

**CURRIKI ALGEBRA UNIT 2**  
Linear and Exponential Relationships  
Lesson 2.5: Division Properties of Exponents

**Unit 2: Linear and Exponential Relationships**

The first nine lessons (2.1-2.9) provide the instruction and practice that supports the culminating two-day final unit project.

**Lesson 2.5: Division Properties of Exponents**

Both multiplication and division properties of exponents have the basic rules of operation for exponents. The associative and communicative laws of multiplication underlie the multiplication properties of exponents. We use the associative law to remove parentheses and the commutative law to rearrange factors within a product. In this lesson, students will learn to relate these considerations to the Division Properties of Exponents. Through using these division properties people can find useful information such as ratios.

**Common Core State Standards by Cluster**

Grade Level	Cluster	CCS Standard
8		8.EE.1
9	Extend the properties of exponents to rational exponents	N.RN.2 (Note: This standard is covered because the lesson deals with rational exponents “rewrite expressions involving rational exponents using the properties of exponents.”)

**Lesson Preparation Resources for Teachers:**

<http://www.khanacademy.org/video/exponent-properties-4?topic=exponents-radicals> (Sal Khan’s Video about exponent properties)

TE\_Vocabulary 2.5

TE\_Division Properties of Exponents

TE\_Division Properties of Exponents Assessment

TE\_Extension Activity 2.5

**Instructional Materials for Students (Print one copy for each student.)**

SE\_Vocabulary Student worksheet

SE\_Division Properties of Exponents

SE\_Division Properties of Exponents assessment

SE\_Extension Activity Sheet

<http://www.khanacademy.org/video/exponent-properties-4?topic=exponents-radicals> (Sal Khan’s Video about exponent properties)

**Time:** 50-minute session

**Lesson Objectives:**

Students will be able to:

- Apply the associative and communicative laws of multiplication that underlie the multiplication properties of exponents
- Use the associative law to remove parentheses and the commutative law to rearrange factors within a product
- Relate these considerations to the Division Properties of Exponents
- Understand that using these division properties people can find useful information such as ratios

**Lesson Content**

**1. Background Building Activity for Students (5 minutes)**

Ask students to recall what they learned about Multiplication Properties of Exponents. The material in this lesson, Division Properties of Exponents is similar. Both properties have the basic rules of operation for exponents. The associative and communicative laws of multiplication underlie the multiplication properties of exponents. We use the associative law to remove parentheses and the commutative law to rearrange factors within a product. In this lesson, students will learn to relate these considerations to the Division Properties of Exponents. Through using these division properties people can find useful information such as ratios. We will find the average salary of major league baseball players.

a. Vocabulary Building:

Distribute the Vocabulary student worksheet for this lesson. Be sure that students have access to dictionaries or a computer. Ask students to work in pairs to read the sentences that contain today's math vocabulary words. Student pairs should write down what they think the words mean from the context of the sentences and discuss the meaning.

Students can use the CSSR (Context, Structure, Sound, Reference) vocabulary development method.

- Arrive at the gist of the meaning through *context*
- Examine the *structure* of the word (prefixes, suffixes, roots, etc.) and combine that information with context.
- Pronounce a word (identifying its *sound*).
- Check an outside *reference* by looking it up in a dictionary or asking someone else.

The teacher should review the meaning of the vocabulary words and then discuss their meanings in context of the sentences (TE Vocabulary). Students

should work in pairs to write out their own meanings of each vocabulary word on the vocabulary worksheet after this discussion.

b. Warm-Up problem:

There are two division properties of exponents that will be covered in this lesson.

- **Quotient of powers property**

To divide powers that have the same base, you subtract the exponents.

- **Power of a quotient property**

To find a power of a quotient, first find the power of the numerator and the power for the denominator, and then divide.

Examples:

Write these warm-up questions on the board.

1. Quotient of powers property

Simplify the quotient:

$$5^8/5^6 = 5^{8-6}$$

Ask students to solve the problem individually.

Then write the solution on the board:

$$5^8/5^6 = 5^{8-6}$$

When using the quotient of powers property, subtract the exponents.

$$5^2 = 25$$

2. Power of a quotient property

Simplify the quotient.

$$(3/5)^2 = 3^2/5^2$$

Ask students to solve the problem individually.

Then write the solution on the board:

$$(3/5)^2 = 3^2/5^2$$

Evaluate the powers.

$$9/25$$

**2. Today's focus question (write it on the board)**

The average salary  $s$  (in thousands) for a professional baseball player can be shown by

$$S = 1000 (1.20)^t$$

$T = 0$  and represents the year 1995

Find the ratio of the average salary in 2000 to the average salary in 2012.

**a. Whole Group Activity**

The teacher writes the following model on the board

Because 1000 is a common factor to the average salaries for both years, you can omit it from the ratio.

$$\frac{\text{Average salary in 2012}}{\text{Average salary in 2000}} = \frac{(1.20)^{17}}{(1.20)^7} = (1.20)^{17-7}$$

$$(1.20)^{10} = 6.19$$

The ratio of the average salaries in 2007 to the average salaries in 2012 is 6.19 to 1. The average salary in 2012 is about 6 times higher than in 2007.

### b. Small Group Activity

Ask students to work in small groups of 3-4 to solve the following two questions.

**Power of a Quotient Property**

A team of deep-sea divers was given the task of exploring the bottom of both the Atlantic Ocean and the Pacific Ocean. They need to find out the ratio of the two ocean's depths to be sure they have the proper equipment.

The average depth of the Atlantic Ocean is  $108^2$  feet.

The average depth of the Pacific Ocean is 14,000 feet or  $118^2$  feet.

1. What is the ratio between the depths of the two oceans?

Solution:

$$118^2/108^2 = (118/108)^2 = 1.09^2 = 1.188$$

The ratio is 1.188 to 1.

2. John inherited \$1 million dollars in January 2008. February 1 of 2008, he bought  $4^5$  shares of Google stock at \$515.90 each. February of the 2012, he bought  $3^5$  additional shares of Google stock at \$606.52 each. What is the ratio the stock price in 2008 to 2012?

Solution:

$$(4 \cdot 515.90)^5 / (3 \cdot 606.52)^5 = (2,063.60/1,819.56)^5 = 1.134^5 = 1.87$$

The ratio is 1.87 to 1.

Ask groups to think of a real life example of ratios and write a problem. They can locate facts and figures on Google if there are computers available. Each group will pass their problem to the group to the right to solve. Discuss with the whole class the answers to the first two problems and the answers to the group authored problems.

### c. Individual Activity:

Teacher should distribute a copy of the *Division Properties of Exponents* student worksheet to each student. Ask students to solve the problems on the worksheet.

### 3. Whole class discussion (10 minutes)

Ask students to first share their solutions to a partner. The partners will determine the correct solutions. Call on partners to present one problem to the class, explain how to solve it, and identify the property they used. Ask students to discuss how this property might be used in real life by citing the problems solved in the small group activity.

**Algorithm:**

There are two division properties of exponents discussed in this lesson:

- **Quotient of powers property**  
To divide powers that have the same base, you subtract the exponents.
- **Power of a quotient property**  
To find a power of a quotient, first find the power of the numerator and the power for the denominator, and then divide.

**4. Assessment Activity (5 minutes)**

Teacher should distribute a copy of *Division Properties of Exponents* assessment sheet. Ask students to complete the problems. Once they complete the problems, students should pass their papers to the person on their right (or to another person under the teacher's arrangement). Students will add their names to the paper as "reviewer" then review the other student's solutions and add comments. The teacher will collect the papers and evaluation results both from the reviewers and the students.

**5. Extension or Homework Activities:**

Teacher should distribute the *Extension Activity Sheet* to each student. After students solve the problems on the sheet, students will work in pairs to use a computer to view Sal Khan's video to watch how he solves the problems and compare their solution process with his.

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