

Note: This document has been officially deprecated as of July 8, 2015. For the latest version, or to view other materials on computational thinking, visit: g.co/exploringCT.

Lesson Plan: Multiplying by Numbers Between Zero and One

Common Core Standard

- **Grade 7 - The Number System 7.NS:** Apply and extend previous understandings of multiplication and division of fractions to multiply and divide rational numbers.

The following examples are based on released question #7 from the [California High School Exit Exam](#).
One hundred is multiplied by a number between 0 and 1...

Decomposing the Question

Student Questions:

1. Given the question, decompose or break the problem down into as many pieces of information as you can.

A: One possible answer could be:

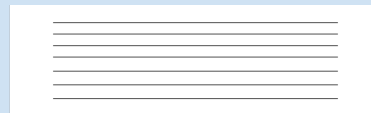
1. You are asked to multiply two numbers.
2. The first number is 100
3. The second number is greater than 0 but less than 1.

CT: *Decomposing a problem helps to clarify what information you are given.*

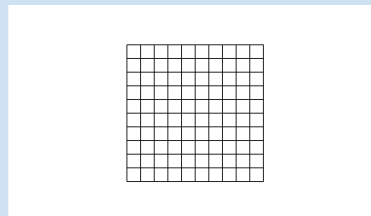
2. What are some ways to represent 100?

A: Some ideas the students create could be:

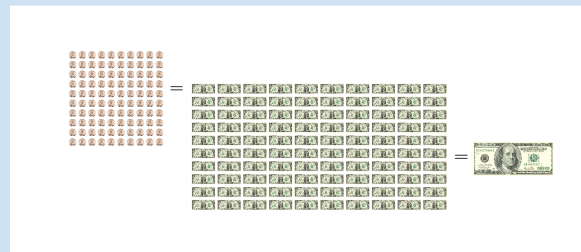
1. A stack of paper



2. A square divided into pieces



3. Coins or paper money that adds up to 100



CT: Representing the data in multiple ways may help in seeing patterns.

3. What are some ways to represent numbers greater than 0 but less than 1?

A: Some examples may include:

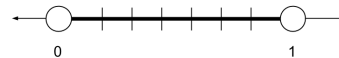
1. Decimal

$0.12, 0.333..., 0.5, 0.75$

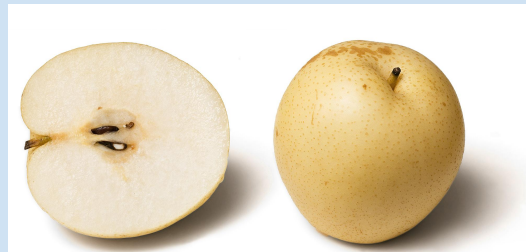
2. Fraction

$\frac{3}{10}, \frac{40}{100}, \frac{1}{2}$

3. Timeline



4. Part of a whole



CT: Representing the data in multiple ways may help in seeing patterns.

4. What do you think happens when you multiply two numbers together? Will the result always be greater than either of the two numbers, smaller, or will it depend on the numbers multiplied?
5. Now thinking specifically about this problem: What do you think will happen when you multiply 100 times by a number that is between 0 and 1? How would you design an experiment to test out your hypothesis to questions 4 and 5?

CT: It is helpful when decomposing a problem to determine what existing patterns and conceptions (or even misconceptions) you have about the information.

Example 1

- Type the following problems into the Python interpreter (or a calculator). Look for patterns in the product of two numbers when one of the numbers is between zero and one.

Exercise	Product	Greater than 100 or less than 100?
(a) $100 * 0.5$	50	less
(b) $100 * 0.2$	20	less
(c) $100 * 0.85$	_____	_____

(d) $100 * 0.13$	_____	_____
(e) $100*(5*10^{-1})$	_____	_____

Student Questions:

2. Complete the table above. When we multiply 100 by a number between zero and one, is the product greater than 100, less than 100, or does it depend on what number we multiply by?
A: From the answers above, it appears that the product of 100 and a number between zero and one is always less than 100.
CT: The *pattern* in the third column indicates that the product is always less than 100.

3. What is the greatest three digit number between zero and one? Multiply 100 by this number to see if the product exceeds 100. **A:** The greatest three digit number between zero and one is .999; $100 \times .999 = 99.9$. The product is still less than 100.
CT: Even though .999 is very close to one, when we multiply it by 100 we still get a result that is less than 100, following the *pattern* found in the previous question.

3. What is the smallest three digit number between zero and one? Multiply this number by 100. Based on all the products you have calculated, what would you say is the approximate range of results when we multiply a 100 by a number between zero and one?
A: The smallest three digit number between zero and one is .001; $100 \times .001 = .1$. The product is greater than zero but less than 100..
CT: As we multiply by smaller numbers the product decreases. We don't need to compute the product of 100 and every number between zero and one. Instead, we can **generalize** to conclude that the range of products is approximately from .1 to 99.9.

Example 2

- Type the following problems into the Python interpreter (or a calculator). Look for patterns in the product of two numbers when one of the numbers is between zero and one.

Exercise	Product	Greater than 40 or less than 40?
(a) $40*.8$	32	less
(b) $40*.35$	14	less
(c) $40*.5$	_____	_____
(d) $40*.99$	_____	_____
(e) $40*(8*10^{-1})$	_____	_____

Student Questions:

1. Complete the chart above. When we multiply 40 by a number between zero and one, is the product greater than 40, less than 40, or does it depend on what decimal we multiply by?

A: The product appears to always be less than 40.

CT: *Students identify a **pattern** to make a **generalization**.*

2. What is the largest three digit number between zero and one? Multiply 40 by this number to see if the product exceeds 40. **A:** The greatest 3 digit number between zero and one is .999; $40 \times .999 = 39.96$. The product is still less than 40.

CT: *Even though .999 is very close to one, when we multiply it by 40 we still get a result that is less than 40, following the **pattern** found in the previous question.*

3. What is the smallest three digit number between zero and one? Multiply this number by 40. Based on all the products you have calculated, what would you say is the approximate range of results when we multiply a 40 by a number between zero and one?

A: The smallest three digit number between zero and one is .001; $40 \times .001 = .04$. Instead of multiplying by every decimal between zero and one we can conclude that the range of results is between slightly greater than zero to slightly less than 40.

CT: *As we multiply by smaller numbers, the product decreases. We don't need to compute the product of 40 and every number between zero and one. Instead, we can **generalize** and conclude that the range of products is approximately from .04 to 39.96.*

4. Based on the patterns found in **Example 1** and **Example 2**, if we multiply any number x by a number between zero and one, what is the range of values for the product?

A: When we multiply any number by a number between zero and one, the range of possible products is between zero and the number.

CT: *Based on similarities in the two examples above, we can **generalize** to conclude that when we multiply any number x by any number between zero and one, the possible products range from slightly more than zero to slightly less than x .*

More lessons and examples can be found at [Google's Exploring Computational Thinking](#) website.

Except as otherwise [noted](#), the content of this lesson is licensed under the [Creative Commons Attribution 3.0 License](#).