

## **Title: Frosty's Ice Cream Parlor**

### **Brief Overview:**

Students will become owners of an ice cream shop so they can use bar graphs, probability, line plots, and averages to run their shop effectively. They will interpret data of ice cream toppings for their customers.

### **NCTM Content Standard/National Science Education Standard:**

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

- Design investigations to address a question and consider how data-collection methods affect the nature of the data set
- Collect data using observations, surveys, and experiments
- Represent data using tables and graphs such as line plots, bar graphs, and stem and leaf plots

Select and use appropriate statistical methods to analyze data.

- Use measures of center, focusing on the median, and understand what each does and does not indicate about the data set.

Understand and apply basic concepts of probability

- Predict the probability of outcomes of simple experiments and test the predictions

### **Grade/Level:**

Grades 3-4

### **Duration/Length:**

Three days (60 – 75 minutes each day)

### **Student Outcomes:**

Students will:

- Survey classmates to collect data
- Create a bar graph to represent comparative data
- Calculate, describe and analyze the mean, median, mode, and range of data
- Predict outcomes using a spinner
- Create a line plot to represent numerical data

## Materials and Resources:

### Day 1

- Probably Pistachio by Stuart J. Murphy
- Student Resource 1 Pre assessment
- Teacher Resource 1 Pre assessment Answer Sheet
- Student Resource 2 Favorite Ice Cream Flavors
- Student Resource 3 Parts of a Graph
- Student Resource 4 Bar Graph Grid
- Student Resource 5 Toppings Choices
- Student Resource 6 Favorite Toppings Chart
- Student Resource 7 SALT Rubric
- Student Resource 8 Analyzing Frosty Ice Cream Toppings
- Teacher Resource 11 Vocabulary Cards
- Teacher Resource 2 SALT Explanation

### Day 2

- Teacher Resource 3 Probability Cards
- Teacher Resource 4 Probability Scale Labels
- Teacher Resource 5 Ice Cream Flavors Spinner
- Teacher Resource 6 Class Spinner Sample
- Teacher Resource 11 Vocabulary Cards
- Teacher Resource 7 Ice Cream Flavor Results
- Student Resource 9 Ice Cream Toppings Spinner
- Student Resource 10 Analyzing Frosty Toppings Result
- Student Resource 11 Costumers Toppings
- Student Resource 12 Prediction Wheel

### Day 3

- Student Resource 13 Set of Number Cards
- Student Resource 11 Costumers Toppings
- Teacher Resource 8 Students Name Cards
- Teacher Resource 9 Toppings Line Plot Answer Key
- Teacher Resource 11 Vocabulary Cards
- Student Resource 14 Topping Prices
- Student Resource 15 Analyzing Toppings Cost
- Student Resource 16A-E Summative Assessment
- Teacher Resource 10A-E Summative assessment Answer Key

## Development/Procedures:

### Day 1

- Pre-assessment

Students will complete the pre-assessment (Student Resource 1) to evaluate whether they are able to interpret a bar graph to calculate the range, mode, and median. Use the answer key (Teacher Resource 1) to evaluate the parts of a bar graph and range, mode and median.
- Engagement
  - Read Probably Pistachio by Stuart J. Murphy
  - While reading, discuss the various situations where Jack made predictions and whether or not his predictions were correct.
  - Periodically stop and ask questions, such as “Why didn’t Jack’s predictions come true?” or “How could he have made a better prediction?”
  - Discuss actual situations where students might use information to make predictions (weather, lunch, sports, etc.)
- Exploration
  - Tell the students that they are the owners of Frosty’s Ice Cream Parlor from Probably Pistachio and they want to determine different ways to improve their store to generate more income. The first thing they need to do is to figure out what type of ice cream customers like the best so Frosty’s can make sure they are making enough of the right flavors.
  - Discuss with students the best way to collect this information. Explain that collecting a small survey can represent a larger population.
  - As a class, decide which flavors to survey. Have students vote and record information in the Favorite Ice Cream Flavors Table (Student Resource 2) on the overhead or as a poster.
  - Introduce the parts of a bar graph using the sample bar graph (Student Resource 3).
  - Use the data to create a class bar graph of ice cream flavors on the grid (Student Resource 4) on the overhead or a poster. Be sure to include scale, axis, labels, title (SALT). Refer to Teacher Resource 2.
  - Introduce bar graph vocabulary using the vocabulary cards (bar graph, labels, scale, title, axes). (Teacher Resource 11).
- Explanation
  - Discuss the results with the class.

Which flavor should Frosty's make more? Why?  
Which flavor should Frosty's stop making? Why?  
What would happen if they stopped making everybody's favorite flavor?

- Application
  - Now tell students that they also need to determine which toppings Frosty's should purchase. Students will be responsible for making sure that Frosty's isn't wasting money buying toppings that no one wants. They are in a hurry so they can't ask everyone.
  - Students will have 8 toppings from which to choose. Because they are in a rush, they can't survey all 8 toppings. They will choose 5 toppings that they will use for their survey.
  - Display the topping choices (Student Resource 5) on the overhead or a poster for students to see the toppings that they can survey. Using the Favorite Toppings Chart (Student Resource 6), students will survey the class to determine their favorite toppings. Each student will create their own survey.
  - Using their survey data, students will then create their own bar graph to display their data using the SALT rubric (Student Resource 7).
  - After students create their graph, have them analyze the data using Student Resource 8.
  
- Differentiation
  - Reteaching –Students who are missing parts of their graph, should review the parts and have them work in small group with you.
  
  - Enrichment –Students who mastered all the parts of their graph should create their own bar graphs using Student Resource 3. This time they will survey everyone in their group for their favorite topping using all 8 toppings. They will use Student Resource 8 to analyze data.
  
- Assessment
  - While students are creating their bar graph, observe whether students include all of the parts of a graph using the SALT rubric.
  - Evaluate whether or not the analysis of the graph matches the students' data.

## Day 2

- Engagement
  - Create a probability scale to display on the board or wall using a sentence strip or ribbon and the Probability Scale Labels (Teacher Resource 4).

- Cut the Probability Cards (Teacher Resource 3) and give them to the students.
  - Have students discuss where they would place each card on the scale and explain why they think that it describes the probability of each event.
- Exploration
  - Before presenting the lesson, the create a spinner of the different ice cream flavors to represent the class bar graph on Teacher Resource 5 (Refer to Teacher Resource 6 as a sample).
  - Ask students to make predictions using the probability words, less likely, more likely, equally likely, impossible, and certain to predict what will happen when they spin the spinner. Use Teacher Resource 11 to introduce the probability vocabulary, more likely, less likely, certain, impossible, equally likely.
  - Have more students spin the spinner using Teacher Resource 5 while the remainder of the class will record the results using the Ice Cream Flavor Results sheet (Teacher Resource 7).
  - After recording the data ask volunteers to record the result on the created data sheet on the board.
  - Discuss whether the data collected from the spinner matches the class data on flavors.
- Explanation
  - Using the data gathered from spinning the spinner, discuss why the data from the graph matched or did not match with the class data on flavors.
  - Explain that the likelihood of spinning a certain flavor depends on the number of votes a specific flavor has. For example, if there are 6 students who voted for cookie dough, 12 for chocolate, 2 for strawberry, and 4 mint chocolate chip it is more likely that the spinner will land on chocolate because 12 out of 24 ( $\frac{1}{2}$ ) of the students voted for chocolate. Also, explain that it is less likely that the spinner will land on strawberry because only 3 out of 24 students voted for that flavor. It is impossible for the spinner to land on Mango because mango is not included in the spinner. However, it is certain that the spinner will land on chocolate, cookie dough, strawberry, or mint chocolate chip because they are all on the spinner.
  - Emphasize that you approximated equivalent fractions  $\frac{12}{24}$  and  $\frac{3}{24}$  to show that there are 12 students who voted for chocolate out of 24 students in the class. That is half of the class so half of the spinner is chocolate. There are 3 out of 24 students who voted for strawberry and that is about 2 out of 12 so 2 of the spinner pieces are strawberry.

- Application
  - Divide the students into groups of 4.
  - Each group of students will receive a blank spinner (Student Resource 9). Students will choose one of the group members' bar graphs to use for the activity.
  - Based on the results of their bar graph, the group will create a spinner that represents their data. If more people voted for cherries than whipped cream, that should be represented on the spinner.
  - Before students spin the spinner, they will make a prediction on which topping will be spun the most and which topping will be spun the least on Student Resource 10.
  - Have each member of the group take turns spinning the spinner. Students will tally their data after each spin until they reach 50 spins.
  - Have all the students complete the "After" section of Student Resource 10 to explain whether their predictions were correct or not and why they think so.
  - After completing the data have them share and discuss their answers with the other groups in the class.
  - Have students spin the spinner 96 more times to fill in the toppings for the customers on Students Resource 11. This will be used for Day 3.
  
- Differentiation
  - Reteaching – Students who have difficulty creating spinners that represent their data can be given data from 12 students. They may use one space on the spinner for each student.
  - Enrichment - Students who were successful in making predictions and recording data in the tally table will work in pairs to complete the Prediction Wheel (Student Resource 12)
  
- Assessment (Ongoing formative assessment for Day 2.)
  - While students are creating their spinners, observe whether students' spinners represent the data from the bar graph.
  - Evaluate students' ability to make predictions based on the data and their ability to evaluate the results of the spinner compared to their original bar graph.

### Day 3

- Engagement
  - Each student will be given a set of numbers in a plastic sandwich bag. Use Student Resource 13.
  - Have students arrange the numbers from least to greatest.

- Ask the questions below:  
What is the greatest number?  
What is the least number?  
What is the difference between the greatest and the least number in the set?  
If you ordered the numbers from least to greatest, what number would be in the middle?  
Which number appears the most in the number set?
    - Record students' response on chart paper.
  - Exploration
    - Provide students the data they gathered from the previous activity on their favorite toppings for Student Resource 11.
    - Cut apart the digits and name cards (Teacher Resource 8) and create a number line with the digits 0-8. Each student will be given a name card that represents each of the customers.
    - Ask students to put the name card on the created number line on the board, floor, or wall which will indicate how many scoops of topping each customer had. Each spin represents one scoop. The type of topping does not matter for this activity. Refer to Teacher Resource 9 for an example.
    - Introduce the vocabulary words from Teacher Resource 11 for line plots (line plot, outlier, cluster, gap, mean, median, mode, range).
  - Explanation
    - Model how to compute the range, mean, median, and mode using a calculator.  
Range = greatest number - least number ( $8 - 0 = 8$ ).
    - Model how to calculate the mean.  
Mean = Total Number of Toppings Ordered  $\div$  Total Number of Students ( $96 \div 24 = 4$ )
    - Model how to calculate the mode.  
The number that appears the most
    - Model how to calculate the median.  
Arrange the numbers from least to greatest, then find the middle number.
    - Provide an example of an outlier on the sample data to show if someone ordered 20 toppings for their ice cream, how would that change the data?
  - Application
    - Ask students to work with a partner or assign partners with similar abilities.
    - Have each pair of students use the data they gathered from the previous activity (Student Resource 11).

- Based on the needs of the group, they are going to make a line plot and calculate the mean, median, mode, and range of their data using dollars (Student Resource 14A), cents (Student Resource 14B), or dollars and cents (Student Resource 14C). Students will be able to use a calculator to help them calculate the mean.
  - The value of each topping is listed on Student Resource 15.
  - After completing the data, each pair of students will create a line plot of how much the customers spent and record the range, mode, median, and mean on Student Resource 15.
- Differentiation
- Reteaching – Students who had difficulty calculating for the range, mean, median, and mode will work with you using whole numbers. The group will use Student Resource 14A.
  - Enrichment - Students who mastered how to calculate the range, mean, median and mode will work with a partner using whole numbers and decimals. Each pair will use Student Resource 14C.

**Summative Assessment:**

By the end of the unit, students will be able to create and read bar graphs to compare data, use spinners to predict probability, create a line plot to describe numerical data, and calculate the range, mode, median, and mean to describe the averages of data. Use Student Resource 16A-D to assess student understanding. See Teacher Resource 10A-D for the answer key.

**Authors:**

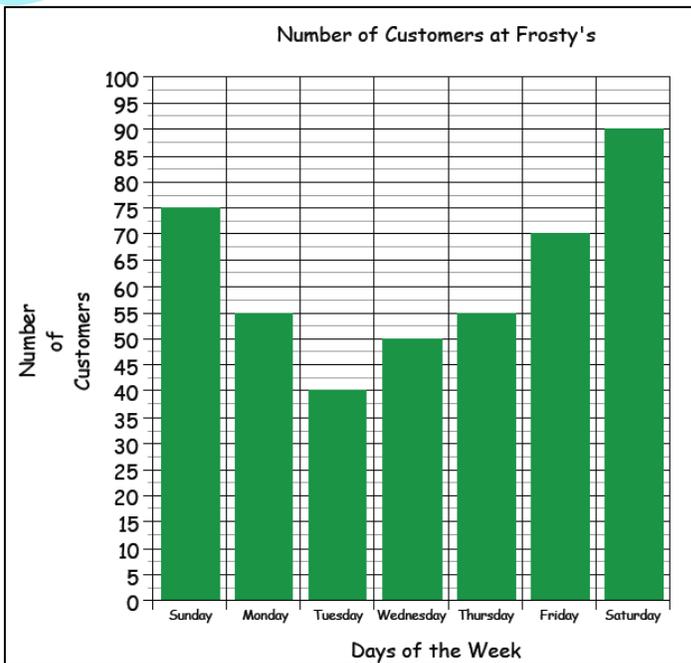
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 Patuxent Elementary School  
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Anita Chan  
 Sequoyah Elementary School  
 Montgomery County Public Schools

Pre-assessment



Examine the data in the table and answer the questions below about the customers at Frosty's Ice Cream Parlor.



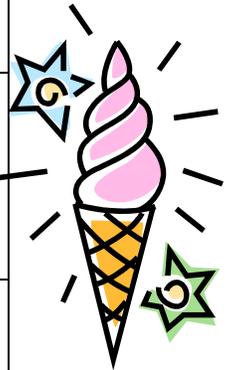
Identify the range of the number of customers. \_\_\_\_\_

Identify the mode number of customers. \_\_\_\_\_

Identify the median number of customers. \_\_\_\_\_

Which day had the most number of customers? \_\_\_\_\_

Favorite Ice Cream Flavors	
Flavors	Votes



Scale - the numbers that show the units used for the bar graph, starts at zero, skip counts by the same unit

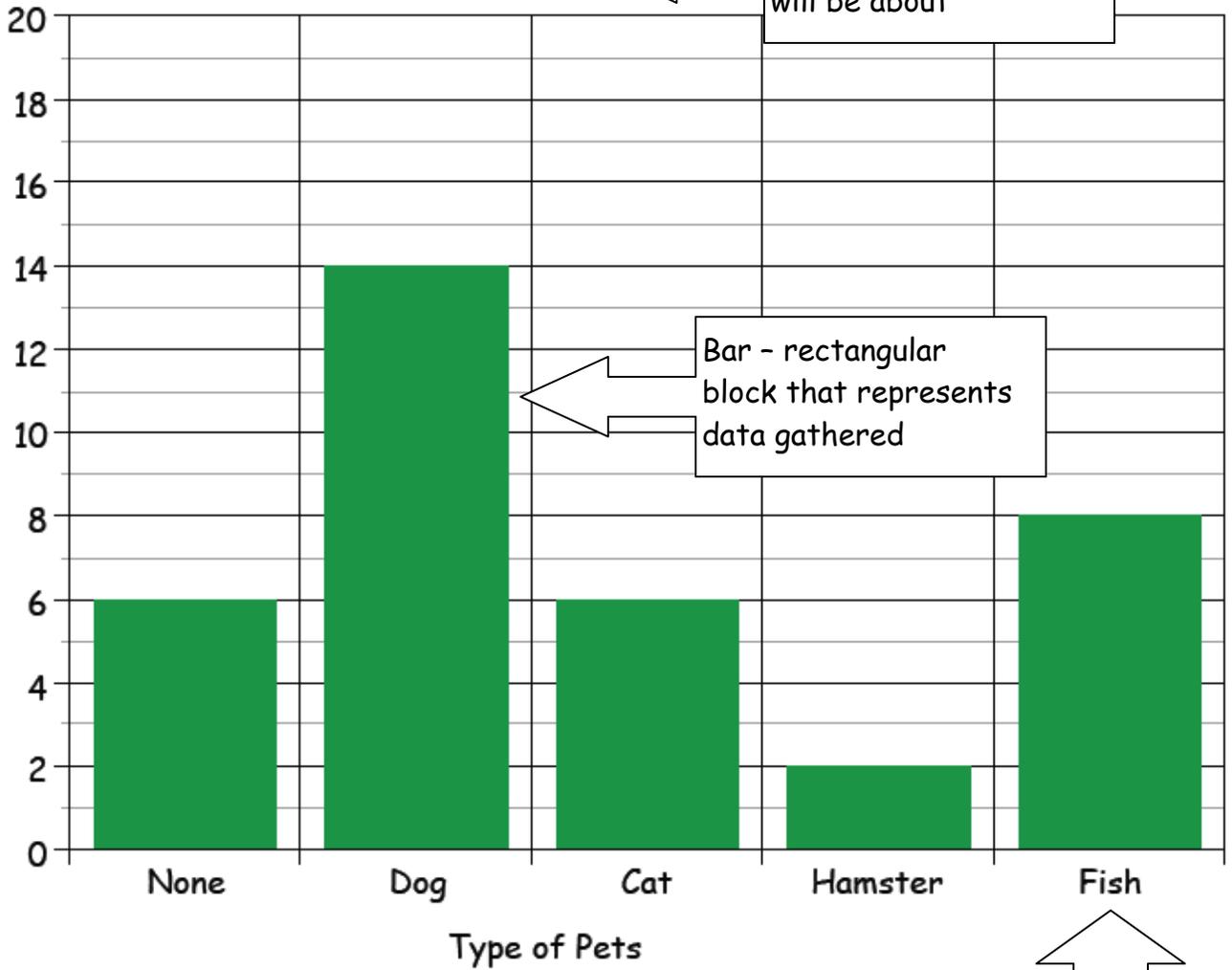
Pets

Title - tells the reader what the graph will be about

Number of Students

Bar - rectangular block that represents data gathered

Label - tells what is being counted



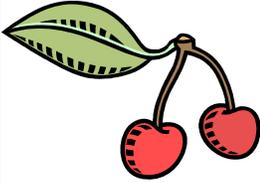
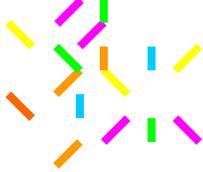
Label - tells what kind of data is graphed

Group Data Axis - tells what type of data the bar represents



# Frosty's Topping Choices



			
Nuts	Cherries	Chocolate Chips	Sprinkles
			
Jelly Beans	Strawberries	Marshmallows	Whipped Cream

Favorite Toppings	
Toppings	Votes





## S A L T Rubric

- 2 The bar graph demonstrates a complete understanding of data.
  - All the parts of the bar graph are complete.  
(Scale, axes, labels, title)
  - All the data are properly displayed on the bar graph.
- 1 The bar graph displays partial understanding of data.
  - One or some parts of the bar graph is/are missing.
  - Some data are not/incorrectly displayed on the bar graph.
- 0 Most parts of the bar graph are missing. Data are irrelevant.



## Analyzing Frosty's Ice Cream Toppings

Which topping do people like the most? \_\_\_\_\_

How many people like that topping? \_\_\_\_\_

Which topping do people like the least? \_\_\_\_\_

How many people liked that topping? \_\_\_\_\_

As the owner of Frosty's Ice Cream Parlor you need to make some changes to your menu, which topping should you stop offering your customers? Why would you discontinue that topping? Use numbers and words to explain your answer.

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Why is it important to include all the parts of the bar graph?

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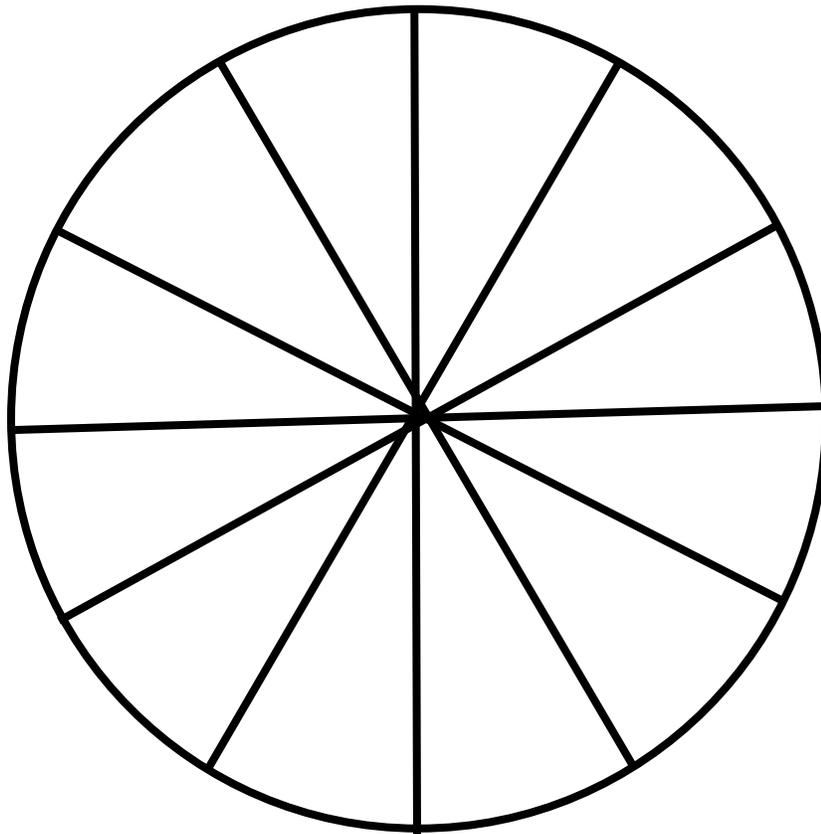
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Using your bar graph, create a spinner that matches the toppings that people like the most. Your spinner should represent the choices that people voted for.



## Frosty's Ice Cream Toppings





### Analyzing Frosty's Topping Results

Predict

Which topping choice will have the most spins? \_\_\_\_\_

Why do you think the spinner will land there more often? \_\_\_\_\_

\_\_\_\_\_

Which topping choice will have the least spins? \_\_\_\_\_

Why do you think the spinner will land on there the least often? \_\_\_\_\_

\_\_\_\_\_

Spin the spinner 50 times. Record the results in the tally table below.

Topping Choices	Number of Times Spun

After

Did you correctly predict the topping choice that had the most spins? \_\_\_\_\_

Why do you think you were or were not correct? \_\_\_\_\_

\_\_\_\_\_

Did you correctly predict the topping choice that had the least spins? \_\_\_\_\_

Why do you think you were or were not correct? \_\_\_\_\_

\_\_\_\_\_

How was your toppings bar graph and spinner related? \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Spin your spinner to fill in each of the customer's topping choices. Each customer can have the same topping more than once.

Ryan									
Marissa									
Eduardo									
Bryan									
Linda									
Bobbi									
Serena									
Trevor									
Ian									
Vivian									
Scott									
Caleb									
Emily									
Lucas									
Nadia									
Angela									
Darius									
Francis									
Gail									
Hilda									
Jacob									
Kaelyn									
Oscar									
Pierre									



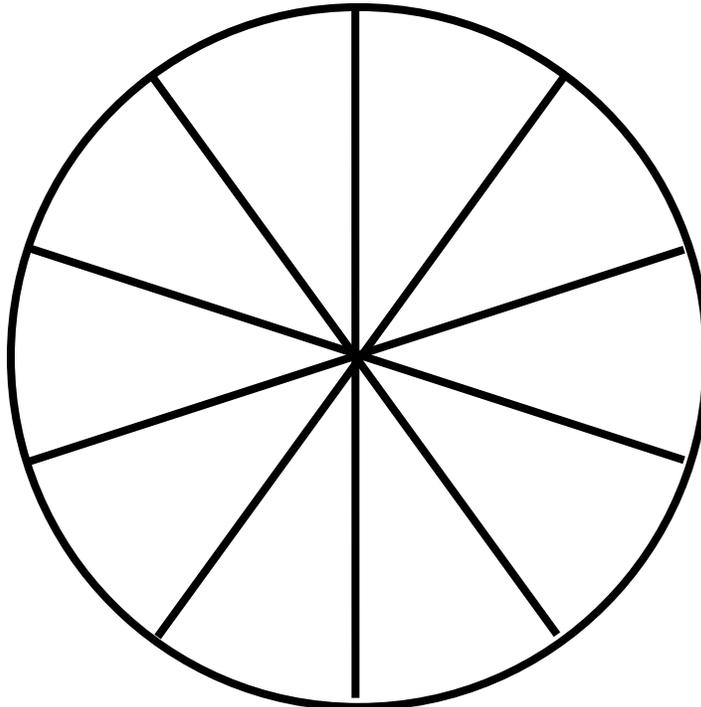
### Prediction Wheel

Ms. Smith's 4<sup>th</sup> grade class made a survey of their favorite color.  
Use the data below to create a tally chart.

Colors	
Colors	Frequency
Blue	6
Yellow	2
Red	4
Black	2
Purple	4
Pink	5

Colors	
Colors	Tally
Blue	
Yellow	
Red	
Black	
Purple	
Pink	

Use the data above to predict the colors on the spinner.



Set of Number Cards

10	3	24
15	7	18
9	15	12
23	21	16

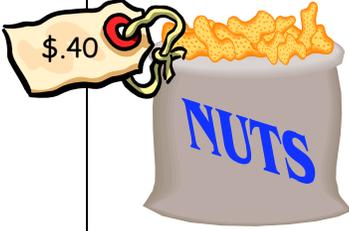
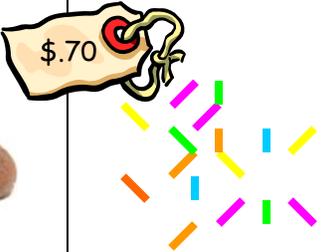
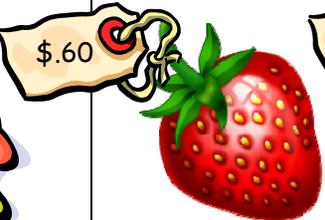
# Frosty's Topping Prices (A)



<p>Nuts</p>	<p>Cherries</p>	<p>Chocolate Chips</p>	<p>Sprinkles</p>
<p>Jelly Beans</p>	<p>Strawberries</p>	<p>Marshmallows</p>	<p>Whipped Cream</p>

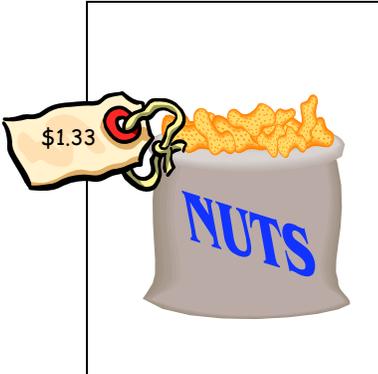
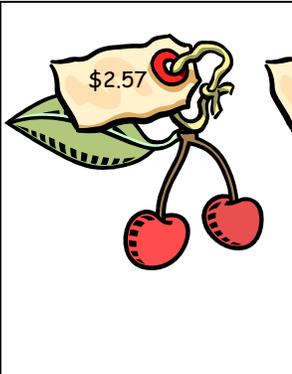
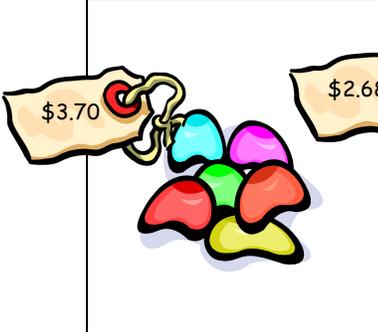
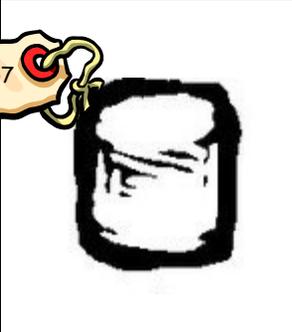
# Frosty's Topping Prices (B)



			
Nuts	Cherries	Chocolate Chips	Sprinkles
			
Jelly Beans	Strawberries	Marshmallows	Whipped Cream

# Frosty's Topping Prices (C)



			
Nuts	Cherries	Chocolate Chips	Sprinkles
			
Jelly Beans	Strawberries	Marshmallows	Whipped Cream



## Analyzing Toppings Cost

As the owner of Frosty's you want to know the average Amount of money you earn from each customer.

Graph the amount of money each customer spent on toppings. Don't forget to add a title and label.



What is the range of the amount of money that customers spent on toppings at Frosty's? \_\_\_\_\_

What is the mode of the money that customers spent on toppings at Frosty's? \_\_\_\_\_

What is the median amount of money that customers spent on toppings at Frosty's? \_\_\_\_\_

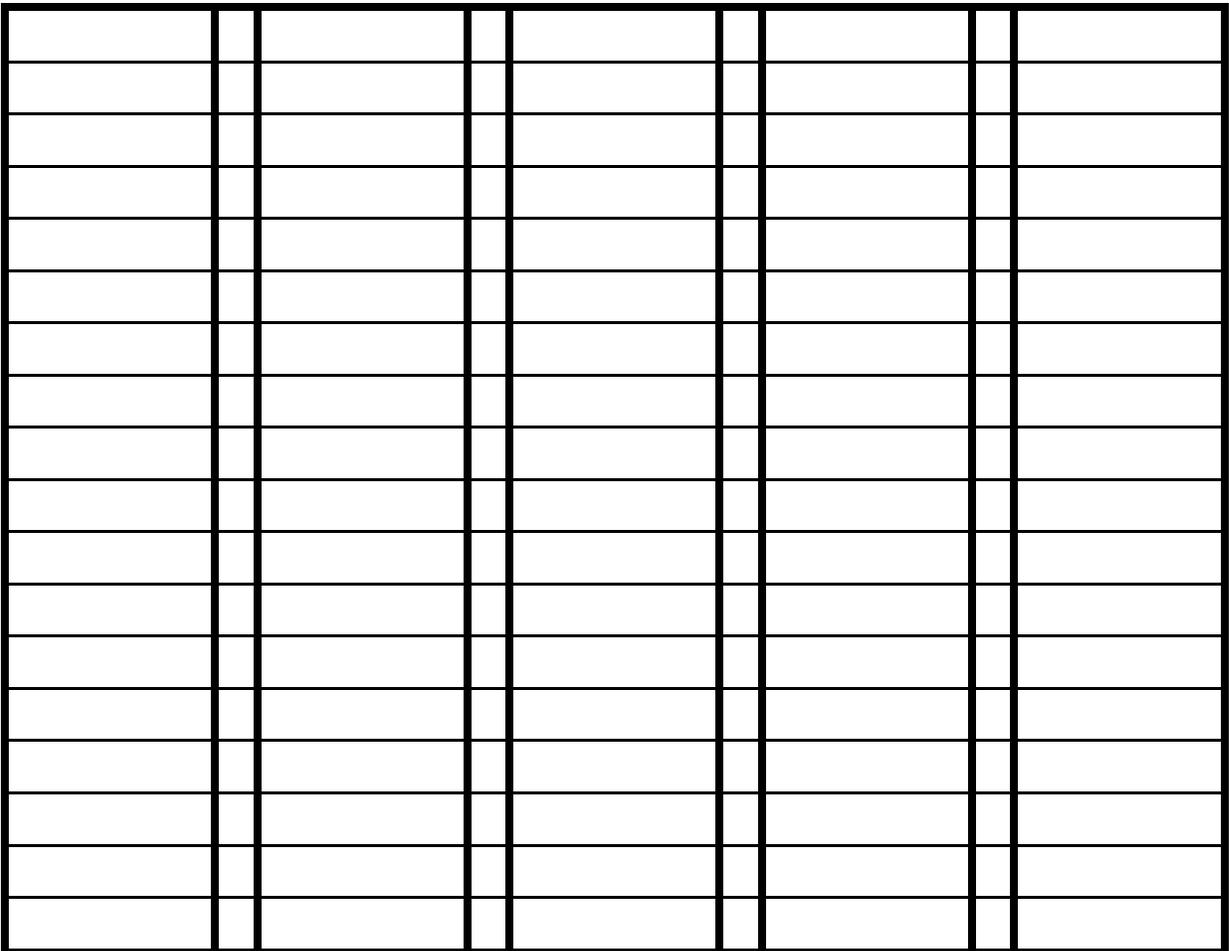
What is the mean amount of money that customers spent on toppings at Frosty's? \_\_\_\_\_

### Summative Assessment

1. Use the data in the table to create a bar graph. Be sure to include all the parts of a bar graph.

Part A

Favorite Colors	
Color	Number of Students
Blue	12
Red	8
Purple	9
Green	3
Yellow	7



Part B

Why is a bar graph better for showing our Favorite Colors than other types of graphs?

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2. How many more people like purple than green? \_\_\_\_\_

3. If we wanted to buy color T-shirts for the class, what color should we buy to make the most people happy? Why? \_\_\_\_\_

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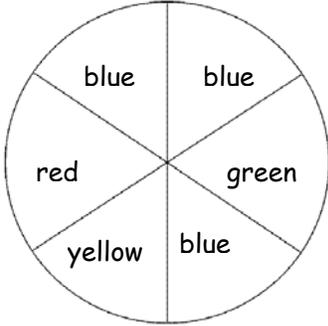
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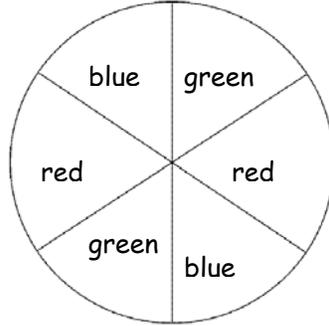
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4. Which spinner would be more likely to spin blue? \_\_\_\_\_

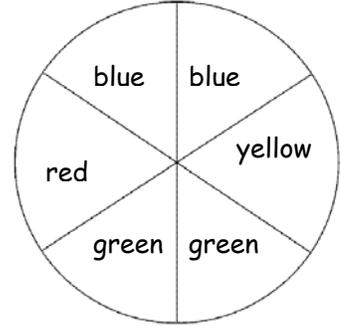
Spinner A



Spinner B



Spinner C



Why would you be more likely to spin blue on that spinner? Explain using words and numbers. \_\_\_\_\_

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5. Students in your class are collecting data on how many letters are in their name. Use the names below to create a line plot. Be sure to include all the parts of a line plot.

Lori	Marcelo	Kimberly
Stephanie	George	Douglas
Dennis	Janice	Kyla
Sarika	Terrence	Shawna
Pamela	Vo	Sam



6. What is the range of the number of letters in the students' names? \_\_\_\_\_

7. What is the mode for the number of letters in the students' names? \_\_\_\_\_

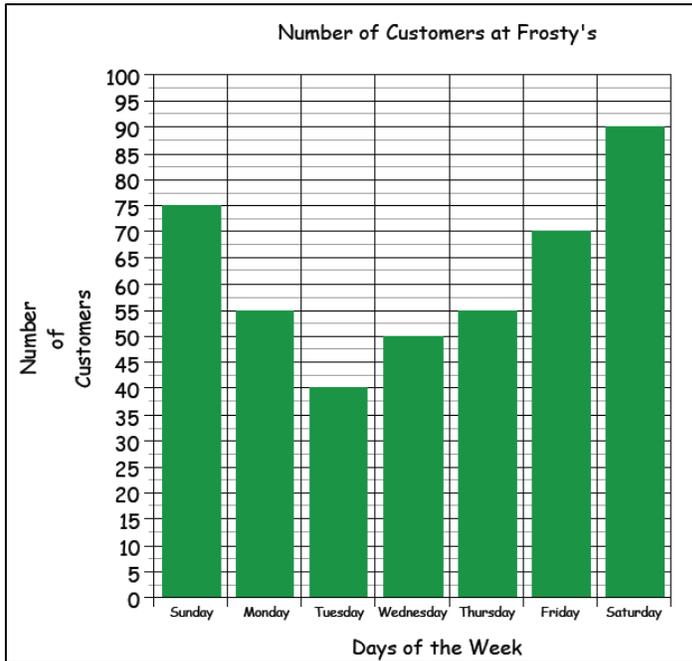
8. What is the median number of letters in the students' names?  
\_\_\_\_\_

9. What is the mean number of letters in the student's names?

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Pre-assessment (Answer Key)

Examine the data in the table and answer the questions below.



Identify the range of the number of customers. 90 - 40 = 50

Identify the mode number of customers. 55

Identify the median number of customers. 50

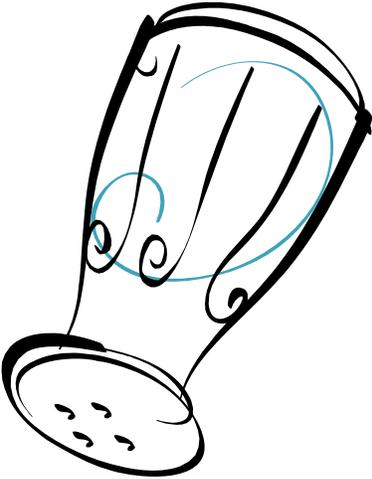
Which day had the most number of customers? Saturday

**S**cale

**A**xes

**L**abels

**T**itle



You will watch  
television  
today.

You will read a  
book today.

You will have  
homework  
tonight.

It will rain  
today.

You will eat  
pizza for  
lunch.

You will be  
struck by  
lightning.

It will be  
sunny today.

You will see a  
live dinosaur  
today.

You will blink  
your eyes.

Certain

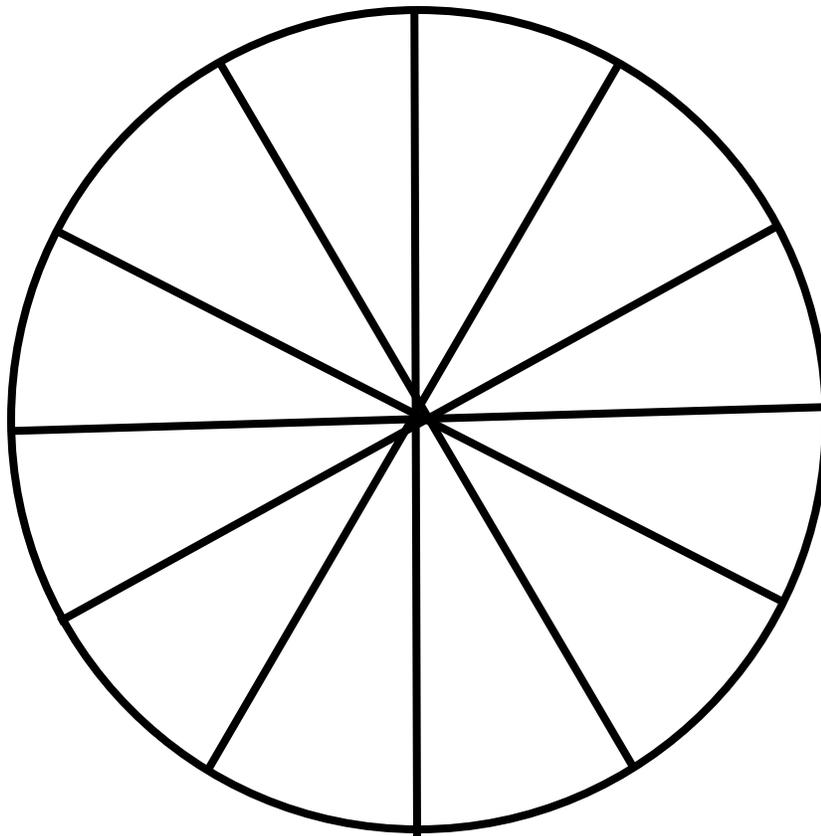
Impossible

Equally  
Likely

More  
Likely

Less  
Likely

Using the class data for ice cream flavors, create a spinner before class to represent an approximate response of students.



Class Spinner Sample

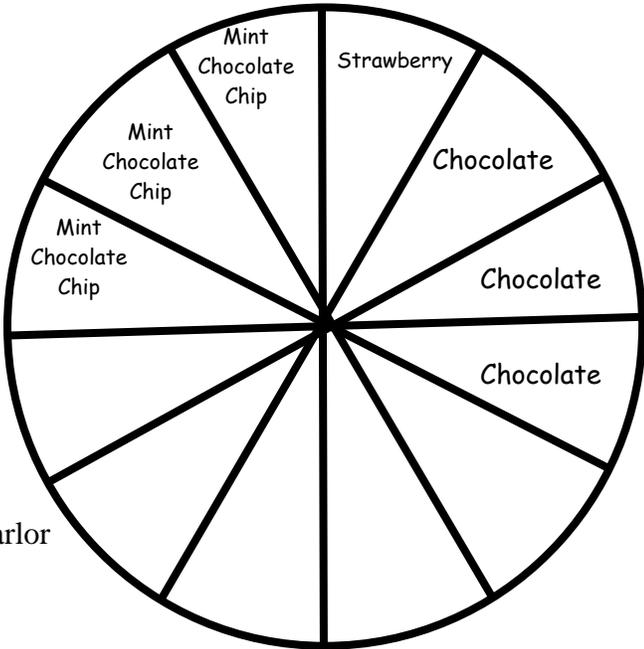
Flavors	Votes
Chocolate	6
Strawberry	2
Mint Chocolate Chip	5
Cookie Dough	8
Bubble Gum	3

There are 12 slots on the spinner so you will take about half of the number to fill in the slots

$\frac{6}{24}$  is about  $\frac{3}{12}$  of the slots. Therefore, 3 slots should be Chocolate.

$\frac{2}{24}$  is about  $\frac{1}{12}$  of the slots. Therefore, 1 slots should be Strawberry.

$\frac{5}{24}$  is about  $\frac{3}{12}$  of the slots. Therefore, 3 slots should be Mint Chocolate Chip.

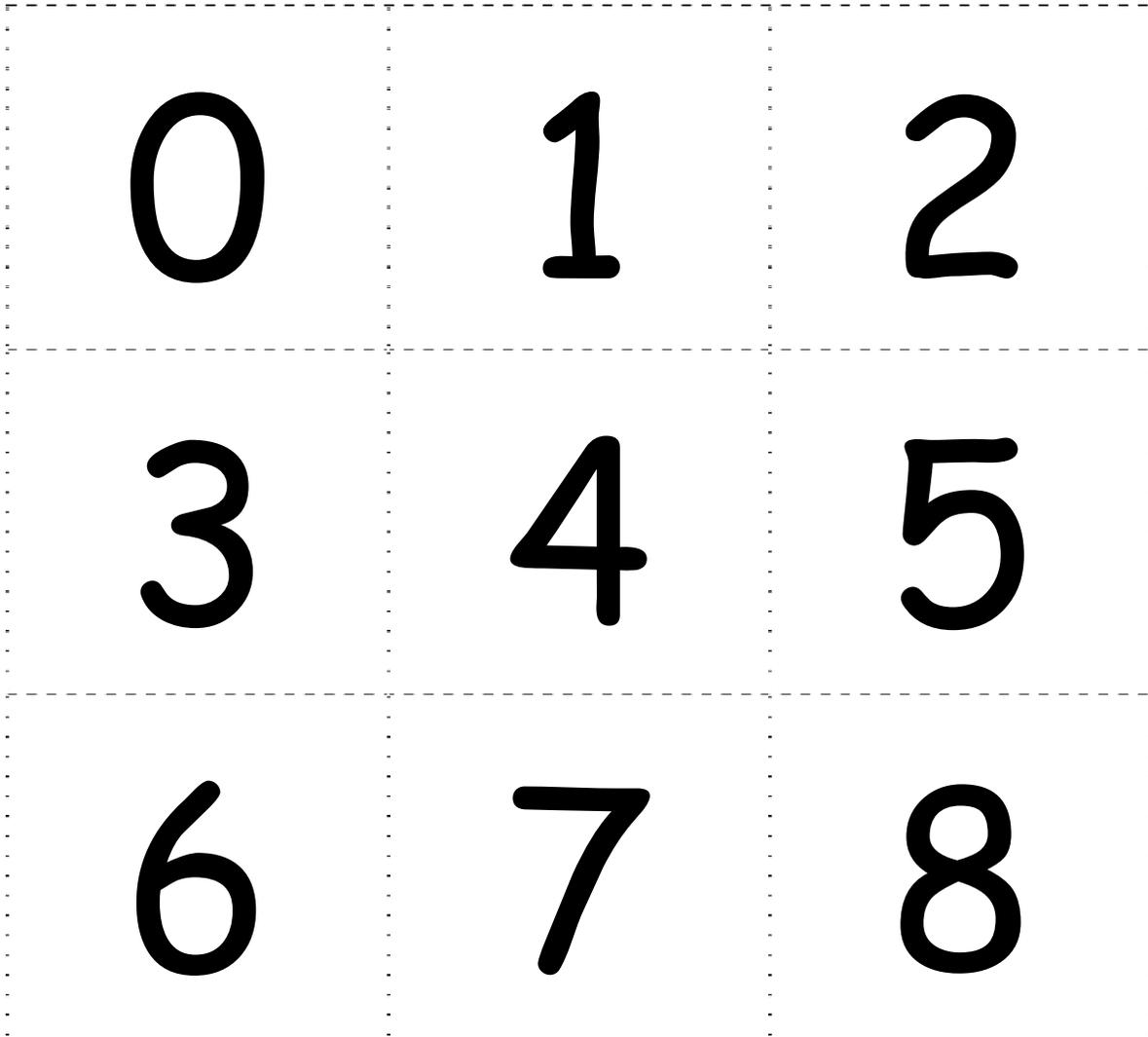


# Ice Cream Flavor Results

Flavors	Number of Times Spun

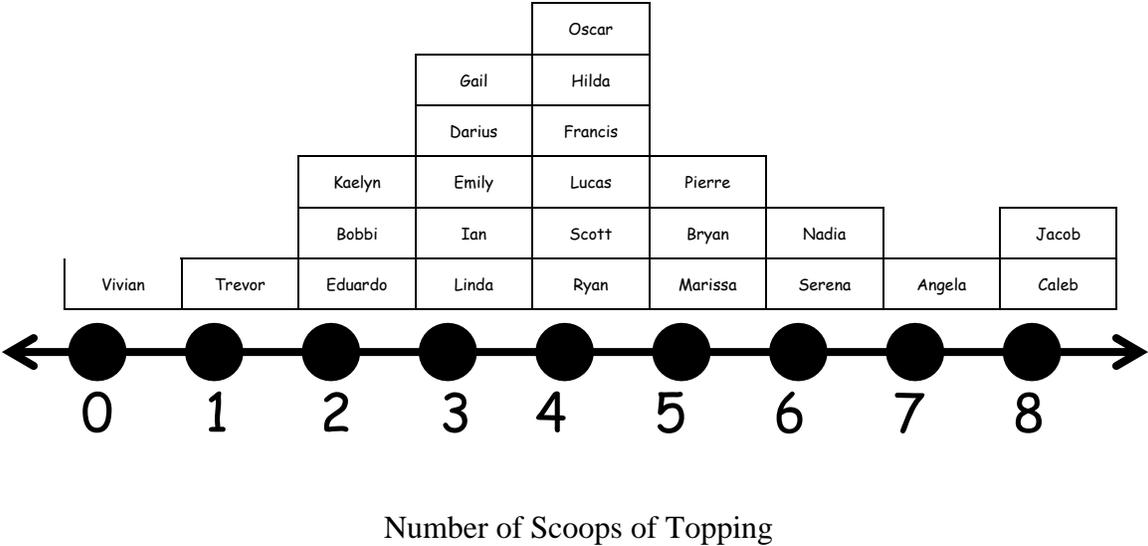
Create a number line on the floor or wall from 0 to 8.

Give each student a name of a customer and have them put how many toppings each customer ordered on the number line to create a line plot.



Bryan	Trevor	Caleb	Angela
Francis	Hilda	Kaelyn	Pierre
Darius	Gail	Jacob	Oscar
Eduardo	Serena	Scott	Nadia
Marissa	Bobbi	Vivian	Lucas
Ryan	Linda	Ian	Emily

### Number of Toppings Line Plot (Answer Key)

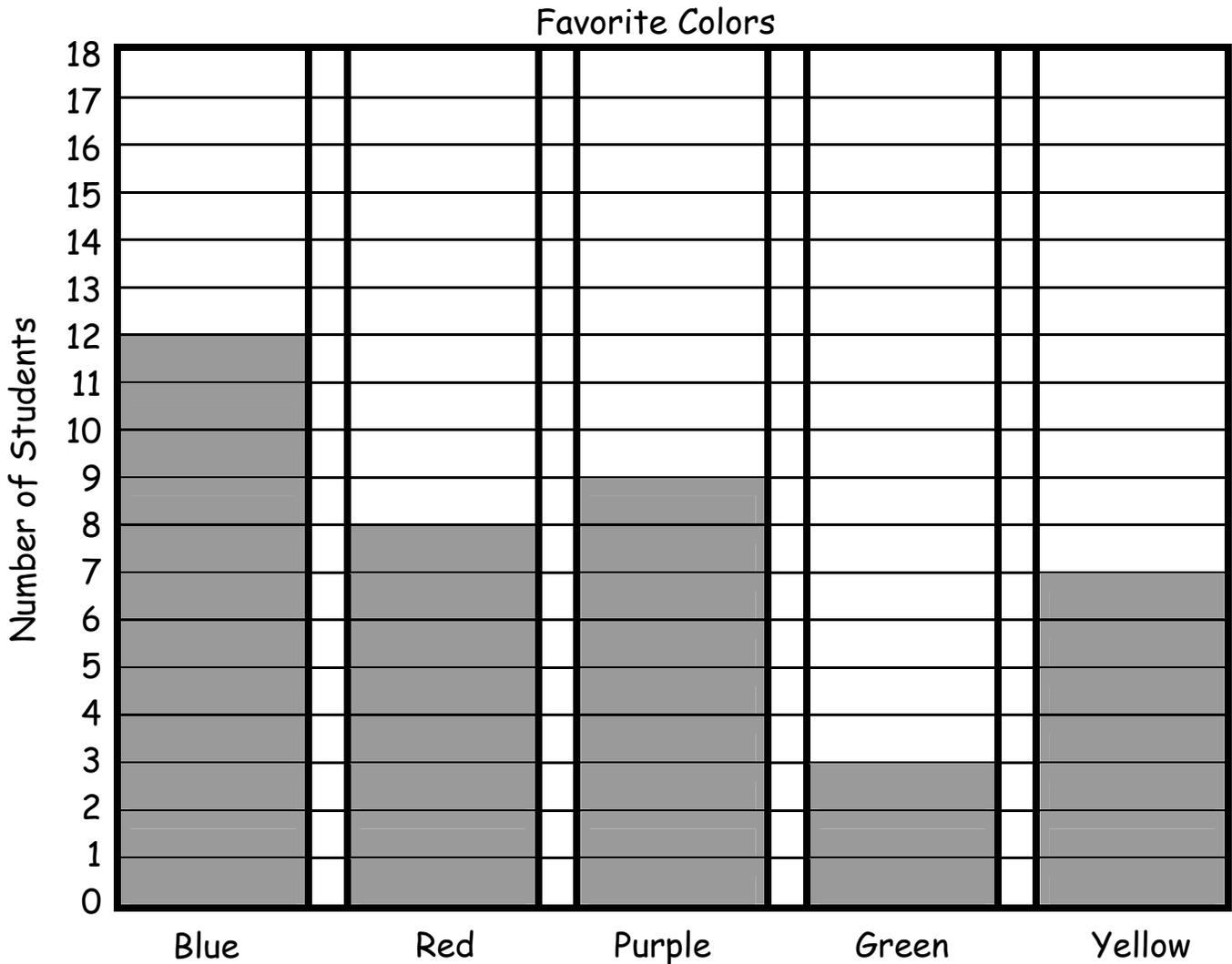


Summative Assessment (Answer Key)

1. Use the data in the table to create a bar graph. Be sure to include all the parts of a bar graph.

Part A

Favorite Colors	
Color	Number of Students
Blue	12
Red	8
Purple	9
Green	3
Yellow	7



Part B

Why is a bar graph better for showing our Favorite Colors than other types of graphs?

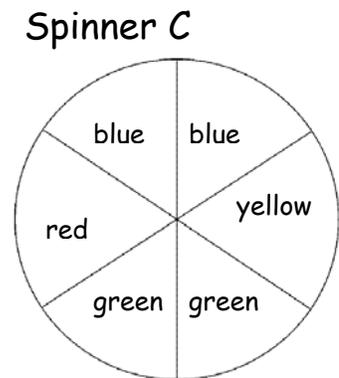
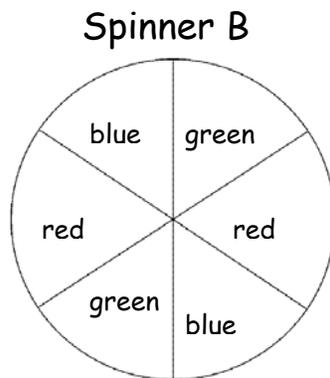
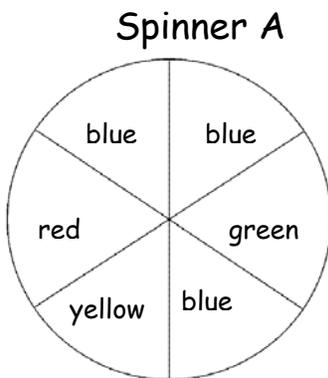
A bar graph is better for showing favorite colors because we are comparing data. We showed the choices of the colors blue, red, purple, green, and yellow and how many students voted for each choice.

2. How many more people like purple than green? 6

3. If we wanted to buy color T-shirts for the class, what color should we buy to make the most people happy? Why?

We should buy blue T-shirts because the most people like blue more than any other color. I know this because 12 students like blue and only 8 students like red, 9 students like purple, and 3 students like green and 7 students like yellow.

4. Which spinner would be more likely to spin blue? Spinner A

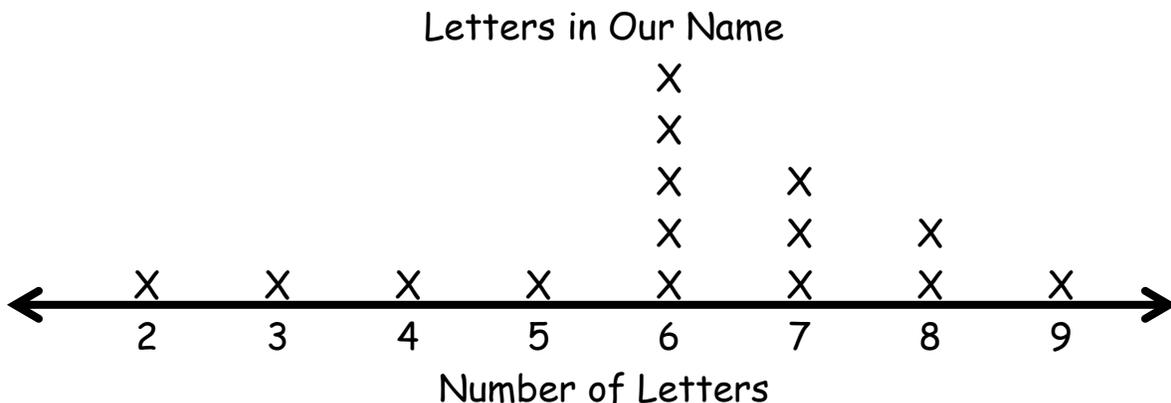


Why would you be more likely to spin blue on that spinner? Explain using words and numbers.

We would be more likely to spin blue on Spinner A because 3 out of 6 spaces are blue, 1 out of 6 is red, 1 out of 6 is green, and 1 out of 6 is yellow. There are more blue spaces than red, green, or yellow spaces. It wouldn't be Spinner B because there are 2 out of 6 spaces of each color so there is an equal chance of landing on blue, green, or red. Spinner C is not right because there is an equal change of landing on blue or green and less of a change of landing on red or yellow.

5. Students in your class are collecting data on how many letters are in their name. Use the names below to create a line plot. Be sure to include all the parts of a line plot.

Lorie	Marcelo	Kimberly
Stephanie	George	Douglas
Dennis	Janice	Kyla
Sarika	Terrence	Shawna
Pamela	Vo	Sam



6. What is the range of the number of letters in the students' names?  $9 - 2 = 7$

7. What is the mode for the number of letters in the students' names? 6

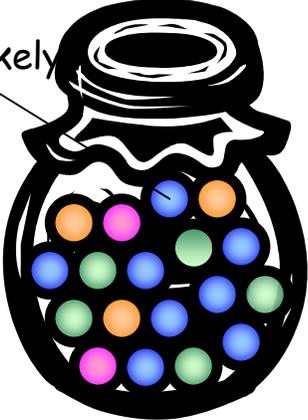
8. What is the median number of letters in the students' names?

6

9. What is the mean number of letters in the student's names?

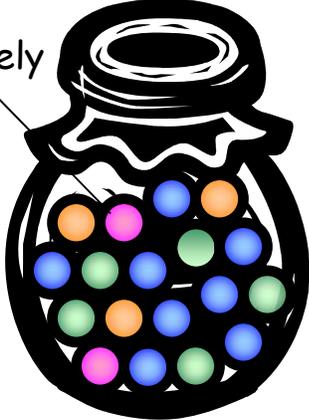
$90 \div 15 = 6$

Blue is more likely



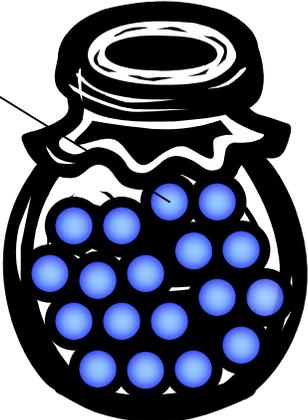
**More Likely**  
an event that will probably happen more often

Pink is less likely



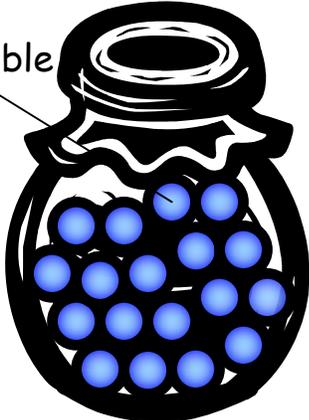
**Less Likely**  
an event that will probably not happen more often

Blue is certain

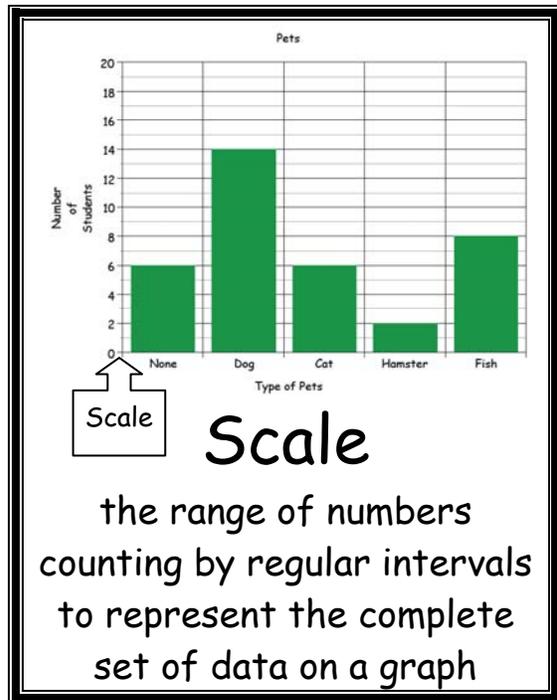
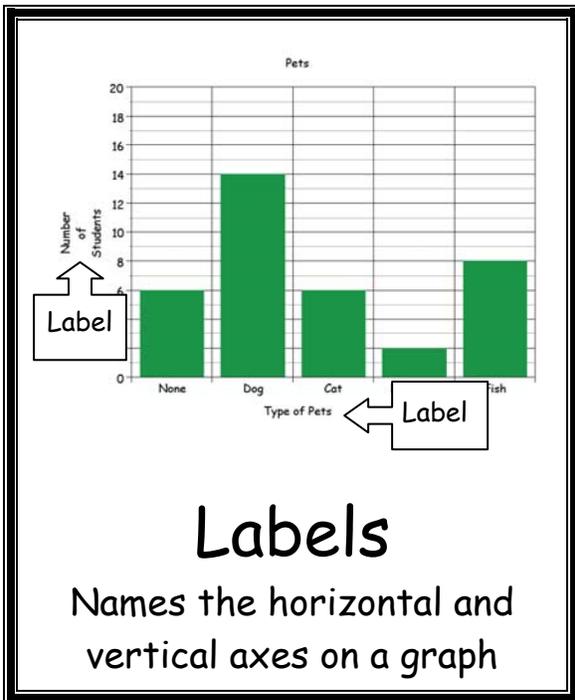
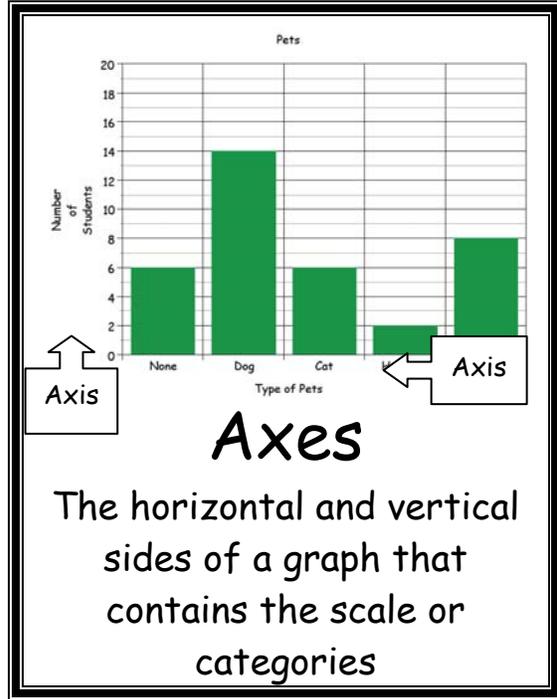
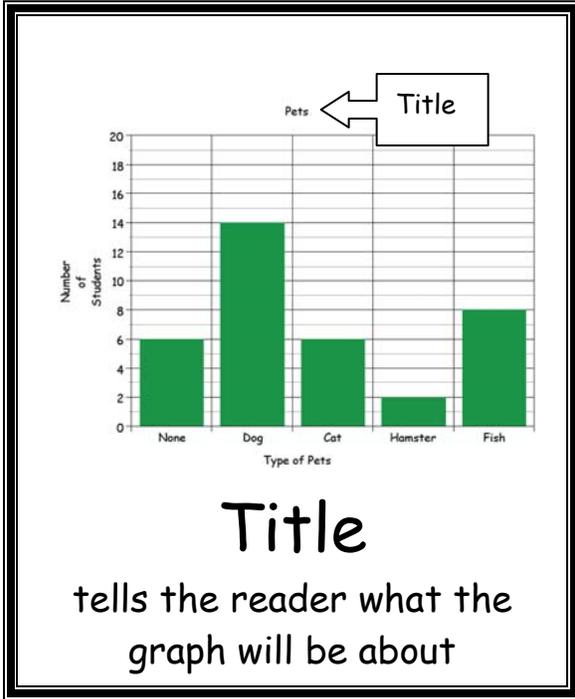


**Certain**  
an event that will always happen

Pink is impossible



**Impossible**  
an event that will never happen



6, 3, 4, 6, 8, 9, 6

$$6 + 3 + 4 + 6 + 8 + 9 + 6 = 42$$

$$42 \div 7 = 6$$

**Mean**

the arithmetic average of a set of data computed by adding all the data together and then dividing by the number of data collected

6, 3, 4, 6, 8, 9, 6

~~6~~, ~~3~~, ~~4~~, ~~6~~, ~~8~~, ~~9~~, ~~6~~

**Median**

the middle number in a set ordered from least to greatest

6, 3, 4, 6, 8, 9, 6

3, 4, 6, 6, 6, 8, 9

**Mode**

the number that occurs most often

6, 3, 4, 6, 8, 9, 6

3, 4, 6, 6, 6, 8, 9

$$9 - 3 = 6$$

**Range**

The difference between the greatest and least numbers in a data set

