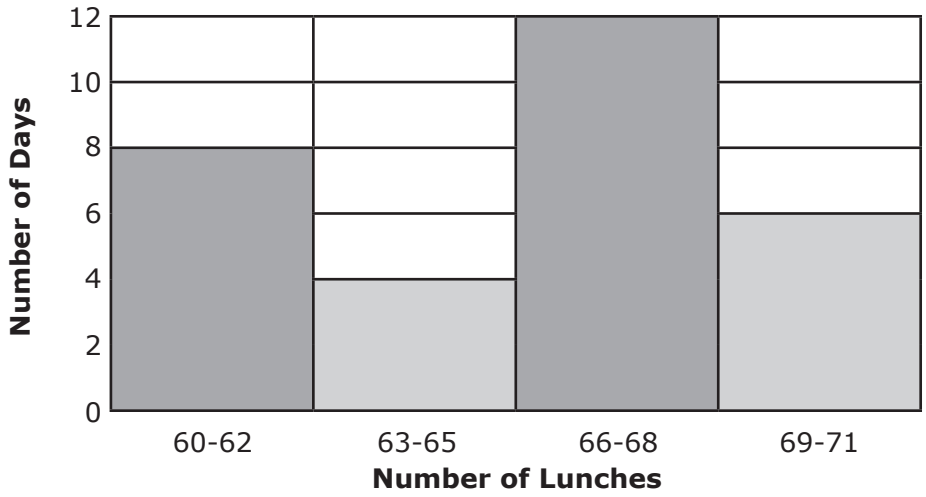
V Estimate your answer. **About 15 days**
Carry out your plan.

Number of Lunches Served in Sixth Grade in 30 Days



Number of Lunches in Intervals of 3	
Number of Lunches	Frequency
60 – 62	**8**
63 – 65	**4**
66 – 68	**12**
69 – 71	**6**

Number of Lunches Served in Sixth Grade in 30 Days



12 + 6 = 18

The number of days is 18.

E Does your answer make sense? (Compare your answer to the question.) **Yes, because I was looking for the number of days.**
Is your answer reasonable? (Compare your answer to the estimate.) **Yes, because it is close to my estimate of about 15 days.**
Is your answer accurate? (Check your work.) **Yes**
Write your answer in a complete sentence. **The number of days where 66 or more lunches were sold is 18.**

LESSON 33: Histograms

Here is the key to **S413**.

Directions: Complete this page with your teacher and partner.

~~Mr. Henderson's 6th grade math class had an assignment for data and graphing.~~| One group of students compiled data for 30 days about how many lunches were served to sixth-grade students. | The data they collected is shown in the frequency table below.|

Number of lunches	60	61	62	63	64	65	66	67	68	69	70	71
Frequency	2	3	3	1	1	2	5	4	3	2	2	2

Create a histogram to represent the data set and determine how many days the number of lunches sold was 66 or greater.

S Underline the question.
This problem is asking me to find **the number of days that 66 or more lunches were sold and to create a histogram.**

O Identify the facts.
Eliminate the unnecessary facts.
List the necessary facts. **data in the frequency table**

L Write in words what your plan of action will be.

1. List the **frequency values** in order from **lowest** to **highest**.
2. Count the **total number** of data points and determine the **number of intervals** based on divisibility.
3. Create a **frequency table** using the intervals determined.
4. Construct a **histogram** with a title, **label** and scale the *x*-axis, **label** and scale the *y*-axis, and then **shade** the columns to represent the different intervals.
5. Use the information in the **histogram** to determine what we are looking for.

Choose an operation or operations. **N/A**

Here is the key to **S414**.

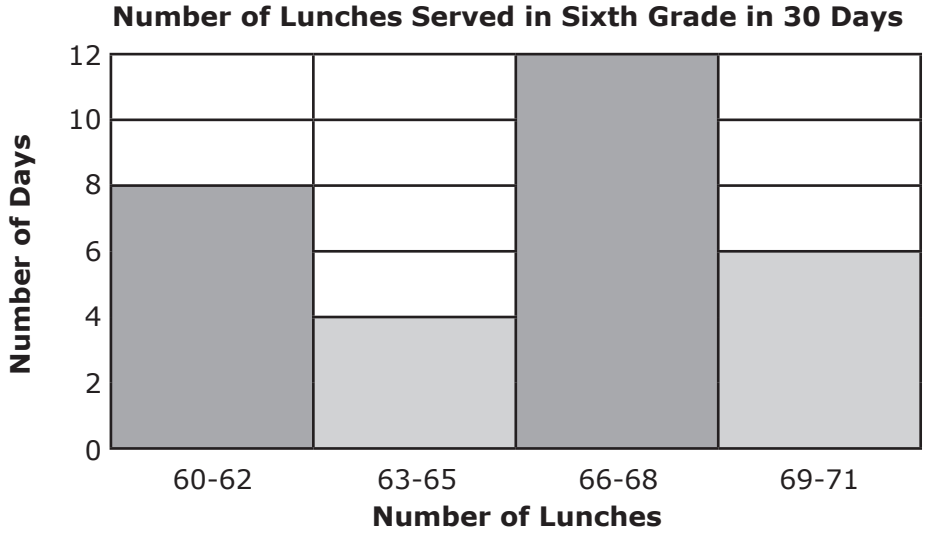
Directions: Complete this page with your teacher and partner.

V Estimate your answer. **About 15 days**

Carry out your plan.

Frequency Values from Lowest to Highest
60, 60, 61, 61, 61, 62, 62, 62, 63, 64, 65, 65, 66, 66, 66, 66, 66, 67, 67, 67, 67, 68, 68, 68, 69, 69, 70, 70, 71, 71

Number of Lunches in Intervals of **3**	
Number of Lunches	Frequency
60 – 62	**8**
63 – 65	**4**
66 – 68	**12**
69 – 71	**6**



12 + 6 = 18

The number of days is 18.

E Does your answer make sense? (Compare your answer to the question.) **Yes, because I was looking for the number of days.**

Is your answer reasonable? (Compare your answer to the estimate.) **Yes, because it is close to my estimate of about 15 days**

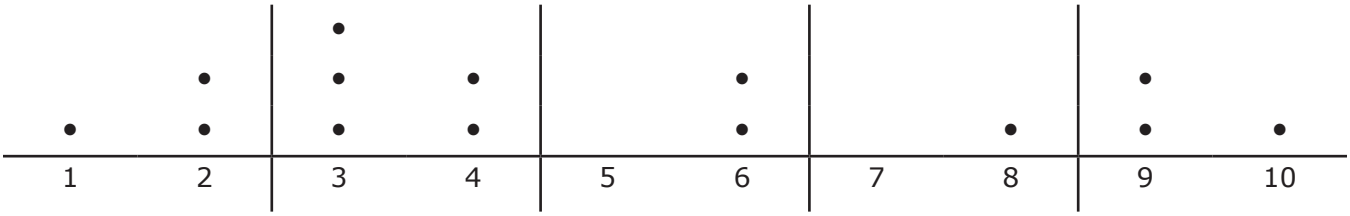
Is your answer accurate? (Check your work.) **Yes**

Write your answer in a complete sentence. **The number of days where 66 or more lunches were sold is 18.**

Here is the key to **S415**.

Directions: Complete this page with your partner.

Number of Inches of Snowfall on 14 Different Days



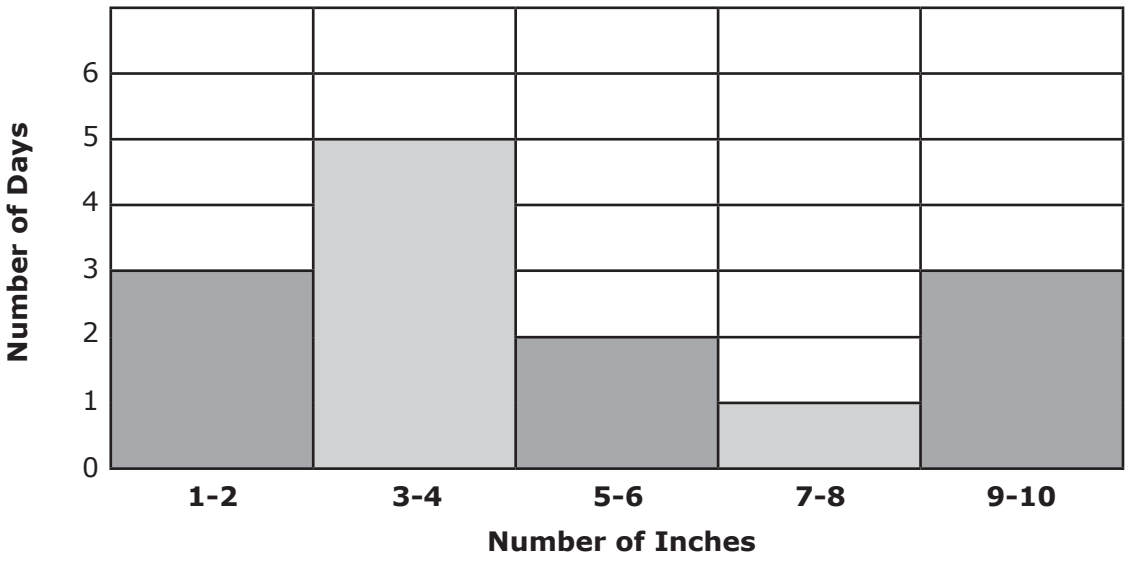
Number of Inches

Number of Inches in Intervals of **2**	
Number of Inches	Frequency
1 - 2	**3**
3 - 4	**5**
5 - 6	**2**
7 - 8	**1**
9 - 10	**3**

Frequency Values from Least to Greatest

1, 2, 2, 3, 3, 3, 4, 4, 6, 6, 8, 9, 9, 10

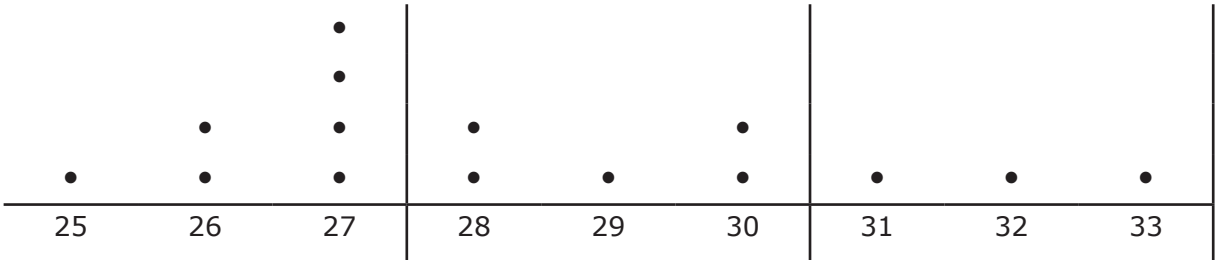
Number of Inches of Snowfall on 14 Different Days



Here is the key to **S416**.

Directions: Complete this page with your partner.

Number of Words Read in 1 Minute by 15 First Graders



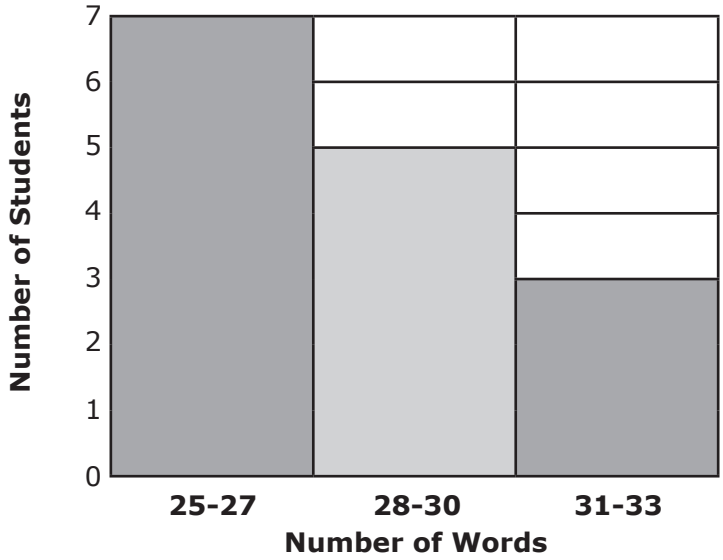
Number of Words

Number of Words in Intervals of **3**	
Number of Words	Frequency
25 – 27	**7**
28 – 30	**5**
31 – 33	**3**

Frequency Values from Least to Greatest

25, 26, 26, 27, 27, 27, 27, 28, 28, 29, 30, 30, 31, 32, 33

Number of Words Read in 1 Minute by 15 First Graders



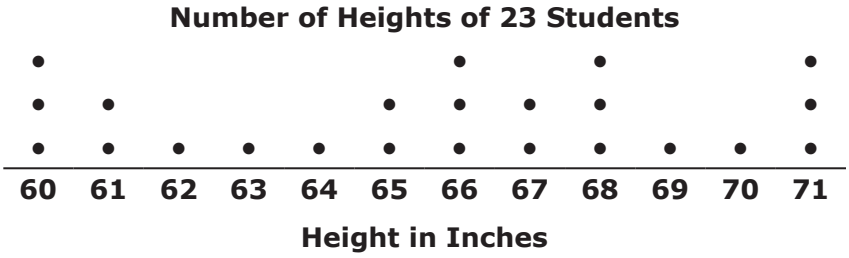
Here is the key to **S417**.

Directions: Complete this page with your teacher and partner.
Use the heights of the students in your class to create a histogram to display the data.

1. Measure the height of each student in the room and round to the nearest inch.
2. With your cooperative group, determine which method you will use to create the histogram. (creating a dot plot or listing the values from lowest to highest)
3. Choose an appropriate interval for the histogram.
4. Use the intervals to create a frequency table with the groupings of data.
5. Create a histogram with a title, labels for both the *x*-axis and *y*-axis, scale, and proper shading.
6. Have students share group histograms and compare answers.

Sample Answer:

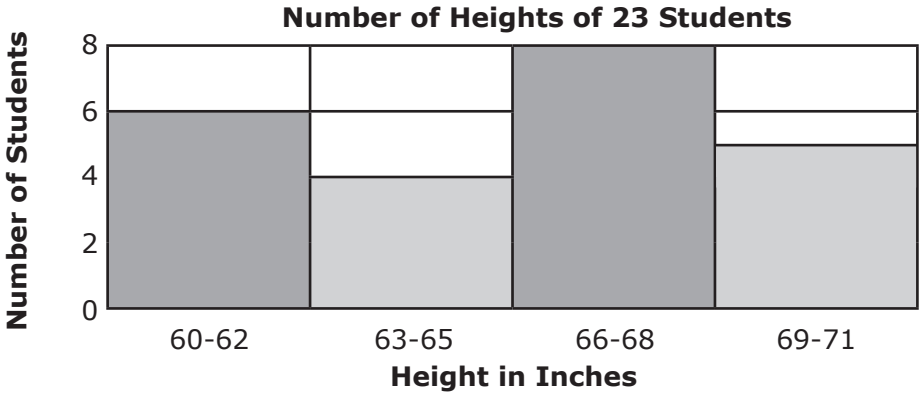
Height in Inches	Student Frequency
60	**3**
61	**2**
62	**1**
63	**1**
64	**1**
65	**2**
66	**3**
67	**2**
68	**3**
69	**1**
70	**1**
71	**3**



Heights in Intervals of **3**	
Heights	Frequency
60 – 62	**6**
63 – 65	**4**
66 – 68	**8**
69 – 71	**5**

Frequency Values from Lowest to Highest

60, 60, 60, 61, 61, 62, 63, 64, 65, 65, 66, 66, 66, 67, 67, 68, 68, 68, 69, 70, 71, 71, 71



Here is the key to **S418**.

Directions: Use the data in the table to create a histogram. Start by completing the frequency table to identify intervals for the histogram.

Business	Daily Frequency
A	2
B	1
C	3
D	2
E	2
F	1
G	4
H	3
I	2
J	1
K	5
L	6
M	5
N	3
O	1

Letters Mailed Daily in Intervals of **2**	
Daily Frequency of Letter Mailing	Number of Businesses
1-2	**8**
3-4	**4**
5-6	**3**

Here is the key to **S419**.

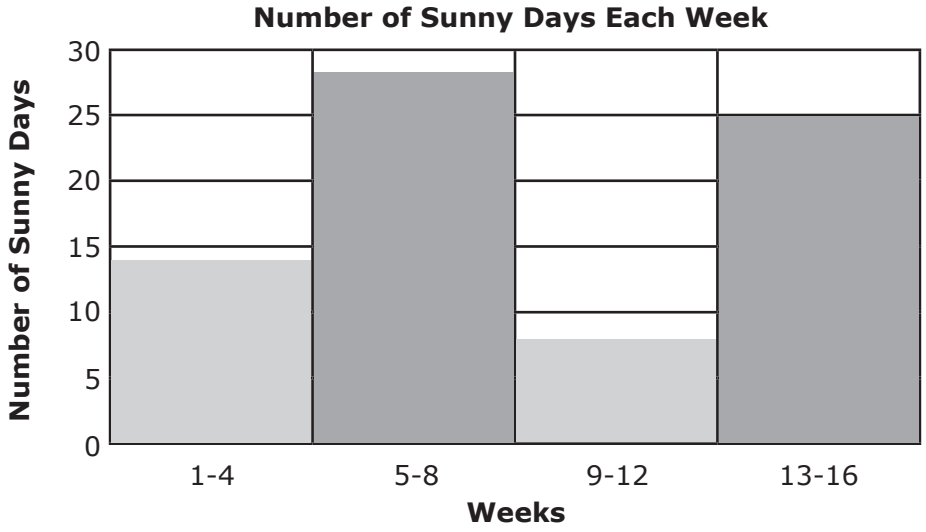
Homework

Name_____ Date _____

Directions: Use the data in the table to create a histogram.

Weeks	Sunny Day Frequency
1	3
2	2
3	1
4	8
5	7
6	6
7	8
8	7
9	1
10	1
11	2
12	4
13	7
14	7
15	6
16	5

Number of Weeks	
Weeks	Sunny Day Frequency
1 – 4	**14**
5 – 8	**28**
9 – 12	**8**
13 – 16	**25**

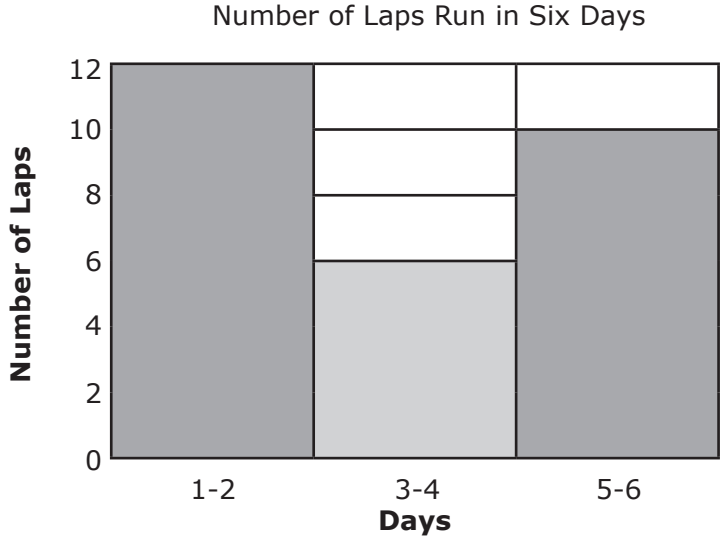


LESSON 33: Histograms

Name _____ Date _____

Quiz

Directions: Use the following histogram to answer Questions 1 – 10.



1. How many laps were run on Days 1 and 2?

A. 6
B. 8
C. 10
D. 12

2. During what interval were the fewest laps run?

A. Days 1 and 2
B. Days 3 and 4
C. Days 5 and 6
D. Days 1 and 2

3. What is the total number of laps run in the 6 days?

A. 16
B. 18
C. 26
D. 28

4. What is the difference in the number of laps run on Days 3 and 4 and Days 5 and 6?

A. 2
B. 3
C. 4
D. 6

5. How many laps were run in Days 1 and 2 and Days 5 and 6?

A. 16
B. 18
C. 20
D. 22

6. What number describes the width of the intervals?

A. 1
B. 2
C. 3
D. 4

7. Which frequency table shows the correct data?

A.

Day	Lap Frequency
1	7
2	4
3	2
4	3
5	4
6	6

B.

Day	Lap Frequency
1	7
2	5
3	2
4	4
5	4
6	6

C.

Day	Lap Frequency
1	5
2	3
3	2
4	4
5	4
6	6

D.

Day	Lap Frequency
1	6
2	2
3	2
4	4
5	4
6	6

---

8. Which of the following interval tables matches the histogram?

A.

Number of Days	Lap Frequency
1 – 2	10
3 – 4	12
5 – 6	6

B.

Number of Days	Lap Frequency
1 – 2	12
3 – 4	6
5 – 6	10

C.

Number of Days	Lap Frequency
1 – 2	12
3 – 4	10
5 – 6	6

D.

Number of Days	Lap Frequency
1 – 2	6
3 – 4	10
5 – 6	12

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9. Which of the following statements is true about the histogram?

A. The spread of the data is the same for all three days.

B. The spread of the data is greater on Days 3 and 4 than on Days 5 and 6.

C. The spread of the data is less on Days 1 and 2 than on Days 3 and 4.

D. The spread of the data is greatest over Days 1 and 2.

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10. What is the best use of a histogram?

A. to show the growth of data over time

B. to show data that falls into specific ranges or intervals

C. to show the spread of the data with the clusters of data clearly evident

D. to show the percentage of a category