ADDING AND SUBTRACTING DECIMALS

Adding and subtracting decimals is nearly identical to adding and subtracting whole numbers. If students have reviewed the latter and are confident, the least amount of time should be allotted to this portion of the lesson. Students can see that if we line up and add or subtract numbers by place value, the decimal point naturally falls into place below the decimal points in the original numbers. Ensure that students practice using numbers that require regrouping.

COMMON MISCONCEPTIONS

• When multiplying, line up numbers by place value.

When using any operation with whole numbers, and when using addition and subtraction with decimals, students are taught to begin by lining up numbers by place value. This is not the case with the multiplication algorithm, where we instead align both numbers to the right. You can explain to students that, when multiplying with decimals, the number of decimal places in the answer is different from the number of decimal places in the starting factors. If we align by decimal points and decimal place, we end up with the same number of decimal places. Instead, we pay attention to the numerals first, and we later decide what value each place should have.

• Students turn the divisor into a whole number without applying the same operation to the dividend.

In this lesson, students are taught to change the divisor to a whole number before proceeding with long division. In order keep the overall value of the expression the same, the dividend needs to be multiplied by the same number. This can be a challenging concept for students to understand. In Grade 5, students learned to connect fractions and division. Use fraction concepts to help explain why this problem is equivalent. Present a simple division problem as a fraction. Now if we multiply the numerator by 10 and the denominator by 10, we have an equivalent fraction (or division problem), and we have not changed the overall value.

• Students put the decimal point in the wrong place after an operation.

The rules for where to place the decimal point are different for addition and subtraction, multiplication, and division. For addition and subtraction, the number of decimals in the sum or difference is typically the same as in the original numbers. For multiplication, the number of decimal places in the product is the sum of the number of decimal places in the factors. For division, the decimal point is carried upward at the end of the long division process. Go over the different rules as a class several times before having students practice on their own.

TEACHER GUIDE

STANDARD ALGORITHM WITH DECIMALS (ALL 4 OPERATIONS)

GRADES 6–8
Students also learn how to add and subtract with numbers that have a different number of decimal places, such as 1.74 + 3.2. Since we line numbers up by place value, the 4 is left without a mate, and we write a 0 after the 2. Remind students that if there is no number in the hundredths place, that is the same as writing a 0 in the hundredths place: the value of the number does not change. Now, we can proceed as usual.

**MULTIPLYING DECIMALS**

When students multiplied whole numbers, it was natural to line two numbers up by place value. However, when we multiply decimals, we can align two numbers as far to the right as possible, even if the numbers farthest to the right do not have the same place value. Next, instruct students to ignore the decimal point and proceed to multiply using the standard algorithm, as if these were whole numbers. Once they finish, the product is a seemingly large whole number, and at this point, students need to decide where to place the decimal point. We do this by observing the number of decimal places in each factor, and adding the number of places together. The sum is the number of decimal places in the product. For example, 1.2 × 3.45 has 3 decimal places, because 1.2 has one, and 3.45 has two. However, it is equally important to check our work by rounding and estimating. If we multiply 12 × 345, we get 4,140. Looking at the original factors, 1.2 is approximately 1, and 3.45 is approximately 3, so we estimate that the product is around 3 or 4. Given 4,140, we can estimate that our decimal point should be placed to the right of the first 4. Encourage students to use both methods to determine decimal point placement.

**DIVIDING DECIMALS**

We can simplify division of decimals by changing the divisor to a whole number. That means that both the divisor and the dividend need to be multiplied by a power of 10 until the divisor is a whole number. For example, to divide 3.18÷0.6, we can multiply 3.18 by 10, and 0.6 by 10. Now, the division problem is 31.8÷6, which is simpler. The goal is for the divisor to be a whole number, and we multiply the dividend accordingly. Now, students can proceed with the long division algorithm they are familiar with. When the quotient is at the top, we bring the decimal point straight up above its position in the dividend. Encourage students to check if their answer makes sense by rounding and estimating.

**TEACHER TIPS**

As always, avoid teaching students to replace visual methods with algorithms altogether. Algorithms are more efficient, but they should only be used if they are well understood, and once the slower, more visual method has been well established. Particularly when multiplying and dividing with decimals, it is essential for students to have an estimate of the answer they expect; otherwise, they may blindly move decimals according to rules that they may or may not remember correctly. Encourage students to draw area models on the side, shade in decimal squares, or use manipulatives, particularly when regrouping from one place value to another.