

PBS TeacherLine New York

Rational Numbers, Fractions, Decimals and Percents

Grades 5 – 8

New York State Learning Standards: Mathematics, Science, and Technology - Standard 3

Students will:

- understand the concepts of and become proficient with the skills of mathematics;
- communicate and reason mathematically;
- become problem solvers by using appropriate tools and strategies;

through the integrated study of number sense and operations, algebra, geometry, measurement, and statistics and probability.

Number Sense and Operations Strand

Students will understand numbers, multiple ways of representing numbers, relationships among numbers, and number systems.

Number Systems

5.N.1 Read and write whole numbers to millions

5.N.2 Compare and order numbers to millions

5.N.3 Understand the place value structure of the base ten number system: 10 ones = 1 ten, 10 tens = 1 hundred, 10 hundreds = 1 thousand, 10 thousands = 1 ten thousand, 10 ten thousands = 1 hundred thousand, 10 hundred thousands = 1 million

5.N.4 Create equivalent fractions, given a fraction

5.N.5 Compare and order fractions including unlike denominators (with and without the use of a number line) *Note: Commonly used fractions such as those that might be indicated on ruler, measuring cup, etc.*

5.N.6 Understand the concept of ratio

5.N.7 Express ratios in different forms

5.N.8 Read, write, and order decimals to thousandths

5.N.9 Compare fractions using $<$, $>$, or $=$

5.N.10 Compare decimals using $<$, $>$, or $=$

5.N.11 Understand that percent means part of 100, and write percents as fractions and decimals

6.N.6 Understand the concept of rate

6.N.7 Express equivalent ratios as a proportion

6.N.8 Distinguish the difference between rate and ratio

6.N.9 Solve proportions using equivalent fractions

6.N.10 Verify the proportionality using the product of the means equals the product of the extremes

6.N.11 Read, write, and identify percents of a whole (0% to 100%)

6.N.12 Solve percent problems involving percent, rate, and base

6.N.14 Locate rational numbers on a number line (including positive and negative)

7.N.1 Distinguish between the various subsets of real numbers (counting/natural numbers, whole numbers, integers, rational numbers, and irrational numbers)

7.N.2 Recognize the difference between rational and irrational numbers (i.e., explore different approximations of π)

7.N.3 Place rational and irrational numbers (approximations) on a number line and justify the placement of the numbers

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Students will understand meanings of operations and procedures, and how they relate to one another.

Operations

- 5.N.18 Evaluate an arithmetic expression using order of operations including multiplication, division, addition, subtraction and parentheses
- 5.N.19 Simplify fractions to lowest terms
- 5.N.20 Convert improper fractions to mixed numbers, and mixed numbers to improper fractions
- 5.N.21 Use a variety of strategies to add and subtract fractions with like denominators
- 5.N.22 Add and subtract mixed numbers with like denominators
- 5.N.23 Use a variety of strategies to add, subtract, multiply, and divide decimals to thousandths

- 6.N.16 Add and subtract fractions with unlike denominators
- 6.N.17 Multiply and divide fractions with unlike denominators
- 6.N.18 Multiply and divide mixed numbers with unlike denominators
- 6.N.19 Identify the multiplicative inverse (reciprocal) of a number
- 6.N.20 Represent fractions as terminating or repeating decimals
- 6.N.21 Find multiple representations of rational numbers (fractions, decimals, and percents 0 to 100)
- 6.N.22 Evaluate numerical expressions using order of operations (may include exponents of two and three)
- 6.N.23 Represent repeated multiplication in exponential form

- 7.N.11 Simplify expressions using order of operations Note: Expressions may include absolute value and/or integral exponents greater than 0.
- 7.N.12 Add, subtract, multiply, and divide integers
- 7.N.13 Add and subtract two integers (with and without the use of a number line)
- 7.N.14 Develop a conceptual understanding of negative and zero exponents with a base of ten and relate to fractions and decimals (i.e., $10^{-2} = .01 = 1/100$)

- 8.N.3 Read, write, and identify percents less than 1% and greater than 100%
- 8.N.4 Apply percents to: Tax, Percent increase/decrease, Simple interest, Sale price, Commission, Interest rates, Gratuities

Students will compute accurately and make reasonable estimates.

Estimation

- 5.N.25 Estimate sums and differences of fractions with like denominators
- 5.N.26 Estimate sums differences, products, and quotients of decimals
- 5.N.27 Justify the reasonableness of answers using estimation

- 6.N.26 Estimate a percent of quantity (0% to 100%)
- 6.N.27 Justify the reasonableness of answers using estimation (including rounding)

- 7.N.19 Justify the reasonableness of answers using estimation

- 8.N.5 Estimate a percent of quantity, given an application
- 8.N.6 Justify the reasonableness of answers using estimation

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Algebra Strand

Students will represent and analyze algebraically a wide variety of problem solving situations.

Variables and Expressions

5.A.1 Define and use appropriate terminology when referring to constants, variables, and algebraic expressions

Students will perform algebraic procedures accurately.

Equations and Inequalities

6.A.5 Solve simple proportions within context

Problem Solving Strand

Students will build new mathematical knowledge through problem solving.

5.PS.1 Know the difference between relevant and irrelevant information when solving problems

5.PS.2 Understand that some ways of representing a problem are more efficient than others

5.PS.3 Interpret information correctly, identify the problem, and generate possible strategies and solutions

6.PS.1 Know the difference between relevant and irrelevant information when solving problems

6.PS.2 Understand that some ways of representing a problem are more efficient than others

6.PS.3 Interpret information correctly, identify the problem, and generate possible strategies and solutions

7.PS.1 Use a variety of strategies to understand new mathematical content and to develop more efficient methods

7.PS.2 Construct appropriate extensions to problem situations

7.PS.3 Understand and demonstrate how written symbols represent mathematical ideas

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8.PS.2 Construct appropriate extensions to problem situations

8.PS.3 Understand and demonstrate how written symbols represent mathematical ideas

Students will solve problems that arise in mathematics and in other contexts.

5.PS.4 Act out or model with manipulatives activities involving mathematical content from literature

5.PS.5 Formulate problems and solutions from everyday situations

5.PS.6 Translate from a picture/diagram to a numeric expression

5.PS.7 Represent problem situations verbally, numerically, algebraically, and/or graphically

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5.PS.8 Select an appropriate representation of a problem
5.PS.9 Understand the basic language of logic in mathematical situations (and, or, not)

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6.PS.5 Formulate problems and solutions from everyday situations

6.PS.6 Translate from a picture/diagram to a numeric expression

6.PS.7 Represent problem situations verbally, numerically, algebraically, and/or graphically

6.PS.8 Select an appropriate representation of a problem

6.PS.9 Understand the basic language of logic in mathematical situations (and, or, and not)

7.PS.4 Observe patterns and formulate generalizations

7.PS.5 Make conjectures from generalizations

7.PS.6 Represent problem situations verbally, numerically, algebraically, and graphically

8.PS.4 Observe patterns and formulate generalizations

8.PS.5 Make conjectures from generalizations

8.PS.6 Represent problem situations verbally, numerically, algebraically, and graphically

Students will apply and adapt a variety of appropriate strategies to solve problems.

5.PS.10 Work in collaboration with others to solve problems

5.PS.11 Translate from a picture/diagram to a number or symbolic expression

5.PS.12 Use trial and error and the process of elimination to solve problems

5.PS.13 Model problems with pictures/diagrams or physical objects

5.PS.14 Analyze problems by observing patterns

5.PS.15 Make organized lists or charts to solve numerical problems

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6.PS.15 Make organized lists or charts to solve numerical problems

7.PS.7 Understand that there is no one right way to solve mathematical problems but that different methods have advantages and disadvantages

7.PS.8 Understand how to break a complex problem into simpler parts or use a similar problem type to solve a problem

7.PS.9 Work backwards from a solution

7.PS.10 Use proportionality to model problems

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Students will monitor and reflect on the process of mathematical problem solving.

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5.PS.16 Discuss with peers to understand a problem situation
5.PS.17 Determine what information is needed to solve problem
5.PS.18 Determine the efficiency of different representations of a problem
5.PS.19 Differentiate between valid and invalid approaches
5.PS.20 Understand valid counterexamples
5.PS.21 Explain the methods and reasoning behind the problem solving strategies used
5.PS.22 Discuss whether a solution is reasonable in the context of the original problem
5.PS.23 Verify results of a problem

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6.PS.22 Discuss whether a solution is reasonable in the context of the original problem
6.PS.23 Verify results of a problem

7.PS.12 Interpret solutions within the given constraints of a problem
7.PS.13 Set expectations and limits for possible solutions
7.PS.14 Determine information required to solve the problem
7.PS.15 Choose methods for obtaining required information
7.PS.16 Justify solution methods through logical argument
7.PS.17 Evaluate the efficiency of different representations of a problem

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8.PS.13 Set expectations and limits for possible solutions
8.PS.14 Determine information required to solve the problem
8.PS.15 Choose methods for obtaining required information
8.PS.16 Justify solution methods through logical argument
8.PS.17 Evaluate the efficiency of different representations of a problem

Reasoning and Proof Strand

Students will recognize reasoning and proof as fundamental aspects of mathematics.

5.RP.1 Recognize that mathematical ideas can be supported using a variety of strategies
5.RP.2 Understand that mathematical statements can be justified, using models, facts and relationships to explain their thinking

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7.RP.1 Recognize that mathematical ideas can be supported by a variety of strategies
7.RP.2 Understand that mathematical statements can be justified using inductive reasoning

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Students will make and investigate mathematical conjectures.

5.RP.3 Investigate conjectures, using arguments and appropriate mathematical terms
5.RP.4 Make and evaluate conjectures, using a variety of strategies

6.RP.3 Investigate conjectures, using arguments and appropriate mathematical terms
6.RP.4 Make and evaluate conjectures, using a variety of strategies

7.RP.3 Investigate conjectures in mathematical terms, using mathematical strategies to reach a conclusion
7.RP.4 Evaluate conjectures by distinguishing relevant from irrelevant information to reach a conclusion or make appropriate estimates
7.RP.5 Provide supportive arguments for conjectures

8.RP.3 Investigate conjectures in mathematical terms, using mathematical strategies to reach a conclusion
8.RP.4 Evaluate conjectures by distinguishing relevant from irrelevant information to reach a conclusion or make appropriate estimates
8.RP.5 Provide supportive arguments for conjectures

Students will develop and evaluate mathematical arguments and proofs.

5.RP.5 Justify general claims or conjectures, using manipulatives, models, expressions, and mathematical relationships
5.RP.6 Develop and explain an argument verbally, numerically, and/or graphically
5.RP.7 Verify claims other students make, using examples and counterexamples when appropriate

6.RP.5 Justify general claims or conjectures, using manipulatives, models, expressions, and mathematical relationships
6.RP.6 Develop and explain an argument verbally, numerically, algebraically, and/or graphically
6.RP.7 Verify claims other students make, using examples and counterexamples when appropriate

7.RP.6 Justify general claims using inductive reasoning
7.RP.7 Develop, explain, and verify an argument using mathematical ideas and language

8.RP.6 Justify general claims using inductive reasoning
8.RP.7 Develop, explain, and verify an argument using mathematical ideas and language

Students will select and use various types of reasoning and methods of proof.

5.RP.8 Justify an argument through examples/counterexamples and special cases

6.RP.8 Justify an argument through examples/counterexamples and special cases
6.RP.9 Devise ways to verify results

7.RP.8 Justify an argument by using a systematic approach
7.RP.9 Devise ways to verify results, using counterexamples and indirect proof

8.RP.8 Justify an argument by using a systematic approach
8.RP.9 Devise ways to verify results, using counterexamples and indirect proof

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Communication Strand

Students will organize and consolidate their mathematical thinking through communication.

5.CM.1 Provide an organized thought process that is correct, complete, coherent, and clear

5.CM.2 Explain a rationale for strategy selection

5.CM.3 Organize and accurately label work

6.CM.1 Provide an organized thought process that is correct, complete, coherent, and clear

6.CM.2 Explain a rationale for strategy selection

6.CM.3 Organize and accurately label work

7.CM.1 Provide a correct, complete, coherent, and clear rationale for thought process used in problem solving

7.CM.2 Provide an organized argument which explains rationale for strategy selection

7.CM.3 Organize and accurately label work

8.CM.1 Provide a correct, complete, coherent, and clear rationale for thought process used in problem solving

8.CM.2 Provide an organized argument which explains rationale for strategy selection

8.CM.3 Organize and accurately label work

Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.

5.CM.4 Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, diagrams, models, and symbols in written and verbal form

5.CM.5 Answer clarifying questions from others

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8.CM.4 Share organized mathematical ideas through the manipulation of objects, numerical tables, drawings, pictures, charts, graphs, tables, diagrams, models and symbols in written and verbal form

8.CM.5 Answer clarifying questions from others

Students will analyze and evaluate the mathematical thinking and strategies of others.

5.CM.6 Understand mathematical solutions shared by other students

5.CM.7 Raise questions that elicit, extend, or challenge others' thinking

5.CM.8 Consider strategies used and solutions found by others in relation to their own work

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6.CM.6 Understand mathematical solutions shared by other students
6.CM.7 Raise questions that elicit, extend, or challenge others' thinking
6.CM.8 Consider strategies used and solutions found by others in relation to their own work

7.CM.6 Analyze mathematical solutions shared by others
7.CM.7 Compare strategies used and solutions found by others in relation to their own work
7.CM.8 Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others

8.CM.6 Analyze mathematical solutions shared by others
8.CM.7 Compare strategies used and solutions found by others in relation to their own work
8.CM.8 Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others

Students will use the language of mathematics to express mathematical ideas precisely

5.CM.9 Increase their use of mathematical vocabulary and language when communicating with others
5.CM.10 Use appropriate vocabulary when describing objects, relationships, mathematical solutions, and rationale
5.CM.11 Decode and comprehend mathematical visuals and symbols to construct meaning

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6.CM.10 Use appropriate vocabulary when describing objects, relationships, mathematical solutions, and rationale
6.CM.11 Decode and comprehend mathematical visuals and symbols to construct meaning

7.CM.9 Increase their use of mathematical vocabulary and language when communicating with others
7.CM.10 Use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale
7.CM.11 Draw conclusions about mathematical ideas through decoding, comprehension and interpretation of mathematical visuals, symbols, and technical writing

8.CM.9 Increase their use of mathematical vocabulary and language when communicating with others
8.CM.10 Use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale
8.CM.11 Draw conclusions about mathematical ideas through decoding, comprehension and interpretation of mathematical visuals, symbols, and technical writing

Connections Strand

Students will recognize and use connections among mathematical ideas.

5.CN.1 Understand and make connections and conjectures in their everyday experiences to mathematical ideas

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5.CN.2 Explore and explain the relationship between mathematical ideas
5.CN.3 Connect and apply mathematical information to solve problems

6.CN.1 Understand and make connections and conjectures in their everyday experiences to mathematical ideas
6.CN.2 Explore and explain the relationship between mathematical ideas
6.CN.3 Connect and apply mathematical information to solve problems

7.CN.1 Understand and make connections among multiple representations of the same mathematical idea
7.CN.2 Recognize connections between subsets of mathematical ideas
7.CN.3 Connect and apply a variety of strategies to solve problems

8.CN.1 Understand and make connections among multiple representations of the same mathematical idea
8.CN.2 Recognize connections between subsets of mathematical ideas
8.CN.3 Connect and apply a variety of strategies to solve problems

Students will understand how mathematical ideas interconnect and build on one another to produce a coherent whole.

5.CN.4 Understand multiple representations and how they are related
5.CN.5 Model situations with objects and representations and be able to draw conclusions

6.CN.4 Understand multiple representations and how they are related
6.CN.5 Model situations with objects and representations and be able to draw conclusions

7.CN.4 Model situations with objects, representations and equations, draw conclusions, and formulate new situations
7.CN.5 Understand how models in one area of mathematics can be used to solve problems in other areas of mathematics

8.CN.4 Model situations with objects, representations and equations, draw conclusions, and formulate new situations
8.CN.5 Understand how models in one area of mathematics can be used to solve problems in other areas of mathematics

Students will recognize and apply mathematics in contexts outside of mathematics.

5.CN.6 Recognize and provide examples of the presence of mathematics in their daily lives
5.CN.7 Apply mathematics to problem situations that develop outside of mathematics
5.CN.8 Investigate the presence of mathematics in careers and areas of interest
5.CN.9 Recognize and apply mathematics to other disciplines and areas of interest

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7.CN.6 Recognize and provide examples of the presence of mathematics in their daily lives

7.CN.7 Apply mathematical ideas to problem situations that develop outside of mathematics

7.CN.8 Investigate the presence of mathematics in careers and areas of interest

7.CN.9 Recognize and apply mathematics to other disciplines, areas of interest, and societal issues

8.CN.6 Recognize and provide examples of the presence of mathematics in their daily lives

8.CN.7 Apply mathematical ideas to problem situations that develop outside of mathematics

8.CN.8 Investigate the presence of mathematics in careers and areas of interest

8.CN.9 Recognize and apply mathematics to other disciplines, areas of interest, and societal issues

Representation Strand

Students will create and use representations to organize, record, and communicate mathematical ideas.

5.R.1 Use physical objects, drawings, charts, tables, graphs, symbols, equations, and technology as representations

5.R.2 Explain, describe, and defend mathematical ideas using representations

5.R.3 Read, interpret, and extend external models

5.R.4 Use standard and nonstandard representations with accuracy and detail

6.R.1 Use physical objects, drawings, charts, tables, graphs, symbols, equations, and technology as representations

6.R.2 Explain, describe, and defend mathematical ideas using representations

6.R.3 Read, interpret, and extend external models

6.R.4 Use standard and nonstandard representations with accuracy and detail

7.R.1 Use physical objects, drawings, charts, tables, graphs, symbols, equations, and technology as representations

7.R.2 Explain, describe, and defend mathematical ideas using representations

7.R.3 Recognize, compare, and use an array of representational forms

7.R.4 Explain how different representations express the same relationship

7.R.5 Use standard and non-standard representations with accuracy and detail

8.R.1 Use physical objects, drawings, charts, tables, graphs, symbols, equations, and technology as representations

8.R.2 Explain, describe, and defend mathematical ideas using representations

8.R.3 Recognize, compare, and use an array of representational forms

8.R.4 Explain how different representations express the same relationship

8.R.5 Use standard and non-standard representations with accuracy and detail

Students will select, apply, and translate among mathematical representations to solve problems.

5.R.5 Use models to explore problem situations

5.R.6 Investigate relationships between different representations and their impact on a given problem

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6.R.5 Use models to explore problem situations
6.R.6 Investigate relationships between different representations and their impact on a given problem

7.R.6 Use models to explore problem situations
7.R.7 Investigate relationships between different representations and their impact on a given problem
7.R.8 Use representation as a tool for exploring and understanding mathematical ideas

8.R.6 Use models to explore problem situations
8.R.7 Investigate relationships between different representations and their impact on a given problem
8.R.8 Use representation as a tool for exploring and understanding mathematical ideas

Students will use representations to model and interpret physical, social, and mathematical phenomena.

5.R.7 Use mathematics to show and understand physical phenomena (i.e., determine the perimeter of a bulletin board)
5.R.8 Use mathematics to show and understand social phenomena (i.e., construct tables to organize data showing book sales)
5.R.9 Use mathematics to show and understand mathematical phenomena (i.e., find the missing value that makes the equation true: $(3 + 4) + 5 = 3 + (4 + \underline{\quad})$)

6.R.7 Use mathematics to show and understand physical phenomena (i.e., determine the perimeter of a bulletin board)
6.R.8 Use mathematics to show and understand social phenomena (i.e., construct tables to organize data showing book sales)
6.R.9 Use mathematics to show and understand mathematical phenomena (i.e., Find the missing value: $(3 + 4) + 5 = 3 + (4 + \underline{\quad})$)

7.R.9 Use mathematics to show and understand physical phenomena (i.e., make and interpret scale drawings of figures or scale models of objects)
7.R.10 Use mathematics to show and understand social phenomena (i.e., determine profit from sale of yearbooks)
7.R.11 Use mathematics to show and understand mathematical phenomena (i.e., use tables, graphs, and equations to show a pattern underlying a function)

8.R.9 Use math to show and understand physical phenomena (i.e., make and interpret scale drawings of figures or scale models of objects)
8.R.10 Use math to show and understand social phenomena (i.e., determine profit from sale of yearbooks)
8.R.11 Use math to show and understand mathematical phenomena (i.e., use tables, graphs, and equations to show a pattern underlying a function)