

## Lesson 8: Working With Powers of 10 (2 Days)

### Getting Started

Now that you understand powers of 10, you're going to learn a new way to write them. Watch the video at the following web link.

#### Powers of 10 and Exponents

[www.movingbeyondthepage.com/link/8641/](http://www.movingbeyondthepage.com/link/8641/)

You now know that you can write big power of 10 numbers in four different ways: number form, word form, expanded form, and exponent form.

**Number form:** 10,000

**Word form:** ten thousand

**Expanded form:**  $10 \times 10 \times 10 \times 10$

**Exponent form:**  $10^4$  (10 to the power of 4)

Use the "Powers of 10 and Exponents" sheet to create a page for your Interactive Notebook. Cut out the boxes from the sheet and glue them to a piece of card stock to show how to write and say powers of 10 using exponents. Be sure to group equal amounts together on the page. You can color the title of the page, too.

### Stuff You Need

- ✓ 3-hole drilled card stock (kit)
- ✓ fine point dry-erase markers (kit)
- ✓ Interactive Notebook
- ✓ scissors
- ✓ colored pencils or markers
- ✓ glue or glue stick
- ✓ laminated decimal place value chart (kit)

### Ideas to Think About

- What are powers of ten?
- What is an exponent?
- How do you read and write numbers in exponent form?

## Things to Know

- **Exponent:** a number written to the right and slightly above a base number that shows how many times to multiply the base number by itself (for example,  $10^2 = 10 \times 10$ )
- Scientific notation is a method of writing very large numbers.
- To multiply by powers of 10, you either move the digits to the left or the decimal point to the right.
- To divide by powers of 10, you either move the digits to the right or the decimal point to the left.

## Activities

### Activity 1: Multiplying by Powers of 10

Quick! Find the following products:

- $5 \times 1,000$
- $100 \times 6$
- $10,000 \times 2$

You should have found the following products: 5,000, 600, and 20,000. These were probably pretty easy for you because you know, for instance, that 5 groups of 1,000 totals 5,000. You may also remember that when you multiply a whole number by a power of 10, the product has the same number of zeros as the power of 10 number. For instance, with  $10,000 \times 2$ , the answer, 20,000, has the same number of zeros as the power of 10 number, 10,000.

You also learned in the introduction to this lesson that powers of 10 can be expressed in exponent form. That means  $5 \times 1,000$  can also be shown as  $5 \times 10^3$ , and the answer is the same: 5,000. Likewise,  $100 \times 6$  is the same as  $10^2 \times 6$ , and  $10,000 \times 2$  is the same as  $10^4 \times 2$ .

Read the information and examples on the "Exponents, Powers of 10, and Multiplication" sheet. Then, follow the instructions provided.

### Activity 2: Multiplying by Powers of 10: Moving the Decimal

You can use what you know about exponents and multiplying and dividing by powers of ten when working with decimal numbers, too. On a scratch piece of paper, write the multiplication sentence  $4.5 \times 10,000$ . What would that look like in exponent form? Write your answer on the scratch paper. You should have written  $4.5 \times 10^4$ .

Next, watch the following video about multiplying decimals by powers of 10 to see how to solve this type of problem.

### More Powers of 10 and Decimals

[www.movingbeyondthepage.com/link/9059/](http://www.movingbeyondthepage.com/link/9059/)

Now, go back to the multiplication problems you wrote on the scratch paper. Use what you learned in the video to find the products. You should notice that  $4.5 \times 10,000$  and  $4.5 \times 10^4$  both work out to 45,000 using the method shown in the video. That's because the zeros in the first problem and the exponent in the second problem both tell you how many times to move the decimal to the right when multiplying, in this case, four times.

Next, read the information provided at the following web link. You'll explore how scientific notation works. Note that in many countries, exponents are called "indices." Some of the reading will be review for you. As you read, skip the "Negative Powers of 10" section.

### Scientific Notation

[www.movingbeyondthepage.com/link/8601/](http://www.movingbeyondthepage.com/link/8601/)

Now, go to the "Try It Yourself" section. In the top box, enter the following numbers, and notice how to write them in scientific notation using exponents:

- 356,251
- 7,584
- 2,718,578

In the second box, enter the following in scientific notation, and notice the resulting numbers:

- $2.34 \times 10^4$
- $5.19 \times 10^6$
- $6.92 \times 10^3$

Now, you're going to read and complete the "Multiplying Decimals by Powers of 10" sheet. Use the examples shown to guide you as you complete the problems. When you finish, you'll begin to create a page for your Interactive Notebook. Get out a sheet of 3-hole drilled card stock and write the title "Working With Powers of 10" at the top. Then cut out the box from the activity page along the dotted lines and glue it under the title. Save this page to complete on Day 2.

**Day 2** **Activity 3: Dividing By Powers of 10**

Take a look at the following division problems:

$$34,000 \div 10 = 3,400$$

$$3,400 \div 10 = 340$$

$$340 \div 10 = 34$$

$$34 \div 10 = 3.4$$

$$3.4 \div 10 = 0.34$$

$$0.34 \div 10 = 0.034$$

What do you notice happening to the digits in the numbers as the numbers are divided by 10? Write each of the dividends (the first number in each problem) on a separate row on the laminated decimal place value chart. Which way are the digits moving and why? You should note that they are moving to the right because the numbers are getting smaller as they are divided by 10.

Now, what do you notice about the decimal point in each number? Remember that every whole number can be followed by a decimal point, but you typically don't write decimal points unless you're working with decimal numbers. For example, 150 can be written as 150. or as 150.0, although that's not the way you typically write it.

You can think of moving the decimal point in this way:

$$3,400 \div 10 = 340.0$$

$$34 \div 10 = 3.4$$

$$3.4 \div 10 = .34$$

Now, check out this pattern:

$$\begin{aligned}45,000 \div 10 &= 4,500 \\45,000 \div 100 &= 450 \\45,000 \div 1,000 &= 45 \\45,000 \div 10,000 &= 4.5 \\45,000 \div 100,000 &= 0.45 \\45,000 \div 1,000,000 &= 0.045\end{aligned}$$

Wow! The dividend (starting number) gets really small very quickly when it's divided by a big power of 10. What do you notice about the relationship between the number of zeros in the power of 10 and the quotient (answer)? For example, how many places smaller does 45,000 get when it's divided by 100? How is dividing by powers of 10 like multiplying by powers of 10?

You should see that if the power of 10 has two zeros in it, then the digits in the number move two places to the right OR the decimal point moves two places to the left. So, whether you're multiplying or dividing by a power of 10, the number of zeros will tell you how many places to move. It's up to you to figure out which way to go, but that will be easy if you remember that multiplying makes numbers larger and dividing makes numbers smaller. Also keep in mind that powers of 10 can be written using exponents.

Now you give it a try. On a piece of scratch paper, write the division sentence  $62 \div 1,000$ . Next, write that same division sentence using scientific notation beneath the first problem. Your scientific notation form should be  $62 \div 10^3$ . Using the method shown in this activity, find the answer to the division problems. Both quotients are 0.062. Why? Because both the number of zeros in the power of 10 and the exponent in scientific notation tell you how many times to move the decimal to the left, in this case, three times.

Practice your learning as you complete the patterns on the "Dividing by Powers of 10" sheet. Be sure to follow the methods you learned when finding the quotients.

### Activity 4: Multiplying and Dividing By Powers of 10

Now, you're going to complete the "Multiplying and Dividing Powers of 10" activity sheet by first coloring the boxes at the bottom of the sheet that say "LEFT" in green and the boxes that say "RIGHT" in red. Next, you'll cut out all of those boxes and glue them to the correct places in the table on the top of the page. Then, you'll follow the instructions to complete the rest of the sheet. As you work on it, keep in mind that you already know that you can write powers of 10 using exponents.

Now, get out the Interactive Notebook page that you started in Activity 2. Cut out the chart on the "Multiplying and Dividing Powers of 10" sheet you just completed. Glue this table below the first box on the card stock. Take a few minutes to review the steps in each section.

Now, use the "Powers of 10 Multiplication and Division" sheet to practice your learning. Follow these steps to complete the page:

1. Fill in the boxes in row 1 with the problem:  $3.2 \times 1,000$ . Find the product.
2. On the long line under row 1, rewrite the problem using scientific notation. Find the product. Be sure that both products for #1 are the same.
3. Fill in the boxes in row 2 with the problem:  $75 \div 1,000$ . Find the quotient.
4. On the long line under row 2, rewrite the problem using scientific notation. Find the quotient. Be sure that both quotients for #2 are the same.
5. In row 3, write a decimal number of your choosing in the first box and a power of ten number in the second box. On the long line underneath, write how your problem looks in scientific notation form. Then, find the product of both multiplication problems.
6. In row 4, write a number of your choosing in the first box and a power of ten number in the second box. On the long line underneath, write how your problem looks in scientific notation form. Then, find the quotient of both division problems.

Remember that both the number of zeros in a power of ten number and the exponent in scientific notation tell you how many times to move the decimal to the right when multiplying or to the left when dividing. Show your completed page to a parent and then store this page and the "Working with Powers of 10" sheet you made in your Interactive Notebook.

### Activity 5: Powers of 10 Matching

For this activity, you're going to cut out the cards on the "Powers of 10 Matching" sheet. Once you've cut all of them out, you'll match pairs of cards that show the same amounts. Every card will have a matching card. When you've finished making the matches, show them to a parent, and explain how you created them.

Next, complete the "Powers of 10 Problems" page.

**Wrapping Up**

You've spent the past few lessons working with numbers that are really big and numbers that are really small. Think about how much more 1,000,000 is than 0.001. It's quite a lot! Next up, you'll explore a number system that's totally different, but that's still used in our world today.

**Learning Gates**

Complete the Learning Gates quiz for this lesson using the iPad app or a browser at [www.movingbeyondthepage.com/online/](http://www.movingbeyondthepage.com/online/).

## Lesson 8: Working With Powers of 10 (2 Days)

### Getting Started

#### ? Big Ideas

- What are powers of ten?
- What is an exponent?
- How do you read and write numbers in exponent form?

#### Facts and Definitions

- **Exponent:** a number written to the right and slightly above a base number that shows how many times to multiply the base number by itself (for example,  $10^2 = 10 \times 10$ )
- Scientific notation is a method of writing very large numbers.
- To multiply by powers of 10, you either move the digits to the left or the decimal point to the right.
- To divide by powers of 10, you either move the digits to the right or the decimal point to the left.

#### ⦿ Skills

- Explain patterns in the number of zeros of the product when multiplying a number by powers of 10, and explain patterns in the placement of the decimal point when a decimal is multiplied or divided by a power of 10
- Use whole-number exponents to denote powers of 10

### Introducing the Lesson

Your child is now ready to learn about exponents. An exponent simply means repeated multiplication. So,  $10 \times 10 \times 10$  can be written as  $10^3$  ("ten to the power of 3" or "ten to the third power"). To begin the lesson, your child will watch a video introduction about exponents and create a page about them for her Interactive Notebook.

#### Answer Key:

- 100;  $10 \times 10$ ;  $10^2$ ; 10 to the power of 2 or 10 to the second power
- 1,000;  $10 \times 10 \times 10$ ;  $10^3$ ; 10 to the power of 3 or 10 to the third power
- 10,000;  $10 \times 10 \times 10 \times 10$ ;  $10^4$ ; 10 to the power of 4 or 10 to the fourth power
- 100,000;  $10 \times 10 \times 10 \times 10 \times 10$ ;  $10^5$ ; 10 to the power of 5 or 10 to the fifth power

During this lesson, your child will also extend her work with how to multiply and divide by powers of 10. For example,  $4.25 \times 100$  is 425. You can find this by moving all of the digits two places to the left OR moving the decimal point two places to the right. Your child will begin learning this process by reviewing how to write and say powers of 10 in exponent form.

### Activities

#### Activity 1: Multiplying by Powers of 10

Here, your child will begin to multiply by powers of 10 starting with whole numbers. She should already be familiar with multiplying whole numbers by multiples of 10.

#### Answer Key:

- $5 \times 10^3 = (5,000)$
- $12 \times 10^2 = (1,200)$
- $7 \times 10^5 = (700,000)$

- $35 \times 10^4 = (350,000)$
- $461 \times 10^3 = (461,000)$
- $6 \times 10^4 = 60,000$
- $16 \times 10^5 = 1,600,000$
- $314 \times 10^2 = 31,400$
- $22 \times 10^8 = 2,200,000,000$

### Activity 2: Multiplying by Powers of 10: Moving the Decimal

Now, your child is going to apply what she knows about multiplying by powers of 10 to doing so when working with decimals. She's going to explore two methods for this process: moving digits and moving the decimal point. When moving digits, she'll practice moving digits to the left to make numbers greater. When moving the decimal point, she'll practice moving it to the right. Both methods are common ways to multiply decimals by powers of 10.

Your child will complete an activity sheet. She will then use the top section of the activity sheet to start a page for her Interactive Notebook. This page will be completed on Day 2.

#### Answer Key:

- $3.75 \times 10^3 = (3,750)$
- $7.23 \times 10^5 = (723,000)$
- $9.99 \times 10^6 = (9,990,000)$
- Think About It! Meg says that 8.75 times 10 to the power of 4 is greater than 90,000. Catalina disagrees. Who is right? How would you explain this to Meg and Catalina? (Catalina is right because 87,500 is less than 90,000, 10 to the power of 4 is 10,000 so you'd move the digits 4 places to left or the decimal point 4 places to the right)

## Day 2

### Activity 3: Dividing By Powers of 10

Your child is now ready to divide whole and decimal numbers by powers of 10. She'll connect this process to her work with multiplying by powers of 10 and will look at patterns to explore how this process works. As with multiplying by powers of 10, there are two methods available to her. Basically, when dividing by powers of 10, digits will move to the left OR the decimal point will move to the right.

#### Answer Key:

- $653,000 \div 10 = (65,300)$
- $653,000 \div 100 = (6,530)$
- $653,000 \div 1,000 = (653)$
- $653,000 \div 10,000 = (65.3)$
- $653,000 \div 100,000 = (6.53)$
- $653,000 \div 1,000,000 = (0.653)$
- $72,000 \div 10^2 = (720)$
- $72,000 \div 10^3 = (72)$
- $72,000 \div 10^4 = (7.2)$
- $72,000 \div 10^5 = (0.72)$
- $72,000 \div 10^6 = (0.072)$

**Activity 4: Multiplying and Dividing By Powers of 10**

For this activity, your child will review the steps used to multiply and divide by powers of 10. She will complete an activity sheet, and then finish the page she started in Activity 2 for her Interactive Notebook.

Answer Key:

- $45 \times 10^2 = (4,500)$
- $8,300 \div 1,000 = (8.3)$
- $7.3 \times 10,000 = (73,000)$
- $56 \times 10^5 = (5,600,000)$
- What is the product of 0.74 and 100? (74)
- If you divide 3.1 by  $10^2$ , what is the quotient? (0.031)
- What is 498 divided by 10 to the second power? (4.98)

It's important that your child understand that she can solve these problems either by moving the digits OR moving the decimal point but that she can't do both at the same time. She will show her understanding of this by writing and answering example problems on the "Powers of 10 Multiplication and Division" page. Note that she will create and solve her own multiplication and division problems for the last two rows. After you check her problems for accuracy, have her store this page in the Interactive Notebook as well.

1.  $3.2 \times 1000 = 3,200$   
 $3.2 \times 10^3 = 3,200$
2.  $75 \div 1000 = 0.075$   
 $75 \div 10^3 = 0.075$
3. Answers will vary, however, both problem forms should yield the same product.
4. Answers will vary, however, both problem forms should yield the same quotient.

**Activity 5: Powers of 10 Matching**

During this activity, your child is going to cut out cards that show different problems involving multiplying and dividing by powers of 10. Then, she'll create matched pairs of cards that show the same number. When she's finished, she'll share her matches with you. Be ready to ask her how she solved the problems on the cards, and ask her to explain whether she moved the digits or the decimal point in the numbers. She should match the following cards:

- $20 \div 10^2$ ,  $0.02 \times 10$  (both equal 0.2)
- $0.02 \times 1,000$ ,  $2,000 \div 100$  (both equal 20)
- $0.002 \times 10^3$ ,  $200,000 \div 10^5$  (both equal 2)

Answer Key:

1. A popular fast food chain sells  $3.5 \times 10^6$  hamburgers each year. How many hamburgers is that? (3,500,000 hamburgers)
2. The moon is  $2.4 \times 10^5$  miles from the Earth. How many miles away is that? (240,000 miles)
3. If one grape weighs 1.25 grams, how much would 10,000 grapes weigh? (12,500 grams)
4. Ben likes to save his money. If he saves \$25.50 every week for 100 weeks, how much money will he have saved? (\$2,550)
5. The shortest wavelength in visible light (violet) has a wavelength of  $4 \div 10^7$  of a meter. How long is that? (0.0000004 meter)
6. A grain of sand has a diameter of about  $2.4 \div 10^3$  of an inch. How wide is that? (0.0024 inch)

7. The alien spaceship has to travel 5,400 light years in 1,000 days. How many light years will it have to travel each day? (5.4 light years)
8. If a grand prize of \$750 has to be shared among 100 people, how much money will each person receive? (\$7.50)

### Wrapping Up

#### Questions to Discuss

- If you were going to teach someone else about multiplying by powers of 10, what would tell them? (digits move to the left OR the decimal point moves to the right)
- What if you were going to teach them about dividing by powers of 10? (digits move to the right OR the decimal point moves to the left)
- What's 4 times 10 to the power of 4? (40,000, forty thousand)
- What's 300 divided by ten to the power of 3? (0.3, three tenths)
- Which method do you prefer to use, moving digits or moving decimals? Why? (answers will vary)

#### Things to Review

Review the steps for multiplying and dividing by powers of 10

Review which ways digits OR decimal points move when multiplying and dividing by powers of 10