🌸 Operations with Decimal Fractions

Background Information

Students learn the four basic operations with decimal fractions: addition, subtraction, multiplication, and division. The first three operations make use of the Decimal Fraction Board, the Decimal Fraction Material and the Decimal Checkerboard Material (multiplication). Division is done with skittles and the Decimal Fraction Material.

Adding and Subtracting Decimal Fractions

Adding and subtracting decimal fractions is much like adding and subtracting whole numbers. First, the decimal points must be lined up. Then, the adding or subtracting is done in the usual way and a decimal point is lined up in the sum or difference. Here are some examples:

$$
\begin{array}{r}
15.9 \\
+\ \ 4.2 \\
\hline
20.1
\end{array}
\qquad
\begin{array}{r}
13.410 \\
+\ 45.206 \\
\hline
58.616
\end{array}
\qquad
\begin{array}{r}
9.4 \\
-\ 6.3 \\
\hline
3.1
\end{array}
\qquad
\begin{array}{r}
15.09 \\
-\ 12.62 \\
\hline
2.47
\end{array}
$$

Students first learn this concept by making addends, minuends, and subtrahends on the Decimal Fraction Board and working with them to find sums and differences.

Multiplying Decimal Fractions

Multiplying decimal fractions is much like multiplying whole numbers. Once the multiplication is complete, the product must have the same number of decimal places as in the multiplicand and multiplier

combined. The number of decimal places is always counted from the right.

For example, to multiply 26 by 0.2, first the numbers are multiplied as if they were whole numbers. Then a decimal point is added before the final digit in the product. This gives one decimal place in the product, just as there is a total of one decimal place in the multiplicand and multiplier.

$$
\begin{array}{r}
26 \\
\times\ 0.2 \\
\hline
5.2
\end{array}
$$

Here are two more examples:

$$
\begin{array}{r}
480 \\
\times\ 1.05 \\
\hline
2400 \\
000\ \ \ \\
480\ \ \ \ \ \\
\hline
504.00
\end{array}
$$

← two decimal places (on the 1.05)
← two decimal places (on the 504.00)

$$
\begin{array}{r}
23.486 \\
\times\ 20.125 \\
\hline
117430 \\
46972\ \ \\
23486\ \ \ \\
00000\ \ \ \ \\
46972\ \ \ \ \ \\
\hline
472.655750
\end{array}
$$

← three decimal places (on the 20.125)
← six decimal places (on the 472.655750)

When learning to multiply decimals, students use the Decimal Fraction Board, the Decimal Fraction Material and the Decimal Checkerboard, to keep track of their multiplicands, multipliers, and products.

Dividing Decimal Fractions

Dividing decimal fractions is similar to dividing whole numbers, but the decimal point must be kept track of and put in the right place in the quotient. The division is set up the same way as with whole numbers, like this:

$$0.2\,\overline{)\,8.4}$$

Then, the divisor is made into a whole number by multiplying it by 10 or, if needed, a multiple of 10. In the illustrated example, multiplying by 10 is sufficient: 0.2 x 10 = 2. The dividend must be multiplied by the same amount: 8.4 x 10 = 84. The division equation now looks like this:

$$0.2\overline{)8.4.}$$

Multiplying the divisor and dividend by 10

A decimal point is placed in the quotient immediately above the new location of the decimal point in the dividend. The division equation is then solved the same way as a division equation with whole numbers. The answer to the original equation is 42. That is, 8.4 ÷ 0.2 = 42.

$$02.\overline{)84.}$$

The decimal points in the quotient and dividend line up

$$2.\overline{)84.} = 42.$$
$$\underline{8}$$
$$04$$
$$\underline{4}$$
$$0$$

Long division is carried out as usual

Students first learn to divide decimal fractions with the help of Fraction Skittles, beads in place-value colors, and the Decimal Fraction Material.

Learning to divide with decimal fractions

Dividing a Decimal Fraction by 10 or a Multiple of 10, Using the Decimal Fraction Board

Dividing a decimal fraction by 10

Setting up the equation 1 ÷ 10 =

Exchanging 1 unit for 10 tenths

Sharing out the tenths

Purpose

To understand how to divide a decimal fraction by 10 or a multiple of 10.

Material

Decimal Fraction Board.

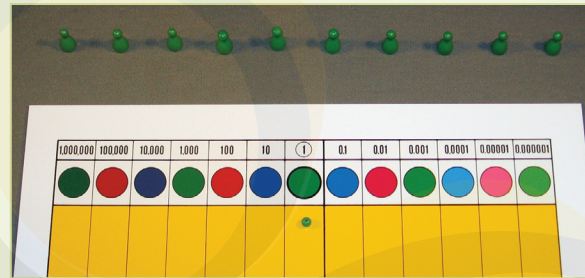Beads from the Long Division Material.

Decimal Fraction Material.
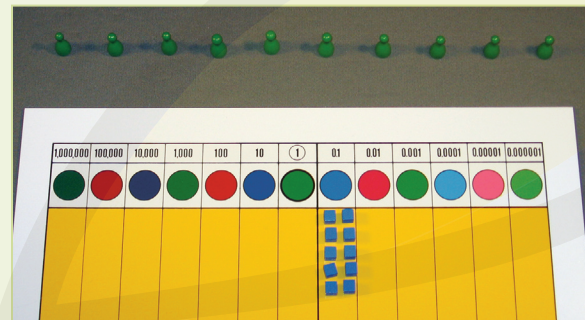
Whiteboard and whiteboard markers.
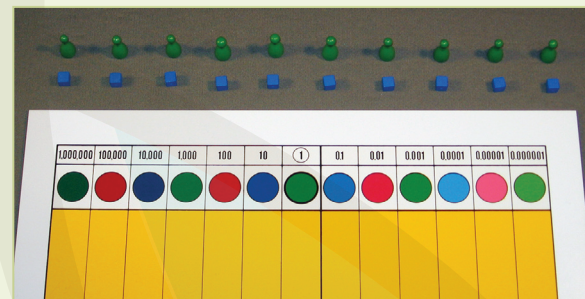
Math journals and pencils.

Presentation

■ Most Montessori teachers present this concept in Year 4.

■ Invite a small group of students to a mat or table to learn to divide decimal fractions by 10 and multiples of 10.

Dividing by 10 on the Decimal Fraction Board

■ Write the equation 1 ÷ 10 = on the whiteboard.

■ Place the Decimal Fraction Board in the work area, and place a single unit bead in the units column to represent the dividend 1.

- Place 10 Large Green Skittles in a row to represent the divisor.

- Invite a student to divide 1 by 10 using the material.

- The student will need to exchange the unit bead for 10 tenths decimal cubes. Then, the student will be able to share the tenths decimal cubes equally among the 10 skittles. Each skittle will receive 1 tenth decimal cube.

```
    1 ÷ 10 =       0.1
  0.1 ÷ 10 =       0.01
0.01 ÷ 10 =      0.001

When a number is divided by 10, the
decimal point moves one place to the left.
```

Dividing by 10 moves the decimal point one place to the left

- Ask the student how much each skittle received. (One tenth, or 0.1.)

- Complete the equation on the whiteboard: 1 ÷ 10 = 0.1. Encourage the students to copy this equation in their journals.

- Repeat the exercise, only this time for the equation 0.1 ÷ 10 = . Repeat again, only this time for the equation 0.01 ÷ 10 = . Each time, record the equation on the whiteboard and invite the students to copy it into their journals. The equations should look like this:

```
1    ÷ 10 =      0.1
0.1  ÷ 10 =    0.01
0.01 ÷ 10 =   0.001
```

- Invite the students to notice how the decimal point moves one place to the left every time a number is divided by 10.

- Ask the students to record the following statement in their journals: When a number is divided by 10, the decimal point moves one place to the left.

Dividing by 10 Abstractly

- Write the following equation on the whiteboard: 150 ÷ 10 =. Ask the students the answer. (15.) Record the answer on the whiteboard.

- Ask the students to write the equation in their journals: 150 ÷ 10 = 15.

- Repeat the exercise for 15 ÷10, 1.5 ÷ 10, 0.15 ÷ 10, and 0.015 ÷ 10. Encourage the students to write each equation in their journals so they end up with a list like this:

```
150 ÷ 10 =          15
15 ÷10 =           1.5
1.5 ÷ 10 =        0.15
0.15 ÷ 10 =      0.015
0.015 ÷ 10 =  0.0015
```

- Invite the students to look for a pattern: When a number is divided by 10, the decimal point moves one place to the left.

- Encourage the students to write the above statement about the pattern in their journals.

Dividing Decimal Fractions by 100

- Write the following equation on the whiteboard: 150 ÷ 100 =   .

9–12 Math 1 – Whole Numbers & Fractions | © NAMC - North American Montessori Center

- Ask the students to write this equation in their journals next to the other equations, like this:

150 ÷ 10 =   15   150 ÷ 100 =
15 ÷ 10 =   1.5
1.5 ÷ 10 =   0.15
0.15 ÷ 10 =   0.015
0.015 ÷ 10 = 0.0015

150 ÷ 10 =   15   150 ÷ 100 =   1.5
15 ÷ 10 =   1.5   15 ÷ 100 =   0.15
1.5 ÷ 10 =   0.15   1.5 ÷ 100 =   0.015
0.15 ÷ 10 =   0.015   0.15 ÷ 100 =   0.0015
0.015 ÷ 10 =   0.0015   0.015 ÷ 100 =   0.00015

When a number is divided by 10, the decimal point moves one place to the left.

When a number is divided by 100, the decimal point moves two places to the left.

Dividing by 100 moves the decimal point two places to the left

- Encourage the students to say the answer and write it down.

- Repeat the exercise for 15 ÷ 100, 1.5 ÷ 100, 0.15 ÷ 100, and 0.015 ÷ 100.

- The students' pages should show the following:

150 ÷ 10 =   15   150 ÷ 100 =   1.5
15 ÷ 10 =   1.5   15 ÷ 100 =   0.15
1.5 ÷ 10 =   0.15   1.5 ÷ 100 =   0.015
0.15 ÷ 10 =   0.015   0.15 ÷ 100 =   0.0015
0.015 ÷ 10 = 0.0015   0.015 ÷ 100 = 0.00015

- Invite the students to look for the pattern and write the statement about the pattern in their journals. (When a number is divided by 100, the decimal point moves two places to the left.)

Extension

- When a number is divided by 10, the decimal point moves one place to the left. When a number is divided by 100, the decimal point moves two places to the left. Where does the decimal point move to when a number is divided by 1,000? By 10,000? Write the answers in the journal.