The previous lesson looked at multiplying and dividing by factors of 10 greater than 1. There are three examples below:

\[
\begin{align*}
8 \times 100 &= 800 \\
12.47 \div 1000 &= 0.01247 \\
0.039 \times 10000 &= 390
\end{align*}
\]

- put a decimal after the 8, move it 2 places to the right.
- move the decimal place 3 places to the left. 0 goes into empty space.
- move the decimal place over 4 spaces to the right. Fill with 0.

We can do the same with factors of 10 less than 1. This, however, begs the question, what exactly does that mean?

Factors of 10 less than 1 would include the following numbers:

\[
0.1, 0.01, 0.001, 0.0001
\]

We can get these by dividing the number 1 by any factor of 10. For example, if we take the 1 and divide it by 100 we get 0.01.

**Activity 1:** Determine what the decimal is when dividing 1 by these factors of 10.

a) \(1 \div 10 = \) _______

b) \(1 \div 100 = \) _______

c) \(1 \div 1000 = \) _______

d) \(1 \div 10000 = \) _______

e) \(1 \div 100000 = \) _______

Notice a pattern? The number of 0's relates to the number of decimal places in the answer, and the final digit always is 1. Use that information to determine what each value was divided by. For example, the decimal 0.001 has 3 decimal places, so it must have been \(1 \div 1000\).

**Activity 2:** Determine what the factor of 10 was that 1 was divided by to get the value given.

a) \(0.0001 = 1 \div \) _______

b) \(0.001 = 1 \div \) _______

c) \(0.00001 = 1 \div \) _______

d) \(0.1 = 1 \div \) _______

e) \(0.01 = 1 \div \) _______

f) \(0.000001 = 1 \div \) _______

So now here is the weird thing. At the top we looked at multiplying and dividing by factors of 10 that were greater than 1 (10, 100, 1000, …). Now we are going to look at multiplying and dividing by factors of 10 that are less than 1 (0.1, 0.01, 0.001 …). In order to do that effectively, we have to talk about **reciprocals**. A reciprocal is a fraction turned upside down. For example, the reciprocal of \(\frac{1}{2}\) is \(\frac{2}{1}\). We could then say the reciprocal of 0.5 is 2, or the reciprocal of 2 is 0.5.

**Activity 3:** Write the reciprocal of each number. Write them in decimal format (not fraction).

a) 10 _______

b) 0.01 _______

c) 1000 _______

d) 0.1 _______

e) 10000 _______

f) 0.001 _______

g) 100 _______

h) 0.0001 _______

This is useful to know because multiplying by a number is the same as dividing by its reciprocal. When working with factors of ten, dividing a number by 0.01 is the same as multiplying by its reciprocal, which is 100. Use this to answer the questions below.

**Activity 4:** Determine the answer by moving decimal places only – **no calculators**.

a) \(2.3 \div 0.01 = \) _______

b) \(0.06 \div 0.1 = \) _______

c) \(2.3 \div 0.01 = \) _______

d) \(9 \div 0.001 = \) _______

e) \(0.004 \div 0.001 = \) _______

f) \(0.3 \div 0.0001 = \) _______
Homework:

1. Determine what the decimal is when dividing 1 by these factors of 10.
   a) \( \frac{1}{1000} = \) ____
   b) \( \frac{1}{1000000} = \) ____
   c) \( \frac{1}{10000} = \) ____
   d) \( \frac{1}{100} = \) ____
   e) \( \frac{1}{100000} = \) ____
   f) \( \frac{1}{10} = \) ____

2. Determine what the factor of 10 was that 1 was divided by to get the value given.
   a) \( 0.001 = \frac{1}{________} \)
   b) \( 0.000001 = \frac{1}{________} \)
   c) \( 0.0000001 = \frac{1}{________} \)
   d) \( 0.00000001 = \frac{1}{________} \)
   e) \( 0.000000001 = \frac{1}{________} \)
   f) \( 0.0000000001 = \frac{1}{________} \)

3. Write the reciprocal of each number. Write them in decimal format (not fraction).
   a) \( 100 = \) _______
   b) \( 0.1 = \) _______
   c) \( 10000 = \) _______
   d) \( 0.001 = \) _______
   e) \( 1000 = \) _______
   f) \( 0.001 = \) _______
   g) \( 10 = \) _______
   h) \( 0.01 = \) _______

4. Convert each division into a multiplication question using reciprocals, then answer them.
   Example: \( 3.45 \div 0.001 = 3.45 \times \frac{1}{0.001} = \) ________ (answers: 1000 and 3450)
   a) \( 2 \div 0.01 = 2 \times \frac{1}{0.01} = \) _______
   b) \( 6 \div 0.1 = 6 \times \frac{1}{0.1} = \) _______
   c) \( 0.025 \div 0.001 = 0.025 \times \frac{1}{0.001} = \) _______
   d) \( 13 \div 0.0001 = 13 \times \frac{1}{0.0001} = \) _______
   e) \( 0.00458 \div 0.001 = 0.00458 \times \frac{1}{0.001} = \) _______
   f) \( 0.00009 \div 0.00001 = 0.00009 \times \frac{1}{0.00001} = \) _______
   g) \( 51.03 \div 0.1 = 51.03 \times \frac{1}{0.1} = \) _______
   h) \( 200 \div 0.001 = 200 \times \frac{1}{0.001} = \) _______

5. Below are a variety of questions using factors of 10. Answer them without a calculator.
   a) \( 5 \times 100 = \) _______
   b) \( 0.02 \div 0.01 = \) _______
   c) \( 4.01 \times 0.0001 = \) _______
   d) \( 20 \div 10000 = \) _______
   e) \( 0.032 \times 10000 = \) _______
   f) \( 300 \div 0.001 = \) _______
   g) \( 73 \times 0.0001 = \) _______
   h) \( 0.0004 \div 0.0001 = \) _______
   i) \( 0.0037 \times 10 = \) _______
   j) \( 0.061 \div 0.00001 = \) _______
   k) \( 5.33 \times 0.01 = \) _______
   l) \( 6020 \div 1000 = \) _______