



**THIRD SPACE
LEARNING**

Math Intervention Pack

Understanding scientific
notation

Grade 8

How To Use This Resource

1. Title Slide

Use this slide to activate prior knowledge needed for lesson. Students should be encouraged to initially attempt the question presented independently.

2. Prior Learning

Use this slide to review the knowledge that will be required to be successful in this lesson. If students feel confident on the prior learning section of the Title Slide then this slide can be skipped

3. Let's Learn

Use this slide to introduce the concept. Tutors should work with the student to explore the concept together, usually using diagrams to support understanding.

4. Follow Me + Your Turn

The tutor should work through the follow me slide, modeling the process and explaining their thinking out loud.

Students should use the your turn slide as an opportunity to work through a question similar to the follow me questions. They should apply the method modeled by the tutor in the follow me slide. Students should be encouraged to explain their thinking out loud.

5. You Do

Students should work through a range of questions that build in complexity.

Tutors can offer support but students should initially be encouraged to attempt these questions independently.

6. Go Further

Use this slide to allow students to apply their understanding to a more challenging question in an unfamiliar context.

How To Use This Resource

7. Support for Slides

The support slide is used to support students during the lesson. In the tutor notes, there will be guidance as to when to use the support slide.

8. Check Your Understanding

Tutors should use this slide to assess the student's knowledge and whether or not they have mastered the concept within the lesson.

Standard

8.EE.A.3 - Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3×10^8 and the population of the world as 7×10^9 , and determine that the world population is more than 20 times larger.

Key Mathematical Ideas

1. Identify and expand powers of 10 written with exponents.
2. Convert between a number and its scientific notation.
3. Compare two numbers written in scientific notation by reasoning about each part of the expressions.

Overview

Terminology

- **Base:** The number multiplied by itself in an exponential term. For example, in 4^2 , 4 is the base.
- **Exponent:** The small number that tells how many times the base is multiplied by itself in an exponential term. For example, in 4^2 , 2 is the exponent so $4^2 = 4 \times 4$.

Sentence Stems

- ___ is ___ place value positions larger than ___.
- Negative powers of 10 represent (smaller/larger) numbers, because...
- Positive powers of 10 represent (smaller/larger) numbers, because...

Overview

Common Misconceptions

Common Misconceptions	Tutoring Strategies	Checks for Understanding
Students who do not use place value reasoning when working with scientific notation.	While it is not incorrect to solve an expression with scientific notation to generate the exact number, the focus should be on using place value reasoning to figure out the number's exact value.	Ask students to explain how they solved and how the power of 10 connects to the value of the exact number.

Title Slide

If students...

- get both sections correct:
 - start at You do
- miss the learning goal section only:
 - start at Let's Learn
- miss the prior learning section:
 - start at Prior Learning

Prior Learning

If stuck

- Choose the method the student prefers to convert from fractions to decimals.
 - Read the fractions and identify the decimal place value needed.
 - Divide the numerator by the denominator.
- Performing calculations is not a goal of this lesson, so let students use a calculator when necessary.

Let's Learn

If stuck

- Review the powers of 10 from the Prior Learning slide.

Questions

- Why are larger numbers represented by positive powers of 10? (Multiplying a number by positive powers of 10 increases the place value - therefore moving the decimal to the right.)
- Why are smaller numbers represented by negative powers of 10? (Multiplying a number by negative powers of 10 decreases the place value - therefore moving the decimal to the left.)
- How can you prove the numbers are equivalent to their scientific notation form? (Complete the scientific notation calculation.)
- Why is it useful to write really small (or big) numbers with scientific notation? (Answers will vary.)

Watch out for

- Students who miscount the number of place value changes - decimals movements.

Answers

- $6,100,000,000 = 6.1 \times 10^9$
- $0.0005 = 5 \times 10^{-4}$

Follow me

Modeling prompts

- a) Identify the starting number by placing the decimal after 3.
- a) Count the number of place value position changes from 3.01 to 0.0301 and identify this as the power of 10.)
- b) Identify the number of place value position changes and the direction based on the power of 10.
- b) Write the number.
- c) Identify that 8×10^6 will be larger, since the power of 10 is larger.
- c) Compare each part of 8×10^6 to 4×10^4 .

Answers

- a) 3.01×10^{-2}
- b) 1,800,000
- c) 8 is 2 times larger than 4.
- 10^6 is 100 times larger than 10^4 .
- $2 \times 100 = 200$
- 8×10^6 is 200 times larger.

Your turn

If stuck

- Use similar guidance given in the Modeling prompts.

Questions

- d) How many place value positions larger is 9 than the number shown? (7.)
- d) Is the power of 10 negative or positive? Why? (Since we are representing a number smaller than 9, we use a negative power to 10, which decreases the place value.)
- e) Identify the number of place value position changes and the direction based on the power of 10. (The number will increase by 7 place value positions.)
- f) Which expression is larger and how do you know? (9×10^{10} is larger than 3×10^7 because there are three more powers of 10, which is three place value positions larger.)

Watch out for

- Students who miscount the number of place value changes - decimals movements.

Answers

- d) 9×10^{-7}
- e) 40,100,000
- f) 9 is 3 times larger than 3.
- 10^{10} is 1000 times larger than 10^7 .
- $3 \times 1000 = 3,000$
- 3×10^7 is 3,000 times larger.

You do

If stuck

- Use the Support slide for question c.

Questions

- a) How many place value positions smaller is 8 than the number shown? (11.)
- a) Is the power of 10 negative or positive? Why? (Since we are representing a number larger than 9, we use a positive power to 10, which increases the place value.)
- b) Identify the number of place value position changes and the direction based on the power of 10. (The number will decrease by 8 place value positions.)
- c) Which expression is larger and how do you know?
(3.9×10^4 is larger than 1.3×10^3 because there is one more power of 10, which is one place value position larger.)

Watch out for

- Students who miscount the number of place value changes - decimals movements.

Answers

- a) $800,000,000,000 = 8 \times 10^{11}$
- b) 0.000000022
- c) 3.9 is 3 times larger than 1.3.
- 10^4 is 10 times larger than 10^3 .
- $3 \times 10 = 30$, so 3.9×10^4 is 30 times larger than 1.3×10^3 .

Go further

If stuck

- Performing calculations is not a goal of this lesson, so let students use a calculator when necessary.
- Remind students that we compare one scientific number to another - which includes both parts of the expression.

Questions

- Why is “50 times larger” a reasonable answer? (Looking at the power of 10, 4×10^6 is 100 times larger than 8×10^4 . However, since 4 is half of 8 the overall difference value of the numbers will be half of 100, which is 50.)
- Why are the “times smaller” and “times larger” the same number? (The number represents the distance between the two numbers, which has the same magnitude, regardless of the comparison direction.)

Watch out for

- Students who think that both parts of the expression should increase from the largest expression to the smallest.

Answers

- 4 is 0.5 times larger than 8.
- 10^6 is 100 times larger than 10^4
- $0.5 \times 100 = 50$, so 4×10^6 is 50 times larger.
- This also means that 8×10^4 is 50 times smaller.
- 1.2 is 0.25 times larger than 4.8.
- 10^{10} is 1000 times larger than 10^7
- $0.25 \times 1000 = 250$, so 1.2×10^{10} is 250 times larger.
- This also means that 4.8×10^7 is 250 times smaller.

Support for Slide(s)

Questions

- 1) Which expression is larger and how do you know?
(3.9×10^4 is larger than 1.3×10^3 because there is one more power of 10, which is one place value position larger.)
- What does $\frac{1.3}{1.3}$ simplify to? (1.)
- Compare each strategy. Which do you prefer? (Answers will vary.)

Answers

- 1. a) 1,000
- b) 10,000
- c) 10
- 2. a) 3
- 3. 1.3×10^3 is 30 times smaller than 3.9×10^4 .
- $\frac{3 \times 10}{1}$

Check your Understanding

Correct answer:

400

Today you will learn about

Understanding scientific notation



Learning Goal

Compare the value of numbers shown in scientific notation.

$$2 \times 10^5 \text{ and } 4 \times 10^6$$

4×10^6 is times larger.

Prior Learning

Write 10^{-2} as a fraction and a decimal.

<input type="text"/>
.....
<input type="text"/>
.....

.....

Prior learning

Before understanding scientific notation, we need to understand the value of **powers of 10**.

Powers of 10 are exponents that have 10 as a base.

$$10^1 = 10$$

$$10^2 = 10 \times 10 = 100$$

$$10^3 = 10 \times 10 \times 10 = \dots\dots\dots$$

$$10^4 = 10 \times 10 \times 10 \times 10 = 10,000$$

Use the rule for negative exponents to simplify

$$10^{-1} = \frac{1}{10^1} = \frac{1}{10} = 0.1$$

$$10^{-2} = \frac{1}{10^2} \times \frac{1}{100} = 0.01$$

$$10^{-3} = \frac{1}{10^3} \times \frac{1}{1000} = \dots\dots\dots$$

$$10^{-4} = \frac{1}{10^4} \times \frac{1}{10000} = 0.0001$$

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

Let's practice a few.

a $10^8 = \dots\dots\dots$

b $10^{-6} = \dots\dots\dots$

c $10^6 = \dots\dots\dots$

Let's learn

Scientific notation allows us to represent **very big** numbers in a simplified way.

A number in scientific notation is written as: $a \times 10^b$

A number bigger than or equal to 1 and less than 10 \rightarrow a \leftarrow A positive power of 10 b

For example,

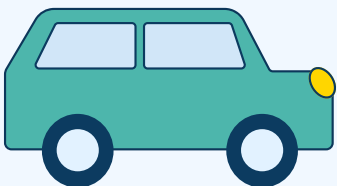
The distance to the sun in meters:



150,000,000,000 m

scientific notation = 1.5×10^{11}

The weight of a car in grams:



1,900,000 g

scientific notation = 1.9×10^6

To write a number in scientific notation, we need to write it as a multiplication of a value between 1 and 10 and a power of 10.

- Put the new decimal point after the first non-zero digit.
- Count how many place value position changes are needed.

same as the
exponent in
the power of 10

Write 6,100,000,000 in scientific notation:

$$6 \downarrow 100,000,000. = \dots \times \dots$$

(Note: In the original image, orange arrows indicate counting 10 places from the first non-zero digit to the decimal point.)

Let's learn

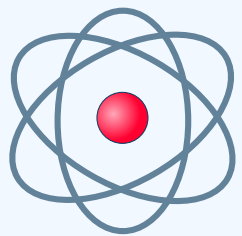
Scientific notation allows us to represent **very small** numbers in a simplified way.

A number in scientific notation is written as: $a \times 10^{-b}$

A number bigger than or equal to 1 and less than 10 → A negative power of 10

For example,

The width of an atom in meters:



0.00000000025 m

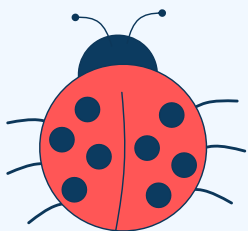
scientific notation = 2.5×10^{-10}

To write a number in scientific notation, we need to write it as a multiplication of a value between 1 and 10 and a power of 10.

- Put the new decimal point after the first non-zero digit.
- Count how many place value position changes are needed.

same as the exponent in the power of 10

The mass of a lady bug in kilograms:



0.00002 kg

scientific notation = 2×10^{-5}

Write 0.0005 in scientific notation:

$$0.0005 = \dots \times \dots$$

(Note: The diagram shows a blue arrow pointing down to the decimal point and four orange curved arrows pointing from the decimal point to the right, indicating the movement of the decimal point to the right to create a number between 1 and 10.)



Follow me



Let's practice using scientific notation.

- a Write 0.0301 in scientific notation:
- b Write the number represented by 1.8×10^6 :

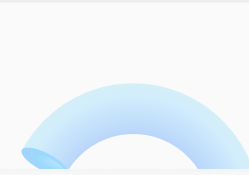
Let's compare numbers using scientific notation.

c 8×10^6 and 4×10^4

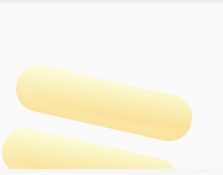
compare the first factor 8 is times larger than 4.

compare the powers of 10 10^6 is times larger than 10^4 .

$2 \times 100 = \dots\dots\dots$, so 8×10^6 is times larger.



Your turn



Let's practice using scientific notation.

- d Write 0.0000009 in scientific notation:
- e Write the number represented by 4.01×10^7 :

Let's compare numbers using scientific notation.

f 3×10^7 and 9×10^{10}

compare the first factor 9 is times larger than 3.

compare the powers of 10 10^{10} is times larger than 10^7 .

$3 \times 1,000 = \dots\dots\dots$, so 3×10^7 is times larger.

a Write 800,000,000,000 in scientific notation:

$$8 \downarrow 00,000,000,000. = \dots \times \dots$$

(Note: In the original image, a blue arrow points to the first zero after the 8, and orange wavy arrows indicate moving the decimal point 11 places to the right.)

b Write the number represented by 2.2×10^{-8} .

c Compare the numbers.

$$1.3 \times 10^3 \text{ and } 3.9 \times 10^4$$

..... is times smaller than

Go further

Let's look at examples where the a of the larger number is smaller.

For example,

$$4 \times 10^6 \text{ and } 8 \times 10^4$$

compare the first factor 4 is times larger than 8.

compare the powers of 10 10^6 is times the size of 10^4 .

$$\frac{1}{2} \times 100 = \dots\dots\dots, \text{ so } 4 \times 10^6 \text{ is } \dots\dots\dots \text{ times larger.}$$

This also means that 8×10^4 is times smaller.

For example,

$$4.8 \times 10^7 \text{ and } 1.2 \times 10^{10}$$

compare the first factor 1.2 is times larger than 4.8.

compare the powers of 10 10^{10} is times the size of 10^7 .

$$\dots\dots\dots \times \dots\dots\dots = \dots\dots\dots, \text{ so } 1.2 \times 10^{10} \text{ is } \dots\dots\dots \text{ times larger.}$$

This also means that 4.8×10^7 is times smaller.

Let's take a closer look at comparing these numbers.

1 First, expand the powers of 10 to show all factors of 10.

a $1.3 \times 10^3 = 1.3 \times$

b $3.9 \times 10^4 = 3.9 \times$

c 10^3 is times smaller than 10^4 .

2 Then compare the first factors.

a $1.3 \times$ $= 3.9$

3 is times smaller than

We can also use fraction notation to compare.

$$\begin{aligned} \frac{3.9 \times 10^4}{1.3 \times 10^3} &= \frac{3.9 \times 10 \times 10 \times 10 \times 10}{1.3 \times 10 \times 10 \times 10} \\ &= \frac{3 \times 1.3 \times 10 \times 10 \times 10 \times 10}{1.3 \times 10 \times 10 \times 10} \\ &= \frac{\boxed{} \times \boxed{}}{\boxed{}} \end{aligned}$$

Check your understanding

Compare the value of numbers shown in scientific notation.

$$1.1 \times 10^3 \text{ and } 4.4 \times 10^5$$

1.1×10^3 is times smaller.

Why do I need to try this question on my own first?

- To show your tutor what you understand
- To give you more practice
- To show your teacher how you are doing



Do you have a group of students who need a boost in math?

Each student could receive personalized lessons every week from our specialist one-on-one math tutors.




- ✓ Differentiated instruction for each student
- ✓ Aligned to your state's standards
- ✓ Scaffolded learning to close gaps

“We just had our first session and it went great! The kids really liked it and felt like they were learning! One even said he finally felt like math was making sense.”



Michelle Craig, Instructional Coach,
Sherwood Forest Elementary, Washington

Speak to us

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