Constructing Task: Relative Value of Places

Adapted from Relative Value of Places, nzmaths, Adding, Subtraction and Place Value

STANDARDS FOR MATHEMATICAL CONTENT

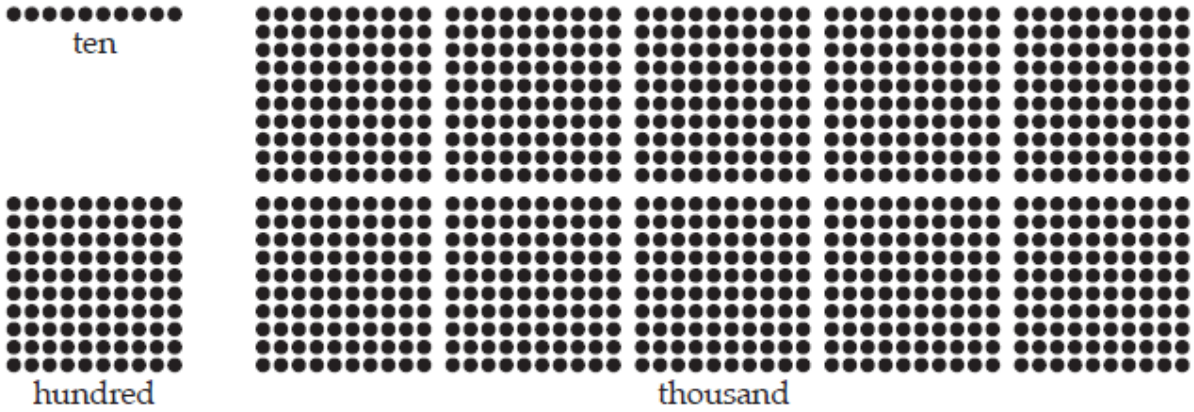
MCC4.NBT.1 Recognize that in a multi-digit whole number, a digit in one place represents ten times what it represents in the place to its right. For example, recognize that 700 ÷ 70 = 10 by applying concepts of place value and division.
MCC4.NBT.2 Read and write multi-digit whole numbers using base-ten 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.
MCC4.OA.1 Interpret a multiplication equation as a comparison, e.g., interpret 35 = 5 × 7 as a statement that 35 is 5 times as many as 7 and 7 times as many as 5. Represent verbal statements of multiplicative comparisons as multiplication equations.

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.

BACKGROUND KNOWLEDGE

Students unfamiliar with dotty arrays will need to become familiar with the representation of 1, 10, 100, 1 000, and so on as arrays of single dots. This will help them to recognize the relative value of the places.



ESSENTIAL QUESTIONS

- What conclusions can I make about the places within our base ten number system?
- What happens to a digit when multiplied and divided by 10?
- What effect does the location of a digit have on the value of the digit?

MATERIALS

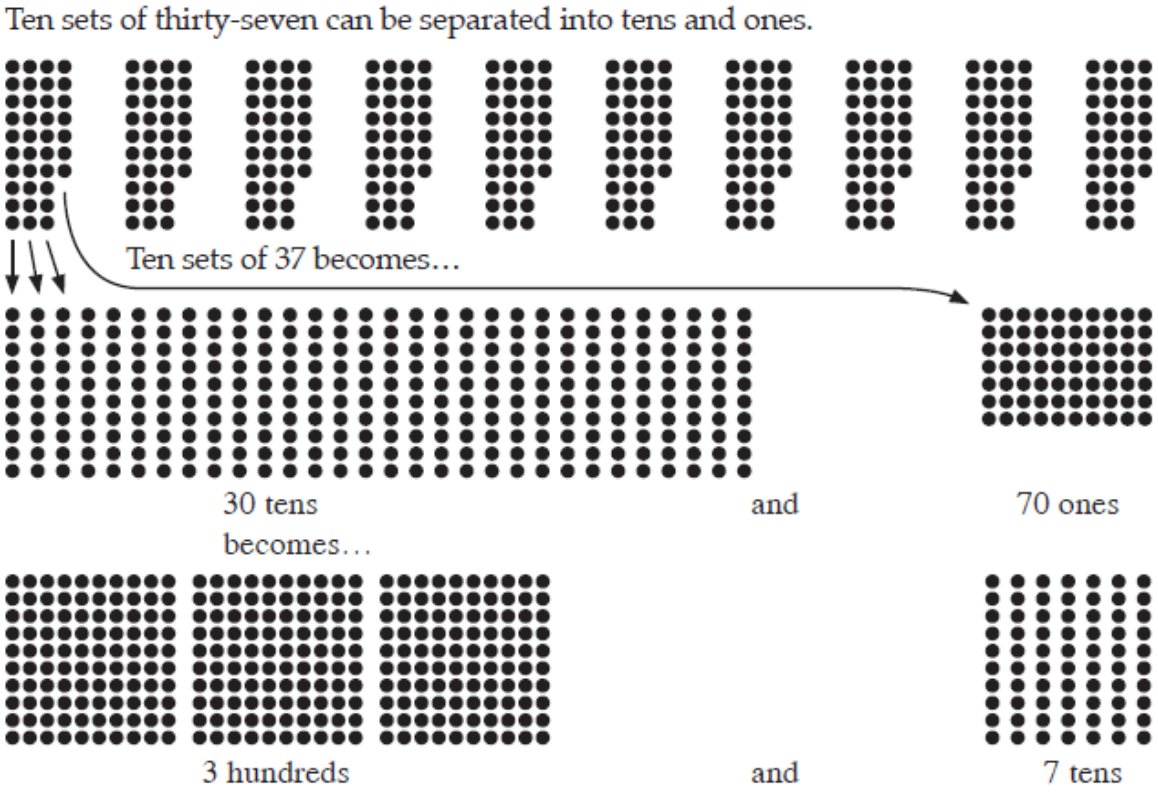
- Large dot arrays

GROUPING

Partner or small group

TASK DESCRIPTION, DEVELOPMENT AND DISCUSSION

Comments:
Ask ten students to make a two-digit number, e.g., 37, using the dotty array pieces.
Pose this problem: "Imagine there are ten students and they each have 37 marbles/apples/dollars."
Put the sets of 37 into a central space. "How many dots is that altogether?"
Some students are likely to have symbolic algorithms, such as "add a zero," that enable them to get an answer of 370. Examine the actions on materials that explain the use of zero as a place holder.
For example:



Using a place value chart, connect 37 with the result of 10 x 37:

Ten Thousands	Thousands	Hundreds	Tens	Ones
			3	7
		3	7	0

In this way, the students may notice that the digits have shifted one place to the left. Pose several other problems where ten students make numbers with dot array parts and look at the combined product. For each example, separate the place values to see what contribution they make to the whole product, and write the number and it's ten times equivalent on the place value chart.

Further challenge the students by making a two-digit number and posing problems such as, "Imagine that one hundred students had 42 marbles/apples/dollars each. How many would that be in total?" Ask the students how this might be modeled. In these cases, each of the ten students will need to create each number ten times. This is a useful generalization that shows that ten times ten times of any number is one hundred times that number.

Transfer the focus to dividing by ten and by one hundred. Begin with a four-digit number like 3,800 (zero in the tens and ones places). Make this number with dot array pieces. Pose this problem: "I have 3,800 marbles and I am going to share them equally among all ten of you. How many marbles will you get each?" Ask the students to predict the result of the sharing, and then confirm it by modeling with the materials.

The result of dividing 3,800 by ten can be shown on a place value chart as:

Ten Thousands	Thousands	Hundreds	Tens	Ones
	3	8	0	0
		3	8	0

The symbolic effect of dividing by ten is to shift the digits of the dividend (3,800) one place to the right. Ask the students to predict what the result would be if they shared 3,800 into one hundred equal sets. Expect them to realize that the shares would be one-tenth of 380, which is 38. This may need to be acted out by cutting the 3 hundreds in 30 tens and the 8 tens into 80 ones so the tenth shares can be established. Use the place chart to connect 3,800 and the result of 3,800 ÷ 100 = 38. In this case, the symbolic effect is a two-place shift to the right.

Pose problems like these below, expecting the students to reason the answers using place value understanding. The students must be able to justify their answers by explaining what occurs with the quantities involved.

1. 100 boxes of 376 coins (100 x 376 = 37,600)
2. 960 skittles shared among 10 people (960 ÷ 10 = 96)
3. 30 sets of 40 pencils (30 x 40 = 1 200)
4. 4,300 movie tickets shared among 100 people (4,300 ÷ 100 = 43)
5. 20 sets of 56 marbles (20 x 56 = 1,120)
6. $5,000,000 shared among 1,000 people (5,000,000 ÷ 1,000 = $5,000)

FORMATIVE ASSESSMENT QUESTIONS

- What happens to the value of the digit in the ones place when the number is multiplied by 10?
- What happens to the value of the digit in the tens place when the number is divided by 10?
- What can you concluded about the value of a digit in the ones place compared to the value of that same digit in the tens place? What about the tens place and hundreds place? What about the hundreds place and thousands place?
- Which number is larger 960 or 96? How do you know? Why?

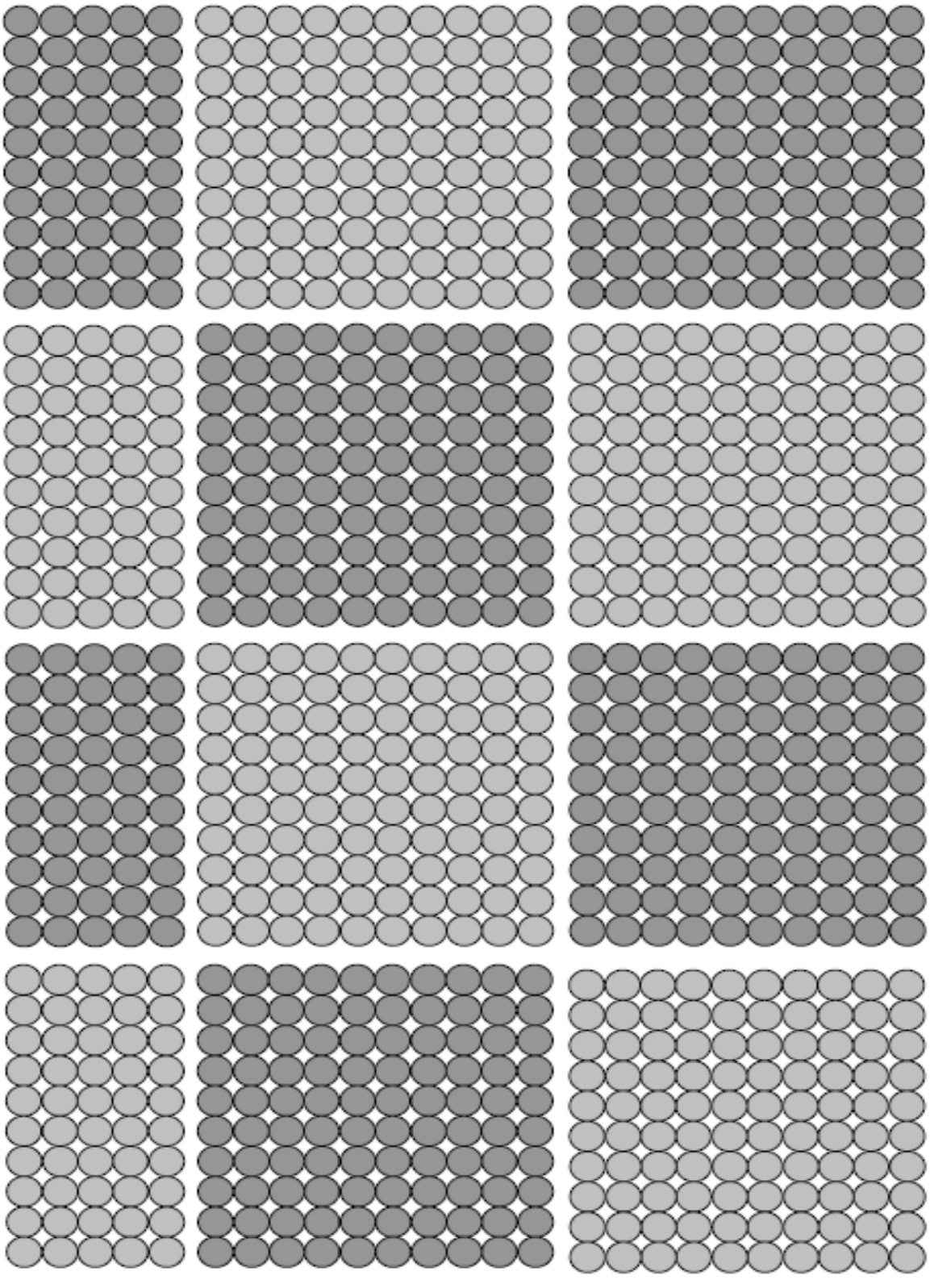
DIFFERENTIATION

Extension

- Have students explain what the value of a digit to the right of the ones place would be based on their conclusion about whole numbers.
- Have students record the number sentences associated with each problem.

Intervention

- Allow students to use base ten blocks to build numbers.



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