

SITES-M Mathematics Challenge

Field Trip to the Zoo



Level: Grade Three

Standard: Data, Probability and Statistics

Learning Target: Focus on Data Representations

Checks for Understanding

- 0306.5.2** Construct a frequency table and bar graph of collected data.
- 0306.5.3** Compare and interpret different representations of the same data.
- 0306.5.4** Solve problems using data from frequency tables and bar graphs.

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Focus on Data Representations Grade 3

Field Trip to the Zoo Data Representations

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. Each Challenge includes a set of tasks that require higher-order thinking skills. Because these types of tasks may be new for students and they will have varying levels of understanding, the student responses will vary. The Challenges and guiding questions were designed to help teachers plan their implementation and elicit, analyze, and act on evidence of student understanding.

You will be able to choose which Mathematics Challenge Packet to implement each month, according to the learning needs of your students and your teaching context. Each packet contains all the materials necessary to implement the Mathematics Challenge including a grade-appropriate Challenge, the Mathematics Challenge Meeting Protocol, and the Guiding Questions for Analyzing Student Responses to Mathematics Challenges.

For each Challenge, you will complete a six step process of planning, implementation, and analysis and reflection.

The Mathematics Challenge Process

Stage	Step	Task
Planning	Step 1.	Review the Mathematics Challenge Meeting Protocol
	Step 2.	Review and solve the Mathematics Challenge prior to your Professional Learning Community (PLC) meeting. Think about your responses to the guiding questions on the Meeting Protocol
	Step 3.	Hold your PLC meeting and discuss your responses to the Guiding Questions on the Meeting Protocol
Implementation	Step 4.	Implement the Mathematics Challenge with your class
Analysis and Reflection	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
	Step 6.	To help us improve the Challenges and to provide recommendations for teachers implementing them in future years, complete the Mathematics Challenge Feedback Log and provide copies of all student work to the Assessment Coordinator

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Mathematics Challenge Meeting Protocol

Each month, your Professional Learning Community will meet to discuss the implementation of one Mathematics Challenge. In preparation for your monthly meeting, please print and review this month's Mathematics Challenge, solve all tasks within the Challenge, and think about the guiding questions below. These questions will be used to facilitate a group discussion regarding the implementation of the upcoming Mathematics Challenge.

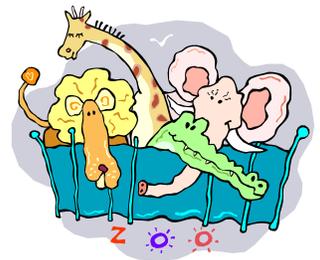
Guiding Questions for Implementing the Mathematics Challenges

1. What is the title of the Challenge that you will use this month?
2. What skills or standards is this Challenge measuring?
3. Where does this Challenge fit within your curriculum? Within which unit?
4. At what point during the unit will you administer this Challenge (e.g., At the beginning of a unit to determine what students do or do not know, at the end of a unit to assess what students have or have not learned, in the middle of a unit to determine where to go next instructionally)?
5. How will your students complete this Challenge (e.g., individually, one-on-one, in small groups, as a class)? Why?
6. Are there any prerequisite skills, common misunderstandings, or vocabulary needs that you will have to address? What are they?
7. What difficulties do you anticipate your students will have with the Challenge? How will you address them?
8. Are these skills and difficulties different for special needs students, ELL students, etc.? How? Will you do anything different for these students? What?
9. How will you evaluate student responses (e.g., grade responses with the provided rubric, scan responses to identify common mistakes/misconceptions, have students evaluate one another's responses, have students evaluate their own response)?
10. What will student responses to this Challenge tell you about student understanding?
11. How might you use this evidence of student understanding to adapt your teaching and learning?
12. What other materials, resources, or support might you need? Where can you get them?
13. How can your colleagues assist you in the analysis of student understanding?
14. What other questions or concerns do you have about this Mathematics Challenge?

After you have implemented the challenge with your class, be sure to respond to the Guiding Questions on the Analyzing Student Responses Protocol.



SITES-M Mathematics Challenge Focus on Data Representations Grade 3



Field Trip to the Zoo Data Representations

Standard: Data Analysis, Statistics, and Probability

Learning Target: Focus on data analysis

Claims:

Students should understand and be able to explain or demonstrate how to:

- ✓ Construct a frequency table and bar graph of collected data;
- ✓ Compare and interpret different representations of the same data;
- ✓ Solve problems using data from frequency tables and bar graphs.

Task Preparation:

Each student will need a copy of the student response sheet and the data sheet, a pencil, and crayons (optional).

Stimulus Cards (Drawing or Word Description):

Each student needs a copy of the data sheet.

Manipulatives/Supplies:

Copies of the student response sheet and data sheet for each student

Pencils

Crayons (optional)

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Focus on Data Representations Grade 3

Cues/Directions:

Distribute student response sheets and data sheets. Students should be directed to look at each figure carefully. Allow students time to answer.

Instruct students to follow along as you read aloud and say: **Ms. Perkins' class went to the zoo. After the trip, the students voted for the animal they liked best.** Have students look at their data sheets.

1. Say: **Use the data sheet, "Animals the Students Liked Best," to complete the table below of the number of votes each animal got from both boys and girls. (TEACHER NOTE: Students should write the number to record the votes for each animal in the table.)**
2. **Which animal got the fewest votes in all? Show how you get your answer. (TEACHER NOTE: Students should show their work or explain their answers in the box.) The animal with the fewest votes is the _____. (TEACHER NOTE: Students should fill in the blank with the correct animal name.)**
3. **Now make a bar graph of all the students' votes for the animal they liked best. The bar graph below has been started for you. Remember to put a title and labels on your graph. (TEACHER NOTE: Students who would like to use crayons to make their bar graphs may do so. As students work, monitor what they are doing, and ask if they are forgetting something if they do not include the title and labels.)**
4. **Look at your bar graph from question 3. How many votes are there in all? Show how you get your answer. (TEACHER NOTE: Students should show their work or explain their answers in the box.) Answer: _____ votes in all (TEACHER NOTE: Students should fill in the blank with the correct number.)**
5. **Now look at your table from question 1. How many votes are there in all? Show how you get your answer. (TEACHER NOTE: Students should show their work or explain their answers in the box. They should NOT do exactly the same thing as they did in question 4 to get their answers although the answer is the same.) Answer: _____ votes in all (TEACHER NOTE: Students should fill in the blank with the correct number.)**
6. **Could you use your bar graph to find out how many girls voted for elephants? Yes or no? (TEACHER NOTE: Students should check the correct box.) Why or why not? (TEACHER NOTE: Students should write their answers in the box.) Could you use your table to find out how many girls voted for elephants? Yes or no? (TEACHER NOTE: Students should check the correct box.) Why or why not? (TEACHER NOTE: Students should write their answers in the box.)**

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The graph below is a double bar graph, showing the data from the data sheet. Each pair of bars shows the votes for an animal by the boys and the girls. Have students look at the double bar graph.

7. **Write in the animal that belongs on the line below each pair of bars on the graph. (TEACHER NOTE:** Students should compare the heights of the bars with the entries in the table to determine which animal matches up with each pair of bars.)

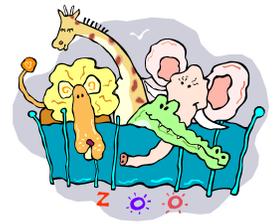
8. **Look at the double bar graph in question 7. Each bar is labeled with a letter. Using the list below, draw a line from each letter to the group the bar represents. (TEACHER NOTE:** Each bar and each group will be used once in the matching exercise. An overlay transparency key would be helpful in checking this item.)

9. **Whose votes do the dotted bars represent? _____ Whose votes do the striped bars represent? _____ (TEACHER NOTE:** Students should write the correct word in each blank.)

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Student Response Sheet
Field Trip to the Zoo Data Representations

Name: _____

Date: _____

Ms. Perkins' class went to the zoo. After the trip, the students voted for the animal they liked best.

1. Use the data sheet, "Animals the Students Liked Best," to complete the table below of the number of votes each animal got from both boys and girls.

Animal	Number of Votes	
	Boys	Girls
Elephant		
Monkey		
Zebra		

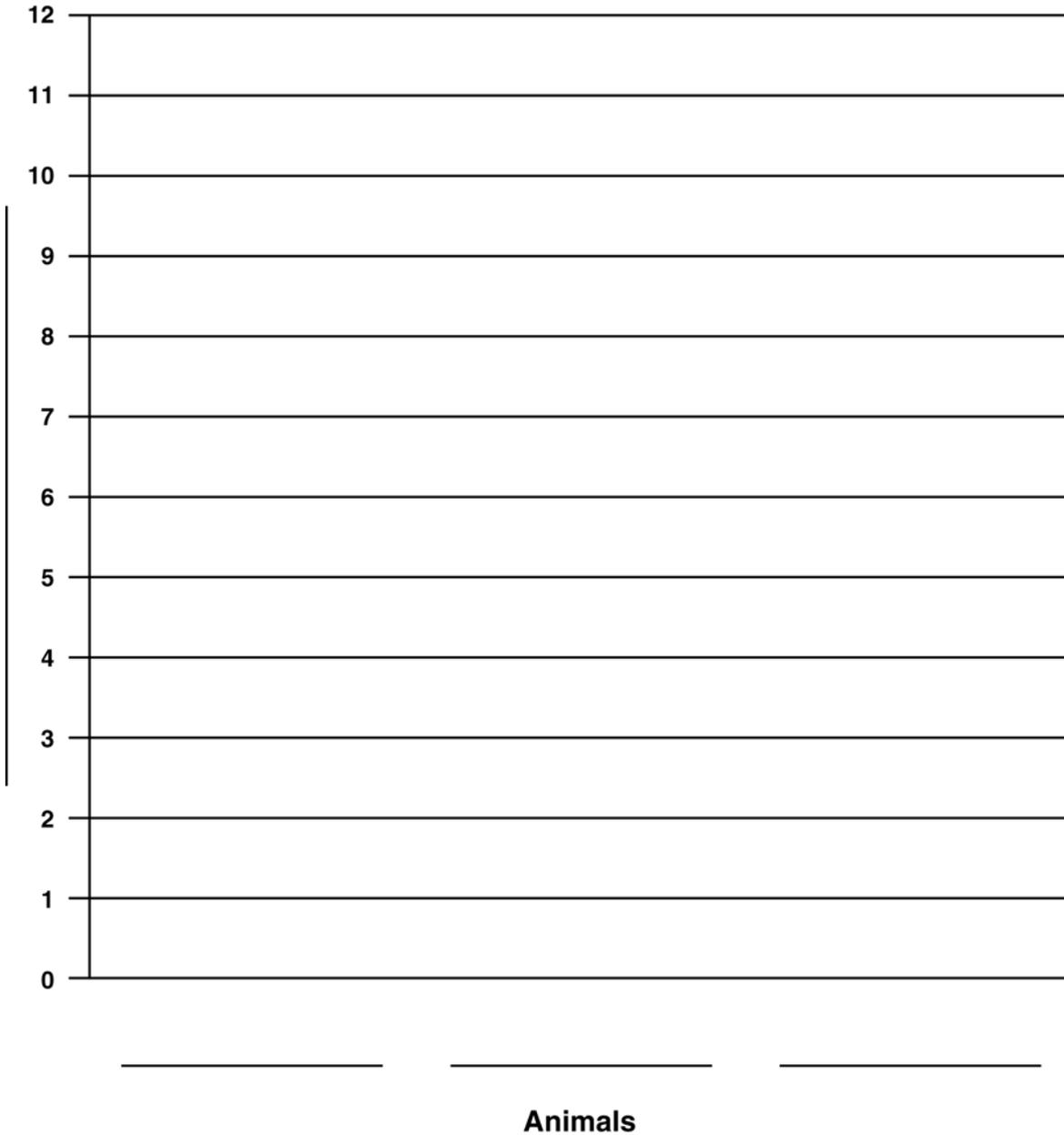
2. Which animal got the fewest votes in all? Show how you get your answer.

The animal with the fewest votes is the _____.

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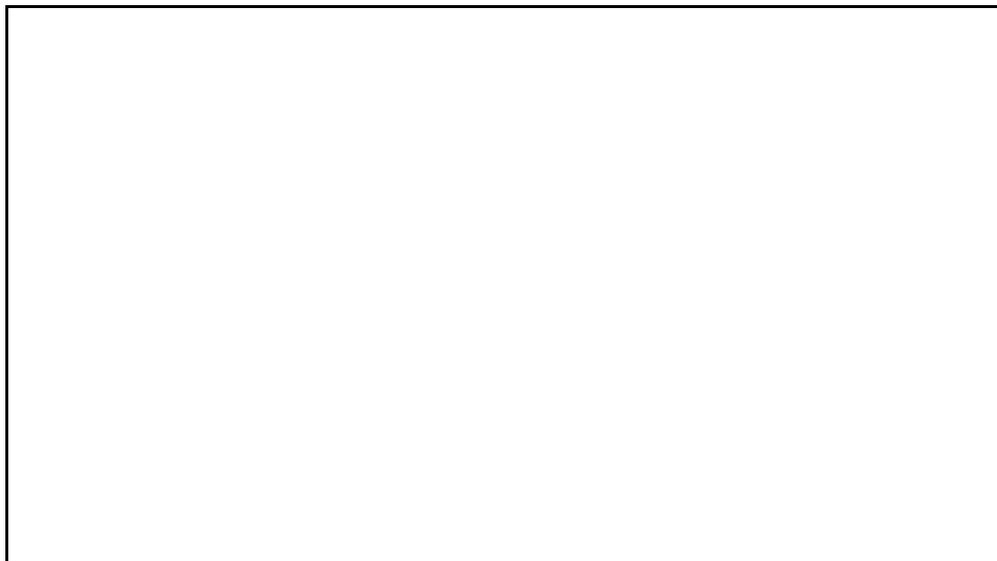
3. Now make a bar graph of all the students' votes for the animal they liked best. The bar graph below has been started for you. Remember to put a title and labels on your graph.

Title: _____



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4. Look at your bar graph from question 3. How many votes are there in all? Show how you get your answer.



Answer: _____ **votes in all**

5. Now look at your table from question 1. How many votes are there in all? Show how you get your answer.



Answer: _____ **votes in all**

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6. Could you use your bar graph to find out how many girls voted for elephants?

yes

no

Why or why not?

Could you use your table to find out how many girls voted for elephants?

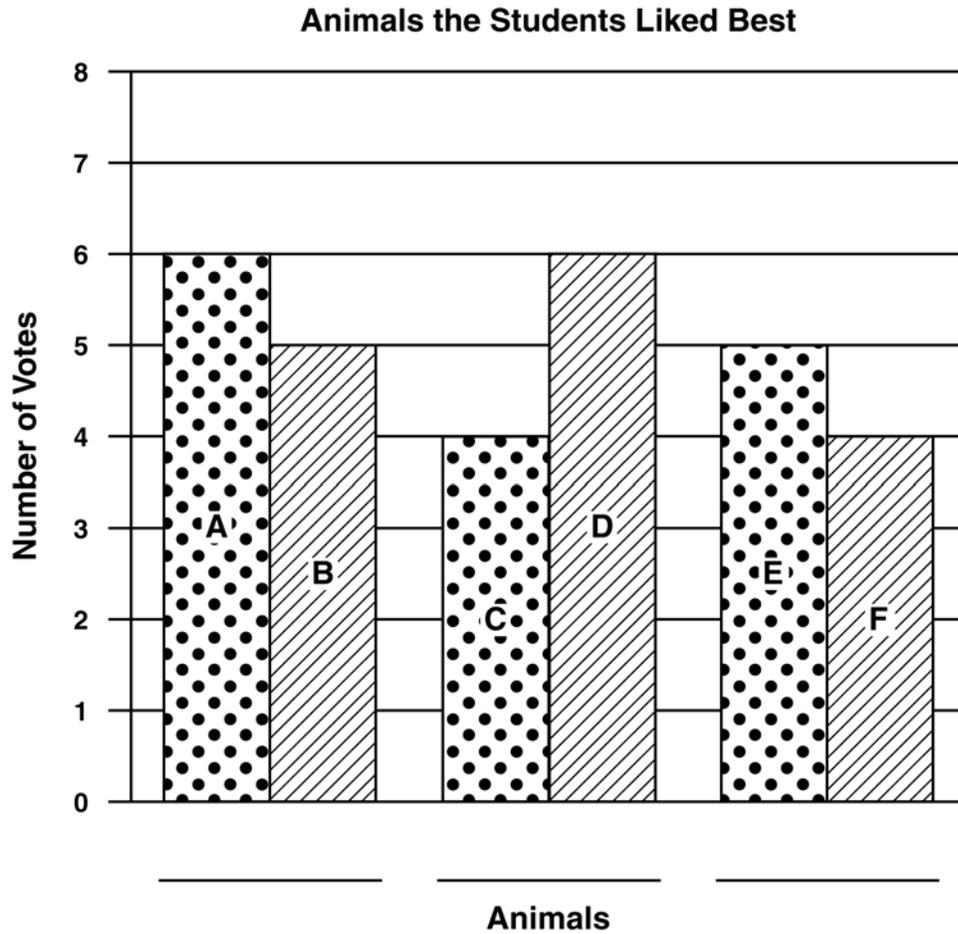
yes

no

Why or why not?

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The graph below is a double bar graph, showing the data from the data sheet. Each pair of bars shows the votes for an animal by the boys and the girls.



7. Write in the animal that belongs on the line below each pair of bars on the graph.

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8. Look at the double bar graph in question 7. Each bar is labeled with a letter. Using the list below, draw a line from each letter to the group the bar represents.

Bar	Group
A	Girls' votes for monkeys
B	Girls' votes for elephants
C	Girls' votes for zebras
D	Boys' votes for monkeys
E	Boys' votes for elephants
F	Boys' votes for zebras

9. Whose votes do the  bars represent? _____

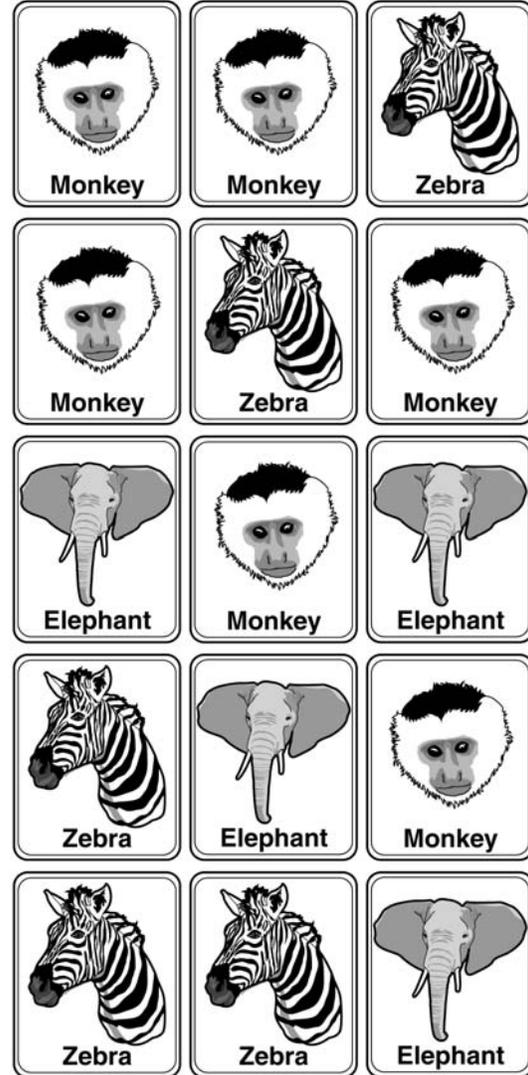
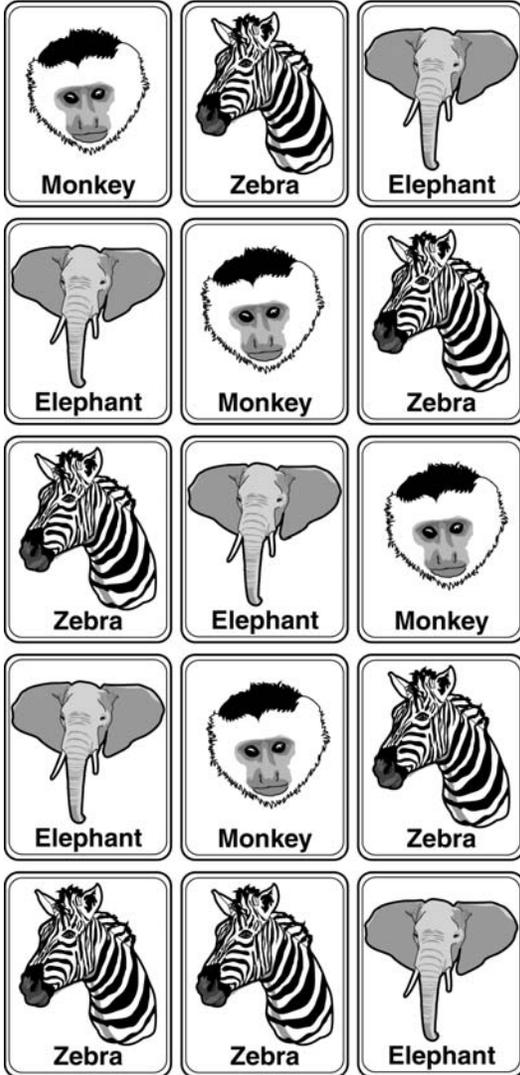
Whose votes do the  bars represent? _____

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Data Sheet
 Animals the Students Liked Best

Boys

Girls



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Learning and Teaching Considerations

Task 1:

- A) Be sure that students understand that the words, “number of votes,” specifically mean a digit or digits (0 - 9) that represent how many votes each animal got from the boys and the girls. Some students may answer in words, symbols, pictures, tally marks, etc.
- B) Be sure that students understand that the number of any object is represented by a digit or a string of digits. The location of the digit tells whether it is in the unit’s place, ten’s place, hundred’s place, etc. (how many one’s, ten’s, hundred’s, etc. there are or which power of 10 it multiplies). In this task, each digit is in the one’s place, denoting how many one’s there are, e.g., 5 elephants (1 + 1 + 1 + 1 + 1), 4 monkeys (1 + 1 + 1 + 1), and 6 zebras (1 + 1 + 1 + 1 + 1 + 1). Working with base-ten blocks may help.
- C) Be sure that students make the connection between orally counting up or physically adding up the animal pictures on the data sheet with putting the correct numbers in the table that represent the vote totals.

Task 2:

- A) Be sure that students understand that the word “fewest” signifies “fewer than all the others, when comparing numbers.” The word “fewer” signifies a smaller number than one other or some others. For this task, students must compare the number of votes for all three animals.
- B) Some students may have the misconception that the word “fewer” signifies the same meaning as “fewest” and so will write the monkey, because there are fewer monkeys than zebras. Working with manipulatives of different numbers may help.
- C) Be sure that students understand that the words, “in all,” signify a total or a sum. For this task, they have to total the votes across both boys’ and girls’ groups, before they can compare. Some students may answer monkey for the boys and elephant for the girls.
- D) Students may answer in words, symbols (digits, dots, dashes, base-10 block representations, M’s, E’s, Z’s, etc.), pictures (Elephants, Monkeys, Zebras), or by using manipulatives (blocks, cubes). They may also count on their fingers, use number lines, or recall number sense and addition facts. Be sure they understand that they can get the correct answer using any of these strategies, though some are more efficient.

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- E) Be sure that students understand that as you move right (\rightarrow) on a number line, the numbers increase in value. As you move left (\leftarrow), the numbers decrease in value.
- F) If a student says or writes, “I just know,” prompt him or her by saying something like “I’m glad you know, but it’s important in math to be able to explain your answers so other people can understand what you’re thinking.” (This applies to the other tasks, as well.)
- G) If a student says or writes, “I don’t know,” say something positive like “Let’s start with what you do know about this problem.” Students often know more than they think or say, and getting them to vocalize or write about that knowledge is all they need. (This applies to the other tasks, as well.)

Task 3:

- A) Be sure that students understand the basic parts of a bar graph: 1) a descriptive title, 2) the axes and their labels (the “grouped data axis” that displays the type of data being graphed and is always at the base of the bars; and the “frequency data axis” that has a scale and measures the frequency, number, or count of the data groups), and 3) the bars are rectangular blocks and can be either horizontal or vertical. Each bar represents the data for only one data group and begins at the appropriate axis, though in no particular order.
- B) Be sure that students understand that all the basic parts of a bar graph must be accurately labeled and completed. For this task, the title should tie “animals” to either “votes” or “students,” the horizontal axis should be labeled with the three animal groups, the bar heights should match the vote count for the corresponding animal groups, and the vertical axis should be labeled as a count or number of votes.
- C) Be sure that students understand that the animal groups and their associated data bars do not have to be ordered like the table (elephant, monkey, zebra). Any order is fine as long as the animal groups match the appropriate data bar height.
- D) Some students may have the misconception that you can draw a segmented bar, e.g., stack the girls’ votes on top of the boys’ votes, or vice versa, and include a line to delineate the two.

Task 4:

- A) Be sure that students understand that the words “in all” generally signify the addition operation. For this task, they have to total the votes across all three groups of animals by adding.
- B) Though they are asked to use the bar graph to determine the total votes, some students may use the table. Be sure students understand how to obtain the number of votes for

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each animal group by matching the top of the appropriate bar with the correct value on the scale of the frequency axis.

- C) Be sure that students understand that they can get the correct answer by adding any combination of the three numbers, e.g., $9 + 10 + 11 = 11 + 10 + 9 = 10 + 9 + 11 = 30$. This is an important property of addition.

Task 5:

- A) Though they are asked to use the table to determine the total votes, some students may use the bar graph. Be sure students implement a different strategy for this task than they did for the previous task.
- B) Some students may add all of the boy's votes and then the girls' votes or vice versa, before adding the subtotals. Others may first add both the boy's and girls' votes for elephants, followed by monkeys and zebras, before adding the subtotals. Still others may add all the individual cells. Be sure they understand they can get the correct answer using any of these strategies.

Task 6:

- A) Be sure that students understand that the bars on the bar graph represent the combination of both boys' and girls' votes for each animal. Therefore, you cannot tell from the bar graph how many girls (or boys) voted for any animal.
- B) Some students may have incorrectly created a bar graph with segmented bars to separate the girls' votes from the boys' votes. So, they may say that you can use the bar graph to find out how many girls voted for elephants.
- C) Be sure that students understand that data from each group is separated in the table, making it easy to determine the number of votes by boys or girls for each animal.

Task 7:

- A) Some students will reflexively write in elephant, monkey, and zebra, because they are ordered that way in the table. Be sure students understand that they need to carefully analyze the double bar graph to determine which groups of animals are represented by which data bars.
- B) Be sure that students understand that they should refer to the table in Task 1 to correctly determine which combinations of student votes match which animal groups, e.g., the only combination of 6 votes and 5 votes is for the zebra.

Tasks 8:

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- A) Be sure that students understand that they should refer to the table in Task 1 to correctly determine which combinations of student votes match which animal groups, e.g., the only combination of 6 and 5 votes is for the zebra. Therefore, Bar A must represent boys' votes for zebras, Bar B must represent girls' votes for zebras, and so on.

Task 9:

- A) Be sure that students understand that each double bar on this type of graph represents data from two different groups, e.g., boy and girls. Each double bar on the graph always represents the two different groups in the same order, for consistency. In this case it is boys/girls, but it could be the other way around.

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Name: ANSWER KEY

Date: _____

Ms. Perkins' class went to the zoo. After the trip, the students voted for the animal they liked best.

1. Use the data sheet, "Animals the Students Liked Best," to complete the table below of the number of votes each animal got from both boys and girls.

Animal	Number of Votes	
	Boys	Girls
Elephant	5	4
Monkey	4	6
Zebra	6	5

2. Which animal got the fewest votes in all? Show how you get your answer.

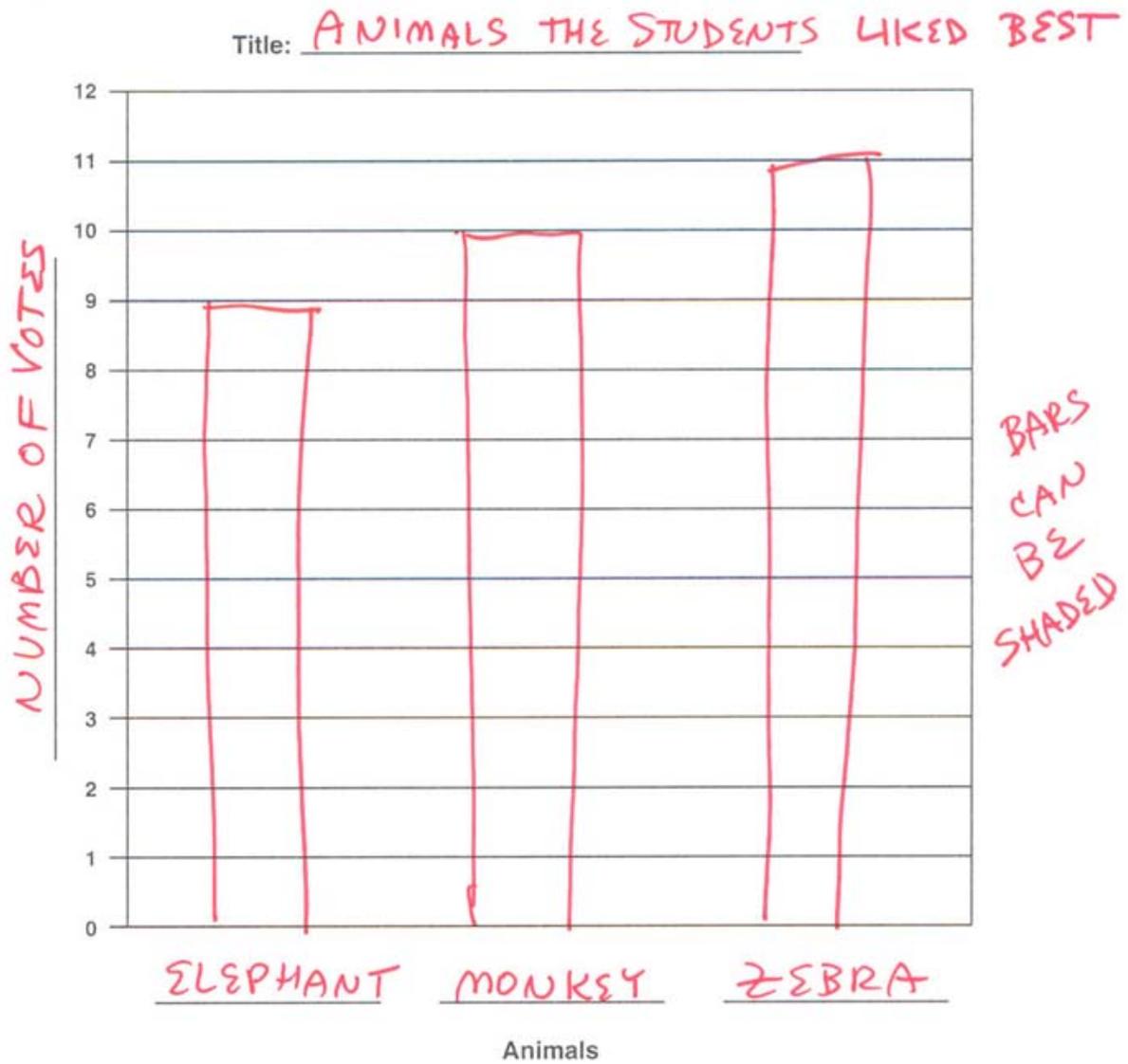
ELEPHANT	$5 + 4 = 9$
MONKEY	$4 + 6 = 10$
ZEBRA	$6 + 5 = 11$

(METHODS MAY VARY.)

The animal with the fewest votes is the ELEPHANT.

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3. Now make a bar graph of all the students' votes for the animal they liked best. The bar graph below has been started for you. Remember to put a title and labels on your graph.



NOTE: ORDER OF ANIMALS IS NOT IMPORTANT

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4. Look at your bar graph from question 3. How many votes are there in all? Show how you get your answer.

ELEPHANT BAR IS 9
MONKEY BAR IS 10
ZEBRA BAR IS 11
 $9 + 10 + 11 = 30$

(ANSWERS CAN VARY)

Answer: 30 votes in all

5. Now look at your table from question 1. How many votes are there in all? Show how you get your answer.

$5 + 4 = 9$
 $4 + 6 = 10$
 $6 + 5 = 11$
 $9 + 10 + 11 = 30$

OR
 $5 + 4 + 6 = 15$
 $4 + 6 + 5 = 15$
 $15 + 15 = 30$

(METHOD MAY VARY)

Answer: 30 votes in all

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6. Could you use your bar graph to find out how many girls voted for elephants?

yes

no

Why or why not?

BECAUSE THE BOYS + GIRLS
ARE COMBINED IN THE
GRAPH.

(ANSWERS CAN VARY)

- Could you use your table to find out how many girls voted for elephants?

yes

no

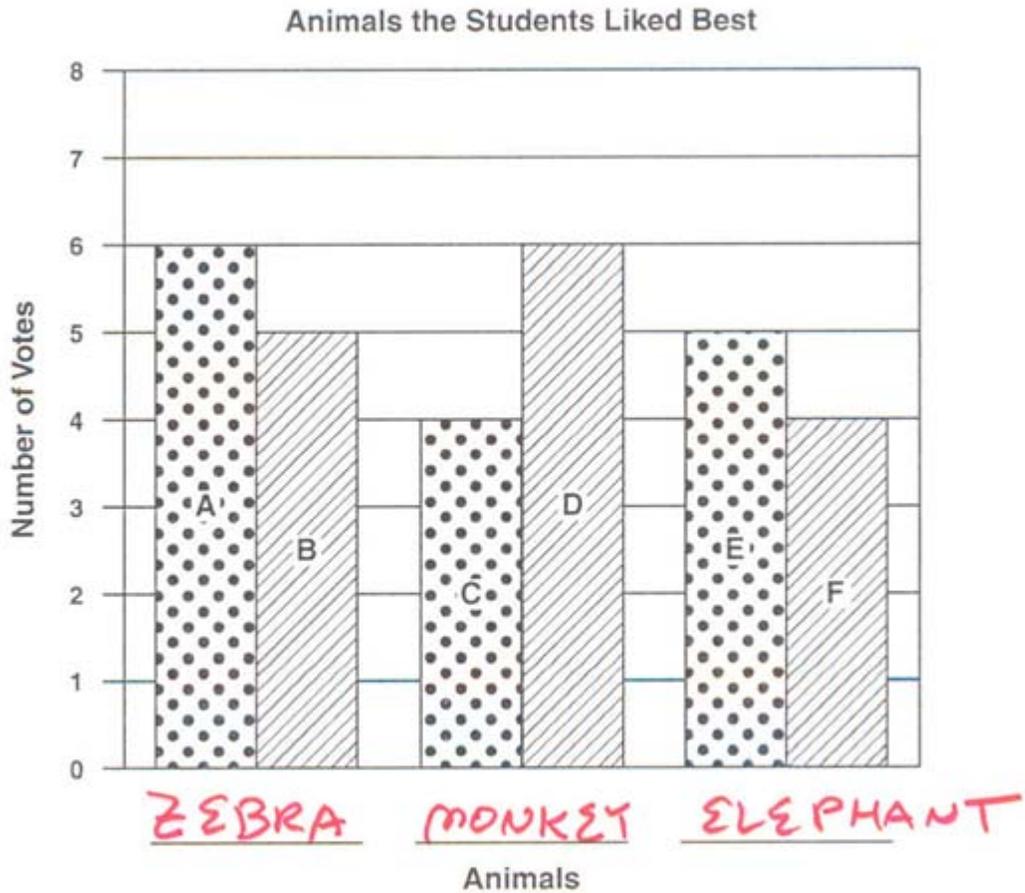
Why or why not?

BECAUSE THE BOYS +
GIRLS ARE SEPARATE
IN THE TABLE.

(ANSWERS CAN VARY)

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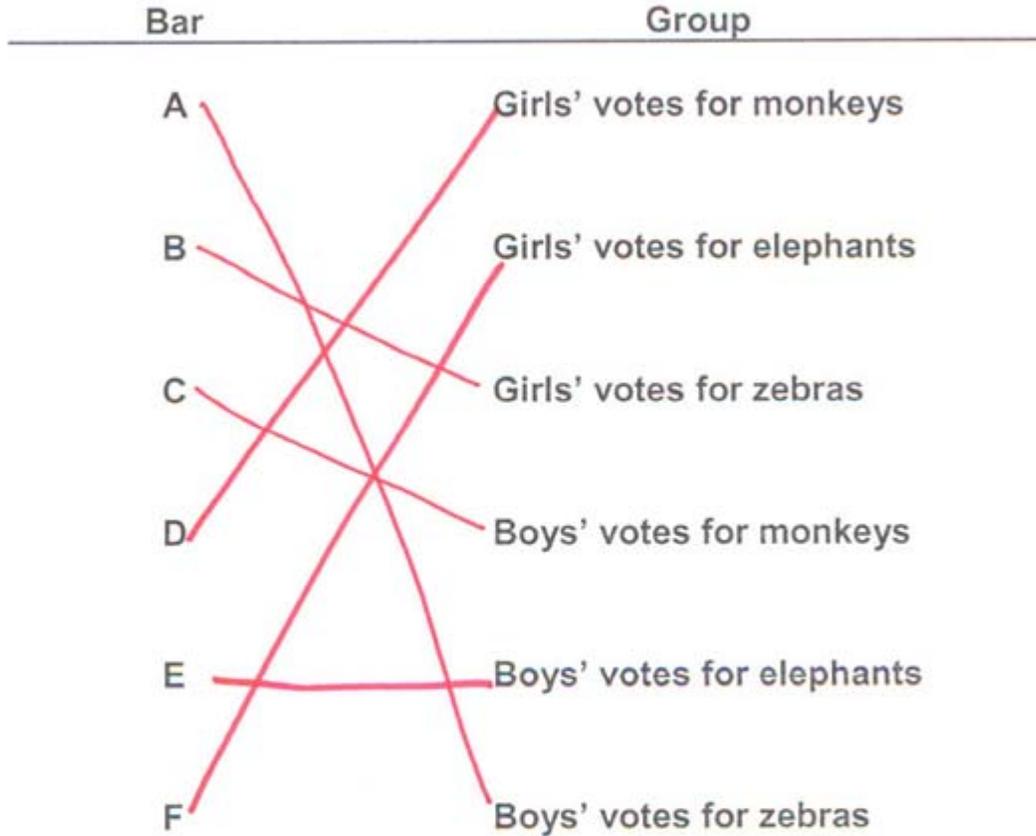
The graph below is a double bar graph, showing the data from the data sheet. Each pair of bars shows the votes for an animal by the boys and the girls.



7. Write in the animal that belongs on the line below each pair of bars on the graph.

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8. Look at the double bar graph in question 7. Each bar is labeled with a letter. Using the list below, draw a line from each letter to the group the bar represents.



9. Whose votes do the  bars represent? BOYS

Whose votes do the  bars represent? GIRLS

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**SITES-M Mathematics Challenge Rubric
Focus on Data Representations Grade 3**

CATEGORY	4	3	2	1
Mathematical Concepts	Response shows complete understanding of the mathematical concepts used to solve the problem(s).	Response shows substantial understanding of the mathematical concepts used to solve the problem(s).	Response shows some understanding of the mathematical concepts needed to solve the problem(s).	Response shows very limited understanding of the underlying concepts needed to solve the problem(s), OR the response is not written.
	<p>Response shows evidence in at least 6 of the following parts of tasks.</p> <p>Task 3. Bars drawn by student have correct heights and are matched with correct animal.</p> <p>Task 3. Bars are centered over each animal label (and not bunched up to one side or bunched together).</p> <p>Task 5. Student provides evidence that the procedure used in Task 5 is <u>different</u> from the procedure used in Task 4. It should be clear that animal totals are used in Task 4, and IF animal totals are used in Task 5, they should come from a totaling of boys and girls FIRST.</p> <p>Task 6. Bar graph: If student answers no, there must be evidence that bars represent a combination of boys' and girls' votes. If student answers yes, there must be evidence that a segmented bar graph was drawn or could be drawn.</p> <p>Task 6. Table: Yes. Student should provide evidence that girls' votes are separate from boys' votes in the table and that numbers in the girls column can be added.</p> <p>Task 7. Student writes the correct animal under each pair of bars.</p> <p>Task 9. Student answers that the dotted bars represent boys' votes and the striped bars represent girls' votes.</p>	Response shows evidence in only 4 or 5 of the tasks described in category 4.	Response shows evidence in only 2 or 3 of the tasks described in category 4.	Response shows evidence in only 1 or none of the tasks described in category 4.

**SITES-M Mathematics Challenge Rubric
Focus on Data Representations Grade 3**

CATEGORY	4	3	2	1
Strategy/ Procedures	Student typically uses an efficient and effective strategy to solve the problem(s).	Student typically uses an effective strategy to solve the problem(s).	Student sometimes uses an effective strategy to solve problem(s), but not consistently.	Student rarely uses an effective strategy to solve problem(s).
	Response shows evidence in ALL of the following tasks. Task 2. Student provides evidence of addition of votes per animal ($5 + 4 = 9$, $4 + 6 = 10$, $6 + 5 = 11$). Task 4. Student provides evidence of addition of animal totals ($9 + 10 + 11 = 30$). Task 5. Student provides evidence of addition of individual table cells ($5 + 4 + 6 + 4 + 6 + 5 = 30$, OR addition of boys + addition of girls). Task 8. Student correctly matches bar with group.	Response shows evidence in only 3 of the tasks described in category 4.	Response shows evidence in only 2 of the tasks described in category 4.	Response shows evidence in only 1 of the tasks described in category 4 or the response shows no evidence of strategy.

**SITES-M Mathematics Challenge Rubric
Focus on Data Representations Grade 3**

CATEGORY	4	3	2	1
Explanation/ Communication	Explanation is detailed and clear; uses appropriate terminology and/or notation.	Explanation is clear; uses some appropriate terminology and/or notation.	Explanation is a little difficult to understand, but includes critical components; little use of appropriate terminology and/or notation.	Explanation is difficult to understand, is missing several components, does not use or include appropriate terminology and/or notation.
	<p>Response shows evidence in ALL of the following parts of tasks.</p> <p>Task 3. Student provides a title that is descriptive of the situation, such as “Votes for Animals”, etc.</p> <p>Task 3. Student provides a label on the vertical axis that includes the word “number” or “frequency” or “count” (or synonym for count). A label simply of “Votes” is not enough.</p> <p>Task 6. Graph: If the graph has been drawn correctly, the answer should be no, and the reason should include a reference to the bars representing the boys and girls combined. It is possible that a graph is drawn in segments (block on top of block) which would show a line between the number of boys’ and girls’ votes. If by chance this graph exists, the student may answer yes and give a good reason.</p> <p>Task 6. Table: Answer should be yes and the reason should include a reference on how the numbers are separate in the table and how the girls’ votes can be totaled.</p>	Response shows evidence in only 3 of the explanations described in category 4.	Response shows evidence in only 2 of the explanations described in category 4.	Response shows evidence in 1 explanation from category 4, or response gives no explanations.

**SITES-M Mathematics Challenge Rubric
Focus on Data Representations Grade 3**

CATEGORY	4	3	2	1
Mathematical Accuracy	Response shows all or almost all of the steps and solutions have no mathematical errors.	Response shows most of the steps and solutions have no mathematical errors.	Response shows some of the steps and solutions have no mathematical errors.	Response shows few of the steps and solutions have no mathematical errors.
	<p>Student provides correct answers for ALL of the following tasks.</p> <p>Task 1. Student correctly fills in “boys” column 5, 4, 6 matched with correct animal and correctly fills in “girls” column 4, 6, 5 matched with correct animal</p> <p>Task 2. Student answers elephant.</p> <p>Task 4. Student answers 30.</p> <p>Task 5. Student answers 30.</p>	<p>Student provides correct answers for only 3 of the tasks described in category 4.</p>	<p>Student provides correct answers for only 2 of the tasks described in category 4.</p>	<p>Student provides correct answer for only 1 task or none of the tasks described in category 4.</p>

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Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Completes table correctly.		Accuracy
Task 2		
Evidence of addition of votes per animal ($5 + 4 = 9$, etc.).		Strategy
Answers elephant.		Accuracy
Task 3		
Draws correct bar height with correct animal.		Concept
Bars are centered over animal label and not bunched to one side or together.		Concept
Provides a title that is descriptive and connects animals with students or votes.		Explanation
Provides a label on the vertical axis that includes reference to number or count (“Votes” is not enough).		Explanation
Task 4		
Provides evidence of addition of animal totals ($9 + 10 + 11$).		Strategy
Answers 30.		Accuracy
Task 5		
Provides evidence that the method used to find the answer is different from the method used in Task 4.		Concept
Provides evidence of addition of individual table cells or addition of boy totals and girl totals.		Strategy
Answers 30.		Accuracy
Task 6		
Bar graph: If student answers no, a reason must be given about how the bars represent both groups. If student answers yes, the bar graph should be segmented.		Concept
Table: Provides evidence that numbers are separate in table and have not been combined.		Concept
Bar graph: If graph is drawn correctly, reason should state that bars represent both boys and girls combined.		Explanation
Table: Reason should state that the numbers in the table are separate.		Explanation
Task 7		
Writes the correct animal under each pair of bars.		Concept
Task 8		
Matches bar label with correct group.		Strategy
Task 9		
Identifies the dotted bars as boys and the striped bars as girls.		Concept

SITES-M Mathematics Challenge
Focus on Data Representations Grade 3

