

# \*Unit 7: Exponents and Scientific Notation

Content Area: **Mathematics**  
Course(s): **Math - Grade 8**  
Time Period: **4th Marking Period**  
Length: **6 weeks**  
Status: **Published**

## Unit Overview

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Perform operations and compare values with exponents, perform operations, write, evaluate, and compare numbers in scientific notation

## Transfer

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*Students will be able to independently use their learning to appropriately apply skills in real-life situations ...*

Apply properties of exponents

Write and compare values in exponential form.

Write and understand scientific notation

Perform operations with numbers in scientific notation

## Meaning

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## Understandings

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Students will

Critique

- reasoning about powers of powers (Lesson 3)
- reasoning about zero exponents (Lesson 4)
- applications of exponent rules (Lesson 7)
- reasoning about scientific notation (Lesson 15)

Represent

- situations using exponents (Lesson 1)
- large and small numbers using number lines, exponents, and decimals (Lesson 9–11)
- situations comparing quantities expressed in scientific notation (Lesson 14)

Justify

- reasoning about multiplying powers of 10 (Lesson 2)
- reasoning about powers of powers (Lesson 3)
- reasoning about dividing powers of 10 (Lesson 4)
- whether or not expressions are equivalent to exponential expressions (Lesson 6)
- reasoning about situations comparing powers of 10 (Lesson 12)

## **Essential Questions**

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At the end of this unit, students should be able to answer

- How can mathematical ideas be represented?
- Why is it helpful to write numbers in different ways?
- When do place values in standard vs. scientific form?
- How do you compare quantities expressed in scientific notation?
- What professions use scientific notation?
- How do you use and apply the laws of exponents?
- How do you place a standard notation value into scientific notation?

## **Application of Knowledge and Skill**

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### **Students will know...**

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Students will know...

- Exponent operation properties. (8.EE.1)
- Apply exponent rules to perform operations with numbers in scientific notation.
- Create and compare quantities in exponent form
- How to write quantities in scientific notation
- How and when to represent a value in scientific notation

### **Students will be skilled at...**

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Students will be skilled at...

- Apply the properties of integer exponents to generate equivalent numerical expressions. (8.EE.1)
- Estimate very large or very small quantities using a single digit times a power of ten. (8.EE.3)
- Express how much larger one number expressed as a single digit times a power of ten is than another in the context of the situation. (8.EE.3)
- Express numbers in scientific notation. (8.EE.4)
- Perform operations with numbers expressed in scientific notation and a mix of scientific notation and decimal notation. (8.EE.4)
- Choose appropriate units of measurements for a given number in scientific notation. (8.EE.4)
- Interpret scientific notation that has been generated by technology. (8.EE.4)

### **Academic Vocabulary**

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receptive, productive, power, exponent, factor, reciprocal, power of 10, repeated multiplication, power of powers, base (of an exponent), expanded, positive exponent, zero exponent, negative exponent, evaluate, square ( of a number), billion, trillion, integer, scientific notation

### **Learning Goal 1**

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Know that there are numbers that are not rational, and approximate them by rational numbers. Use rational approximations to estimate roots and to compare real numbers

### **Target 1.1--(Level of Difficulty: Retrieval (recalling), DOK: 1- Recall)**

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SWBAT:

Write fractions as decimals and decimals as fractions. (Chapter 10, Lesson 11 & 12)

Examples:)

- 1) 50% of tasks require students to write a fraction  $a/b$  as a repeating decimal by showing, filling in, or otherwise producing the steps of a long division  $a \div b$ .
- 2) 50% of tasks require students to write a given repeating decimal as a fraction.
- 3) Tasks should involve no more than two repeating decimals i.e. 2.1666..., 0.23232323.

every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion which repeats eventually into a rational number.

MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.6	Attend to precision.
MA.K-12.7	Look for and make use of structure.
MA.K-12.8	Look for and express regularity in repeated reasoning.

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### **Target 1.2--(Level of Difficulty: Retrieval(executing), DOK: 3 - Strategic Thinking)**

SWBAT:

Write and evaluate expressions involving powers and exponents

**(Chapter 9, Lesson 1 to 4; Chapter 10, Lesson 1 to 3)**

**Chapter 9- taught with scientific notation**

**Chapter 10-taught with Irrational numbers & Scientific Notation**

Clarification from PARCC EOY:

i)Tasks do not have a context.

MA.8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
MA.8.EE.A.2	Use square root and cube root symbols to represent solutions to equations of the form $x^2 = p$ and $x^3 = p$ , where $p$ is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that $\sqrt{2}$ is irrational.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.8	Look for and express regularity in repeated reasoning.

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### **Learning Goal 2**

Work with radicals and integer exponents

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### **Target 2.1--(Level of Difficulty: Retrieval(executing), DOK: 3 - Strategic Thinking)**

SWBAT:

Apply the properties of integer exponents to simplify and write equivalent numerical expressions. **(Chapter 9, Lesson 4)-Applying All properties**

Simplify a real number expressions by mutiplying and dividing monomials (**Chapter 9, Lesson 1 & 2**)

Examples:)

- 1) Tasks center on the properties and equivalence, not on simplification. For example, a task might ask a student to classify expressions according to whether or not they are equivalent to a given expression.
- 2) 50% of expressions should involve one property
- 3) 30% of expressions should involve two properties
- 4) 20% of expressions should involve three properties
- 5) Tasks should involve a single common base

MA.8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.

**Target 2.2--(Level of Difficulty: Retrieval (recalling), DOK: 1- Recall)**

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SWBAT: Use the Laws of Exponents to find powers of monomials (**Chapter 9, Lesson 1**)

MA.8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.

**Target 2.3--(Level of Difficulty: Retrieval, DOK: 2 - Skill/Concept)**

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SWBAT: Simplify expressions involving negative exponents. (**Chapter 9, Lesson 3**)

MA.8.EE.A.1	Know and apply the properties of integer exponents to generate equivalent numerical expressions.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.

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### **Target 2.4 -- (Level of Difficulty: Analysis, DOK: 3 - Strategic Thinking)**

In real-world problem solving situations choose units of appropriate size for measurement of very small and very large quantities. **(Chapter 9, Lesson 6)**

Examples:

- 1) The testing interface can provide students with a calculation aid of the specified kind for these tasks.
- 2) Tasks may require students to recognize  $3.7E-2$  (or  $3.7e-2$ ) from technology as  $3.7 \times 10^{-2}$

MA.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.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.

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### **Target 2.5-- (Level of Difficulty: Retrieval (executing), DOK: 1- Recall)**

Use scientific notation to write large and small numbers. **(Chapter 9, Lesson 5)**

MA.8.EE.A.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.7	Look for and make use of structure.

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### **Target 2.6-- (Level of Difficulty: Retrieval to Analysis, DOK: 2- Skill/Concept)**

Compute with numbers written in scientific notation.

\* Adding & Subtracting numbers in Scientific Notation (**Chapter 9, Lesson 7**)

\* Multiplying & Dividing numbers in Scientific Notation (**Chapter 9, Lesson 8**)

Interpret scientific notation when using technology

MA.8.EE.A.4	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.

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### **Target 2.10-- (Level of Difficulty: Analysis (matching), DOK: 2 - Skill/Concept)**

Compare mathematical expressions (**Chapter 10, Lesson 5**)

MA.8.NS.A.2	Use rational approximations of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line diagram, and estimate the value of expressions (e.g., $\pi^2$ ).
MA.K-12.1	Make sense of problems and persevere in solving them.
MA.K-12.3	Construct viable arguments and critique the reasoning of others.
MA.K-12.4	Model with mathematics.
MA.K-12.5	Use appropriate tools strategically.

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### **21st Century Life and Careers**

CRP.K-12.CRP1	Act as a responsible and contributing citizen and employee.
CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.
CAEP.9.2.8.B.3	Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.
CAEP.9.2.8.B.6	Demonstrate understanding of the necessary preparation and legal requirements to enter the workforce.

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### **Technology**

TECH.8.1.8	Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
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## **Formative Assessment and Performance Opportunities**

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Mid Chapter check assessments

Inquiry Labs

Tests

Quizzes

Informal Assessments

Graded Classwork

Surveys

WhiteBoard Activities

Exit tickets

Group activities

Projects

Teacher Observations

Student Interviews

Aleks Assessments

Linkit

## **Summative Assessment**

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Chapter Test/Unit Test-Found on Linkit

Aleks-overall percentage check

Unit Project

Performance based assessment

## **Accommodations & Modifications**

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See Unit resources below for specific targeted resources

- Calculator for support
- Extra Time to complete mathematics
- Interactive Notebook Sheets-including visual for vocabulary (number system)
- Listed Number System w/ Examples
- Modifications as per IEP/504
- Number line to follow decimal with Scientific Notation
- Review and Practice
- Small Group Instruction

- Translate Text
- word bank w/Vocabulary
- Worked examples with procedural steps

## Unit Resources

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Additional files located in Unit folder

- <http://www.youtube.com/watch?v=0fKBhvDjuy0>
- Aleks online supplement
- <http://achievethecore.org/coherence-map/#8/35/396/196/1>
- <http://illuminations.nctm.org/LessonsList.aspx?grade=3&standard=all>
- <http://insidemathematics.org/index.php/8th-grade>
- <http://learnzillion.com/>
- <http://www.illustrativemathematics.org/>
- <https://www.khanacademy.org/>
- Inquiry Labs
- Unit 1 Project
- [www.desmos.com](http://www.desmos.com)
- [www.geogebra.org](http://www.geogebra.org)
- [www.quizlet.com](http://www.quizlet.com)

## Interdisciplinary Connections

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Planets Project where students discuss the distance in scientific notation as well as the size of the planets. (8.EE.4)

6-8.MS-ESS1-3	Analyze and interpret data to determine scale properties of objects in the solar system.
6-8.MS-ESS1-2.4.1	Models can be used to represent systems and their interactions.
6-8.MS-PS4-1.1.1	Graphs and charts can be used to identify patterns in data.