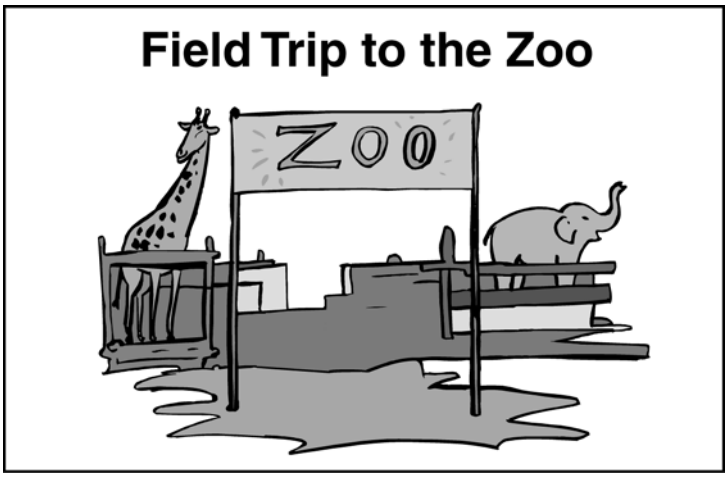
SITES-M Mathematics Challenge



Level: Grade One

Standard: Data, Probability and Statistics

Learning Target: Focus on Data

Grade Level Expectations

GLE 0106.5.1 Use various representations to display and compare data.

Checks for Understanding

0106.5.1 Represent measurements and discrete data using concrete objects, picture graphs, and bar graphs.
0106.5.2 Represent data in both horizontal and vertical form.
0106.5.3 Display data using appropriate titles and labels.
0106.5.4 Count and compare collected data.

SITES-M Mathematics Challenge

Grade 1–Focus on Data
Field Trip to 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 1–Focus on Data
Field Trip to 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.

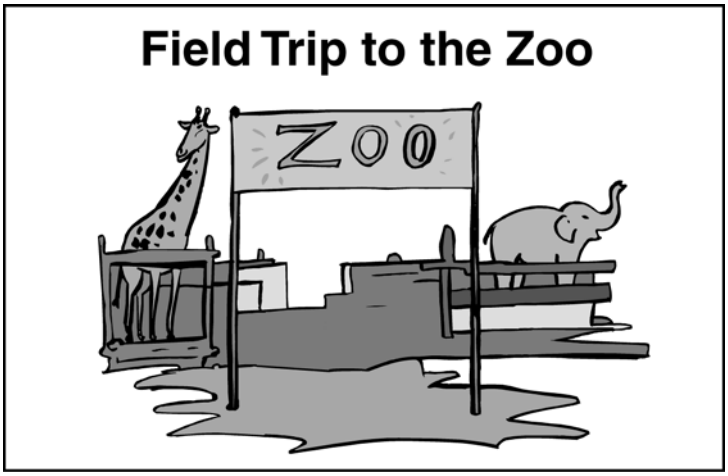
Guiding Questions for Implementing the Mathematics Challenges

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 1–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:

- ✓ Represent measurements and discrete data using concrete objects, picture graphs, and bar graphs;
- ✓ Represent data in both horizontal and vertical form;
- ✓ Display data using appropriate titles and labels;
- ✓ Count and compare collected data.

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
Scissors
Glue

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.

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 the best.** Have students look at the picture graph and make observations.

1. Say: **Each student voted by choosing the picture of the animal he or she liked best. Cut out and glue the pictures of the animals to make a picture graph of the animals the students liked best. (TEACHER NOTE:** Allow about 10 minutes for this activity. Distribute scissors and glue and monitor students as they complete this question. You may want to point out errors here as errors here will impact the next few questions.**)**

2. **Look at your picture graph. Which animal got the most votes? (TEACHER NOTE:** Students should write the name of the animal in the box.**) How can you tell? (TEACHER NOTE:** Students should write their answers in the box.**)**

3. **Complete the table below of the number of votes each animal got. (TEACHER NOTE:** Students should write the number for each animal next to the animal.**)**

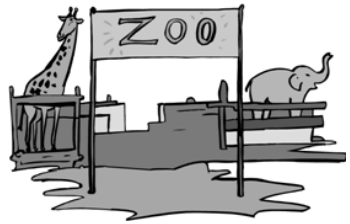
4. **Now make a bar graph of the students' votes for the animal they liked best. The bar graph below has been started for you. Remember to put a title and labels on your graph. (TEACHER NOTE:** Students who would like to use crayons to make their bar graphs may do so. As students work, monitor what they are doing, and ask if they are forgetting something if they do not include the title and labels.**)**

5. **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 answers in the box.**)**

6. **Look at your bar graph. How many votes are there in all? (TEACHER NOTE:** Students should write the number in the box.**) How do you know? (TEACHER NOTE:** Students should write their answers in the box.**)**

SITES-M Mathematics Challenge

Grade 1–Focus on Data



Student Response Sheet

Field Trip to the Zoo

Name: _____ **Date:** _____

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

1. **Each student voted by choosing the picture of the animal he or she liked best. Cut out and glue the pictures of the animals to make a picture graph of the animals the students liked best.**

Zoo Animals the Students Liked Best							
Animal	**Students' Votes**						
Elephant							
Monkey							
Zebra							

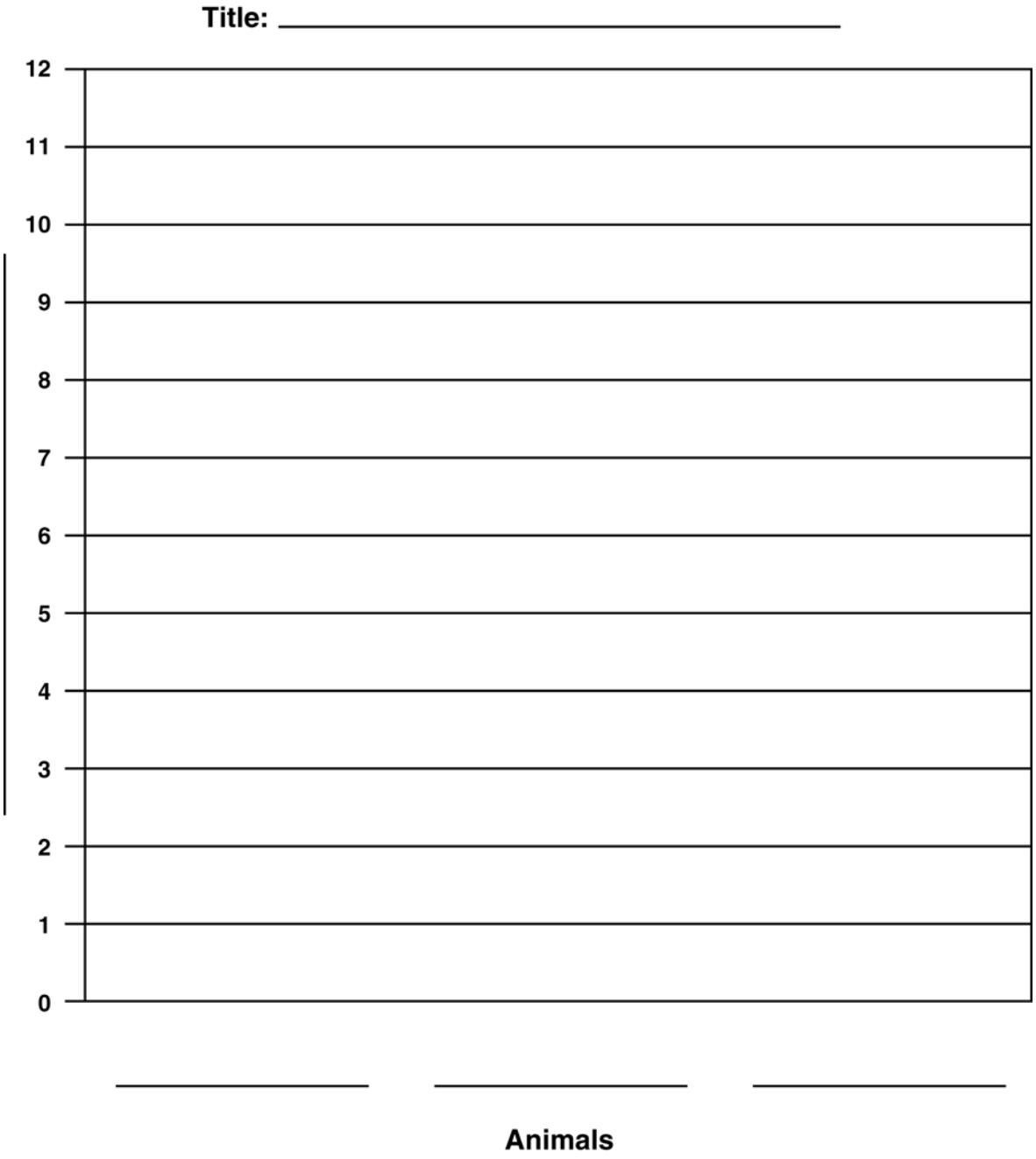
2. Look at your picture graph. Which animal got the <u>most</u> votes?

How can you tell?

3. Complete the table below with the number of votes each animal got.

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

4. Now make a bar graph of 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.



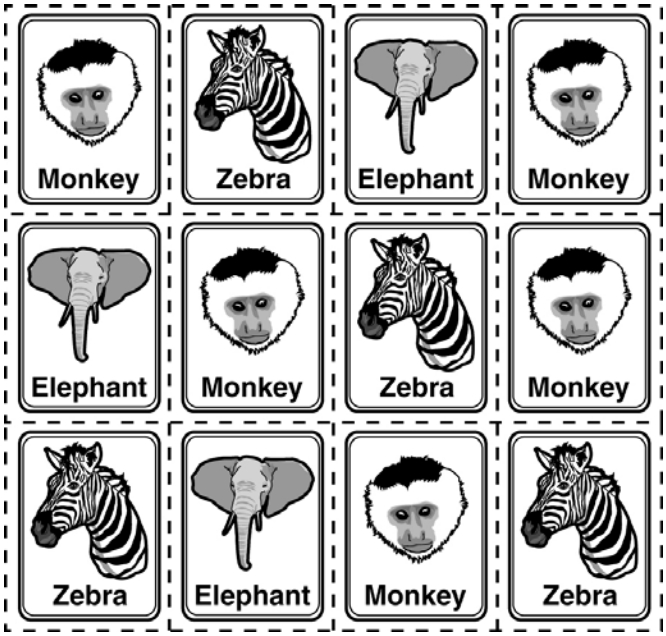
5. Look at your bar graph. How many more votes are there for monkeys than for elephants?

How do you know?

6. Look at your bar graph. How many votes are there in all?

How do you know?

Data Sheet



Learning and Teaching Considerations

Task 1:

A) Be sure that students understand that the rectangles for each specific pictograph category (horizontal rows of animals) should be filled in consecutively and only with pictures from that category.

Task 2:

A) Be sure that students understand that the word "most" signifies more than all the others, when comparing numbers or amounts. The word "more" signifies a greater number or amount than one other or some others. For task 2 students should explain, using either the number or the graph argument, that there are more monkeys than there are zebras or elephants.

B) Some students may have the misconception that the word "more" signifies the same meaning as "most" and will answer zebra because there are more zebras than elephants. Working with manipulatives of different numbers and amounts may help.

C) Students may answer in words, symbols (digits, dots, dashes, base-10 block representations, Es, Ms, Zs, etc.), pictures (elephants, monkeys, aebras), or by using manipulatives (blocks, cubes). They may also count on their fingers, use number lines, or recall number sense. 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 as you move right (→) on a number line, the numbers increase in value. As you move left (←), the numbers decrease in value.

E) 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." (That applies to the other tasks, as well.)

F) 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. (That applies to the other tasks, as well.)

Task 3:

A) Be sure that students understand that the words "number of votes" signify a digit or digits (0 to 9) that represent how many total votes each animal received. 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 units place, tens place, hundreds place, etc. (how many ones, tens, hundreds, etc., there are or which power of 10 it multiplies). In task 3 each digit is in the ones place, denoting how many ones there are, e.g., 3 elephants (1 + 1 + 1), 5 monkeys (1 + 1 + 1 + 1 + 1), and 4 zebras (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 picture graph with putting the correct numbers in the table that represent the vote totals.

Task 4:

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 (rectangular blocks that 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 4, (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.

C) Some students may have the misconception that all the data may be represented by only one bar, e.g., 3 elephants, 5 monkeys, and 4 zebras can be represented by a single bar that extends 12 spaces along the frequency data axis.

Task 5:

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., $5 - 3 = 2$ means $5 = 3 + 2$.

E) Be sure that students understand that $5 - 3 = 2$ is the same as $2 = 5 - 3$. Many textbooks and teachers have a tendency to write equations only one way. Therefore students are confused when they see them written differently. Using a balance scale may help.

F) Some students may have the misconception that $5 - 3$ is the same as $3 - 5$, like addition. Working with manipulatives and number lines may help.

Task 6:

A) Be sure that students understand that the words "in all" generally signify the addition operation. For task 6 they have to total the votes across all three groups of animals by adding.

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 frequency scale.

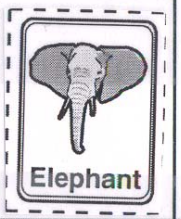
C) Students may answer in words, symbols, or pictures. They may add all three numbers together. Some students may add two of the numbers together first and then add the third one. Be sure that they understand that they can get the correct answer using any of the strategies, though some are more efficient.

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

Name: ANSWER KEY Date: _____

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

1. **Each student voted by choosing the picture of the animal he or she liked best. Cut out and glue the pictures of the animals to make a picture graph of the animals the students liked best.**

Zoo Animals the Students Liked Best							
Animal	**Students' Votes**						
Elephant							
Monkey							
Zebra							

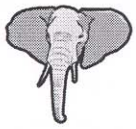
2. Look at your picture graph. Which animal got the most votes?

MONKEY

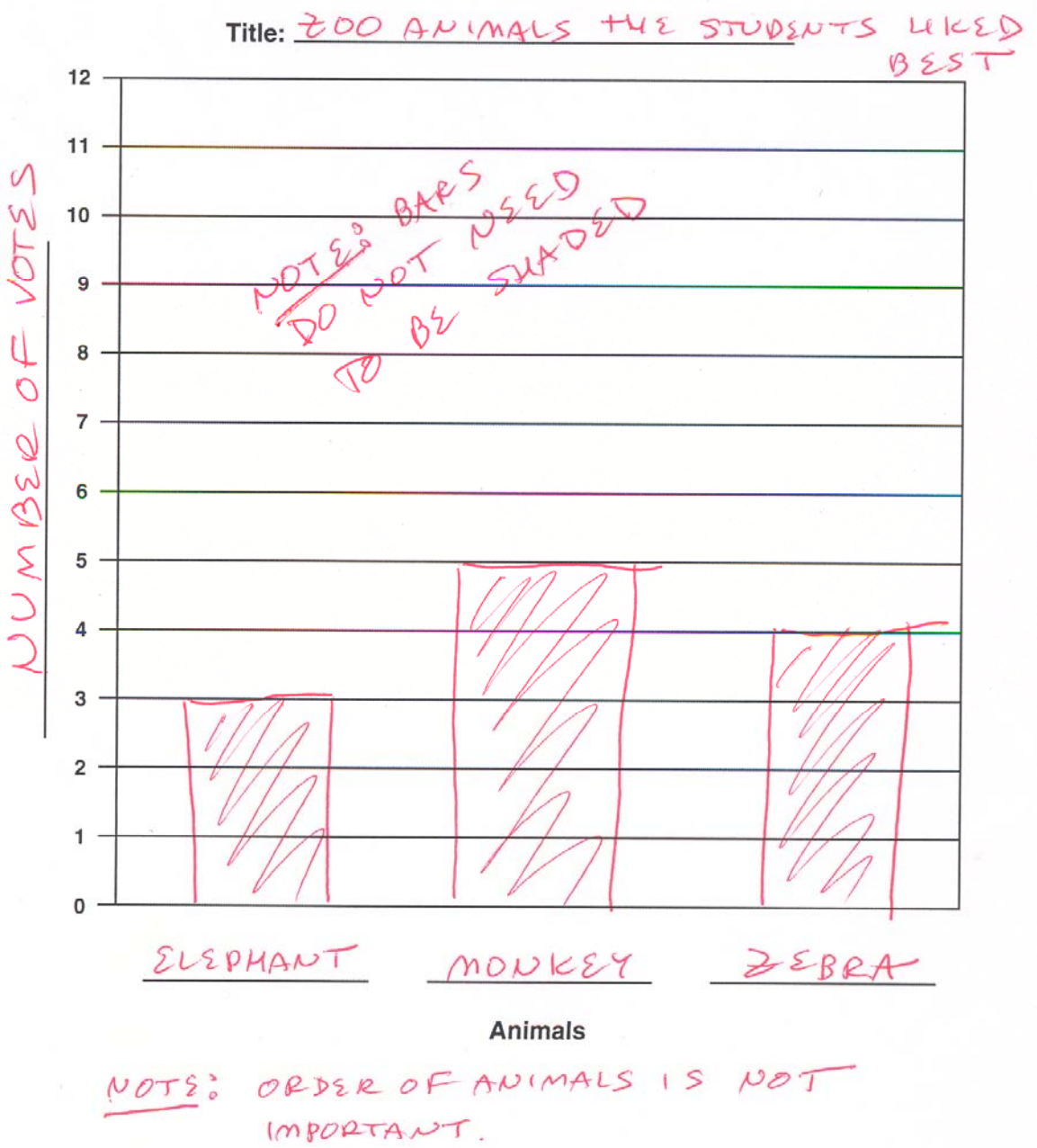
How can you tell?

MONKEY HAS THE LONGEST BAR. OR THE MONKEY GOT 5 VOTES AND 5 IS MORE THAN 3 FOR THE ELEPHANT AND MORE THAN 4 FOR THE ZEBRA.

3. Complete the table below with the number of votes each animal got.

Zoo Animals the Students Liked Best	
Animal	**Number of Votes**
 Elephant	3
 Monkey	5
 Zebra	4

4. Now make a bar graph of 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.



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

2

How do you know?

THE BAR FOR MONKEY IS 2 HIGHER THAN THE BAR FOR ELEPHANTS.

6. Look at your bar graph. How many votes are there in all?

12

How do you know?

IF YOU STACKED THE BARS ON TOP OF EACH OTHER, THEY REACH TO 12.

OR A STUDENT COULD COUNT UP EACH BAR + BEGIN WHERE THE PREVIOS BAR STOPPED.

1 2 3 4 5 6 7 8 9 10 11 12

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SITES-M Mathematics Challenge

Grade 1–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 places each animal in the correct row of the picture graph. **Task 2**. Student shows evidence of comparing either the number or the bar associated with the monkey to both the elephant and the zebra. **Task 3**. Student is able to transfer the number from the pictograph to the table. **Task 4**. 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 5**. Student shows evidence that there are 2 more monkey votes than there are elephant votes. **Task 6**. Student shows evidence of totaling across animals.	Response shows evidence in only 4 or 5 of the task parts described in category 4.	Response shows evidence in only 2 or 3 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 1–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**. Student shows evidence of sorting pictures. **Task 2**. Response shows evidence in dialog box of counting or ordering numbers. **Task 5**. Response shows evidence in dialog box of difference; it can be with numbers (e.g., 5 – 3 = 2 or 3 + 2 = 5) or simply with tally marks. **Task 6**. Response shows evidence in dialog box of addition; it can be with numbers (e.g., 5 + 4 + 3 = 12) or with tally marks.	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 or none of the tasks described in category 4.

SITES-M Mathematics Challenge

Grade 1–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 uses one of the following arguments. • Student says that 5 is more than 4 AND more than 3. • Student says that there are more blocks filled in next to the monkey than next to the other animals. **Task 4**. 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 5**. Student refers directly to bar in the graph; e.g., the bar for the monkey is 2 higher than the bar for the elephant. **Task 6**. Student refers directly to the bars in the graph; e.g., all the bar heights add up to 12.	Response shows evidence in all of the tasks described in category 4, but may lack detail, as evidenced by the following. **Task 2**. Student says that 5 is the biggest number but does not compare it to 4 or 3. **Task 4**. Student provides both a title and a vertical label, but description is not clear and lacks a reference to number. **Task 5**. Student describes having 2 more monkeys than elephants but does not reference the bars in the graph. **Task 6**. Student explains about adding all the numbers but does not reference the bars in the graph.	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 1–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 pastes 3 elephants, 5 monkeys, and 4 zebras correctly in graph. **Task 2**. Student identifies monkey. **Task 3**. Student fills in the numbers 3, 5, and 4 in the table. **Task 4**. Student draws bars to correct heights over corresponding animals. **Task 5**. Student answers 2. **Task 6**. Student answers 12.	Student provides correct answers for only 4 or 5 of the tasks described in category 4.	Student provides correct answers for only 2 or 3 of the tasks described in category 4.	Student provides a correct answer for only 1 task or none of the tasks described in category 4.

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Student places each animal in the correct row of the picture graph.		Concept
Student shows evidence of sorting pictures.		Strategy
Student pastes 3 elephants, 5 monkeys, and 4 zebras correctly in graph.		Accuracy
Task 2		
Student shows evidence of comparing either the number or the bar associated with the monkey to both the elephant and the zebra.		Concept
Response shows evidence in dialog box of counting or ordering numbers.		Strategy
Student uses one of the following arguments. • Student says that 5 is more than 4 AND more than 3. • Student says that there are more blocks filled in next to the monkey than next to the other animals.		Explanation
Student identifies monkey.		Accuracy
Task 3		
Student is able to transfer the number from the pictograph to the table.		Concept
Student fills in the numbers 3, 5, and 4 in the table.		Accuracy
Task 4		
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
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 bars to correct heights over corresponding animals.		Accuracy
Task 5		
Student shows evidence that there are 2 more monkey votes than there are elephant votes.		Concept
Response shows evidence in dialog box of difference; it can be with numbers (e.g., 5 – 3 = 2 or 3 + 2 = 5) or simply with tally marks.		Strategy
Student refers directly to bar in the graph; e.g., the bar for the monkey is 2 higher than the bar for the elephant.		
Student answers 2.		
Task 6		
Student shows evidence of totaling across animals.		Concept
Response shows evidence in dialog box of addition; it can be with numbers (e.g., 5 + 4 + 3 = 12) or with tally marks.		Strategy
Student refers directly to the bars in the graph; e.g., all the bar heights add up to 12.		Explanation
Student answers 12.		Accuracy

SITES-M Mathematics Challenge

Grade 1–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.