

Lesson 3: Properties of Exponents (3 Days)

☐ Getting Started

Have you ever wondered how mathematicians handle really big numbers or very small ones without writing out tons of zeros? Imagine trying to work with 1,000,000,000,000 (one trillion) or 0.000000000001 (one trillionth)—writing out all those zeros every time would be exhausting! The answer lies in exponents—a powerful tool that lets us simplify repeated multiplication and division. In this lesson, you are going to explore the properties of exponents, which are the rules that make working with these numbers much easier.

You will start by learning what happens when exponents go beyond the positive—into the realm of zero and negatives. What does 3^0 equal? What about 2^{-3} ? These might seem tricky at first, but once you understand the rules, they'll make perfect sense.

Then, you will look at how to multiply and divide numbers with exponents. Did you know there's a simple way to combine powers without writing out all the multiplication? Finally, you will learn even more advanced exponent properties, like the power of a power and the power of a product. There's a whole lot of power going on in this lesson.

Stuff You Need

- calculator (kit)
- Interactive Notebook

Ideas to Think About

- How do the properties of exponents reveal deeper patterns in mathematics?
- In what ways do the rules for exponents connect to the distributive or associative property?
- Why are exponents critical for representing and solving problems involving real-world problems?

Things to Know

- **Positive exponents** are repeated multiplication of the same number. For example, $3^3 = 3 \times 3 \times 3 = 27$.
- For **negative exponents**, you flip the base to create a reciprocal. The formula is $a^{-n} = 1/a^n$.
- Any base (except zero) with a **zero exponent** is 1. The formula is $a^0 = 1$.

- The **Product of Powers Rule** states that when multiplying powers with the same base, you add the exponents: $a^m \times a^n = a^{m+n}$.
- The **Quotient of Powers Rule** states that when dividing powers with the same base, subtract the exponents: $a^m/a^n = a^{m-n}$
- The **Power of a Power Rule** states that you start with the base and multiply the exponents: $(a^m)^n = a^{m \times n}$
- The **Power of a Product Rule** states that when a product is raised to a power, the power is applied to each factor inside the parentheses: $(a \cdot b)^m = a^m \cdot b^m$
- The **Power of a Quotient Rule** states that when raising a fraction to a power, apply the exponent to both the numerator and the denominator: $(a/b)^n = a^n/b^n$

Activities

☐ Activity 1: Negative and Zero Exponents

Get ready to bring all your exponent skills together in one place! In this lesson, you'll create an Interactive Notebook page to showcase the properties of exponents. This page will serve as a handy reference tool for everything you've learned, from the product of powers to the power of a power, including how to handle negative exponents. Use the videos in each activity to fill in the activity page titled "Properties of Exponents Notes." By the end, you'll have a personalized resource that makes the rules of exponents clear and easy to remember. Don't forget to store this page in your Interactive Notebook and bring it out to use in each of this lesson's activities.

Watch the video at the following link. In this video, you will fill in notes for **ONLY** the first two rules. Imagine you're climbing a staircase, and each step you take represents a power of a number. Moving up, you're multiplying— 2^1 , 2^2 , 2^3 —but what happens if you step backward or stop at the ground floor? That's where **negative and zero exponents** come in. In this activity, you are going to unlock the mysteries of these unique exponents and learn why they make sense in math.



Negative and Zero Exponents

www.beyondthepage.com/link/12508/

Pause the video when needed to take notes on the first two rules.

It's your turn to practice. Save your notes page in your Interactive Notebook for the next activity. Then, solve the problems on the activity page titled "Negative and Zero Exponents." If you get confused, go back and rewatch the video. You can do this!

☐ Activity 2: Multiplying Exponents – The Product of Powers Rule

In this activity, we are going to look at multiplying numbers with exponents. You already know that when you multiply two numbers together, the answer is called a "product." Multiplying exponents is also called the "**product of powers**." You know that 2^2 is the same as 2×2 . Now, we are going to look at how to multiply powers when using the same base.

Let's start with a simple example:

$$2^2 \times 2^3$$

First, we can write out what each power means:

$$2^2 = 2 \times 2 \text{ and } 2^3 = 2 \times 2 \times 2$$

Now, put all of those together:

$$2^2 \times 2^3 = 2 \times 2 \times 2 \times 2 \times 2$$

How many times are we multiplying 2? That's right – 5 times! So we can write:

$$2^2 \times 2^3 = 2^5$$

But here's the shortcut for you. Instead of writing out all the numbers, you can add the exponents when the bases are the same. The rule is:

$$a^m \times a^n = a^{m+n}$$

So in our example, the equation would be:

$$2^2 \times 2^3 = 2^{2+3} = 2^5$$

Here is another simplified example of how to solve this type of problem.

$$3^2 \times 3^4$$

$$3^{(2+4)} \quad \text{Add the exponents}$$

$$3^6$$

You might be thinking, "Alright, I've got this!" But what happens when you encounter a negative exponent? Don't worry – it's easier than you think! Start by using the rules for adding and subtracting negative numbers. Just follow these steps:

$$3^5 \times 3^{-2} \quad \text{Use the product of powers rule}$$

$$3^{(5+(-2))} \quad \text{Add 5 and -2}$$

$$3^3$$

But what if after you use the product of powers rule, you end up with a negative exponent. No worries! If the exponent is negative, then use the negative exponent rule you just learned. Look at this example:

$$3^2 \times 3^{-5} \quad \text{Use the product of powers rule}$$

$$3^{2+(-5)} \quad \text{Add 2 and -5}$$

$$3^{-3}$$

But WATCH OUT! What if the bases are different? For example:

$$2^3 \times 3^2$$

The bases are not the same, so you cannot add the exponents. Solve each part separately.

$$8 \times 9 \quad 2^3 = 8 \text{ and } 3^2 = 9$$

$$72$$

Since the bases (2 and 3) are not the same, you CANNOT add the exponents. Instead, solve each part separately:

It's time to record this rule. Find your "Properties of Exponents Notes" page in your Interactive Notebook and fill in the notes for this rule. Don't forget to return the page to your Interactive Notebook so you can easily find it for the next activity.

Here's the key to mastering multiplying exponents:

Imagine you're solving a puzzle. If the bases are the same, it's like combining pieces that fit perfectly—you simply add the exponents while keeping the base the same.

But what if the bases are different? No worries! Just tackle each base and its exponent separately, like solving mini-puzzles, and then multiply the answers together at the end. It's your turn to practice this skill. Complete the problems on the activity page titled "Multiplying Exponents."

Day 2☐ **Activity 3: Dividing Exponents - The Quotient of Powers Rule**

Now that you've mastered multiplying exponents, it's time to look at dividing exponents. Just like before, there's a rule to make your life easier—but you must remember one thing: the BASES must be the SAME for this rule to work.

Circle the two equations that work for this rule:

$$\frac{4^4}{4^2} \quad \frac{5^3}{2^2} \quad \frac{2^4}{2^2}$$

Did you circle $4^4/4^2$ **and** $2^4/2^2$?

Let's see how this works with a new example and break it down step by step.

$$3^5 \div 3^2$$

First, we write out the exponents as repeated multiplication, just like we did when multiplying:

$$3^5 = 3 \times 3 \times 3 \times 3 \times 3 \text{ and } 3^2 = 3 \times 3$$

Now, set up the division:

$$\frac{3^5}{3^2} = \frac{3 \times 3 \times 3 \times 3 \times 3}{3 \times 3}$$

Next, you will cancel out the matching bases. For every 3 in the denominator, you can cancel one 3 in the numerator.

$$\frac{3 \times 3 \times 3 \times \cancel{3 \times 3}}{\cancel{3 \times 3}} = 3 \times 3 \times 3 = 3^3$$

Instead of writing out all the multiplication, here's the shortcut: When dividing powers with the same base, subtract the exponents. It's like unlocking a secret math trick that saves you time and makes you feel like a math pro.

$$3^5 \div 3^2 = 3^{5-2} = 3^3$$

It's called the **Quotient of Powers Rule**. This means when dividing powers with the same base, subtract the exponents:

$$a^m \div a^n = a^{m-n}$$

And remember, if after you use the product of powers rule you end up with a negative exponent, no worries. If the exponent is negative, then use the negative exponent rule you just learned to solve for the final answer.

But you need to **WATCH OUT!**

What if you have different bases?

Just like with multiplication, you **CANNOT** combine exponents if the bases aren't the same. Instead, solve each base and exponent separately.



$$\frac{2^4}{3^2}$$

SOLVE SEPARATELY

$$2^4 = 16 \text{ AND } 3^2 = 9$$

$$\frac{16}{9} = 1\frac{7}{9}$$

It's time to record this rule. Find your "Properties of Exponents Notes" page in your Interactive

Notebook and fill in the notes for this rule. Don't forget to return the page to your Interactive Notebook so you can easily find it for the next activity.

Now that you've seen how dividing exponents works, it's your turn. Remember: If the bases are the same, subtract the exponents. If the bases are different, solve each part separately and then divide. Complete the problems on the activity page titled "Dividing Exponents."

☐ Activity 4: Power of a Power

Have you ever seen a problem like this: $(2^3)^2$? It looks a bit intimidating, right? Don't worry—today, we're going to unlock the "**Power of a Power**" rule. By the end of this

activity, you'll have a shortcut for solving problems where an exponent has its own exponent. It's like stacking powers on top of powers—math's version of "Power Tower."

Watch the following video to see how this power works.

**Power of a Power**

www.beyondthepage.com/link/12509/

It's time to record this rule. Find your "Properties of Exponents Notes" page in your Interactive Notebook and fill in the notes for this rule. Don't forget to return the page to your Interactive Notebook so you can easily find it for the next activity. Complete the problems on the activity page titled "Power of a Power Practice" using what you've learned. Follow the steps and use your calculator to find the final answer as a number — not in exponent form.

Day 3☐ **Activity 5: Power of a Product**

You already know how to solve the following equation using Order of Operations (PEMDAS).

$$(2 \cdot 3)^3$$

Using PEMDAS, you would solve the expression inside the parentheses first ($2 \times 3 = 6$) and then solve for the exponents. This leads to $6^3 = 216$.

Today you are going to look at a different rule for simplifying expressions involving products raised to an exponent. It called the **Power of a Product Rule**. Both strategies will lead to the correct answer, but understanding this method will be helpful as you begin your study of Algebra.

Here is how Power of a Product works:

$$(2 \cdot 3)^3$$

$$(2 \times 3) \times (2 \times 3) \times (2 \times 3) \quad \text{Exponents are repeated multiplication}$$

$$(2 \times 2 \times 2) \times (3 \times 3 \times 3) \quad \text{Group the numbers}$$

$$2^3 \times 3^3$$

I know you are thinking, "There must be a shortcut!" You are right! Instead of writing all of that out every time, here's the shortcut: When a product is raised to a power, the power is applied to each factor inside the parentheses.

$$\text{The Rule: } (a \cdot b)^m = a^m \cdot b^m$$

Before we jump into solving, let's take a moment to appreciate how cool this shortcut really is. Imagine having to write out all the multiplication every single time—yikes! The Power of a Product Rule saves us from that tedious work. This lets you leap straight to the answer. Now, let's see how it works in action.

Simplify

$$(4 \cdot 5)^2$$



Apply the power to each factor inside the parentheses.

$$(4 \cdot 5)^2 = 4^2 \cdot 5^2$$



Solve each part.

$$4^2 = 16 \text{ and } 5^2 = 25$$



Multiply the results.

$$16 \cdot 25 = 400$$

So,

$$(4 \cdot 5)^2 = 400$$



Ah...but now you may be saying, "What happens if there's a negative exponent?" No problem! You already know the reciprocal rule for negative exponents. Let's look at

an example:

Simplify
 $(3 \cdot 2)^{-2}$

Step 1 Apply the power to each factor inside the parentheses.
 $(3 \cdot 2)^{-2} = 3^{-2} \cdot 2^{-2}$

Step 2 Rewrite each part with positive exponents.
(remember the reciprocal rule for negative exponents)
 $3^{-2} = \frac{1}{3^2}$ and $2^{-2} = \frac{1}{2^2}$

Step 3 Multiply the results.
 $\frac{1}{3^2} \cdot \frac{1}{2^2} = \frac{1}{9} \cdot \frac{1}{4} = \frac{1}{36}$
So,
 $(3 \cdot 2)^{-2} = \frac{1}{36}$



It's time to record this rule. Find your "Properties of Exponents Notes" page in your Interactive Notebook and fill in the notes for this rule. Don't forget to return the page to your Interactive Notebook so you can easily find it for the next activity.

The Power of a Product Rule helps you simplify expressions with ease and makes exponents way more manageable. Whether the powers are positive or negative, this rule gives you the tools to break problems into bite-sized pieces. Practice on the activity page titled "Power of a Product Practice," and you'll be a pro in no time.

☐ Activity 6: Mixed Review

Get ready to bring all your exponent skills together in one place!

First, watch the video at the following link.



Algebra Basics: Laws Of Exponents - Math Antics
www.beyondthepage.com/link/13013/

Now, complete the activity page titled "Mixed Review." Don't forget to use your "Properties of Exponents Notes" page in your Interactive Notebook as a reference source. Once you have found the answer in Exponent Form, use your calculator to simplify and find the Numerical Answer.

Wrapping Up

You've just completed an exciting journey through the Properties of Exponents! In this lesson, you mastered essential rules that make working with exponents easier and more efficient. Here's a quick recap of what you accomplished:

- **Negative and Zero Exponents:** You learned that any base raised to the power of 0 equals 1, and negative exponents turn into fractions by flipping the base.
- **Product and Quotient of Powers:** You discovered how to multiply and divide exponents with the same base by adding or subtracting their exponents, saving yourself from writing out long strings of multiplication.
- **Power of a Power and Power of a Product:** You explored how to handle exponents stacked on top of each other and how to distribute exponents across products or fractions.

These skills are powerful tools that simplify complex problems and prepare you for more advanced math topics like polynomials and scientific notation. Remember, exponents aren't just abstract math—they help describe real-world phenomena, from population growth to calculating interest. Great work! You're ready for what's next.

☐ Life Application: Exponents in the Real World (Optional)

If you are interested in reading about why exponent powers are important in the real world, read the interesting facts in the following link.



Exponents in the Real World

www.beyondthepage.com/link/12510/

Learning Gates

Take the [Learning Gates quiz](#) for this lesson.



Properties of Exponents Notes

Activity 1

Zero Exponents Rule

$$x^0 = \underline{\hspace{2cm}}$$

 $\underline{\hspace{2cm}}$ Exponents Rule

$$x^{-n} = \underline{\hspace{2cm}}$$

Activity 2

Multiplication (Product of Powers)

$$x^m \cdot x^n = \underline{\hspace{2cm}}$$

Activity 3

Division (Quotient of Powers)

$$\frac{x^m}{x^n} = \underline{\hspace{2cm}}$$

Activity 4

Power of $\underline{\hspace{2cm}}$ Rule

$$(x^m)^n = x^{m \cdot n}$$

Activity 5

Power of $\underline{\hspace{2cm}}$ Rule

$$(x \cdot y)^m = \underline{\hspace{2cm}}$$

Power of $\underline{\hspace{2cm}}$ Rule

$$\left(\frac{x}{y}\right)^n = \underline{\hspace{2cm}}$$

Negative & Zero Exponents

Directions: Solve the following problems.

Negative Exponents: Flip the base to create the reciprocal.	Zero Exponents: Any base except zero raised to the power of 0 is 1.
$a^{-n} = \frac{1}{a^n}$ Example: $2^{-3} = \frac{1}{2^3} = \frac{1}{8}$	$a^0 = 1$ Example: $5^0 = 1$



1. $5^0 =$

6. $4^{-2} =$

2. $3^{-2} =$

7. $7^0 =$

3. $7^{-1} =$

8. $6^{-2} =$

4. $2^{-3} =$

9. $8^{-2} =$

5. $10^0 =$

10. $2^0 =$



$$\frac{1}{5^{-1}} =$$

Multiplying Exponents

Directions: Solve the following problems. Once you have figured out the exponent, you can use a calculator to multiply the base the proper number of times.

The Product of Powers Rule

The Product of Powers Rule states that when multiplying powers with the same base, you add the exponents.

$$a^m \times a^n = a^{m+n}$$

For negative exponents, you flip the base to create a reciprocal.

$$a^{-n} = \frac{1}{a^n}$$



1. $2^3 \times 2^4 =$

6. $7^1 \times 7^4 =$

2. $5^2 \times 5^3 =$

7. $2^1 \times 2^{-3} =$

3. $3^1 \times 3^5 =$

8. $5^2 \times 5^{-4} =$

4. $4^4 \times 4^2 =$

9. $2^3 \times 3^3 =$

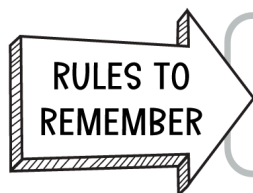
5. $6^2 \times 6^3 =$

10. $4^2 \times 5^1 =$



Dividing Exponents

Directions: Solve the following problems. Once you have figured out the exponent, you can use a calculator on problems 2, 9, and 10 to multiply the base the proper number of times.



1. When the bases are the same: $a^m \div a^n = a^{m-n}$
2. For different bases, simplify each term separately.

1. $5^4 \div 5^2 =$

6. $8^3 \div 8^1 =$

2. $7^6 \div 7^3 =$

7. $6^4 \div 6^5 =$

(Hint: What happens when the exponent becomes negative?)

3. $2^5 \div 2^2 =$

8. $2^3 \div 3^2 =$

4. $4^8 \div 4^6 =$

9. $10^5 \div 2^2 =$

5. $3^7 \div 3^4 =$

10. $5^6 \div 5^0 =$

(Hint: What is anything to the power of 0?)

Challenge Problem

$$(3^4 \div 3^2) \times (2^3 \div 2^1) =$$



Power of a Power Practice

Directions: When you raise a power to another power, you multiply the exponents.

Use the Power of a Power Rule to simplify.

$$(a^m)^n = a^{m \times n}$$

For negative exponents, remember this rule.

$$a^{-n} = \frac{1}{a^n}$$

Use a calculator if needed for large powers.

Example:

$$(2^3)^2$$

Step 1: Multiply the exponents: $3 \cdot 2 = 6$

Step 2: Rewrite as 2^6

Step 3: Simplify: $2^6 = 64$



1. $(3^2)^4 =$ _____

5. $(6^{-2})^3 =$ _____

9. $(10^2)^3 =$ _____

2. $(5^{-3})^{-2} =$ _____

6. $(8^{-3})^2 =$ _____

10. $(2^{-2})^3 =$ _____

3. $(2^4)^3 =$ _____

7. $(2^0)^5 =$ _____

(Hint: Anything to the power of 0 is 1!)

4. $(4^2)^3 =$ _____

8. $(7^{-1})^4 =$ _____

Challenge Question:

$$((3^2)^3)^2$$



Powers of a Product Practice

Power of a Product Rule

$$(a \cdot b)^m = a^m \cdot b^m$$

Directions: Use the Power of a Product Rule to solve the following problems. Distribute the exponent to each base, simplify where possible, and handle negative exponents carefully.

Example:

$$(2 \cdot 3)^3 = \underline{2^3 \cdot 3^3} = 8 \cdot 27 = 216$$

1. $(2 \cdot 5)^2 =$

6. $(6 \cdot 8)^2 =$

2. $(3 \cdot 4)^3 =$

7. $(3 \cdot 7)^{-1} =$

3. $(7 \cdot 6)^1 =$

8. $(2 \cdot 10)^3 =$

4. $(2 \cdot 3)^{-2} =$

9. $(4 \cdot 5)^{-2} =$

5. $(5 \cdot 4)^0 =$

10. $(9 \cdot 2)^2 =$

Challenge Problem

$$(3 \cdot 4)^2 \cdot (2 \cdot 5)^{-1} =$$



Mixed Review



Directions: First, find the answer in Exponent Form. Then use your calculator to simplify and find the Numerical Answer.

1. $3^4 \times 3^2 =$

Exponent Form:

Numerical Answer:

2. $(2^3)^2 =$

Exponent Form:

Numerical Answer:

3. $5^7 \div 5^4 =$

Exponent Form:

Numerical Answer:

4. $(4 \times 5)^3 =$

Exponent Form:

Numerical Answer:

5. $10^{-3} =$

Exponent Form:

Numerical Answer:

6. $8^0 =$

Exponent Form:

Numerical Answer:

7. $(6^2 \times 6^3) \div 6^4 =$

Exponent Form:

Numerical Answer:

8. $\left(\frac{2}{3}\right)^3 =$

Exponent Form:

Numerical Answer:

9. $(7^3 \div 7^5) \times 7^2 =$

Exponent Form:

Numerical Answer:

10. $(4^{-2}) \times (4^3) =$

Exponent Form:

Numerical Answer:

Lesson 3: Properties of Exponents (3 Days)

Getting Started

✿ Ideas to Think About

- How do the properties of exponents reveal deeper patterns in mathematics?
- In what ways do the rules for exponents connect to the distributive or associative property?
- Why are exponents critical for representing and solving problems involving real-world problems?

📖 Things to Know

- **Positive exponents** are repeated multiplication of the same number. For example, $3^3 = 3 \times 3 \times 3 = 27$.
- For **negative exponents**, you flip the base to create a reciprocal. The formula is $a^{-n} = 1/a^n$.
- Any base (except zero) with a **zero exponent** is 1. The formula is $a^0 = 1$.
- The **Product of Powers Rule** states that when multiplying powers with the same base, you add the exponents: $a^m \times a^n = a^{m+n}$.
- The **Quotient of Powers Rule** states that when dividing powers with the same base, subtract the exponents: $a^m/a^n = a^{m-n}$.
- The **Power of a Power Rule** states that you start with the base and multiply the exponents: $(a^m)^n = a^{m \times n}$.
- The **Power of a Product Rule** states that when a product is raised to a power, the power is applied to each factor inside the parentheses: $(a \cdot b)^m = a^m \cdot b^m$.
- The **Power of a Quotient Rule** states that when raising a fraction to a power, apply the exponent to both the numerator and the denominator: $(a/b)^n = a^n/b^n$.

🎯 Skills

- Know and apply the properties of integer exponents to generate equivalent numerical expressions.

Introducing the Lesson

In this lesson, your child will explore the powerful world of exponents and the essential rules that govern them. From understanding the basics of zero and negative exponents to mastering more advanced properties like the product, quotient, and power of exponents, she will gain the tools to simplify complex mathematical expressions with confidence. These concepts are not only foundational for higher-level math courses like algebra and calculus but also have practical applications in science, engineering, and technology. By the end of this lesson, your child will have a deeper understanding of how to work with exponents, enabling her to solve challenging problems and recognize patterns in exponential relationships. This journey will strengthen her problem-solving skills and prepare her for real-world scenarios where precision and efficiency are key.

Activities

Activity 1: Negative and Zero Exponents

In this lesson, your child takes notes for her Interactive Notebook about the rules and properties of exponents. In the first activity, she watches a video to learn about the properties of negative and zero exponents and takes notes on these two rules. The Answer Key for the "Properties of Exponents Notes"

page is available in Activity 5. She learns that any non-zero number raised to the power of zero equals 1, a foundational rule in math. She also discovers how negative exponents work by expressing them as fractions with positive exponents in the denominator (e.g., $2^{-3} = 1/2^3 = 1/8$). Through examples and practice problems, your child strengthens her ability to simplify expressions with exponents, building confidence in applying these rules to solve equations. This lesson lays the groundwork for understanding more complex exponent rules in future math topics.

Answer Key:

- | | |
|-----------|---------------------------|
| 1. 1 | 7. 1 |
| 2. $1/9$ | 8. $1/36$ |
| 3. $1/7$ | 9. $1/64$ |
| 4. $1/8$ | 10. 1 |
| 5. 1 | 11. Challenge Question: 5 |
| 6. $1/16$ | |

Activity 2: Multiplying Exponents – The Product of Powers Rule

In this activity, your child learns how to multiply numbers with exponents by applying the Product of Powers Rule: when the bases are the same, she adds the exponents (e.g., $a^m \times a^n = a^{m+n}$). She discovers that this shortcut simplifies repeated multiplication. She also explores how to handle negative exponents, which require flipping the base to create a reciprocal (e.g., $a^{-n} = 1/a^n$). Additionally, your child practices multiplying exponents with different bases, learning to solve each exponent separately before multiplying the results together. She continues to complete the "Properties of Exponents Notes" page in her Interactive Notebook. The Answer Key for this page is found in Activity 5. This activity reinforces problem-solving skills and builds a deeper understanding of how exponents simplify complex multiplication, preparing her for more advanced mathematical concepts.

Answer Key:

- | | |
|----------|---|
| 1. 2^7 | 6. 7^5 |
| 2. 5^5 | 7. 2^{-2} |
| 3. 3^6 | 8. 5^{-2} |
| 4. 4^6 | 9. $2^3 = 8, 3^3 = 27, 8 \times 27 = 216$ |
| 5. 6^5 | 10. $4^2 = 16, 5^1 = 5, 16 \times 5 = 80$ |

Day 2

Activity 3: Dividing Exponents - The Quotient of Powers Rule

In Activity 3, your child learns how to divide numbers with exponents efficiently by applying a shortcut: when the bases are the same, she subtracts the exponents. For example, $5^4 \div 5^2 = 5^{4-2} = 5^2$. This rule simplifies lengthy division into a quick, logical step. She also discovers what happens when the exponent becomes negative and reviews the rule that anything raised to the power of zero equals one. Additionally, the activity reinforces that when the bases are different, each term must be simplified separately before dividing. She continues completing the "Properties of Exponents Notes" page in her Interactive Notebook. The Answer Key for this page is found in Activity 5.

Answer Key:

1. 5^2

2. 7^3

3. 2^3

4. 4^2

5. 3^3

6. 8^2

7. 6^{-1}

8. $2^3 = 8$, $3^2 = 9$, $8/9$

9. $10^5 = 100,000$, $2^2 = 4$, $100,000/4 = 25,000$

10. 5^6

11. Challenge Question: $3^2 = 9$, $2^2 = 4$, $9 \times 4 = 36$

Activity 4: Power of a Power

In this activity, your child watches a video to explore the Power of a Power Rule, learning how to simplify expressions where one exponent is raised to another. She discovers that the shortcut to solving these problems is to multiply the exponents while keeping the base the same. Your child also practices working with negative exponents, applying the rule to rewrite them as reciprocals, and reinforces her understanding of mathematical patterns and relationships. In addition, she continues to complete the "Properties of Exponents Notes" page in her Interactive Notebook. The Answer Key for this page can be found in Activity 5. This activity encourages critical thinking and builds foundational skills for more advanced algebra concepts.

Answer Key:

1. $3^8 = 6561$

2. $5^6 = 15,625$

3. $2^{12} = 4096$

4. $4^6 = 4096$

5. $6^{-6} = .00021433$

6. $8^{-6} = .000003815$

7. $1^5 = 1$

8. $7^{-4} = .000416493$

9. $10^6 = 1,000,000$

10. $2^{-6} = .015625$

11. Challenge Question: $3^{12} = 531,441$

Day 3**Activity 5: Power of a Product**

In this activity, your child explores the "Power of a Product" rule, a key concept in exponents. She learns how to simplify expressions where a product (multiplication) is raised to a power by applying the rule: $(a \cdot b)^m = a^m \cdot b^m$. This means distributing the exponent to each part of the product. She also practices solving problems with both positive and negative exponents, understanding how the rules apply in each case. In addition, she continues to complete the "Properties of Exponents Notes" page in her Interactive Notebook. The Answer Key for this page can be found in this activity. Through engaging examples and practice, your child strengthens her ability to simplify complex expressions and gains confidence in working with exponent properties.

Answer Key:

1. $2^2 \cdot 5^2 = 4 \cdot 25 = 100$

2. $3^3 \cdot 4^3 = 27 \cdot 64 = 1728$

3. $7^1 \cdot 6^1 = 7 \cdot 6 = 42$

4. $2^{-2} \cdot 3^{-2} = 1/2^2 \cdot 1/3^2 = 1/4 \cdot 1/9 = 1/36$

5. $5^0 \cdot 4^0 = 1 \cdot 1 = 1$

6. $6^2 \cdot 8^2 = 36 \cdot 64 = 2304$

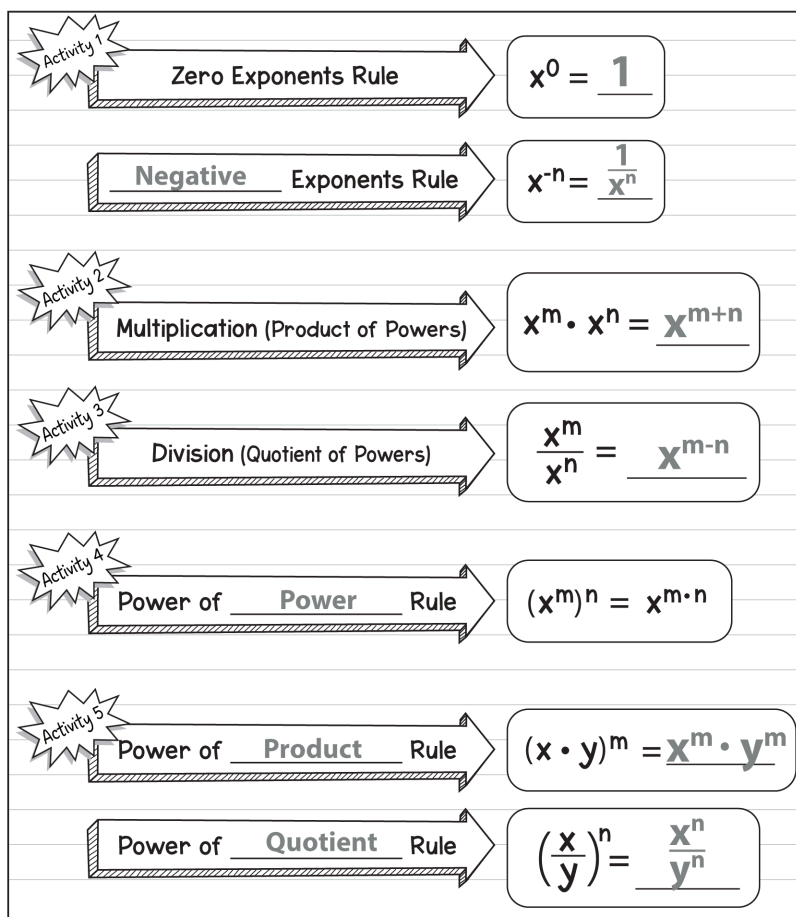
7. $3^{-1} \cdot 7^{-1} = 1/3 \cdot 1/7 = 1/21$

8. $2^3 \cdot 10^3 = 8 \cdot 1000 = 8000$

9. $4^{-2} \cdot 5^{-2} = 1/4^2 \cdot 1/5^2 = 1/16 \cdot 1/25 = 1/400$

10. $9^2 \cdot 2^2 = 81 \cdot 4 = 324$

11. Challenge Question: $(3^2 \cdot 4^2) \cdot (2^{-1} \cdot 5^{-1}) = (9 \cdot 16) \cdot (1/2 \cdot 1/5) = 144 \cdot 1/10 = 144/10 = 14.4$ or $14 \frac{2}{5}$

"Properties of Exponents Notes" Answer Key**Activity 6: Mixed Review**

In this activity, your child reviews and applies all the exponent rules he has learned throughout the lesson. He watches a video on the Laws of Exponents and uses his Interactive Notebook as a reference to solve a variety of exponent problems. This mixed review challenges him to simplify expressions using key exponent properties, including the Product of Powers, Quotient of Powers, Power of a Power, Power of a Product, Zero Exponents, and Negative Exponents. By completing this review, he reinforces his understanding of how exponents work together and gains confidence in solving complex exponent expressions efficiently.

Answer Key:

1. $3^{(4+2)} = 3^6 = 729$

2. $(2^3)^2 = 2^{(3 \times 2)} = 2^6 = 64$

3. $5^{(7-4)} = 5^3 = 125$

4. $(4^3 \times 5^3) = 64 \times 125 = 8000$

5. $10^{-3} = 1/10^3 = 1/1000$

6. $8^0 = 1$

7. $(6^{(2+3)}) \div 6^4 = 6^5 \div 6^4 = 6^{(5-4)} = 6^1 = 6$

8. $(2^3 / 3^3) = 8/27$

9. $(7^{(3-5)}) \times 7^2 = 7^{-2} \times 7^2 = 7^{(-2+2)} = 7^0 = 1$

10. $(4^{-2}) \times (4^3) = 4^{(-2+3)} = 4^1 = 4$

Wrapping Up

In this lesson, your child explored the properties of exponents and built a solid understanding of how these powerful mathematical tools work. She learned how to simplify expressions using the Product of Powers, Quotient of Powers, Power of a Power, and Power of a Product rules. She also practiced applying zero and negative exponents, building flexibility and confidence in handling a wide range of exponent problems. By completing a mixed review and keeping a personalized set of notes in her Interactive Notebook, she is now well prepared to tackle more advanced topics in algebra and to apply these skills in real-world situations where exponents play a key role.

Life Application: Exponents in the Real World (Optional)

As an option, by exploring the provided link, your child can connect the concept of exponent powers to real-world applications, demonstrating their importance in fields like science, technology, and finance.

Questions to Discuss

- Can you explain how negative exponents work and give me an example? (*Negative exponents show that the base is flipped into its reciprocal. For example, $2^{-3} = 1/2^3 = 1/8$*)
- If you see the expression $(3 \cdot 4)^2$, what rule would you use to simplify it, and what is the answer? (*You use the Power of a Product Rule, which says to apply the exponent to each factor. $(3 \cdot 4)^2 = 3^2 \cdot 4^2 = 9 \cdot 16 = 144$*)
- What happens when you divide powers with the same base, like $5^6 \div 5^2$? (*You use the Quotient of Powers Rule, which says to subtract the exponents: $5^6 \div 5^2 = 5^{6-2} = 5^4 = 625$*)

Things to Review

- Review the formulas on the "Properties of Exponents Notes" page in the Interactive Notebook.