SITES-M Mathematics Challenge

Building Numbers

Level: Grade Three

Standard: Number and Operations

Learning Target: Focus on System of Tens

Grade Level Expectations

GLE 0306.2.1 Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.

Checks for Understanding

0306.2.1 Represent whole numbers up to 10,000 using various models (such as base-10 blocks, number lines, place-value charts) and in standard form, written form, and expanded form.

Grade 3–Focus on System of Tens
Building Numbers

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
	Step 1.	Review the Mathematics Challenge Meeting Protocol
Planning	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
	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
Analysis and Reflection	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

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.

Building Numbers
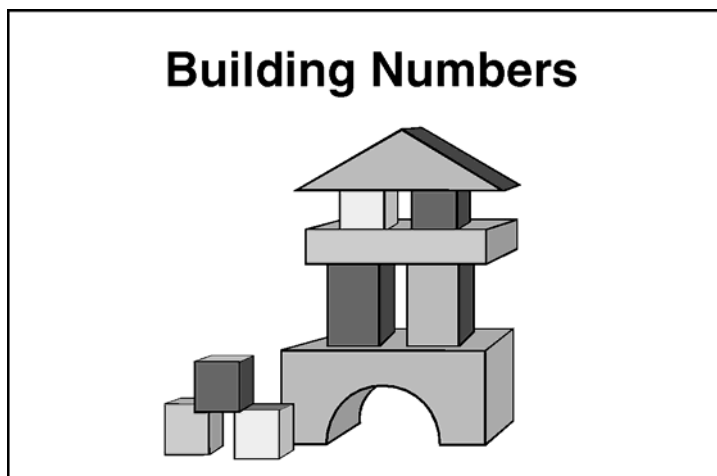
Standard: Number and Operations

Learning Target: Focus on System of Tens

Claims:
Students should understand and be able to explain or demonstrate how to:
- ✓ Represent whole numbers up to 10,000 using various models (such as base-10 blocks, number lines, place-value charts) and in standard form, written form, and expanded form;
- ✓ Understand the place value of whole numbers to ten-thousands place including expanded notation for all arithmetic operations.

Task Preparation:
Each student will need a copy of the Student Response Sheet. Printing the page with the Base-10 Block Pictures and giving a copy to each student may be helpful for students to use as a reference.

Stimulus Cards (Drawing or Word Description):
Base-10 blocks sheet

Manipulatives/Supplies:
Pencils, copy of Base-10 Block Pictures, possibly a set of base-10 blocks for use during activity

Cues/Directions:
Distribute student response sheets. Students should be directed to look carefully at each figure. Allow students time to answer.

Instruct students to follow along as you read aloud.

1. Say: **A number drawn with base-10 blocks is shown below. (TEACHER NOTE:** Students should look at the picture below. Mention the base-10 block pictures on p. 7.**) What number does it represent? (TEACHER NOTE:** Students should write their answer on the line.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**)**

2. **A different number drawn with base-10 blocks is shown below. (TEACHER NOTE:** Students should look at the picture below.**) What number does it represent? (TEACHER NOTE:** Students should write their answer on the line.**) Draw the number in a different way using the <u>fewest </u>number of blocks. (TEACHER NOTE:** Students should draw their answer on the open space provided on the page.**) How do you know your drawing is the same number? (TEACHER NOTE:** Students should write their explanation in the box.**)**

3. **In the space below, draw base-10 blocks to represent 2,167. (TEACHER NOTE:** Students should draw their answer on the open space provided on the page.**) Now trade 1 cube for flats. Draw the new picture in the space below. (TEACHER NOTE:** Students should draw their answer on the open space provided on the page.**) How do you know the two drawings represent the same number? (TEACHER NOTE:** Students should write their explanation in the box.**)**

4. **Look at the chart below. (TEACHER NOTE:** Students should look at the chart**) In the chart below, write the same number in a different way so that there is only 1 digit in each place value. (TEACHER NOTE:** Students should fill in the chart with the correct answers.**) How do you know what digits go in each place? (TEACHER NOTE:** Students should write their explanation in the box.**)**

    a. **Write the number below in expanded notation. (TEACHER NOTE:** Students should write their answer on the line.**)**

5. **Choose a number between 3,000 and 4,000. (TEACHER NOTE:** Students should write their number on the line.**)**

    a. **Draw your number below using base-10 blocks. (TEACHER NOTE:** Students should draw their answer on the open space provided on the page.**)**

b. **Now draw your number a different way using base-10 blocks. (TEACHER NOTE:** Students should draw their answer on the open space provided on the page.**)**

c. **Write your number in expanded form. (TEACHER NOTE:** Students should write their answer on the line.**)**

6. **Janine sees a number drawn with 3 flats and 12 rods. She says this represents the number 312. Is she right? (TEACHER NOTE:** Students should check the correct box.**) How do you know? (TEACHER NOTE:** Students should write their explanation in the box.**)**
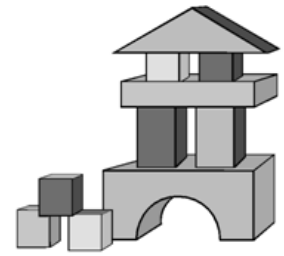
Name: _____   **Date:** _____

1. A number drawn with base-10 blocks is shown below.
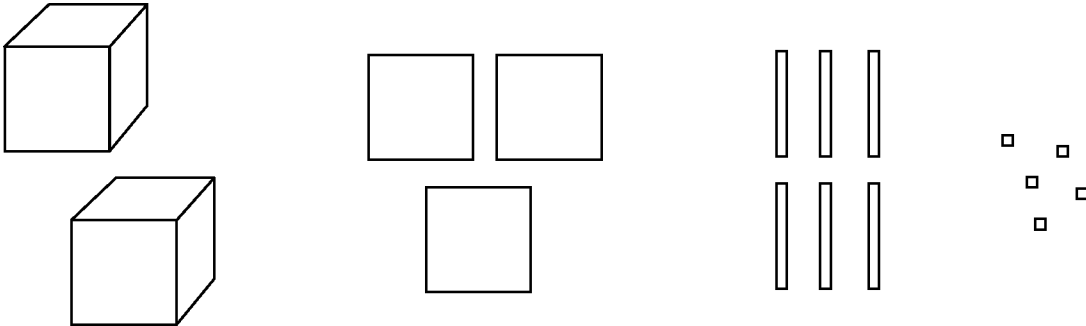
What number does it represent? _____

How do you know?

2. A different number drawn with base-10 blocks is shown below.
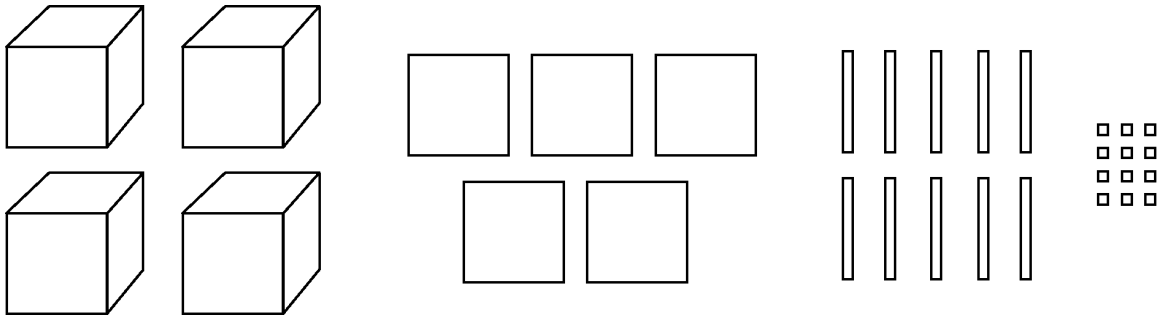
What number does it represent? _____

Draw the number in a different way using the <u>fewest</u> number of blocks.

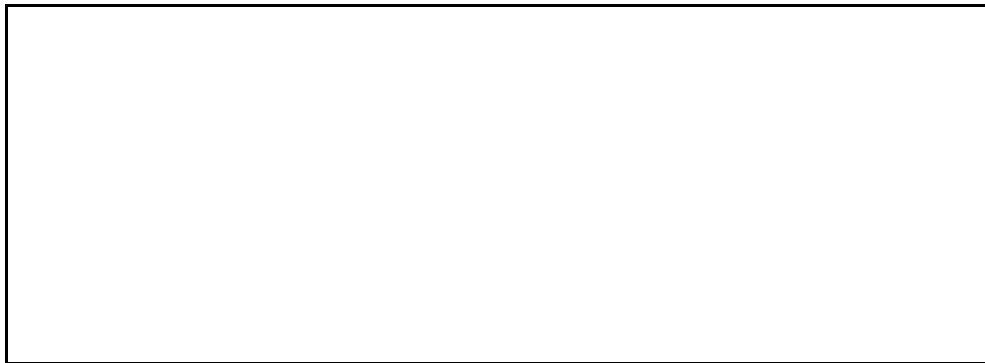**How do you know your drawing is the same number?**

3. **In the space below, draw base-10 blocks to represent 2,167.**

Now trade 1 cube for flats. Draw the new picture in the space below.

How do you know the two drawings represent the same number?

4. Look at the chart below.

Place value	Thousands	Hundreds	Tens	Ones
Number in place	5	12	13	11

In the chart below, write the same number in a different way so that there is only 1 digit in each place value.

Place value	Thousands	Hundreds	Tens	Ones
Number in place				

How do you know what digits go in each place?

Write the number below in expanded notation.

_____

5. Choose a number between 3,000 and 4,000. _____

   a. Draw your number below using base-10 blocks.

   b. Now draw your number a different way using base-10 blocks.

   c. Write your number in expanded form.

   _____

6. Janine sees a number drawn with 3 flats and 12 rods. She says this represents the number 312. Is she right?

Check one: ☐ **Yes** ☐ **No**

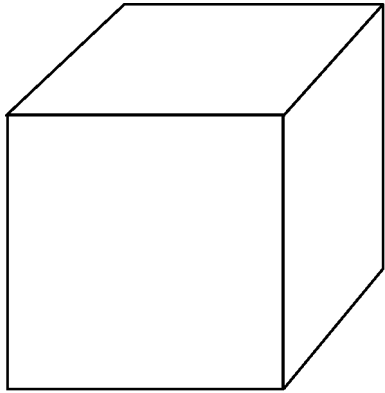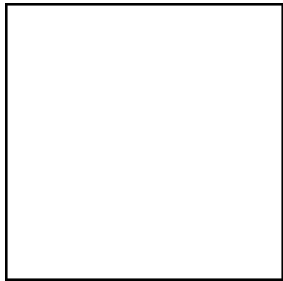**How do you know?**

Base-10 Block Pictures

A Cube represents 1,000.

A Flat represents 100.

A Rod represents 10.

A Unit represents 1.

Learning and Teaching Considerations

Task 1:

A) Be sure students understand that groups of ten (and tens of tens) can be perceived as single entities. These groups can then be counted and used as a means of describing quantities. For example, 2 groups of one thousand, 3 groups of one hundred, 6 groups of ten and 5 units is a base-ten method of describing 2,365 objects.

B) 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."

C) 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 encouraging them to vocalize or write about that knowledge is all they need.

D) The teacher should encourage students to use base 10 blocks or unifix cubes to explore groups of ten (and tens of tens). The base 10 blocks can be used by students as a tool to reason and make sense of our base ten system.

Task 2:

A) Be sure that students understand that numbers can be represented and taken apart in different ways using groupings of ones, tens, hundreds and thousands. There are equivalent representations of numbers. For example, 4,612 can be 4 thousands, 5 hundreds, 10 tens, and 12 ones but also 4 thousands, 6 hundreds, 1 ten, and 2 ones.

B) Students may provide an explanation using expanded notation (multiplication and addition).

C) Be sure students are able to connect their pictures, numbers and words to each other.

D) Students may have the misconception that the number is 451012, not realizing that each place must only contain one digit.

Task 3:

A) Be sure students begin to think about groups of ten things (and tens of tens) as a unit.

B) Be sure students understand the relationship between their pictures and the digits of a number.

C) Students may provide an explanation using multiplication and division (expanded notation).

Task 4:
A) Students may begin to connect the concrete to the abstract. They may no longer need to draw a picture and might write 11 ones as $10 + 1$ and 13 tens as $100 + 30$, for example.

B) Students may have the misconception that two or more digits are allowed in each column.

Task 5:
A) Be sure students understand the relationship between their pictures and digits of their own number.

B) Be sure students understand equivalent representations of a number and trading.

Task 6:
A) Be sure students understand the relationship between their pictures and digits of their own number.

B) Be sure students understand equivalent representations of a number and trading.

C) Be sure students explain why 3 flats and 12 rods does not represent 312.

D) Students may have the misconception that 12 rods means 12 units (mistaking rods for units) and answer yes.

Name: ANSWER KEY   Date: _____

1. A number drawn with base-10 blocks is shown below.
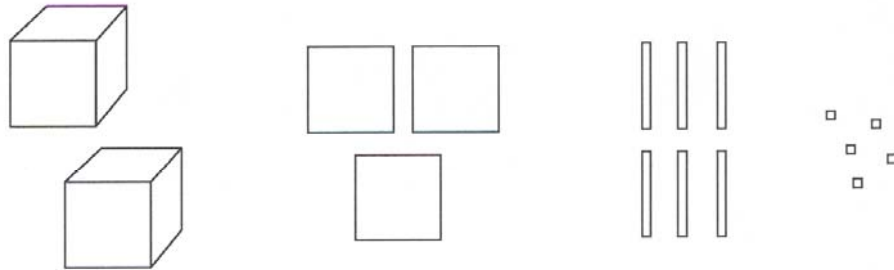
What number does it represent?   2,365

How do you know?

2 CUBES   2 × 1000 = 2000
3 FLATS   3 × 100 =   300
6 RODS   6 × 10 =   60
5 UNITS   5 × 1   =   5

2000 + 300 + 60 + 5 = 2,365

2. A different number drawn with base-10 blocks is shown below.

4

5 +10 0 10 +1 10+2 12
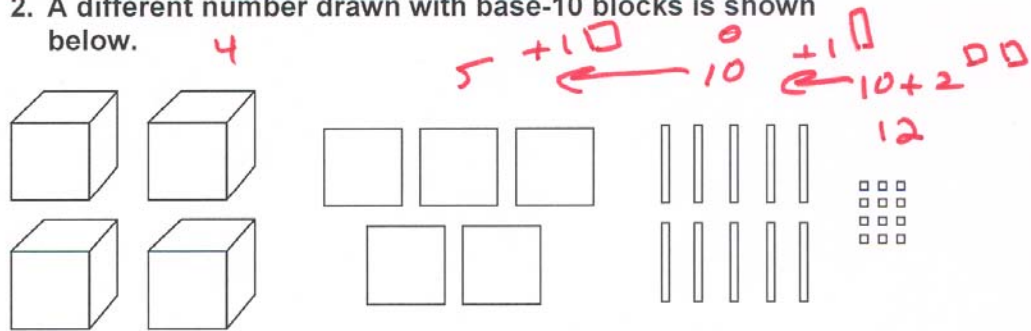
What number does it represent? __4,612__

Draw the number in a different way using the least number of blocks.
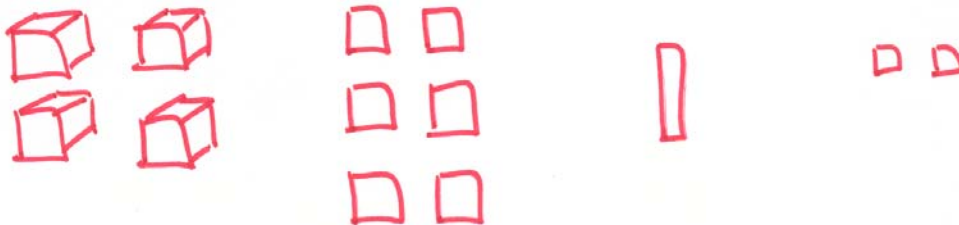
NOTE: DON'T WORRY ABOUT SIZE.

How do you know your drawing is the same number?

IN THE FIRST DRAWING:
$4 \times 1000 = 4,000$
$5 \times 100 = 500$
$10 \times 10 = 100$
$12 \times 1 = 12$

$4000 + 500 + 100 + 12 = 4,612$

3. In the space below, draw base-10 blocks to represent 2,167.
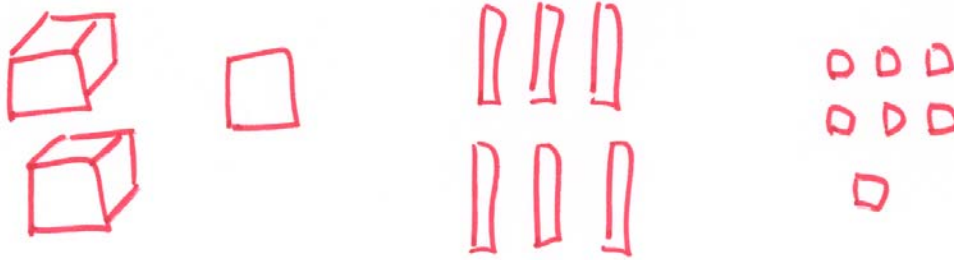
Now trade 1 cube for flats. Draw the new picture in the space below.

How do you know the two pictures represent the same number?

$$1 \times 1000 = 1000$$
$$11 \times 100 = 1100$$
$$6 \times 10 = 60$$
$$7 \times 1 = 7$$

$$\begin{array}{r} 1000 \\ 1100 \\ 60 \\ 7 \\ \hline 2,167 \end{array}$$

4. Look at the chart below.

Place value	Thousands	Hundreds	Tens	Ones
Number in place	5	12	13	11

+1 10 + 2 +1 10 + 3 +1 10 + 1

In the chart below, write the same number in a different way so that there is only 1 digit in each place value.

Place value	Thousands	Hundreds	Tens	Ones
Number in place	6	3	4	1

How do you know what digits go in each place?

$$5 \times 1000 = 5000$$
$$12 \times 100 = 1200$$
$$13 \times 10 = 130$$
$$11 \times 1 = 11$$
$$\overline{6341}$$

a. Write the number below in expanded notation.

$$6(1000) + 3(100) + 4(10) + 1(1)$$

5. Choose a number between 3,000 and 4,000. **3,806**

   a. Draw your number below using base-10 blocks.

   b. Now draw your number a different way using base-10 blocks.

   LOT'S OF ANSWERS!

   c. Write your number in expanded form.

   $$3(1000) + 8(100) + 0(10) + 6(1)$$

NOTE: STUDENT CAN CHOOSE **ANY** NUMBER, SO ANSWERS WILL BE UNIQUE.

6. Janine sees a number drawn with 3 flats and 12 rods. She says this represents the number 312. Is she right?

Check one: ☐ Yes   ☒ No

How do you know?

$$3 \times 100 = 100$$
$$12 \times 10 = 120$$

$$\begin{array}{r} 100 \\ + 120 \\ \hline 220 \end{array}$$

Grade 3–Focus on System of Tens
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 tasks. **Task 1**. Student answers 2,365 and gives an explanation using multiplication and addition (expanded notation). **Task 2**. Student answers 4,612 and gives an explanation using multiplication and addition (expanded notation). Student is able to draw number with 4 cubes, 6 flats, 1 rod, and 2 units. **Task 3**. Student draws 2 cubes, 1 flat, 6 rods, and 7 units for first representation. Student trades correctly and redraws numbers with 1 cube, 11 flats, 6 rods, and 7 units. Student gives an explanation using multiplication and addition (expanded notation). **Task 4**. Student answers 6, 3, 4, 1 and gives appropriate explanation. Student writes expanded notation correctly. (Use of multiplication sign, dot, or parentheses ok.) **Task 5**. Student chooses any number between 3,000 and 4,000 and represents it correctly two different ways. Expanded notation is correct. **Task 6**. Student answers no and explains that drawing represents 420.	Response shows evidence in only 5 of the tasks described.	Response shows evidence in only 4 of the tasks described.	Response shows evidence in 3 or fewer of the tasks described.

SITES-M Mathematics Challenge Rubric
Grade 3–Focus on System of Tens
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 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 1**. Student indicates somewhere on paper that multiplication and addition have taken place. **Task 2**. Student indicates somewhere on paper that 12 units is 1 rod + 2 ones and 10 rods are 1 flat. (Note: this may be indicated with numbers as in 10 + 2, etc.) Student also indicates that there will be trading places or trading symbols. **Task 3**. Student indicates somewhere on paper that 1 cube = 10 flats, and 10 flats are added to 1 flat. **Task 4**. Student indicates somewhere on paper that 11 ones is 10 + 1, that 13 tens is 100 + 30, and that 12 hundreds is 1,000 + 200. **Task 5**. Student indicates somewhere on paper that trading symbols takes place. **Task 6**. Student indicates somewhere on paper that 3 flats = 300 and 12 rods = 120.	Response shows evidence in only 5 of the tasks described.	Response shows evidence in only 4 of the tasks described.	Response shows evidence in 3 or fewer of the tasks described.

Grade 3–Focus on System of Tens
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; 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.**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student explains in some way that 2 cubes = 2,000, 3 flats = 300, 6 rods = 60 and 5 units = 5. **Task 2**. Student explains in some way that 4 cubes = 4,000, 5 flats = 500, 10 rods = 100, and 12 units = 12. Student also explains that groups of 10 can be traded up for next higher symbol. **Task 3**. Student explains in some way that the two representations are equivalent. **Task 4**. Student explains that 5 thousands = 5,000, 12 hundreds = 1,200, 13 tens = 130 and 11 ones = 11. Student also explains how adding these values gives the correct representation of the digits. **Task 5**. Student is able to explain what was done with the number chosen. **Task 6**. Student explains why 3 flats and 12 rods does not represent 312.	Response shows evidence in only 5 explanations described.	Response shows evidence in only 4 explanations described.	Response shows evidence in 3 or fewer explanations described.

Grade 3–Focus on System of Tens
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 answers 2,365. **Task 2**. Student answers 4,612 and draws number with 4 cubes, 6 flats, 1 rod, and 2 units. **Task 3**. Student draws 2 cubes, 1 flat, 6 rods, and 7 units. Student draws new representation with 1 cube and 11 flats. **Task 4**. Student completes table with 6, 3, 4, and 1 as shown on answer sheet. Student writes correct expanded notation. **Task 5**. Student represents number correctly using symbols in two different ways. Student writes correct expanded notation. **Task 6**. Student answers no.	Student provides correct answers for only 5 of the tasks described.	Student provides correct answers for only 4 of the tasks described.	Student provides correct answers for 3 or fewer of the tasks described.

Grade 3–Focus on System of Tens

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Student answers 2,365 and gives an explanation using multiplication and addition (expanded notation).		Concept
Student indicates somewhere on paper that multiplication and addition have taken place.		Strategy
Student explains in some way that 2 cubes = 2,000, 3 flats = 300, 6 rods = 60, and 5 units = 5.		Explanation
Student answers 2,365.		Accuracy
Task 2		
Student answers 4,612 and gives an explanation using multiplication and addition (expanded notation). Student is able to draw number with 4 cubes, 6 flats, 1 rod, and 2 units		Concept
Student indicates somewhere on paper that 12 units are 1 rod + 2 ones and 10 rods are 1 flat. (Note: this may be indicated with numbers as in 10 + 2, etc.) Student also indicates that they will be trading places or trading symbols.		Strategy
Student explains in some way that 4 cubes = 4,000, 5 flats = 500, 10 rods = 100, and 12 units = 12. Student also explains that groups of 10 can be traded up for next higher symbol.		Explanation
Student answers 4,612 and draws number with 4 cubes, 6 flats, 1 rod, and 2 units.		Accuracy
Task 3		
Student draws 2 cubes, 1 flat, 6 rods, and 7 units for first representation. Student trades correctly and redraws numbers with 1 cube, 11 flats, 6 rods, and 7 units. Student gives an explanation using multiplication and addition (expanded notation).		Concept
Student indicates somewhere on paper that 1 cube = 10 flats and 10 flats are added to 1 flat.		Strategy
Student explains in some way that the two representations are equivalent.		Explanation
Student draws 2 cubes, 1 flat, 6 rods, and 7 units. Student draws new representation with 1 cube and 11 flats.		Accuracy
Task 4		
Student answers 6, 3, 4, 1 and gives appropriate explanation. Student writes expanded notation correctly. (Use of multiplication sign, dot, or parentheses OK.)		Concept
Student indicates somewhere on paper that 11 ones are 10 + 1, that 13 tens are 100 + 30, and that 12 hundreds are 1,000 + 200.		Strategy
Student explains that 5 thousands = 5,000, 12 hundreds = 1,200, 13 tens = 130, and 11 ones = 11. Student also explains how adding these values gives the correct representation of the digits.		Explanation
Student completes table with 6, 3, 4, and 1, as shown on answer sheet. Student writes correct expanded notation.		Accuracy

Task 5		
Student chooses any number between 3,000 and 4,000 and represents it correctly in two different ways. Expanded notation is correct		Concept
Student indicates somewhere on paper that trading symbols takes place.		Strategy
Student is able to explain what was done with the number chosen.		Explanation
Student represents number correctly using symbols in two different ways. Student writes correct expanded notation.		Accuracy
Task 6		
Student answers no and explains that the drawing represents 420.		Concept
Student indicates somewhere on paper that 3 flats = 300 and 12 rods = 120.		Strategy
Student explains why 3 flats and 12 rods does not represent 312.		Explanation
Student answers no.		Accuracy

Grade 3–Focus on System of Tens

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.