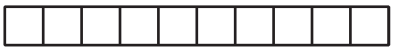
Unit 5, Lesson 2

Using Diagrams to Represent Addition and Subtraction

Let's represent addition and subtraction of decimals.

2.1 Changing Values

1. Here is a rectangle.



What number does the rectangle represent if each small square represents:

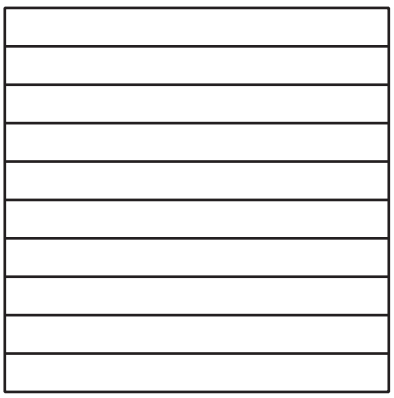
a. 1

b. 0.1

c. 0.01

d. 0.001

2. Here is a square.



What number does the square represent if each small rectangle represents:

a. 10

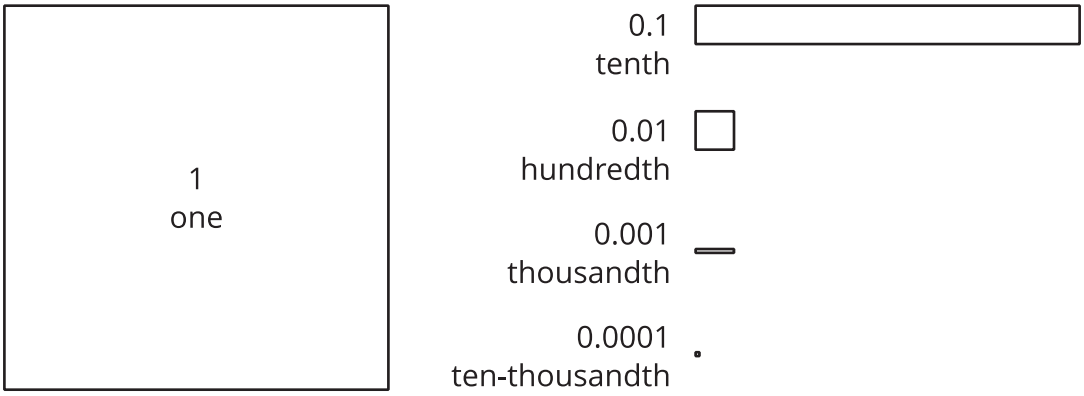
b. 0.1

c. 0.00001

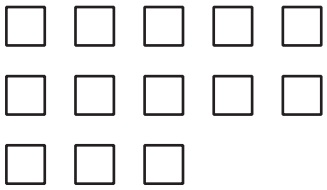
2.2 Squares and Rectangles

Here are some diagrams that we will use to represent base-ten units.

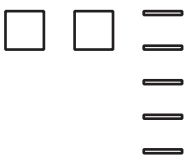
- A large square represents 1 one.
- A medium rectangle represents 1 tenth.
- A medium square represents 1 hundredth.
- A small rectangle represents 1 thousandth.
- A small square represents 1 ten-thousandth.



1. Here is the diagram that Priya drew to represent 0.13. Draw a different diagram that represents 0.13. Be prepared to explain why both Priya's and your diagrams represent the same number.



2. Here is the diagram that Han drew to represent 0.025. Draw a different diagram that represents 0.025. Be prepared to explain why both Han's and your diagrams represent the same number.



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3. For each number, draw or describe two different diagrams that represent it.

   a. 0.1

   b. 0.02

   c. 0.004

4. Use diagrams of base-ten units to represent each sum. Try to use as few units as possible to represent each number.

   a. $0.03 + 0.05$

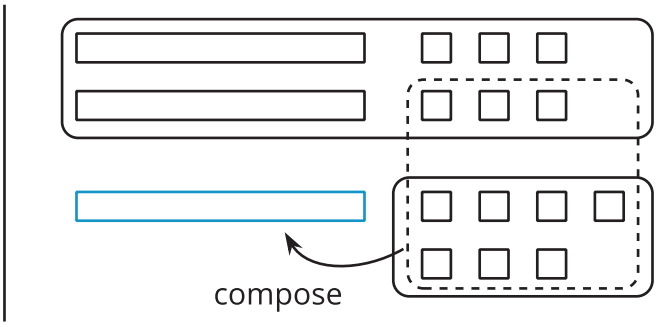
   b. $0.006 + 0.007$

   c. $0.4 + 0.7$

2.3 Finding Sums in Different Ways

1. Here are two ways to calculate the value of $0.26 + 0.07$. In the diagram, each rectangle represents 0.1 and each square represents 0.01.

$$\begin{array}{r} {\scriptstyle 1} \\ 0.26 \\ +\ 0.07 \\ \hline 0.33 \end{array}$$



Discuss with your partner:

   a. Why can 10 ten squares be composed into a rectangle?

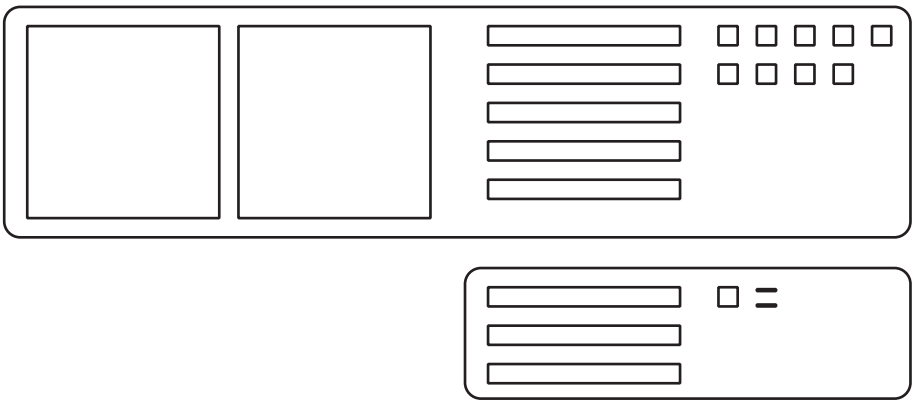
   b. How is this composition represented in the vertical calculation?

2. Find the value of $0.38 + 0.69$ by using base-ten blocks or a diagram. Can you find the sum without composing a larger unit? Would it be useful to compose some pieces? Be prepared to explain your reasoning.

3. Calculate $0.38 + 0.69$. Check if the sum is the same as the value of the base-ten blocks or diagram you used earlier.

4. Find each sum. The larger square represents 1. The rectangle represents 0.1. The small square represents 0.01.

   a.



   b.

$$\begin{array}{r} 6.03 \\ +\ 0.098 \\ \hline \end{array}$$

Are you ready for more?

In a game, special stones are used for bartering. The values of the stones are based on their color and are ranked as shown, with red having the highest value.

red
orange
yellow
green
blue
indigo
violet

Each color is valued at 3 times the color below it in the ranking. So the value of a red stone is 3 times that of an orange stone, and the value of a green stone is 3 times that of a blue stone.

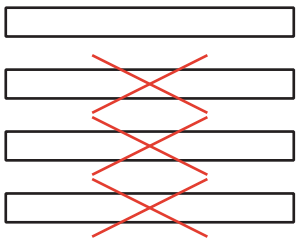
If you had 500 violet stones and wanted to trade so that you would carry as few stones as possible, which stones would you have? Explain or show your reasoning.

2.4 Representing Subtraction

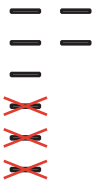
1. Here are diagrams that represent differences. Removed pieces are marked with Xs. The larger rectangle represents 1 tenth.

   For each diagram, write a subtraction expression and find the value of the expression.

   a.

   b.

   c.

2. Express each subtraction in words.

   a. $0.05 - 0.02$

   b. $0.024 - 0.003$

   c. $1.26 - 0.14$

3. Find each difference by drawing a diagram and by calculating with numbers. Make sure the answers from both methods match. If not, check your diagram and your numerical calculation.

   a. $0.05 - 0.02$

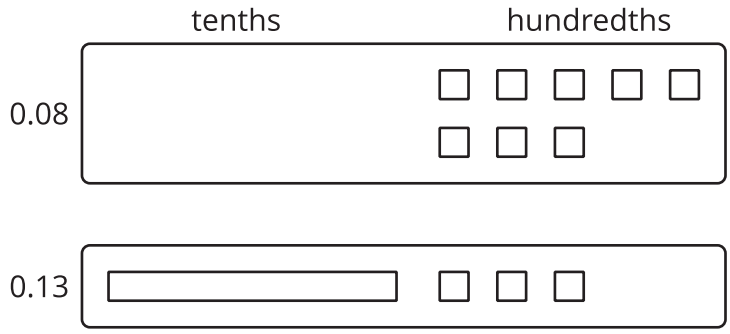
   b. $0.024 - 0.003$

   c. $1.26 - 0.14$

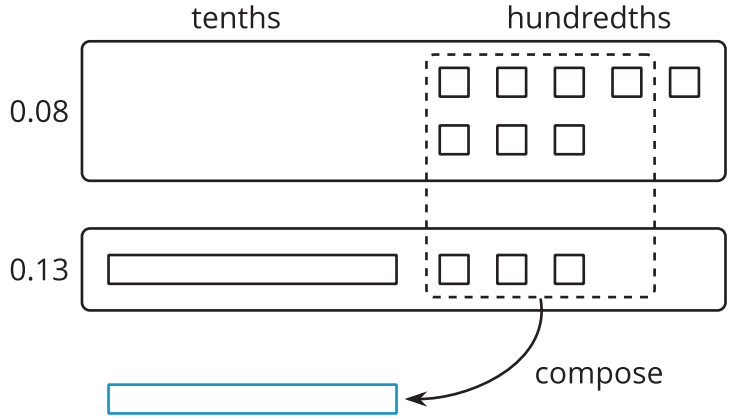
Lesson 2 Summary

Base-ten diagrams represent collections of base-ten units—tens, ones, tenths, hundredths, and so on. We can use them to help us understand sums of decimals.

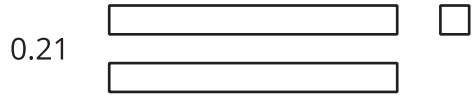
Suppose we are finding $0.08 + 0.13$. Here is a diagram where a square represents 0.01 and a rectangle (made up of ten squares) represents 0.1.



To find the sum, we can compose 10 hundredths into 1 tenth.



We now have 2 tenths and 1 hundredth, so $0.08 + 0.13 = 0.21$.



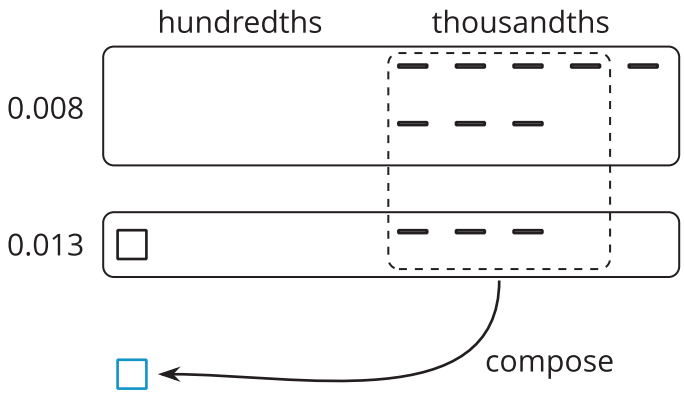
We can also use vertical calculation to find $0.08 + 0.13$.

$$\begin{array}{r} {\scriptstyle 1} \\ 0.13 \\ +\ 0.08 \\ \hline 0.21 \end{array}$$

Notice how this representation also shows 10 hundredths are composed into 1 tenth.

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This works for any decimal place. Suppose we are finding 0.008+0.013. Here is a diagram in which a small rectangle represents 0.001. We can compose 10 thousandths into 1 hundredth.



The sum is 2 hundredths and 1 thousandth.



Here is a vertical calculation of $0.008 + 0.013$.

$$\begin{array}{r} {\scriptstyle 1} \\ 0.013 \\ +\ 0.008 \\ \hline 0.021 \end{array}$$

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