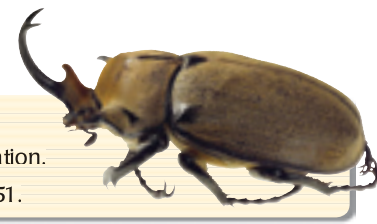


# 8.4 Use Scientific Notation



## 1 PLAN AND PREPARE

### Warm-Up Exercises

#### Transparency Available

- Order the numbers 0.014, 0.1, 0.01 from least to greatest. **0.01, 0.014, 0.1**
- Find the ratio of the mass of the Milky Way galaxy, which is about  $10^{44}$  grams, to the mass of the universe, which is about  $10^{55}$  grams. **about  $\frac{1}{10^{11}}$**

### Notetaking Guide

#### Transparency Available

Promotes interactive learning and notetaking skills, pp. 176–178.

### Pacing

**Basic:** 2 days

**Average:** 2 days

**Advanced:** 2 days

**Block:** 1 block

• See *Teaching Guide/Lesson Plan*.

## 2 FOCUS AND MOTIVATE

### Essential Question

**Big Idea 2, p. 487**

How do you write a number in scientific notation? **Tell students they will learn how to answer this question by rewriting a number as the product of a number from 1 up to 10 and a power of 10.**

### NCTM STANDARDS

**Standard 1:** Compute fluently

**Standard 2:** Analyze situations using algebraic symbols

#### Before

You used properties of exponents.

#### Now

You will read and write numbers in scientific notation.

#### Why?

So you can compare lengths of insects, as in Ex. 51.

### Key Vocabulary

#### scientific notation

Numbers such as 1,000,000, 153,000, and 0.0009 are written in *standard form*. Another way to write a number is to use *scientific notation*.

### KEY CONCEPT

*For Your Notebook*

#### Scientific Notation

A number is written in **scientific notation** when it is of the form  $c \times 10^n$  where  $1 \leq c < 10$  and  $n$  is an integer.

Number	Standard form	Scientific notation
Two million	2,000,000	$2 \times 10^6$
Five thousandths	0.005	$5 \times 10^{-3}$

### EXAMPLE 1

#### Write numbers in scientific notation

a.  $42,590,000 = 4.259 \times 10^7$

Move decimal point 7 places to the left.  
Exponent is 7.

b.  $0.0000574 = 5.74 \times 10^{-5}$

Move decimal point 5 places to the right.  
Exponent is  $-5$ .

### EXAMPLE 2

#### Write numbers in standard form

a.  $2.0075 \times 10^6 = 2,007,500$

Exponent is 6.  
Move decimal point 6 places to the right.

b.  $1.685 \times 10^{-4} = 0.0001685$

Exponent is  $-4$ .  
Move decimal point 4 places to the left.

### READING

A positive number in scientific notation is greater than 1 if the exponent is positive. A positive number in scientific notation is between 0 and 1 if the exponent is negative.

**Animated Algebra** at classzone.com



### GUIDED PRACTICE for Examples 1 and 2

- Write the number 539,000 in scientific notation. Then write the number  $4.5 \times 10^{-4}$  in standard form.  **$5.39 \times 10^5$ ; 0.00045**

## Resource Planning Guide

### Chapter Resource Book

- Teaching Guide/Lesson Plan (pp. 36–37)
- Activity Master (p. 38)
- Practice levels A, B, C (pp. 39–41)
- Study Guide (pp. 42–43)
- Catch-up for Absent Students (p. 44)
- Application (p. 45)
- Challenge (p. 46)

### Workbooks

- Notetaking Guide (pp. 176–178)
- Practice Workbook (pp. 125–126)

### Teaching Options

- Power Presentations CD-ROM** provides dynamic electronic teaching resources for the classroom.
- Activity Generator CD-ROM** provides editable activities for all ability levels.

### Interactive Technology

- Easy Planner
- Power Presentations CD-ROM
- Activity Generator CD-ROM
- Animated Algebra
- Test Generator CD-ROM
- Online Quiz
- eWorkbook
- eEdition
- @HomeTutor

### Resources for English Learners

- Quick Reference for English Learners
- Spanish Study Guide
- Multi-Language Visual Glossary
- Student Resources in Spanish

See also the *Algebra 1 Toolkit* for more strategies for meeting individual needs.

### EXAMPLE 3 Order numbers in scientific notation

Order 103,400,000,  $7.8 \times 10^8$ , and 80,760,000 from least to greatest.

#### Solution

**STEP 1** Write each number in scientific notation, if necessary.

$$103,400,000 = 1.034 \times 10^8 \quad 80,760,000 = 8.076 \times 10^7$$

**STEP 2** Order the numbers. First order the numbers with different powers of 10. Then order the numbers with the same power of 10.

Because  $10^7 < 10^8$ , you know that  $8.076 \times 10^7$  is less than both  $1.034 \times 10^8$  and  $7.8 \times 10^8$ . Because  $1.034 < 7.8$ , you know that  $1.034 \times 10^8$  is less than  $7.8 \times 10^8$ .

$$\text{So, } 8.076 \times 10^7 < 1.034 \times 10^8 < 7.8 \times 10^8.$$

**STEP 3** Write the original numbers in order from least to greatest.

$$80,760,000; 103,400,000; 7.8 \times 10^8$$

### EXAMPLE 4 Compute with numbers in scientific notation

Evaluate the expression. Write your answer in scientific notation.

a.  $(8.5 \times 10^2)(1.7 \times 10^6)$

$$= (8.5 \cdot 1.7) \times (10^2 \cdot 10^6)$$

Commutative property and associative property

$$= 14.45 \times 10^8$$

Product of powers property

$$= (1.445 \times 10^1) \times 10^8$$

Write 14.45 in scientific notation.

$$= 1.445 \times (10^1 \times 10^8)$$

Associative property

$$= 1.445 \times 10^9$$

Product of powers property

b.  $(1.5 \times 10^{-3})^2 = 1.5^2 \times (10^{-3})^2$

$$= 2.25 \times 10^{-6}$$

Power of a product property

Power of a power property

c.  $\frac{1.2 \times 10^4}{1.6 \times 10^{-3}} = \frac{1.2}{1.6} \times \frac{10^4}{10^{-3}}$

$$= 0.75 \times 10^7$$

Product rule for fractions

Quotient of powers property

$$= (7.5 \times 10^{-1}) \times 10^7$$

Write 0.75 in scientific notation.

$$= 7.5 \times (10^{-1} \times 10^7)$$

Associative property

$$= 7.5 \times 10^6$$

Product of powers property

#### AVOID ERRORS

Notice that  $14.45 \times 10^8$  is *not* written in scientific notation because  $14.45 > 10$ .

#### REVIEW FRACTIONS

For help with fractions, see p. 915.



#### GUIDED PRACTICE for Examples 3 and 4

2. Order  $2.7 \times 10^5$ ,  $3,401 \times 10^4$ , and 27,500 from least to greatest.  
**27,500;  $3,401 \times 10^4$ ;  $2.7 \times 10^5$**

Evaluate the expression. Write your answer in scientific notation.

3.  $(1.3 \times 10^{-5})^2$   **$1.69 \times 10^{-10}$**  4.  $\frac{4.5 \times 10^5}{1.5 \times 10^{-2}}$   **$3 \times 10^7$**  5.  $(1.1 \times 10^7)(4.2 \times 10^2)$   **$4.62 \times 10^9$**

### Motivating the Lesson

Knowing how to write numbers in scientific notation allows you to better manage extremely large or small numbers with lots of zeros. For example, the number of electrons that pass through a 1-amp circuit every second is 625 followed by 16 zeros. It is easier to write the number in scientific notation in order to determine how many electrons pass through the circuit in 60 seconds.

### 3 TEACH

#### Extra Example 1

Write in scientific notation.

a. 267,500,000  **$2.675 \times 10^8$**

b. 0.000486  **$4.86 \times 10^{-4}$**

#### Key Question to Ask for Example 1

- How do you know if the power of 10 is positive or negative? **If the original number is greater than 1, the power is positive. If the original number is between 0 and 1, the power is negative.**

#### Extra Example 2

Write in standard form.

a.  $7.0234 \times 10^5$  **702,340**

b.  $3.096 \times 10^{-6}$  **0.00003096**



An **Animated Algebra** activity is available on-line for **Example 2**. This activity is also available on the **Power Presentations CD-ROM**.

#### Extra Example 3

Order 93,000,000,  $9.2 \times 10^6$ , and 9,028,000 from least to greatest.  
**9,028,000,  $9.2 \times 10^6$ , 93,000,000**