Grade 4: Whole Number Place Values

A Set of Related Tasks and Lesson Guides

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ARC OVERVIEW

In this set of related tasks, 4th Grade students will solve real-world problems in which they have to consider the relationships between the digits in multi-digit numbers. They will use written and physical representations as well as mathematical reasoning to link the concept of place value to comparisons and rounding.

The Arc Preview table on page 4 provides the task questions contained in this arc. The tasks are aligned to standards 4.NBT.A.1, 4.NBT.A.2, and 4.NBT.A.3.

- Task 1 will explore modeling and writing multi-digit whole numbers.
- Task 2 and 3 will develop understanding of reading, writing, and comparing multi-digit whole numbers.
- Task 4 will *solidify* understanding of reading, writing, and comparing multi-digit whole numbers.
- Task 5 – 7 will develop ideas about rounding multi-digit whole numbers.
- Task 8 will *solidify* understanding of comparing and rounding multi-digit whole numbers.

Note that the some of the Essential Understandings listed in each task were modified from those contained in Pearson's EnVision Math series. Others were taken from NCTM's Developing Essential Understanding series. Tennessee State Mathematics Standards were retrieved from http://www.tn.gov/education/standards/math.shtml.

By the end of these seven tasks, students will be able to answer the following overarching questions:

- How does the position of a digit in a number affect its value?
- How can you represent the same number in different ways?
- How can place value be used to compare and order numbers?
- Which symbols are used to compare numbers?
- How can place value be used to round numbers?

The assessing questions, advancing questions, and whole group questions provided in this guide will ensure that students are working in ways aligned to the Standards for Mathematical Practice. Although the students will not be aware that this is occurring, the teacher can guide the process so that each MP (Mathematical Practice) is covered through good explanations, understanding of context, and clarification of reasoning behind solutions.

Arc Preview

<table>
<tr>
<td>Task 1: Pennies for the Garden
Meadow View Elementary School is having a fundraiser to support a new garden project. Jill found 47 pennies around her house to donate.
The entire 4th grade brought in over 1,000 times that amount.

a) About how many pennies did the 4th grade donate for the garden project? How do you know?
b) The fifth grade brought in 43,209 pennies. Write the number of pennies donated from the 5th grade in expanded form.</td>
<td>Goals for Task 1:
• Use manipulatives or drawings to model multi-digit whole numbers
• Apply concepts of place value and multiplication to show that a digit in one place represents ten times what it represents in the place to its right
• Write multi-digit numbers in expanded form

Standards for Task 1:
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.</td>
</tr>
<tr>
<td>Task 2: Numbers Big and Small
Sawyer and Olivia have a set of number cards like those below. They are taking turns giving each other challenges with the cards.

1 5 2 4 6 3

a) Solve Sawyer’s challenge to make the largest whole number possible using all 6 cards. Explain your reasoning.
b) Solve Olivia’s challenge to make the smallest whole number possible using all 6 cards. Explain your reasoning.</td>
<td>Goals for Task 2:
• Use place value knowledge to create the largest and smallest numbers possible given specific digits
• Read and write multi-digit whole numbers using base-ten numerals and number names

Standards for Task 2:
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.</td>
</tr>
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Task 3: Task 3: Tall Towers

The United States of America has many tall buildings. The Key Tower in Cleveland is 947 feet tall. The Willis Tower in Chicago is 1,450 feet tall.

a) Which building is the tallest? How do you know?
b) How many times larger is the digit 4 in the height of the Willis Tower than the digit 4 in the height of the Key Tower? Can you demonstrate your reasoning?

Goals for Task 3:

- Read multi-digit whole numbers
- Recognize that a digit in one place represents ten times what it represents in the place to its right
- Compare two multi-digit numbers based on meanings of the digits in each place

Standards for Task 3:

4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*.

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Task 4: Mighty Mountains

Solidifying Understanding

The table below lists the heights and locations of the second and third tallest mountains in the world.

Mountain	Location	Height
Aconcagua	South America	22,837 ft.
Mount McKinley	North America	20,320 ft.

a) Which mountain is taller? Explain your reasoning.
b) Use symbols to compare the heights of the mountains.
c) Describe and compare the value of the digit 3 in each mountain height.
d) Write the heights in expanded form. How does this help in their comparison?

Goals for Task 4:

- Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form
- Compare two multi-digit numbers using >, =, and < symbols

Standards for Task 4:

4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*.

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

Task 5: Park Patrons

The United States of America has many national parks that draw thousands of visitors each year. The table below shows the number of visitors for three national parks in 2011.

Wind Cave	538,394 visitors
Mammoth Cave	483,319 visitors
Canyonlands	473,773 visitors

a) Gianna said, "When I round all these numbers, I get the same number." Zachary said, "I disagree. I get all different numbers." Can they both be correct? Explain your reasoning.

b) Round each number to the hundred thousands place. Explain your reasoning.

Goals for Task 5:

- Read multi-digit whole numbers
- Use place value understanding to round multi-digit whole numbers to any place

Standards for Task 5:

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.

Task 6: Big Bell

When rounded to the nearest thousand, the Liberty Bell's weight is 2,000 pounds.

a) What is the least amount that the Liberty Bell could weigh? Explain your reasoning.

b) What is the greatest amount that the Liberty Bell could weigh? Explain your reasoning.

Goals for Task 6:

- Use place value understanding to round multi-digit whole numbers to any place
- Given a rounded number, recognize all possible values of the original number

Standards for Task 6:

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.

Task 7: Marble Mayhem

The Standing Stone Park in Livingston, TN hosts an annual marble festival. At last year's festival, there was a contest to estimate the number of marbles in a large glass container. The actual number of marbles was announced at the end of the festival.

Lee said, "That number rounds to 10,000 marbles."

Tessa said, "That number rounds to 10,400 marbles."

Rufaro said, "That number rounds to 10,430 marbles."

a) Can all three people be correct? Explain your reasoning.
b) What are the possible values for the actual number of marbles? How do you know?

Goals for Task 7:

- Read multi-digit whole numbers
- Use place value understanding to round multi-digit whole numbers to any place

Standards for Task 7:

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.

Task 8: County Populations

Solidifying Understanding

Tennessee is made up of 95 counties with a wide range of populations. Three counties with similar populations are Cheatham, Dyer, and Warren.

Cheatham County	Dyer County	Warren County
39,705 people	38,335 people	39,839 people

a) Which county has the greatest population? Smallest population? How do you know?

b) Compare the three populations of these counties using symbols.

c) Paula said, "I get the same number when I round all three populations."
Steve said, "When I round them, I get the same number for two of the populations but a different number for the other population."
Compare Paula and Steve's statements. Can both be correct? Explain how you know.

d) When rounded to the nearest hundred, the population of Pickett County is 5,100 people. What is the greatest possible number of people in Pickett County? Explain how you know.

Goals for Task 8:

- Read and write multi-digit whole numbers using base-ten numerals and number names
- Compare two multi-digit numbers using >, =, and < symbols
- Round multi-digit whole numbers to any place

Standards for Task 8:

4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*.

4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.

4.NBT.A.3 Use place value understanding to round multi-digit whole numbers to any place.

Tasks' Standards Alignment

Task	4.NBT.A.1	4.NBT.A.2	4.NBT.A.3	MP 1	MP 2	MP 3	MP 4	MP 5	MP 6	MP 7	MP 8
Task 1 **Pennies for the Garden**	✔	✔		✔	✔	✔	✔	✔		✔	
Task 2 **Numbers Big and Small**	✔	✔		✔	✔	✔		✔		✔	✔
Task 3 **Tall Towers**	✔	✔		✔	✔	✔			✔	✔	
Task 4 **Mighty Mountains** *Solidifying Understanding*	✔	✔		✔	✔	✔	✔	✔	✔	✔	
Task 5 **Park Patrons**		✔	✔	✔	✔	✔	✔	✔	✔	✔	
Task 6 **Big Bell**		✔	✔	✔	✔	✔		✔	✔	✔	
Task 7 **Marble Mayhem**		✔	✔	✔	✔	✔		✔	✔	✔	
Task 8 **County Populations** *Solidifying Understanding*	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔

The Standards for Mathematical Practice
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Name _____

Task 1: Pennies for the Garden

Meadow View Elementary School is having a fundraiser to support a new garden project. Jill found 47 pennies around her house to donate. The entire 4th Grade brought in over 1,000 times that amount.

a) About how many pennies did the 4th Grade donate for the garden project? How do you know?

b) The 5th Grade brought in 43,209 pennies. Write the number of pennies donated from the 5th Grade in expanded form.

Task 1: Pennies for the Garden	**4th Grade**

Meadow View Elementary School is having a fundraiser to support a new garden project. Jill found 47 pennies around her house to donate. The entire 4th Grade brought in over 1,000 times that amount.

a) About how many pennies did the 4th Grade donate for the garden project? How do you know?

b) The 5th Grade brought in 43,209 pennies. Write the number of pennies donated from the 5th Grade in expanded form.

Teacher Notes:

Students must understand the place value system in order to be successful in this task. Although part a) can be completed using multiplication, teachers should use questioning to guide students to use place value understanding to explain their answers.

This task could easily be modified to show changes across only 1 or 2 place values by using smaller numbers.

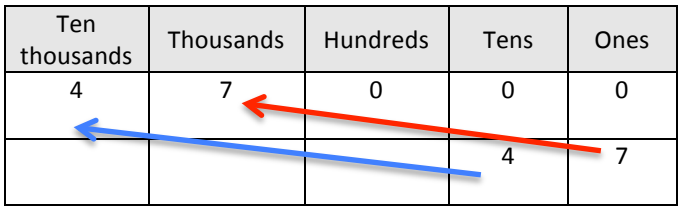
Tennessee State Standards for Mathematical Content	**Tennessee State Standards for Mathematical Practice**
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*. **4.NBT.A.2** Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- The value of the digits can be added together to find the value of the number.

Explore Phase

Possible Solution Paths	**Assessing and Advancing Questions**
a) The 4th Grade donated about 47,000 pennies to support the garden project. Students may multiply 47 x 1,000 to get the answer. Use the advancing questions to guide them to use place value understanding to explain their reasoning. Some students may know that by moving the	**Assessing Questions:** • How did you decide how many pennies the 4th Grade donated for the garden project? • Why is multiplication an appropriate operation to use to solve this problem? **Advancing Questions:** • Can you solve this problem using a place value table?

decimal to the right, the original value is multiplied by 10. Those students might explain the answer by saying that moving the decimal place three spaces to the right multiplies the value of the original number by 1,000 to make 47,000. Other students may show their reasoning by using a place value chart like the one below. This shows the change in value with the arrows.  	• What does the word "about" mean in the problem? • Suppose the number of pennies was 10 times Jill's original 47. What would be the value of that number?
b) 43,209=(4 x 10,000) + (3 x 1,000) + (2 x 100) + (9 x 1) Students may include (0 x 10), which does not change the value and is acceptable.	**Assessing Questions:** • Why did you choose to use multiplication? • Why did you choose to use addition? • How did you select the factor to multiply by each digit in the original number? • How would writing a zero at the end of the standard form number change your answer in expanded form? • Would your answer still be correct without the plus signs? **Advancing Questions:** • Can you read this number aloud? • What is the value of the 4 in 43,209? The 3? The 2? The 9? • What does the zero in the number mean?
Possible Student Misconceptions	**Assessing and Advancing Questions**
Students may have difficulty understanding a digit in one place represents ten times what it represents in the place to its right.	• Can you use a model to build 20? (20 is 2 × 10. Build a set of 2 and repeat it 10 times.) • Can you use a model to build 200? (Build a set of 20 and repeat it 10 times.) • Can you relate these models to the place value chart?
For part a), students using the strategy of moving the decimal to right 3 spaces to show 1,000 times 47 pennies may incorrectly place the original decimal point in 47.	• Where is the decimal in 47? How do you know? • How does the value change to move the decimal point to .47? • How does the value change to move the decimal point to 4.7?

Entry/Extensions	Assessing and Advancing Questions
If students can't get started….	• What do you know about this problem? • Suppose you were looking for a number that was 10 times 47. How would you find that answer? • Suppose you were looking for a number that was 100 times 47. How would you find that answer? • What is the value of the 4 in 43,209? • What is the value of the 3 in 43,209? • What is the value of the 2 in 43,209? • What is the value of the 9 in 43,209?
If students finish early….	• Suppose the 6th grade brought in over 63,000 pennies and that Erin's class brought in 1/10 that amount. About how many pennies did Erin's class bring in for the garden fundraiser? • The 3rd grade brought in 70,361 pennies. Can you write that number in expanded form?

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- How does a place value chart help to find the answer?

Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).

- If a grade level brought in 44,444 pennies, explain the relationship of each 4 in terms of multiples of 10.

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- Which strategy did you use to decide how many pennies the 4th grade donated for the garden project?
- Are there any other strategies that can be used to find the answer?
- Why did you use multiplication in this problem?
- Why did you use addition in this problem?

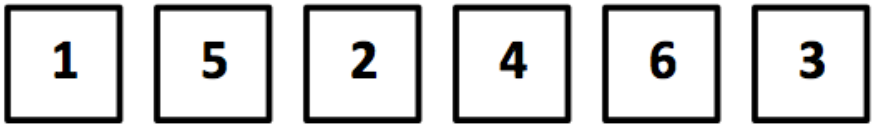
The value of the digits can be added together to find the value of the number.

- What number is represented by (6 x 10,000) + (1 x 1,000) + (2 x 10) + (7 x 1)?
- Explain what is shown when a number is written in expanded form.

Name _____

Task 2: Numbers Big and Small

Sawyer and Olivia have a set of number cards like those below. They are taking turns giving each other challenges with the cards.

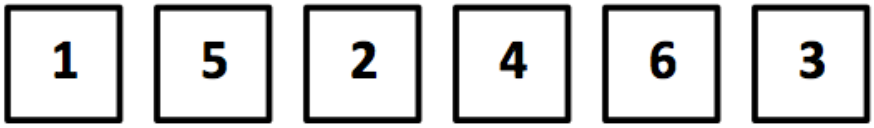


a) Solve Sawyer's challenge to make the largest whole number possible using all 6 cards. Explain your reasoning.

b) Solve Olivia's challenge to make the smallest whole number possible using all 6 cards. Explain your reasoning.

Task 2: Numbers Big and Small — **4th Grade**

Sawyer and Olivia have a set of number cards like those below. They are taking turns giving each other challenges with the cards.



a) Solve Sawyer's challenge to make the largest whole number possible using all 6 cards. Explain your reasoning.
b) Solve Olivia's challenge to make the smallest whole number possible using all 6 cards. Explain your reasoning.

Teacher Notes:

This task can be adapted by varying the quantity and/or value of number cards based on the abilities of students. Teachers may also choose to add other criteria for the challenges in a) and b) such as requiring the target number to be odd, even, or between specific numbers.

Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*. **4.NBT.A.2** Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

Explore Phase

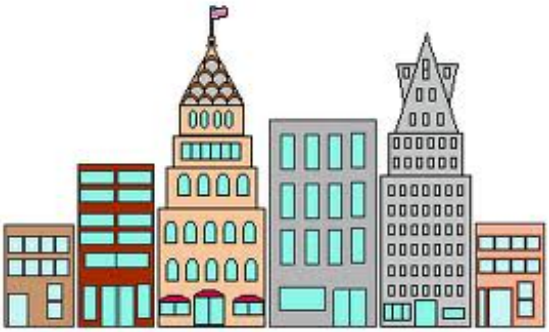
Possible Solution Paths	Assessing and Advancing Questions
a) The largest whole number possible is 654,321. Since a digit in one place represents ten times what it represents in the place to its right the digits should be written in order of their value from the largest to the smallest place value location.	**Assessing Questions:** • How did you decide what the largest number possible was? • Is there any way to make a larger number? **Advancing Questions:** • Which digit has the greatest value? • Which digit has the smallest value? • How do the values of numbers change as you move to the left in place value location? • How do the values of numbers change as you

	move to the right in place value location? • How would your answer change if you could use each digit more than once?
b) The smallest whole number possible is 123,456. Since a digit in one place represents ten times what it represents in the place to its right the digits should be written in order of their value from the smallest to the greatest place value location.	**Assessing Questions:** • How did you decide what the smallest number possible was? • Can you make a smaller number? **Advancing Questions:** • Which digit has the greatest value? • Which digit has the smallest value? • How do the values of numbers change as you move to the left in place value location? • How do the values of numbers change as you move to the right in place value location? • How would your answer change if you could use each digit more than once?
Possible Student Misconceptions	**Assessing and Advancing Questions**
Students do not have a clear understanding of the structure of the number system	• In the number 274 what is the value of the 2? What is the digit in the tens place? • Can you read 1,870? 83,000? 71,094? 812,165? • Which number is larger? 437 or 4730?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• What is this problem asking you to find? • Which digit has the greatest value? • Where should this digit go when making the largest number possible? Smallest number possible? • Which digit has the smallest value? • Where should this digit go when making the largest number possible? Smallest number possible?
If students finish early….	• Suppose Sawyer also said that the number had to be between 400,000 and 300,000. What is the largest whole number possible using all 6 digits? • Suppose Olivia also said that the number had to be between 200,000 and 300,000. What is the smallest whole number possible using all 6 digits? • Can you create a number card challenge for another student? • How would your answer change if you could use each digit more than once?

Discuss/Analyze
Whole Group Questions
Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning. **For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.** • How did you know how to make the largest 6-digit number? • What are the values of each digit in that number? • How did you know how to make the smallest 6-digit number? • What are the values of each digit in that number? **Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).** • Why does it matter which order the digits are in when determining the value of the multi-digit whole number? **Mathematical explanations can be given using words, objects, pictures, numbers, or equations.** • What advice would you give to a student who is struggling to read multi-digit whole numbers?

Name _____

Task 3: Tall Towers



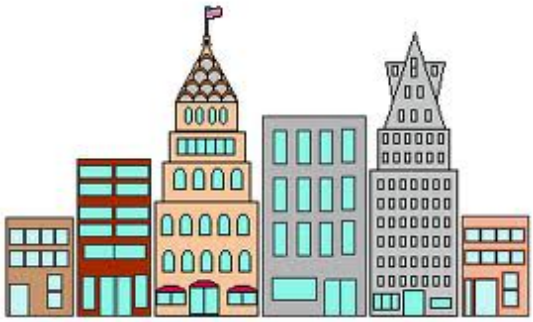
The United States of America has many tall buildings. The Key Tower in Cleveland is 947 feet tall. The Willis Tower in Chicago is 1,450 feet tall.

a) Which building is the tallest? How do you know?

b) How many times larger is the digit 4 in the height of the Willis Tower than the digit 4 in the height of the Key Tower? Can you demonstrate your reasoning?

Task 3: Tall Towers **4th Grade**

The United States of America has many tall buildings.
The Key Tower in Cleveland is 947 feet tall. The Willis Tower in Chicago is 1,450 feet tall.



a) Which building is the tallest? How do you know?

b) How many times larger is the digit 4 in the height of the Willis Tower than the digit 4 in the height of the Key Tower? Can you demonstrate your reasoning?

Teacher Notes:

If this task is too difficult for some students, consider using smaller numbers.

Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*. **4.NBT.A.2** Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

Explore Phase

Possible Solution Paths

a) The Willis Tower in Chicago is the tallest. Students should show some reasoning involving place value to justify their answer. This might include a place value chart or base ten blocks.

Represented with a place value chart:

	Thousands	Hundreds	Tens	Ones
Willis Tower	1	4	5	0
Key Tower		9	4	7

↑

Both tower heights should be written in the place

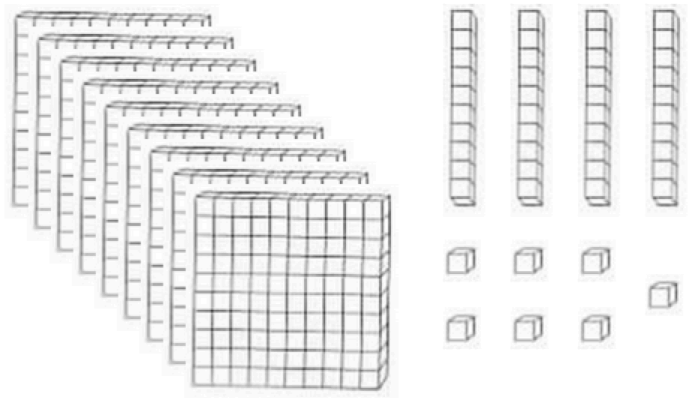
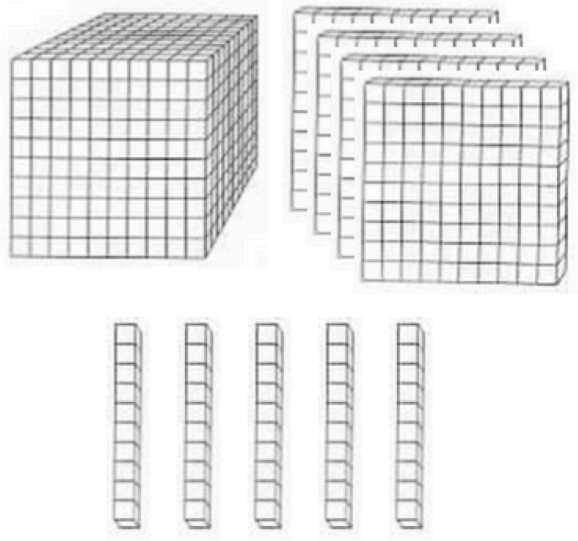
Assessing and Advancing Questions

Assessing Questions:

- How do you know that the Willis Tower is taller than the Key Tower?
- Why did you choose to use a place value chart?
- Why did you choose to use base ten blocks?
- Would your answer change if both numbers started with the same digit? Why or why not?
- Would your answer change if the Key Tower did have a 1 in the thousands place? Why or why not?

Advancing Questions:

- Can you read the numbers aloud?
- Can you represent the heights with base ten blocks?

value chart so that corresponding place value locations are lined up vertically. Beginning with the largest place value location, Willis Tower has a 1 in the thousands place, while Key Tower does not have a digit in the thousands place. Represented with base ten blocks: Key Tower = 947  Willis Tower = 1,450  Beginning with the largest block, the thousands, students can visually see that Willis Tower has 1 thousands block, while Key Tower does not have any thousands blocks.	• Could writing the numbers in expanded form help in comparing them? Why or why not?
b) Students should explain that the digit 4 in the height of thse Willis Tower is 10 times larger than the digit 4 in the height of the Key Tower. Students should recognize that a digit in one place represents ten times what it represents in the place to its right. The 4 in the Willis Tower is in the hundreds place. By moving one place value location	**Assessing Questions:** • How did you find your answer? • Why did you choose to use a place value chart? • Why did you choose to use base ten blocks? • What are the values of each type of base ten block that you used? • How does moving one place to the left change

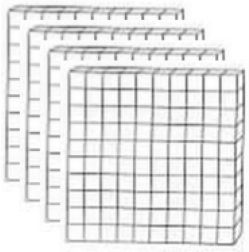
to the right, the 4 in the Key Tower is in the tens place.

Represented with a place value chart:

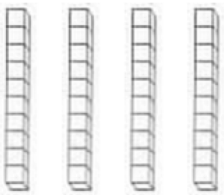
	Thousands	Hundreds	Tens	Ones
Willis Tower	1	4	5	0
Key Tower		9	4	7

➔

Represented with base ten blocks:
The 4 in the Willis Tower has a value of 400.



The 4 in the Key Tower has a value of 40.



Students can visually see the higher value of the 4 in the Willis Tower and that each base ten flat is worth ten times the value of each base ten rod.

the value of the same digit in a multi-digit number?

- How does moving one place to the right change the value of the same digit in a multi-digit number?

Advancing Questions:

- Can you read the numbers aloud?
- Which place value is the 4 in each value?
- Can you represent what each '4' represents with base ten blocks?
- Could writing the numbers in expanded form help in comparing them? Why or why not?

Possible Student Misconceptions	**Assessing and Advancing Questions**
Students may think the first digit of a multi-digit number indicates the *greatness* of its value. For example, with the numbers 947 and 1,450 students may focus on the first digit instead of the number as a whole.	• Can you use a place value chart to vertically line up the numbers being compared? • Can you build the numbers being compared using base ten blocks?
Students may have difficulty understanding a digit in one place represents ten times what it represents in the place to its right.	• Can you use a model to build 20? • Can you use a model to build 200? • Can you relate these models to the place value chart?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• Can you read each number aloud? • How does the name of the number give us clues to the value of the number?

	• What is the value of the 9 in 947? the 4? the 7? • What is the value of the 1 in 1450? the 4? the 5? the 0? • Can you use each digit's value to compare the numbers?
If students finish early….	• How does moving two places to the left change the value of the same digit in a multi-digit number? • How does moving two places to the right change the value of the same digit in a multi-digit number? • Trump International Hotel and Tower in Chicago is 1,389 ft. tall, while Aon Centre in Chicago is 1,136 ft. tall. How many times larger is the 3 in the Trump Tower than the 3 in Aon Centre? • Can you challenge a partner with a similar problem about tall buildings in Tennessee?

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- What effect does the location of a digit have on the value of the digit?
- Which number is larger: 380 or 38? How do you know? Why?
- What conclusions can you make about the places within our base ten number system?

Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).

- What can you conclude about the value of a digit in the ones place compared to the value of the same digit in the tens place?
- What can you conclude about the value of a digit in the tens place compared to the value of the same digit in the hundreds place?
- What can you conclude about the value of a digit in the hundreds place compared to the value of the same digit in the thousands place?
- How does moving one place to the left change the value of the same digit in a multi-digit number?
- How does moving one place to the right change the value of the same digit in a multi-digit number?
- How does this relate to division?

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- How did you choose to represent your reasoning in this task?

Name _____

Task 4: Mighty Mountains

The table below lists the heights and locations of the second and third tallest mountains in the world.

Mountain	Location	Height
Aconcagua	South America	22,837 ft.
Mount McKinley	North America	20,320 ft.

a) Which mountain is taller? Explain your reasoning.

b) Use symbols to compare the heights of the mountains.

c) Describe and compare the value of the digit 3 in each mountain height.

d) Write the heights in expanded form. How does this help you to compare them?

Task 4: Mighty Mountains **4th Grade**

The table below lists the heights and locations of the second and third tallest mountains in the world.

Mountain	Location	Height
Aconcagua	South America	22,837 ft.
Mount McKinley	North America	20,320 ft.

a) Which mountain is taller? Explain your reasoning.
b) Use symbols to compare the heights of the mountains.
c) Describe and compare the value of the digit 3 in each mountain height.
d) Write the heights in expanded form. How does this help you to compare them?

Teacher Notes:

If this task is too difficult for some students, consider using smaller numbers.

Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*. **4.NBT.A.2** Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- The value of the digits can be added together to find the value of the number.

Explore Phase

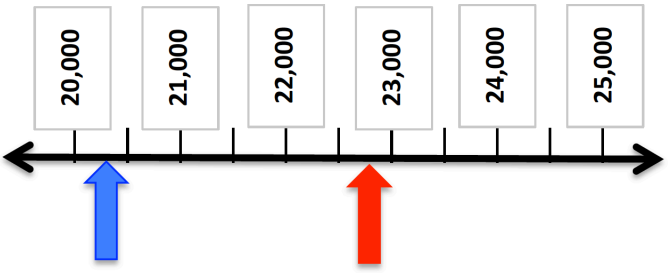
Possible Solution Paths	Assessing and Advancing Questions
a) Beginning with the largest place value location, ten thousands, both mountains have a 2 in this location. Moving to the next larger place value location, thousands, Aconcagua has the larger of the digits, 2. This indicates that Aconcagua is taller than Mount McKinley.	**Assessing Questions:** • How do you know that Aconcagua is taller? • Which place value did you use to make your decision? • Why did you choose to use a place value chart? • Why did you choose to use a number line? • If the thousands place for Mount McKinley had a 2, would that change your answer? Why or why not? **Advancing Questions:** • Can you read the numbers aloud? • Can you place both numbers on a number line?

Represented with a place value chart:

	Ten Thousands	Thousands	Hundreds	Tens	Ones
Aconcagua	2	2	8	3	7
Mount McKinley	2	0	3	2	0

Both mountain heights should be written in the place value chart so that corresponding place value locations are lined up vertically.

Represented on a number line:



The blue arrow points to the approximate location of 20,320 to represent the height of Mount McKinley. The red arrow points to the approximate location of 22,837 to represent the height of Aconcagua. Numbers located to the right on a numberline are larger than numbers to the left demonstrating that Aconcagua is taller than Mount McKinley.

- Can you place both numbers in a place value chart?
- What is the largest place value for both numbers? Which place is the largest place value that contains different digits?

b) After completing part a), students should be aware than Aconcagua is taller than Mount McKinley. Using their heights for the numbers, either inequality below is an acceptable answer.

20,320 < 22,837
or
22,837 > 20,320

Assessing Questions:
- How did you decide which symbol to use?
- How did you decide which number to write first and last?
- Could you write this another way?

Advancing Questions:
- Which symbols could you use to compare numbers?
- Could you use an equal sign in this comparison? Why or why not?
- Which number is the largest?

c) The 3 in Aconcagua's height of 22,837 is in the tens place, so it represents 30. The 3 in Mount McKinley's height of 20,320 is in the hundreds

Assessing Questions:
- How do you know the value of the digit 3 in each mountain height?

place, so it represents 300. The digit 3 has a larger value in Mount McKinley's height than Aconcagua's height, since 300 > 30 or 30 < 300.	• Which 3 digit has a greater value in the mountain heights? • Which 3 digit has a lesser value in the mountain heights? • Can you explain how the same digit can have different values? **Advancing Questions:** • In what place value is the 3 in each mountain's height? • Is there a symbol that you could use in this comparison? • Could you use an equal sign in this comparison? Why or why not?
d) 22,837 = (2 x 10,000) + (2 x 1,000) + (8 x 100) + (3 x 10) + 7 20,320 = (2 x 10,000) + (0 x 1,000) + (3 x 100) + (2 x 10) + 0 Writing multi-digit numbers in expanded form shows the face value of a digit multiplied by its place value or power of ten. Expanded form helps to compare multi-digit whole numbers by showing the value of each digit for easy comparison.	**Assessing Questions:** • How did you select the factor to multiply by each digit in the standard form number? • Can you explain how the standard form relates to the expanded form? • Why are plus signs needed when writing numbers in expanded form? • Suppose both numbers had another zero at the end. How would this change the expanded form? **Advancing Questions:** • Can you read the numbers aloud? • What is the value of the 2 in 22, 837? The 2nd 2? The 8? The 3? The 7?
Possible Student Misconceptions	**Assessing and Advancing Questions**
In the number 20,320, students may not realize the zeros are place holders.	• What does the first 0 from the right represent in 20,320? • What does the last 0 from the right represent in 20,320? • Does it change the value of 20,320 if either or both 0s are removed?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• Can you read each number to me? • Can you place these numbers on a number line? • Can you place these numbers in a place value chart? • What symbols are used to compare two numbers? • Can you write the expanded form for 476?
If students finish early….	• Mount Everest is the Earth's highest mountain, with a peak at 29,029 ft. Can you use symbols to compare its height to the height of Aconcagua? • Can you write Mount Everest's height in expanded form?

Discuss/Analyze
Whole Group Questions
Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning. **For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.** • Why did you choose to use a place value chart? • Why did you choose to use a number line? • How can place value understanding help us with comparing, ordering, and rounding? **Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).** • How do you know the value of the digit 3 in each mountain height? • Which 3 digit has a greater value in the mountain heights? • Which 3 digit has a lesser value in the mountain heights? **Mathematical explanations can be given using words, objects, pictures, numbers, or equations.** • How can numbers be expressed, ordered, and compared? • What symbols can I use to compare numbers? **The value of the digits can be added together to find the value of the number.** • What is the expanded form of 22,837? • Can you explain how the standard form relates to the expanded form? • Why are plus signs needed when writing numbers in expanded form?

Name _____

Task 5: Park Patrons

The United States of America has many national parks that draw thousands of visitors each year. The table below shows the number of visitors for three national parks in 2011.

Wind Cave	538,394 visitors
Mammoth Cave	483,319 visitors
Canyonlands	473,773 visitors

a) Gianna said, "When I round all these numbers, I get the same number." Zachary said, "I disagree. I get all different numbers." Can they both be correct? Explain your reasoning.

b) Round each number to the hundred thousands place. Explain your reasoning.

Task 5: Park Patrons **4th Grade**

The United States of America has many national parks that draw thousands of visitors each year. The table below shows the number of visitors for three national parks in 2011.

Wind Cave	538,394 visitors
Mammoth Cave	483,319 visitors
Canyonlands	473,773 visitors

a) Gianna said, "When I round all these numbers, I get the same number." Zachary said, "I get all different numbers." Can they both be correct? Explain your reasoning.

b) Round each number to the hundred thousands place. Explain your reasoning.

Teacher Notes:

If this task is too difficult for some students, consider using smaller numbers.
Teachers can use the language "close to" and "closest to" as they interact with students to help them understand rounding as a useful and natural activity. Emphasize that only the digit to the right of the place being rounded to is used to make the decision whether to round up or to round down. Some discussion of how to treat the rounding process when the digit to the right is a 5 will be necessary.

Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **4.NBT.A.3** Use place value understanding to round multi-digit whole numbers to any place.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

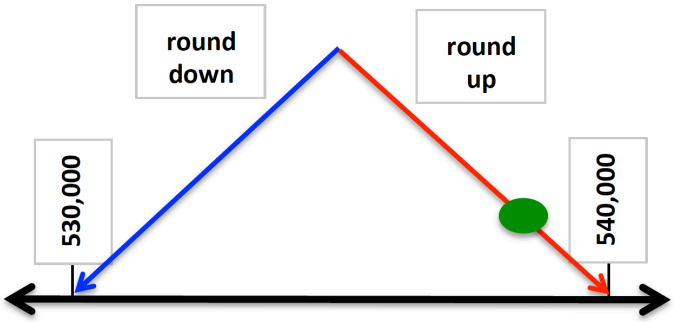
- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

Explore Phase

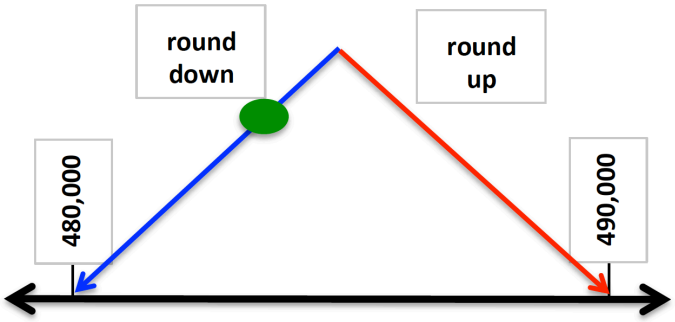
Possible Solution Paths	Assessing and Advancing Questions
a) Gianna is correct that all of these numbers round to 500,000 when they are rounded to the highest place value. Zachary is correct that all of these numbers round to different numbers when they are rounded to places other than the highest place value.	**Assessing Questions:** • How do you know that Gianna is correct in saying that all these numbers round to the same number? • How do you know that Zachary is correct in saying that all these numbers round to different

Gianna's reasoning is demonstrated in the explanation for part a). Answers may vary for Zachary, but the same reasoning can be used to explain Zachary's answer. For example, he could round to ten thousands by changing the values on the number line to 530,000 and 540,000 for Wind Cave; 480,000 and 490,000 for Mammoth Cave; and 470,000 and 480,000 for Canyonlands

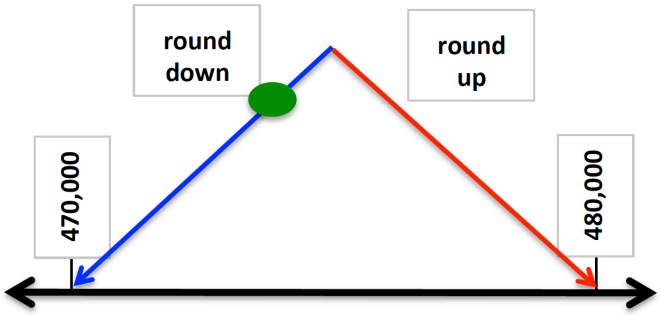
Wind Cave rounds to 540,000



Mammoth Cave rounds to 480,000



Canyonlands rounds to 470,000



numbers?

- How is it possible that both Gianna and Zachary are correct when their answers are different?

Advancing Questions:

- Can you think of 2 different 3-digit numbers that would round to the same number when rounded to the hundreds place and the tens place?
- Can you think of 2 different 4-digit numbers that would round to the same number when rounded to the thousands place, the hundreds place, and the tens place?

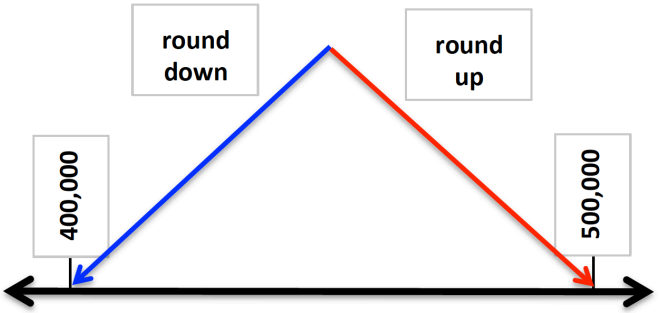
b) Students should round each number to 500,000, as shown in the table below.

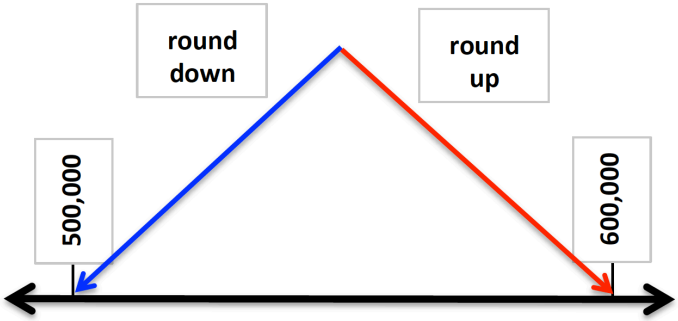
Wind Cave	538,394 visitors	500,000
Mammoth Cave	483,319 visitors	500,000
Canyonlands	473,773 visitors	500,000

Assessing Questions:

- How did you decide that 538,394 rounded to 500,000?
- How did you decide that 483,319 rounded to 500,000?
- How did you decide that 473,773 rounded to 500,000?

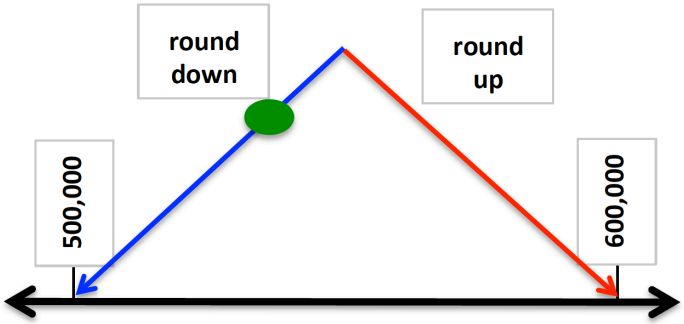
To help students understand rounding, they can think about zooming out on a number line between 400,000 and 500,000 for Mammoth Cave and Canyonlands or between 500,000 and 600,000 for Wind Cave.





This visual helps to explain why the traditional procedure works. If the value to the right of the place being considered is less than 5, the number is rounded down. If the value to the right of the place being considered is greater than or equal to 5, the number is rounded up.

Wind Cave

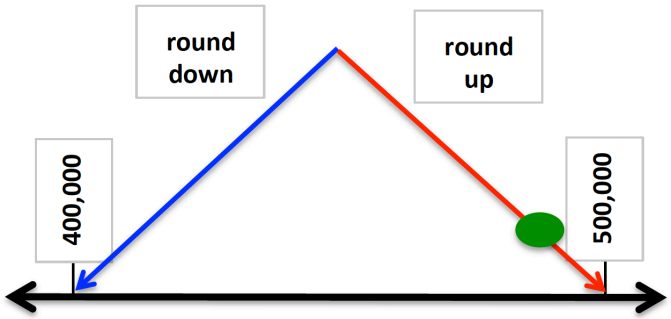


- What is the highest number possible that would round to 500,000, when rounding to the highest place value?
- What is the smallest number possible that would round to 500,000, when rounding to the highest place value?

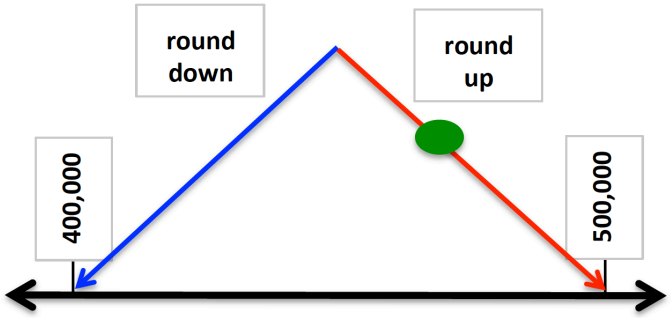
Advancing Questions:

- How would you round 16 to the nearest tens place? 14? 15?
- How do you know to round up or down? What words can you use to express the idea behind "rounding"? *(Close to)*
- Which digit should I look at to round 538,394 to the nearest hundred thousand? 483,319? 473,773?

Mammoth Cave



Canyonlands



Possible Student Misconceptions	**Assessing and Advancing Questions**
Students misapply the rule for "rounding down" and actually lower the value of the digit in the designated place. Example: When asked to round to the nearest ten thousand, students round the number 762,398 to 750,000 or 752,398.	• In the following number, what are the possible values when rounding to the thousands place: 86,214? • How do you know? • Can you explain on a number line?
Students misapply the rule for "rounding up" and change the digit in the designated place while leaving digits in smaller places as they are. Example: Students round 127,884 to 128,884 (nearest thousand).	• In the following number, what are the possible values when rounding to the thousands place: 31,927? • How do you know? • Can you explain on a number line?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• Is 2 closer to 0 or to 10? How do you know? • Is 6 closer to 0 or to 10? How do you know? • Does 5 round to 0 or to 10? How do you know? • Can you read this number orally: 394? • When asked to round 394 to the largest place value, which digit is being rounded? What are the options for that digit? Which place value location helps you decide how to round? • Is there a tool that might help you to solve this problem?
If students finish early….	• Can you round all these numbers to the tens place?

	• Can you round all these numbers to the hundreds place? • Can you round all these numbers to the thousands place? • Can you find another national park that has an annual number of visitors that would round to 500,000?

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- How can place value understanding help us with comparing, ordering, and rounding?

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- How did you choose to show your reasoning about rounding? Explain.

Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

- How do you know that Gianna is correct in saying that all these numbers round to the same number?
- How do you know that Zachary is correct in saying that all these numbers round to different numbers?
- What is the highest number possible that would round to 500,000, when rounding to the highest place value?
- What is the smallest number possible that would round to 500,000, when rounding to the highest place value?
- What do we get when we round 25 to the nearest ten? Why? Is 25 closer to 30 or 20? *(Neither. It's right in the middle.)* Why do you think it rounds to 30? *(It's a mathematical convention.) These questions can stimulate a discussion of where some of our rules come from.*

Name _____

Task 6: Big Bell

When rounded to the nearest thousand, the Liberty Bell's weight is 2,000 pounds.

a) What is the least amount that the Liberty Bell could weigh? Explain your reasoning.

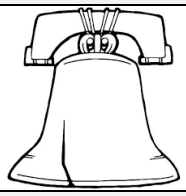
b) What is the greatest amount that the Liberty Bell could weigh? Explain your reasoning.

Task 6: Big Bell	**4th Grade**

When rounded to the nearest thousand, the Liberty Bell's weight is 2,000 pounds.

a) What is the least amount that the Liberty Bell could weigh? Explain your reasoning.

b) What is the greatest amount that the Liberty Bell could weigh? Explain your reasoning.



Teacher Notes:

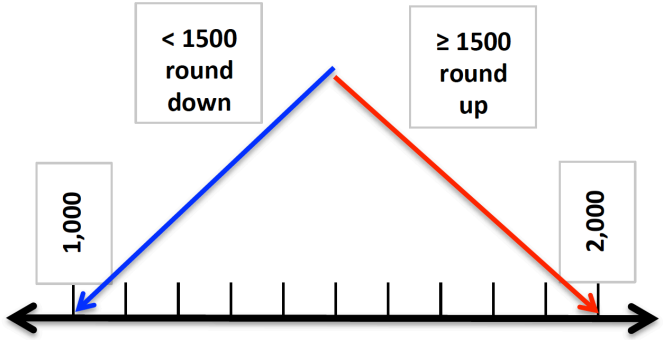
If this task is too difficult for some students, consider using smaller numbers.

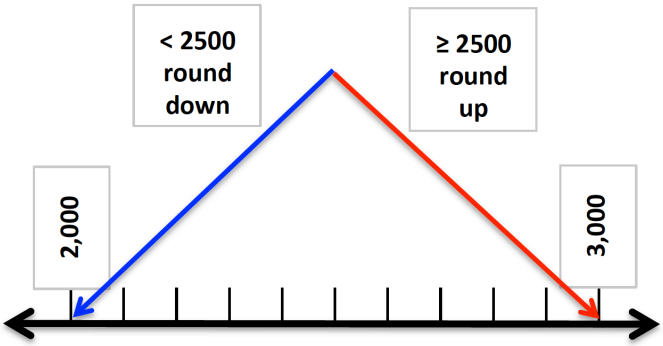
Tennessee State Standards for Mathematical Content	**Tennessee State Standards for Mathematical Practice**
4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **4.NBT.A.3** Use place value understanding to round multi-digit whole numbers to any place.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

Explore Phase

Possible Solution Paths	**Assessing and Advancing Questions**
a) Students should say that when rounded to the nearest thousand, the least amount the Liberty Bell could weigh is 1,500 lbs. Since the least value the weight could be would round UP to 2000, the thousands digit of the number must be 1. The smallest number that could be in the hundreds place would be 5. The tens and ones places must be 0. 	**Assessing Questions:** • How do you know that the least amount the Liberty Bell could weigh is 1,500 lbs. when rounded to the nearest thousand? **Advancing Questions:** • What is the smallest number that would round to 20? • Can you give me an example of a number that would round up to 2000? • Which digit would you use to determine how to round to the thousands place?

b) Students should say that when rounded to the nearest thousand, the greatest amount the Liberty Bell could weigh is 2,499 lbs. Since the greatest value the weight could be would round DOWN to 2000, the thousands digit of the number must be 2. The largest number that could be in the hundreds place is 4. The tens and ones places must be 9 to make the largest number.  	**Assessing Questions:** • How do you know that the greatest amount the Liberty Bell could weigh is 2,499 lbs. when rounded to the nearest thousand? **Advancing Questions:** • What is the largest number that would round to 20? • Can you give me an example of a number that would round down to 2000? • Which digit would you use to determine how to round to the thousands place?
Possible Student Misconceptions	**Assessing and Advancing Questions**
Students misapply the rule for "rounding down" and actually lower the value of the digit in the designated place. Example: When asked to round to the nearest ten thousand, students round the number 762,398 to 750,000.	• Is 86,214 closer to 85,000, 86,000 or 87,000? • Can you place these numbers on a number line? • Can you round 86,214 to the nearest thousands place? • How do you know?
Students misapply the rule for rounding and change the digit in the designated place while leaving digits in smaller places as they are. Example: Students round up 127,884 to 128,884 (nearest thousand).	• When you round 31,927 to the nearest thousands place what are the two possible answers? • How do you know? • Can you explain on a number line?
Students may start at the rightmost place in a decimal number and keep rounding to the value of the next place to the left until reaching the place of the number to be rounded. For example, if a student with this thinking was asked to round 1445 to the nearest thousand: 1445 ➔ 1450 ➔1500 ➔ 2000. This may work for some numbers but not for all such as in the example cited. 1445 is actually closer to 1000 than to 2000 because it is less than 1500.	• Can you round 1445 to the nearest hundred? Thousand? • What do you notice about that relationship? • Can you explain on a number line?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• Is 2 closer to 0 or to 10? How do you know? • Is 6 closer to 0 or to 10? How do you know? • Does 5 round to 0 or to 10? How do you know? • Is there a tool that might help you to solve this problem?

If students finish early….	• The statue of Liberty's weight is 500,000 pounds when rounded to the highest place value. What amounts are possible when considering its actual weight? • When is rounding useful in real life? • Can you research the weight of another historical item? Create a challenge similar to this one for a partner.

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- What is the value of the 7 in the number 762,398? The 6? The 2? Etc?
- How is this knowledge useful in rounding?

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- How is a number line useful when rounding?
- Are there any other representations that can be helpful when rounding?

Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

- When rounding to the thousands place, which digit determines the value in the thousands place? (i.e. which digit is used to make the decision?) For example, when rounding 13,671 to thousands which digit determines if the answer is 13,000 or 14,000?
- If the Liberty Bell weight was rounded up to 2000 lbs, what possible values could have been in the hundreds place of the actual weight?
- If the Liberty Bell weight was rounded down to 2000 lbs, what possible values could have been in the hundreds place of the actual weight?
- When is rounding useful in real life?

Name _____

Task 7: Marble Mayhem

The Standing Stone Park in Livingston, TN hosts an annual marble festival. At last year's festival, there was a contest to estimate the number of marbles in a large glass container. The actual number of marbles was announced at the end of the festival.

Lee said, "That number rounds to 10,000 marbles."

Tessa said, "That number rounds to 10,400 marbles."

Rufaro said, "That number rounds to 10,430 marbles."

a) Can all three people be correct? Explain your reasoning.

b) What are the possible values for the actual number of marbles? How do you know?

Task 7: Marble Mayhem **4th Grade**

The Standing Stone Park in Livingston, TN hosts an annual marble festival. At last year's festival, there was a contest to estimate the number of marbles in a large glass container. The actual number of marbles was announced at the end of the festival.

Lee said, "That number rounds to 10,000 marbles."

Tessa said, "That number rounds to 10,400 marbles."

Rufaro said, "That number rounds to 10,430 marbles."

a) Can all three people be correct? Explain your reasoning.
b) What are the possible values for the actual number of marbles? How do you know?

Teacher Notes:

Notice in part b) that the correct answer is based on Rufaro's rounded number of marbles since it is the most restrictive. This may challenge some students initially. If students are struggling to find this answer consider telling them to work based solely on Rufaro's rounded number.

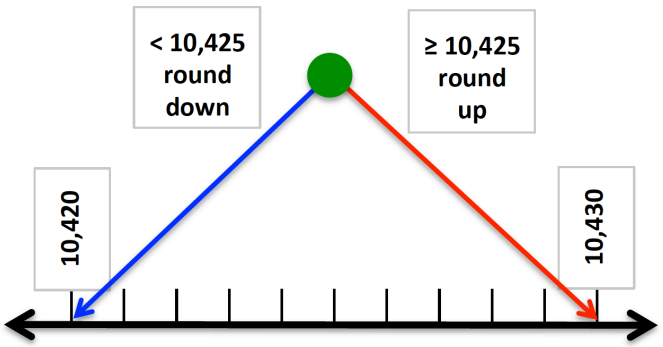
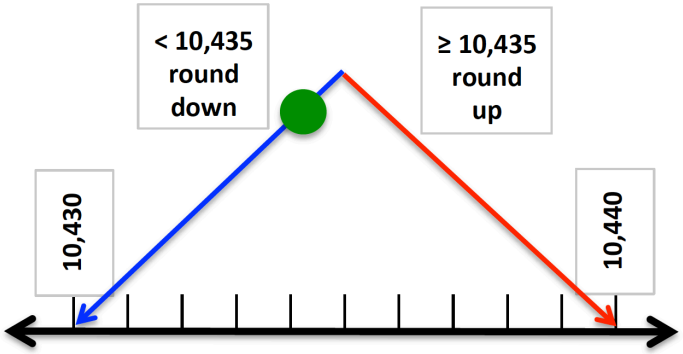
Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.2 Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **4.NBT.A.3** Use place value understanding to round multi-digit whole numbers to any place.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

Essential Understandings:

- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

Explore Phase

Possible Solution Paths	Assessing and Advancing Questions
a) Students should explain that all 3 people can be correct if they are all rounding to a different place value. Suppose that the number of marbles is 10,434. • Rounded to the nearest ten thousand: 10,000 • Rounded to the nearest thousand: 10,000	**Assessing Questions:** • How do you know that all 3 people can be correct? • If everyone was asked to round to the highest place value, could they have different correct answers? Why or why not? • What do the zeros in each person's rounded

• Rounded to the nearest hundred: 10,400 • Rounded to the nearest ten: 10,430	number tell you about how they rounded? • Do all of the zeros have same meaning in the rounded numbers? **Advancing Questions:** • Which place value location do you think each person was rounding to? Explain. • Can you tell me what each digit stands for in 10,430? • Can you give me an example of a number that would be rounded to 10,000? Could you round that number to a different number?
b) Students should say that possible values for the actual number of marbles are 10,425 to 10,434. Anything less than 10,425 rounded to the nearest ten is 10,420 or less.  Anything more than 10,434 rounded to the nearest ten is 10,440 or more.  	**Assessing Questions:** • How do you know the possible values for the actual number of marbles are 10,425 to 10,434? • Why couldn't a number less than 10,425 be possible? • Why couldn't a number more than 10,434 be possible? • How could you use this representation to explain your answer? **Advancing Questions:** • Which person's rounded number would be the most helpful in determining the possible values of the actual number? • Could you use a number line to explain rounding numbers? • Can you give me an example of a number that would be rounded to 10,000? Could you round that number to a different number?
Possible Student Misconceptions	**Assessing and Advancing Questions**
Students may overgeneralize that when rounding numbers, numbers must always be rounded to the highest place value.	• Can you round 7,368 to the nearest thousand? Hundred? Ten?
Students may assume that all math problems have only one correct answer.	• What is a math problem that is equal to 4? (Accept and list all reasonable answers.) • How is it possible that the previous question can have so many different answers?

Entry/Extensions	Assessing and Advancing Questions
If students can't get started….	• What do the zeros in each person's rounded number tell you about how they rounded? • Do all of the zeros have the same meaning in the rounded numbers? • Which place value location do you think each person was rounding to? Explain. • Can you tell me what each digit stands for in 10,430?
If students finish early….	• Can you describe a real world scenario in which rounding is necessary? • Based on Tessa's rounding only, what are the possible values for the actual number of marbles? • Based on Lee's rounding only, what are the possible values for the actual number of marbles?

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- Can you tell me what each digit stands for in 10,430?

Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).

- What do the zeros in each person's rounded number tell you about how they rounded?
- Do all of the zeros have same meaning in the rounded numbers?

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- How could a number line be used to help explain rounding numbers?
- Are there any other representations that might be helpful when rounding?

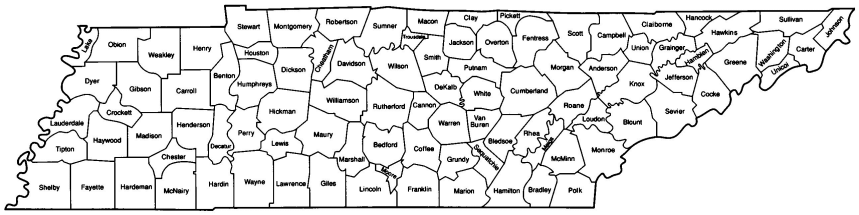
Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

- How do you know that all 3 people can be correct?
- If everyone was asked to round to the highest place value, could they have different correct answers? Why or why not?
- Can you round 85,273 to each place value?
- Do you get different answers for each place value? Why or why not?

Name _____

Task 8: County Populations

Tennessee is made up of 95 counties with a wide range of populations. Three counties with similar populations are Cheatham, Dyer, and Warren.



Cheatham County	Dyer County	Warren County
39,705 people	38,335 people	39,839 people

a) Which county has the greatest population? Smallest population? How do you know?

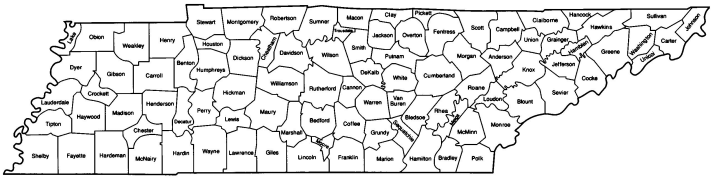
b) Compare the three populations of these counties using symbols.

c) Paula said, "I get the same number when I round all three populations."
Steve said, "When I round them, I get the same number for two of the populations but a different number for the other population." Compare Paula and Steve's statements. Can both be correct? Explain how you know.

d) When rounded to the nearest hundred, the population of Pickett County is 5,100 people. What is the greatest possible number of people in Pickett County? Explain how you know.

Task 8: County Populations — 4th Grade

Tennessee is made up of 95 counties with a wide range of populations. Three counties with similar populations are Cheatham, Dyer, and Warren.



Cheatham County	Dyer County	Warren County
39,705 people	38,335 people	39,839 people

a) Which county has the greatest population? Smallest population? How do you know?

b) Compare the three populations of these counties using symbols.

c) Paula said, "I get the same number when I round all three populations."
Steve said, "When I round them, I get the same number for two of the populations but a different number for the other population." Compare Paula and Steve's statements. Can both be correct? Explain how you know.

d) When rounded to the nearest hundred, the population of Pickett County is 5,100 people. What is the greatest possible number of people in Pickett County? Explain how you know.

Teacher Notes:

Note that in part a) the intention is for students to write one inequality comparing all three population values.

Tennessee State Standards for Mathematical Content	Tennessee State Standards for Mathematical Practice
4.NBT.A.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. *For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division*. **4.NBT.A.2** Read and write multi-digit whole numbers using base-ten numerals, number names, and expanded form. Compare two multi-digit numbers based on meanings of the digits in each place, using >, =, and < symbols to record the results of comparisons. **4.NBT.A.3** Use place value understanding to round multi-digit whole numbers to any place.	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.

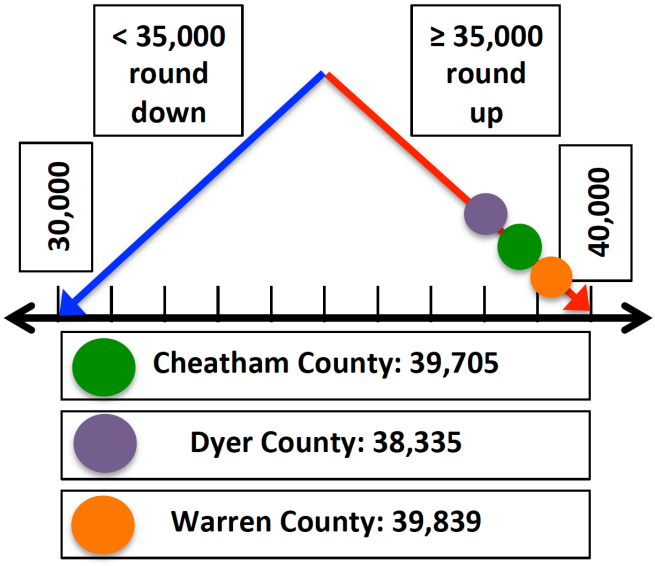
Essential Understandings:

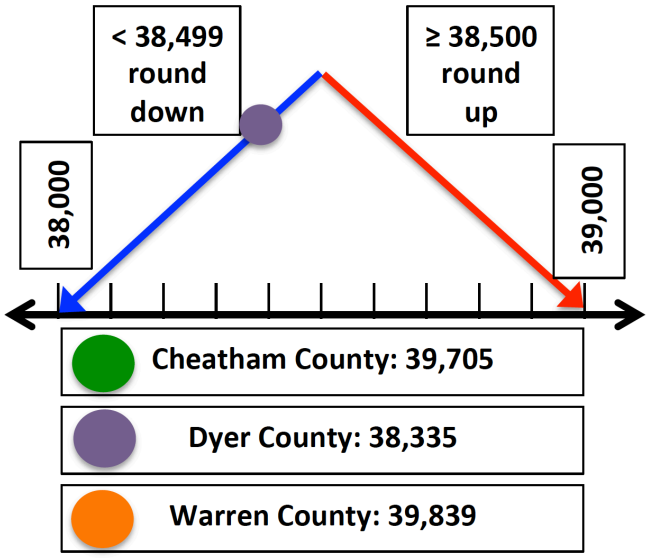
- For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.
- Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).
- Mathematical explanations can be given using words, objects, pictures, numbers, or equations.
- The value of the digits can be added together to find the value of the number.
- Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given. number.

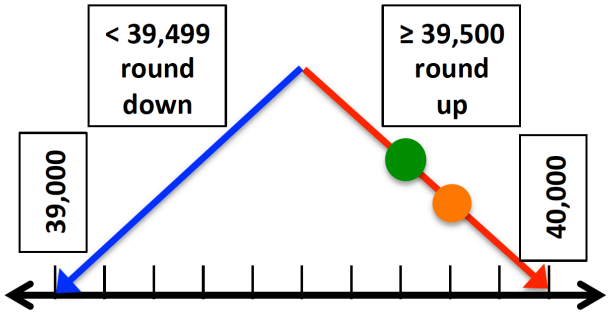
Explore Phase

Possible Solution Paths	Assessing and Advancing Questions
a) Students should say that Warren County has the highest population of 39,839. Dyer County has the smallest population of 38,335. Accept any reasonable explanation of student reasoning, including: Place value chart: All 3 county populations should be written in the place value chart so that corresponding place value locations are lined up vertically. Beginning with the largest place value location, all counties have equal value in the ten thousands place. At the next highest place value, thousands, Dyer County has an 8 whereas the other 2 counties have a 9. This indicates that Dyer county has the smallest population. In the next highest place value location, hundreds, Warren County has an 8 whereas Cheatham County has a 7. This indicates that Warren County has the highest population. Expanded form: 3(10,000) + 9(1,000) + 8(100) + 3(10) + 9 = 39,839 3(10,000) + 9(1,000) + 7(100) + 0(10) + 5 = 39,705 3(10,000) + 8(1,000) + 3(100) + 3(10) + 5 = 38,335 All 3 county populations should be written in expanded form so that corresponding place value locations are lined up vertically. This allows students to compare the values of each digit in each county population. Beginning with the largest place value location, all counties have equal value with 3(10,000) in the ten thousands place. At the next highest place value, thousands, Dyer County has 8(1,000) whereas the other 2 counties have 9(1,000). This indicates that Dyer county has the smallest population. In the next highest place value location, hundreds, Warren County has 8(100) whereas Cheatham County has 7(100). This indicates that Warren County has the highest population.	**Assessing Questions:** • How do you know that Warren County has the highest population? • How do you know that Dyer County has the lowest population? • Why did you use a place value chart to explain your thinking? • Why did you use expanded form to explain your thinking? • Why did you use a number line to explain your thinking? **Advancing Questions:** • Can you compare just 2 of the numbers? • What is the digit in the highest place value in each number? Does this number help to compare? • What is the digit in the next highest place value in each number? Does this number help to compare? • Can you place each number on a number line? • Can you write each number in expanded form? • Can you write each number in a place value chart?

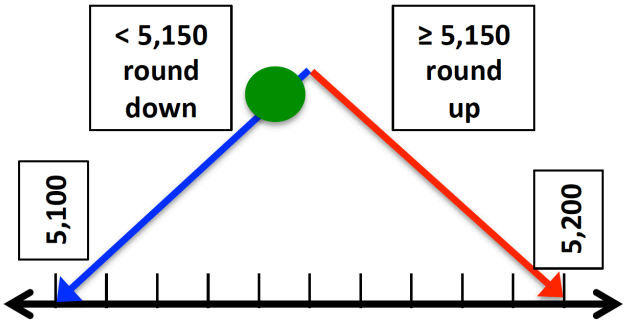
Ten thousands	Thousands	Hundreds	Tens	Ones
3	9	8	3	9
3	9	7	0	5
3	8	3	3	5

b) Students should write one of the following inequalities: 39,839 > 39,705 > 38,335 or 38,335 < 39,705 < 39,839	**Assessing Questions:** • How did you decide to which symbol to use? • How did you decide the order of the numbers? • Could you use 2 different symbols at the same time? • Is there another symbol that you could use**?** • Could you use an "=" sign to answer this problem? **Advancing Questions:** • Can you compare just 2 of the numbers? • What is the digit in the highest place value in each number? Does this number help to compare? • What is the digit in the next highest place value in each number? Does this number help to compare? • Can you place each number on a number line? • Can you write each number in expanded form? • Can you write each number in a place value chart?
c) Students should explain that Paula could get 40,000 for each population if she was rounding to the ten thousands place.  Steve could get 40,000 for Warren and Cheatham Counties and 38,000 for Dyer County if he rounded to the thousands place.	**Assessing Questions:** • How do you know that Paula rounded to the ten thousands place? • How do you know that each number rounds to 40,000 when rounding to the ten thousands place? • How do you know that Steve rounded each number to the thousands place? • How do you know that Steve got 40,000 for Warren County and Cheatham County when rounding to the thousands place? • How do you know that Steve got 38,000 for Dyer County when rounding to the thousands place? **Advancing Questions:** • When rounding a number to the ten thousands place, which digit determines whether the digit in the ten thousands place remains the same or increases to the next highest digit? • Can you round each number to the ten thousands place? • When rounding a number to the thousands place, which digit determines whether the digit in the thousands place remains the same or increases to the next highest digit? • Can you round each number to the thousands place?





d) Students should say that the greatest possible number of people in Pickett County is 5,149. The next whole number is 5,150 and would round up to 5,200.



Assessing Questions:

- How do you know that the greatest possible number of people in Pickett County is 5,149?
- Why could the population not be 5,150?

Advancing Questions:

- When rounding a number to the hundreds place, which digit determines whether the digit in the hundreds place remains the same or increases to the next highest digit?
- What is the highest that determining digit can be before you need to round up?

Possible Student Misconceptions	Assessing and Advancing Questions
Students misapply the rule for "rounding down" and actually lower the value of the digit in the designated place. Example: When asked to round to the nearest ten thousand, students round the number 762,398 to 750,000.	• Is 86,214 closer to 85,000, 86,000 or 87,000? • Can you place these numbers on a number line? • Can you round 86,214 to the nearest thousands place? • How do you know?
Students misapply the rule for rounding and change the digit in the designated place while leaving digits in smaller places as they are. Example: Students	• When you round 31,927 to the nearest thousands place what are the two possible answers?

round up 127,884 to 128,884 (nearest thousand).	• How do you know? • Can you explain on a number line? • When rounding to the nearest thousand, what digits should be in the hundreds, tens, and units places after rounding?
Students may start at the rightmost place in a decimal number and keep rounding to the value of the next place to the left until reaching the place of the number to be rounded. For example, if a student with this thinking was asked to round 1445 to the nearest thousand: 1445 ➔ 1450 ➔1500 ➔ 2000. This may work for some numbers but not for all such as in the example cited. 1445 is actually closer to 1000 than to 2000 because it is less than 1500.	• Can you round 1445 to the nearest hundred? Thousand? • What do you notice about that relationship? • Can you explain on a number line?
Students may overgeneralize that when rounding numbers, numbers must always be rounded to the highest place value.	• Can you round 7,368 to the nearest thousand? Hundred? Ten?
Students may assume that all math problems have only one correct answer.	• What is a math problem that is equal to 4? (Accept and list all reasonable answers.) • How is it possible that the previous question can have so many different answers?
Students may think that a compound inequality can have arrows pointing in different directions. They may write, for example, $38{,}335 < 39{,}839 > 39{,}705$	• How many inequalities are expressed in your statement? *(a total of three)* • Are all of them true? *(It's hard to tell. Is this statement saying that 38,335 is less than 39,705? Or is it saying 38,335 is greater than 39,705. Point out the ambiguity)* • Can you rearrange the numbers so that all of the inequality symbols point in the same direction?
Entry/Extensions	**Assessing and Advancing Questions**
If students can't get started….	• Is 2 closer to 0 or to 10? How do you know? • Is 6 closer to 0 or to 10? How do you know? • Does 5 round to 0 or to 10? How do you know? • Is there a tool that might help you to solve this problem? • Can you compare 2 of the numbers? • When rounding a number to the ten thousands place, which digit determines whether the digit in the ten thousands place remains the same or increases to the next highest digit? Thousands place? Hundreds place? Tens place?
If students finish early….	• Can you find the population of your county? • Can you write your county's population in expanded form? • How does it compare to the 3 counties listed here? • Can you find the population of the 3 TN counties

	with the highest populations? • Can you write those populations in expanded form? • Can you compare those counties using symbols? • Can you round them all to the ten thousands place?

Discuss/Analyze

Whole Group Questions

Since one of the essential understandings of this task (and arc) pertains to the variety and richness of possible mathematical explanations, the whole group discussion should highlight different strategies used to solve the problem and to explain reasoning.

For any number, the place of a digit tells how many ones, tens, hundreds, and so forth are represented by that digit.

- What does the 5 digit stand for in the population of Dyer County?
- What does the 3 digit stand for in the population of Cheatham County?
- What does the 8 digit stand for in the population of Warren County?

Each place value to the left of another is ten times greater than the one to the right (e.g., 100 = 10 x 10).

- What are the values of the 8s in Dyer and Warren counties populations?
- How can the same digit be worth different amounts?

Mathematical explanations can be given using words, objects, pictures, numbers, or equations.

- How is expanded form useful when comparing numbers?
- How is a number line useful when comparing numbers?
- How is a number line useful when rounding numbers?

The value of the digits can be added together to find the value of the number.

- How is expanded form useful when comparing numbers?

Rounding whole numbers is a process for finding the multiple of 10, 100, and so on closest to a given number.

- What words would you use to describe the activity of "rounding to the nearest ten thousand"? *(Emphasize the phrase "close to" or "closest to")*
- What words would you use to describe the activity of "rounding to the nearest ten"?
- How many digits must be zeros when rounding to the nearest ten thousand? Why?