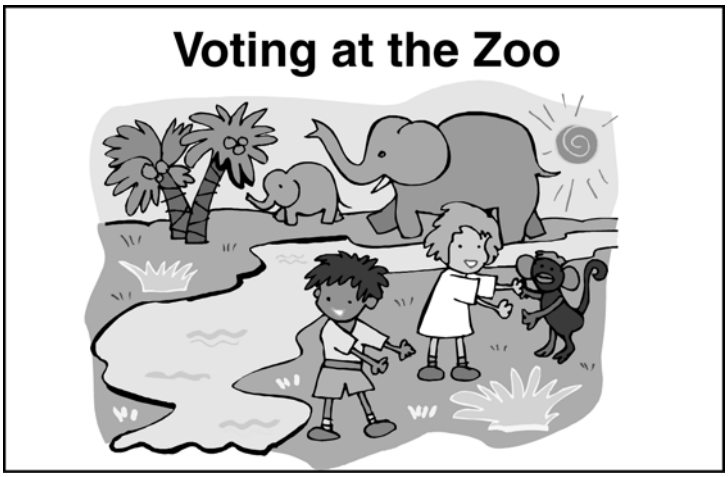
SITES-M Mathematics Challenge



Level: Grade Two

Standard: Data, Probability and Statistics

Learning Target: Focus on Data

Grade Level Expectations

GLE 0206.5.1 Use and understand various representations to depict and analyze data measurements.

Checks for Understanding

0206.5.1 Read, interpret, and analyze data shown in tables, bar graphs, and picture graphs.

0206.5.2 Read, interpret, and create tables using tally marks.

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Voting at the Zoo

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

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Voting at the Zoo

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.

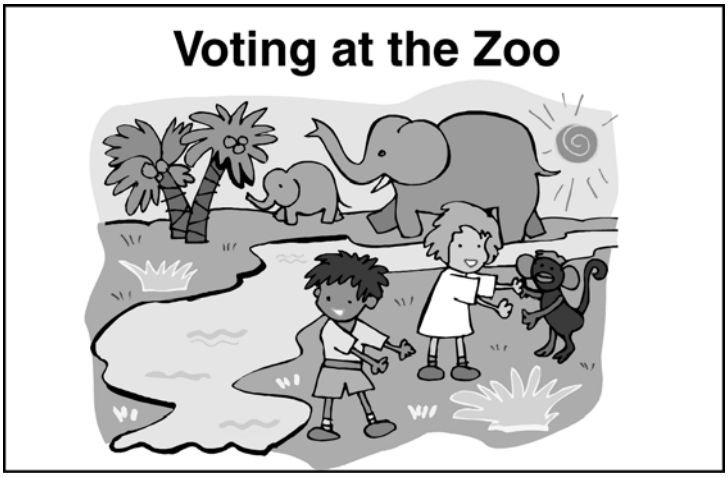
Guiding Questions for Implementing the Mathematics Challenges

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

Grade 2–Focus on Data



Standard: Data, Probability, and Statistics

Learning Target: Focus on Data

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

- ✓ Read, interpret, and analyze data shown in tables, bar graphs, and picture graphs;
- ✓ Read, interpret, and create tables using tally marks.

Task Preparation:

Each student will need a copy of the Student Response Sheet and the Data Sheet, a pencil, a pair of scissors, and glue.

If a student is unable to respond in writing, a scribe may be appointed or verbal answers may be accepted, but the responses will need to be documented for scoring.

Stimulus Cards (Drawing or Word Description):

Each student is required to have a copy of the Data Sheet.

Manipulatives/Supplies:

Copies of the Student Response Sheet and the Data Sheet for each student
Pencils

Cues/Directions:
Distribute student response sheets. If a student is unable to respond in writing, a scribe may be appointed or verbal answers may be accepted, but the responses will need to be documented for scoring. Students should be directed to look carefully at each figure. Allow students time to answer.

Say: **The students in Mr. Martin's class went to the zoo. They saw elephants, monkeys, and zebras.**

1. **The students in Mr. Martin's class voted for the animal they liked best. Look at the student votes on the data sheet. Use tally marks in the table below to show how many votes each animal got. (TEACHER NOTE:** Define "tally marks" and/or give an example of how to tally a number larger than 5 if necessary. Tallies should go in the middle column, and students should count up their tallies to write the number in the right-hand column. Monitor students as they record the data in the table.**) How many votes were there in all? (TEACHER NOTE:** Students should write their answers in the box.**)**

2. **Now make a bar graph of the student 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.**)**

3. **Look at your bar graph. How many more votes are there for monkeys than for elephants? (TEACHER NOTE:** Students should write the number in the box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**) Look at your bar graph. How many votes are there for elephants and zebras combined? (TEACHER NOTE:** Students should write the correct number in the box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**)**

4. **The class made a picture graph of all the votes the animals got. They used a picture of a peanut to represent <u>2 votes</u>, as drawn below. Part of the picture graph is completed below. Is the number of peanuts for the elephants right or wrong? (TEACHER NOTE:** Students should check the correct box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**) How many pictures of peanuts should be in the graph for the zebra votes? (TEACHER NOTE:** Students should write the correct number in the box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**) How many pictures of peanuts should be in the graph for the monkey votes? (TEACHER NOTE:** Students should write the correct number in the box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**)**

SITES-M Mathematics Challenge

Grade 2–Focus on Data

TSM10014

SITES-M Mathematics Challenge
Grade 2–Focus on Data

Student Response Sheet

Voting at the Zoo

Name: _____ **Date:** _____

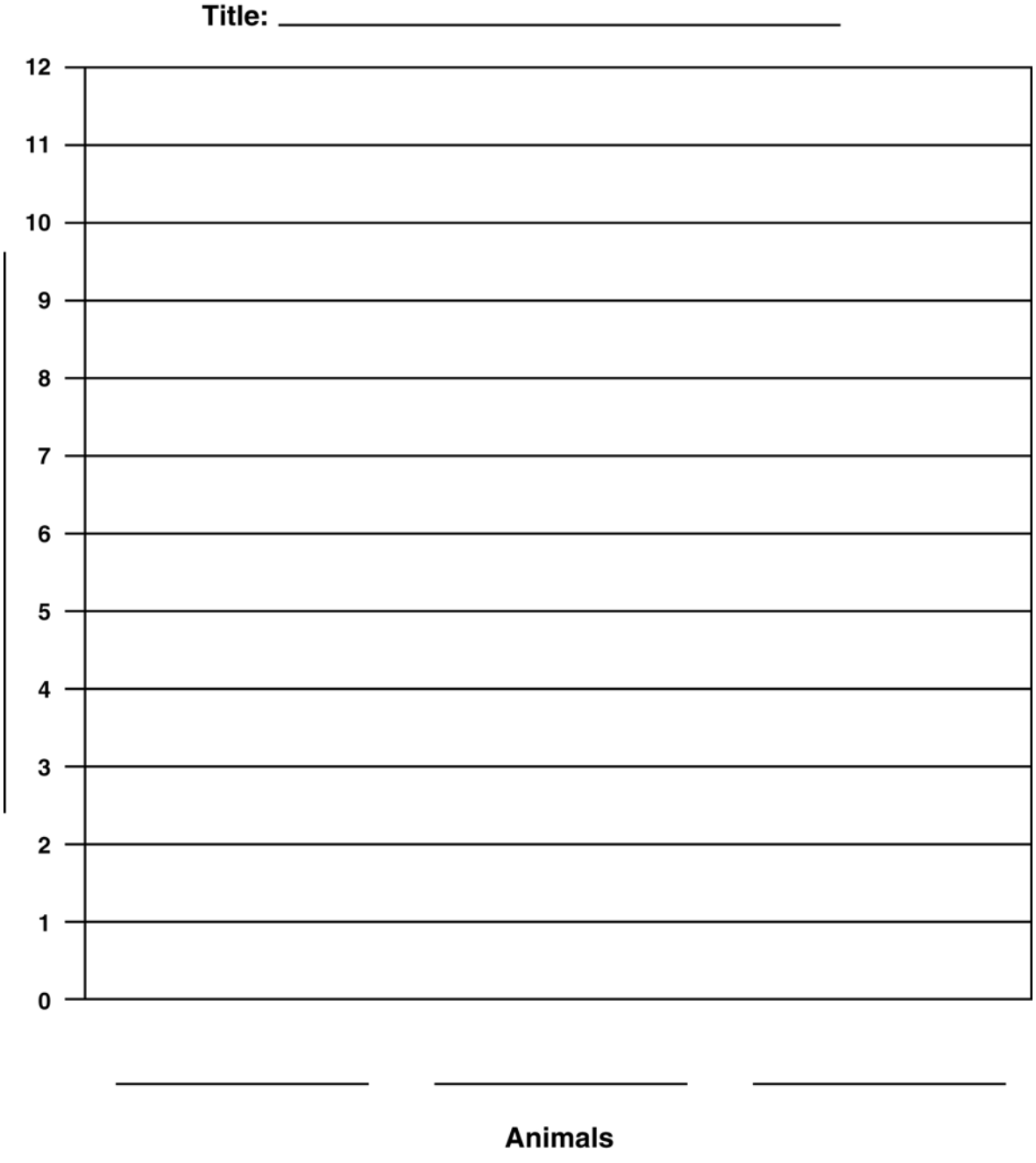
The students in Mr. Martin's class went to the zoo. They saw elephants, monkeys, and zebras.

1. **The students in Mr. Martin's class voted for the animal they liked best. Look at the student votes on the data sheet. Use <u>tally marks</u> in the table below to show how many votes each animal got.**

Zoo Animals the Students Liked Best		
Animal	**Tally**	**Number of Votes**
 Elephant		
 Monkey		
 Zebra		

How many votes were there in all?

2. Now make a bar graph of the student 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.



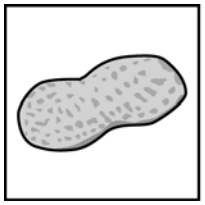
3. a. Look at your bar graph. How many more votes are there for monkeys than for elephants?

How do you know?

b. Look at your bar graph. How many votes are there for elephants and zebras combined?

How do you know?

4. The class made a picture graph of all the votes the animals got. They used a picture of a peanut to represent 2 votes, as drawn below.



is 2 votes.

a. Part of the picture graph is completed below.

Animal	Votes
Elephant	
Zebra	
Monkey	

Is the number of peanuts for the elephants right or wrong?

Check one: ☐ **Right** ☐ **Wrong**

How do you know?

b. How many pictures of peanuts should be in the graph for the zebra votes?

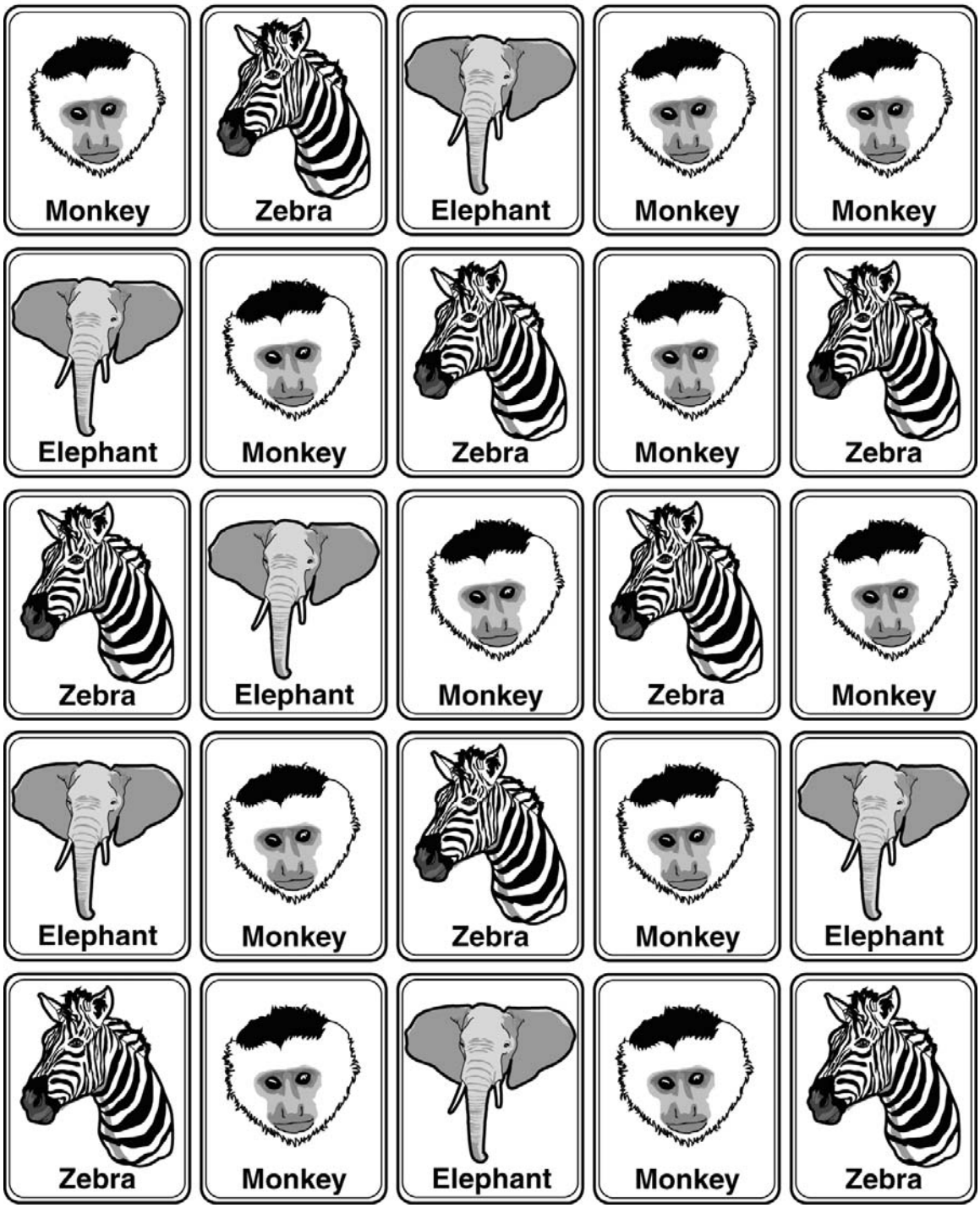
How do you know?

c. How many pictures of peanuts should be in the graph for the monkey votes?

How do you know?

Data Sheet

Student Votes: Zoo Animals They Liked Best



Learning and Teaching Considerations

Task 1:

A) Be sure that students understand how to represent numbers of data with tally marks: (1) each tally mark represents a count of 1 object, (2) the first four marks are vertical, and (3) every fifth line runs diagonally or horizontally across the previous four vertical lines, (4) the resulting mark is sometimes known as a five-bar gate and each one represents a count of 5 objects. There should be some space between each gate for easier reading.

B) Be sure that students understand that counting by five-bar gates is like counting by fives, a quick way of adding 5 ones at a time.

C) Be sure that students understand that the tally for each animal should match the numbers of votes.

D) Be sure that students understand that the words "in all" generally signify the addition operation. For task 1 they have to total the votes across all three groups of animals by adding.

E) Students may answer in words, symbols, or pictures. They may add all three tallies or numbers together. Some students may add two of the tallies or numbers together first and then add the third one. They can also add a combination of tallies and numbers together. Be sure that they understand that they can get the correct answer using any of the strategies, though some are more efficient.

F) Be sure that students understand that they can get the correct answer by adding the three tallies or numbers in any combination. This is an important property of addition.

Task 2:

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 task 2, (1) the title should tie animals to either votes or students, (2) the horizontal axis should be labeled with the three animal groups, (3) the bar heights should match the corresponding animal groups, and (4) the vertical axis should be labeled as a count or number of votes.

Task 3:

A) Be sure that students understand that the word "more" generally signifies comparing numbers or amounts to find out which is greater. Determining exactly how many or how many more signifies subtracting one number or amount from the other.

B) Be sure that students understand how to obtain the number of votes for each animal group by matching the top of the appropriate bar with the correct value on the scale of the frequency axis.

C) Students may answer in words, symbols, pictures, or by using manipulatives. They may also count on their fingers, use number lines, add on, or recall number sense and addition/subtraction facts. Be sure that they understand that they can get the correct answer using any of the strategies, though some are more efficient.

D) Be sure that students understand that addition is assumed in the definition of subtraction so that they can obtain or check their answers by adding, e.g., $11 - 6 = 5$ means $11 = 6 + 5$.

E) Be sure that students understand that $11 - 6 = 5$ is the same as $5 = 11 - 6$. Many textbooks and teachers have a tendency to write equations only one way, and so students are confused when they see them written differently. Using a balance scale may help.

F) Some students may have the misconception that $11 - 6$ is the same as $6 - 11$, like addition. Working with manipulatives and number lines may help.

G) Be sure that students understand that the word "combined" generally signifies the addition operation. For task 3 they have to total the votes across both groups of animals by adding.

H) Students may answer in words, symbols, or pictures. They may also count on their fingers, use number lines, add on, or recall number sense and addition/subtraction facts. Be sure that they understand that they can get the correct answer using any of the strategies, though some are more efficient.

Task 4:

A) Be sure that students understand that there is a 1 to 2 correspondence between the peanut pictures and votes for animals (1 peanut picture = 2 votes). That is an example of creating a pictograph where there is not a 1 to 1 correspondence between the pictures and the number of objects.

B) Some students may have the misconception that you cannot use a portion of a graphic to represent a corresponding portion of a number count (e.g., if 1 peanut picture = 2 votes, 11 monkey votes cannot be represented because it would require using five and one-half peanut pictures).

Name: ANSWER KEY Date: _____

The students in Mr. Martin's class went to the zoo. They saw elephants, monkeys, and zebras.

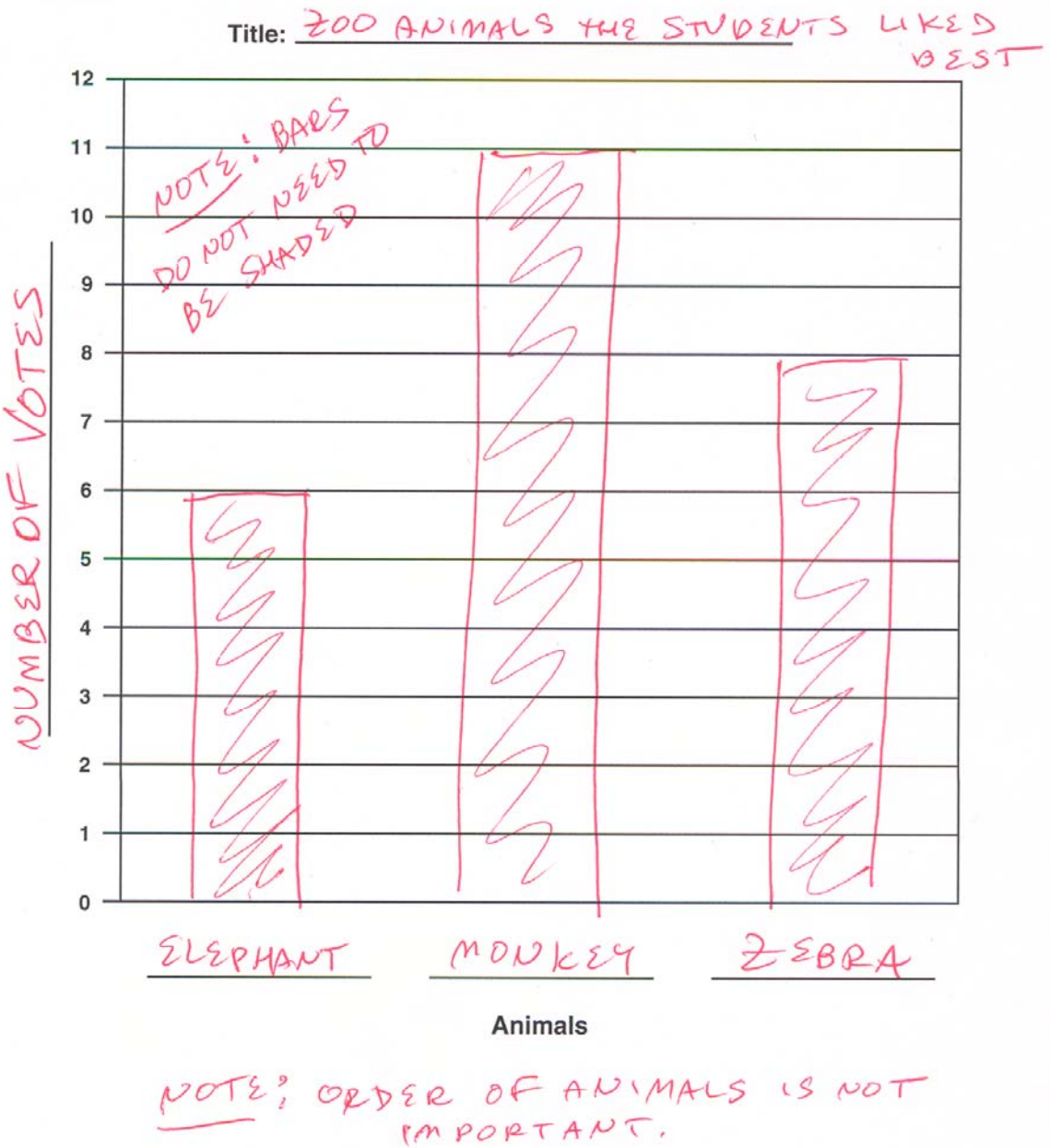
1. **The students in Mr. Martin's class voted for the animal they liked best. Look at the student votes on the data sheet. Use tally marks in the table below to show how many votes each animal got.**

Zoo Animals the Students Liked Best		
Animal	**Tally**	**Number of Votes**
 Elephant	𝍸 I	6
 Monkey	𝍸 𝍸 I	11
 Zebra	𝍸 III	8

How many votes were there in all?

25

2. Now make a bar graph of the student 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.



3. a. Look at your bar graph. How many more votes are there for monkeys than for elephants?

5

How do you know?

THE BAR FOR MONKEY IS 5 HIGHER THAN THE BAR FOR ELEPHANT.

b. Look at your bar graph. How many votes are there for elephants and zebras combined?

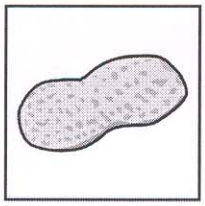
14

How do you know?

IF YOU PUT THE BARS ON TOP OF EACH OTHER THEY WOULD BE UP TO 14, ABOVE THE GRAPH.

OR COUNT EACH SPACE 1 2 3 4 5 6 (6) 7 8 9 10 11 12 13 14 (8)

4. The class made a picture graph of all the votes the animals got. They used a picture of a peanut to represent 2 votes, as drawn below.



is 2 votes.

a. Part of the picture graph is completed below.

Animal	Votes
Elephant	
Zebra	
Monkey	

Is the number of peanuts for the elephants right or wrong?

Check one: ☒ **Right** ☐ **Wrong**

How do you know?

ELEPHANTS GOT 6 VOTES.
1 PEANUT = 2 VOTES
2 PEANUTS = 4 VOTES
3 PEANUTS = 6 VOTES.
OR 2 x 3 = 6

b. How many pictures of peanuts should be in the graph for the zebra votes?

4

How do you know?

2 X 4 = 8 THE ZEBRA GOT 8 VOTES.

1 PEANUT IS 2
2 PEANUTS IS 4
3 PEANUTS IS 6
4 PEANUTS IS 8

c. How many pictures of peanuts should be in the graph for the monkey votes?

$5\frac{1}{2}$

How do you know?

IF 1 PEANUT IS 2 VOTES,
THEN $\frac{1}{2}$ PEANUT IS 1 VOTE.

5 PEANUTS IS 10 VOTES.
$\frac{1}{2}$ PEANUT IS 1 VOTE. 10+1=11

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Rubric

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.**
	Response shows evidence in ALL of the following parts of tasks. **Task 1**. Student shows a tally procedure followed by a number. **Task 2**. Student provides correct bar heights WITH a correctly labeled animal. Student draws bars relatively centered over each animal label (and not bunched up to one side or bunched together). **Task 3**. Student shows evidence that there are 2 more monkey votes than there are elephant votes in part (a). Student shows evidence of combing the elephants and zebras to get 14 votes in part (b). **Task 4**. For part (a) student answers right and shows evidence of using 1 picture to represent 2 things. For part (b) student answers 4 and shows evidence of using 1 picture to represent 2 things. For part (c) if answer is correct, student shows evidence that half a picture means 1 vote; if answer is not correct, there is evidence showing why (e.g., it will not work, 5 is not enough but 6 is too many).	Response shows evidence in only 3 of the task parts described in category 4.	Response shows evidence in only 2 of the task parts described in category 4.	Response shows evidence in only 1 or none of the task parts described in category 4.

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Rubric

CATEGORY	4	3	2	1
Strategy and 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 the problem(s), but not consistently.**	**Student rarely uses an effective strategy to solve the problem(s).**
	Response shows evidence in ALL of the following tasks. **Task 1**. Response shows evidence of adding 6, 11, and 8. **Task 2**. Response shows evidence of correct heights of bars with corresponding animals. **Task 3**. In part (a) response shows evidence of difference of numbers (11 – 6 = 5) or difference in bar height. In part (b) response shows evidence of addition of numbers (6 + 8 = 14) or of adding on bar heights. **Task 4**. Response shows evidence of pairing a peanut with 2 to add up to the correct amount.	Response shows evidence in only 3 of the tasks described.	Response shows evidence in only 2 of the tasks described.	Response shows evidence in only 1 or none of the tasks described.

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Rubric

CATEGORY	4	3	2	1
Explanation and 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; shows little use of appropriate terminology and/or notation.**	**Explanation is difficult to understand, is missing several components, and does not use or include appropriate terminology and/or notation.**
	Response shows evidence in ALL of the following parts of tasks. **Task 2**. Student provides a descriptive title to the graph. A title such as "Animals" is not descriptive enough. It should reference something else like votes or students, etc. Student provides a label for the vertical axis that refers to number, count, frequency, or similar synonym for a value. **Task 3**. In part (a) student refers directly to bars in the graph (e.g., the bar for the monkey is 5 higher than the bar for the elephant). In part (b) student refers directly to the bars in the graph (e.g., if you put the zebra bar on top of the elephant bar, it reaches to 14). **Task 4**. Student explains that if 1 peanut represents 2 votes, then 2 peanuts will be 4 votes, and so on.	Response shows evidence in ALL of the tasks as described in category 4, but may lack detail, as evidenced by the following. **Task 2**. Student provides both a title and a vertical label, but description is not clear and lacks a reference to number. **Task 3**. Student describes having 5 more monkeys than elephants but does not reference the bars in the graph. Student explains about adding all the zebras and elephants but does not reference the bars in the graph. **Task 4**. Student says that 1 peanut represents 2 votes but does not extend to 2 votes representing 4 votes, and so on.	Response shows evidence in only 2 or 3 of the tasks, and may lack detail as described in category 3.	Response shows evidence in only 1 or none of the tasks.

SITES-M Mathematics Challenge

Grade 2–Focus on Data
Rubric

CATEGORY	4	3	2	1
Mathematical accuracy	**All or almost all of the steps and solutions have no mathematical errors.**	**Most of the steps and solutions have no mathematical errors.**	**Some of the steps and solutions have no mathematical errors.**	**Few of the steps and solutions have no mathematical errors.**
	Student provides correct answers for ALL of the following tasks. **Task 1**. Student completes table, as shown on answer sheet, and answers 25. **Task 2**. Student draws correct bar heights over corresponding animals. **Task 3**. Student answers 5 and 14. **Task 4**. Student answers right, 4, and $5\frac{1}{2}$.	Student provides correct answers for only 3 of the tasks described in category 4.	Student provides correct answers for only 2 of the tasks described in category 4.	Student provides a correct answer for only 1 or none of the tasks described in category 4.

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Student shows a tally procedure followed by a number		Concept
Response shows evidence of adding 6, 11, and 8.		Strategy
Student completes table, as shown on answer sheet, and answers 25.		Accuracy
Task 2		
Student provides correct bar heights WITH a correctly labeled animal. Student draws bars relatively centered over each animal label (and not bunched up to one side or bunched together).		Concept
Response shows evidence of correct heights of bars with corresponding animals.		Strategy
Student provides a descriptive title to the graph. A title such as "Animals" is not descriptive enough. It should reference something else like votes or students, etc. Student provides a label for the vertical axis that refers to number, count, frequency, or similar synonym for a value.		Explanation
Student draws correct bar heights over corresponding animals.		Accuracy
Task 3		
Student shows evidence that there are 2 more monkey votes than there are elephant votes in part (a). Student shows evidence of combing the elephants and zebras to get 14 votes in part (b).		Concept
In part (a) response shows evidence of difference of numbers (11 – 6 = 5) or difference in bar height. In part (b) response shows evidence of addition of numbers (6 + 8 = 14) or of adding on bar heights.		Strategy
In part (a) student refers directly to bars in the graph (e.g., the bar for the monkey is 5 higher than the bar for the elephant). In part (b) student refers directly to the bars in the graph (e.g., if you put the zebra bar on top of the elephant bar, it reaches to 14).		Explanation
Student answers 5 and 14.		Accuracy
Task 4		
For part (a) student answers right and shows evidence of using 1 picture to represent 2 things. For part (b) student answers 4 and shows evidence of using 1 picture to represent 2 things. For part (c) if answer is correct, student shows evidence that half a picture means 1 vote; if answer is not correct, there is evidence showing why (e.g., it will not work, 5 is not enough but 6 is too many).		Concept
Response shows evidence of pairing a peanut with 2 to add up to the correct amount.		Strategy
Student explains that if 1 peanut represents 2 votes, then 2 peanuts will be 4 votes, and so on.		Explanation
Student answers right, 4, and $5\frac{1}{2}$.		Accuracy

SITES-M Mathematics Challenge

Grade 2–Focus on Data

Analyzing Student Responses Protocol

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. They include extended responses, open-ended tasks, and tasks that require higher-order thinking skills. Because these types of tasks may be novel for students and they will have varying levels of understanding, the student responses will vary.

The guiding questions below were designed to assist you in analyzing your class' response to the Challenge and determining appropriate next steps for your teaching and learning. Responses to these questions are for your reflection and documentation and will not be collected.

Guiding Questions for Analyzing Student Responses to the Mathematics Challenges

1. When completing the Challenge, what did your students do well? How do you know?

2. When completing the Challenge, what did your students struggle with? How do you know?

3. When your students completed the Challenge, did they implement multiple correct solutions strategies? What insightful approaches to problem solving did you observe?

4. What, if any, patterns (e.g., common errors/misconceptions) did you observe across your student responses?

5. What questions or concerns did your students have when working through this Challenge or a particular task? Are these things you should address for the class as a whole?

6. What, if any, feedback did you provide to your class? How did you provide it?

7. What did you learn about your students' mathematical understanding based on their responses to this Challenge?

Reminders:

1) After you have completed the Challenge with your class and responded to these Guiding Questions for Analyzing Student Responses, please complete the Challenge Feedback Log. A link to this Log is e-mailed to you each month. Responses will be used to improve the Challenges and to provide recommendations for teachers implementing the Challenges in future years.

2) Please provide copies of all student work to the Assessment Coordinator.