# Grade 7 Mathematics, Quarter 2, Unit 2.1
## Conceptual Understanding of Operations of Integers

### Overview

| Number of instructional days: | 10 (1 day = 45–60 minutes) |

### Content to be learned

- Demonstrate conceptual understanding of addition, subtraction, multiplication, and division of integers using models.
- Demonstrate conceptual understanding of absolute value.

### Mathematical practices to be integrated

- Look for and express regularity in repeated reasoning.
  - Notice when calculations are repeated and look for both general methods and shortcuts (operations with integer properties).
  - Continuously evaluate the reasonableness of results.
- Reason abstractly and quantitatively.
  - Create a representation of a problem, considering units.
  - Determine the meaning of quantities, not just how to compute them.
  - Know and flexibly use different properties of operations and objects.
- Model with mathematics.
  - Apply known mathematics to solve problems arising in everyday life, society, and the workplace (operations with integers—temperature or money).
- Use appropriate tools strategically.
  - Use available tools to explore and deepen understanding (operations with integers and absolute value).

### Essential questions

- Why do you think it is important to understand properties and operations involving integers?
- How can you demonstrate addition and subtraction of integers using models?
- When is the sum of two numbers positive?
- What does absolute value mean?
- How do you find the product/quotient of two negative numbers?
- How do you find the product/quotient of one negative and one positive number?
- When is the sum of two numbers negative?
- When is the sum of two numbers zero?
Written Curriculum

Grade-Level Expectations

M(N&O)–7–3 **Demonstrates conceptual understanding of operations with** integers and whole number exponents (where the base is a whole number) using models, diagrams, or explanations. (Local)

M(N&O)–7–2 **Demonstrates understanding of the relative magnitude of numbers** by ordering, comparing, or identifying equivalent rational numbers across number formats, numbers with whole number bases and whole number exponents (e.g., $3^4$, $4^3$), integers, absolute values, or numbers represented in scientific notation using number lines or equality and inequality symbols. (State)

Clarifying the Standards

Prior Learning

In grades K–2, students learned the concepts of addition and subtraction of whole numbers. In grades 3–5, students learned to use inverse operations to learn the concepts of multiplication and division of whole numbers. Students also learned how to add and subtract fractions and decimals. In grade 6, students learned how to add and subtract integers and positive fractions as well as how to multiply and divide fractions and decimals. Students developed the concepts of bases and exponents and their effects on the magnitude of the number.

Current Learning

Students are developing the rules for addition, subtraction, multiplication, and division of integers using the concept of absolute value along with models and representations. Students make calculations simpler by using their conceptual understanding of field properties. Students are solidifying the rules of integer operations through skill-building activities.

Although absolute value is a new concept during this school year, students’ learning will be reinforced in upcoming units, and students will achieve mastery by the end of this year.

Future Learning

In grades 8–9, students will continue to apply their knowledge of operations with integers in problem-solving situations. Properties of numbers and field properties will be applied to simplifying computations. In grade 11, students will apply properties to determine whether a given subset of numbers is closed under a given arithmetic operation and will be able to apply arithmetic properties to matrices.

Additional Research Findings

According to *Principles and Standards for School Mathematics*, students in the middle grades develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use. They should use the associative and commutative properties of addition and multiplication and the distributive property of multiplication over addition to simplify computations with integers (pp. 214–220).
Notes About Resources and Materials
Grade 7 Mathematics, Quarter 2, Unit 2.2
Operations with Integers

Overview

Number of instructional days: 10  
(1 day = 45–60 minutes)

Content to be learned

- Solve problems involving integer addition and subtraction.
- Use the field properties to simplify calculations of integers in real-world contexts.

Mathematical practices to be integrated

Reason abstractly and quantitatively.
- Make sense of quantities and their relationships in problem situations.
- Abstract a given situation, representing it symbolically, and manipulate the representative symbols.
- Know and flexibly use different properties of operations and objects.

Make sense of problems and persevere in solving them.
- Look for meaning in problems involving integers.
- Find entry points to a problem, deciding on a solution pathway before jumping into the work.
- Analyze a problem, make conjectures, and monitor progress, changing course if necessary.
- Transform information into different representations.
- Check solution with another method or model.
- Ask, “Does my answer make sense?”

Essential questions

- In what real-life situations would you need to understand how to add and subtract integers? Name at least two and explain your reasoning.
- What are the similarities between addition and subtraction of integers?
- What does the commutative property state about the addition of rational numbers?
- Do you think there is a commutative property of subtraction? Why or why not?
Written Curriculum

Grade-Level Expectations

M(N&O)–7–4 Accurately solves problems involving the addition or subtraction of integers, raising numbers to whole number powers, and determining square roots of perfect square numbers and non-perfect square numbers. (Local)

M(N&O)–7–6 Uses a variety of mental computation strategies to solve problems (e.g., using compatible numbers, applying properties of operations, using mental imagery, using patterns) and to determine the reasonableness of answers; and mentally calculates benchmark perfect squares and related square roots (e.g., 1^2, 2^2, ..., 12^2, 15^2, 20^2, 25^2, 100^2, 1000^2); determines the part of a number using benchmark percents and related fractions (1%, 10%, 25%, 33 1/3%, 50%, 66 2/3%, 75%, and 100%) (e.g., 25% of 16, 33 1/3% of 330). (Local)

(IMPORTANT: The intent of this GSE is to embed mental arithmetic throughout the instructional program, not to teach it as a separate unit.)

M(N&O)–7–8 Applies properties of numbers (odd, even, remainders, divisibility, and prime factorization) and field properties (commutative, associative, identity, distributive, inverses) to solve problems and to simplify computations, and demonstrates conceptual understanding of field properties as they apply to subsets of the real numbers (e.g., the set of whole numbers does not have additive inverses, the set of integers does not have multiplicative inverses). (Local)

Clarifying the Standards

Prior Learning

In grade 3, students began to accurately solve problems utilizing concepts such as addition and subtraction with regrouping and decimals (in the context of money). In grade 4, concepts of addition and subtraction were extended to include decimals and proper fractions with like denominators. Students in this grade solved problems using multiplication limited to two digits and division limited to one-digit divisors. Students began to solve problems using multiple operations (order of operations). In grade 5, students divided using two-digit divisors. They learned how to apply the conventions of order of operations with and without parentheses. They also continued to make mental computations and applied properties of numbers and field properties appropriate for their grade level.

Current Learning

In grade 7, students are learning to apply the rules of addition and subtraction of integers, using mental computation strategies and properties of numbers to solve problems.

Future Learning

In grade 8, students will continue to accurately solve problems related to operations with integers. They will include multiplication and division processes. Students will apply operations of integers when solving functional relationships. This process will continue in grades 9–10. Students will also use problem-solving skills to solve problems inside and outside of the context of mathematics.
Additional Research Findings

According to *Principles and Standards for School Mathematics*, students in earlier grades should be familiar with the inverse relationship between the operation pairs of addition-subtraction and multiplication. Students in the middle grades continue to refine their understanding of addition, subtraction, multiplication, and division as they use these operations with fractions, decimals, percents, and integers. They will use the associative and commutative properties of addition and multiplication and the distributive property of multiplication to simplify computations with integers. Well-chosen problems can be particularly valuable in developing or deepening students’ understanding of important mathematical ideas including integers (pp. 214-220, 256).

Notes About Resources and Materials
Grade 7 Mathematics, Quarter 2, Unit 2.3
Conceptual Understanding of Proportionality

Overview

Number of instructional days: 10  (1 day = 45–60 minutes)

Content to be learned
- Demonstrate conceptual understanding of percents as a means of comparison and as a way of expressing multiples of a number.
- Demonstrate conceptual understanding of rates and proportional reasoning.
- Determine the reasonableness of answers.
- Mentally calculate part of a number using benchmark percents and related fractions.

Mathematical practices to be integrated
- Reason abstractly and quantitatively.
- Create a representation of a problem, considering the units involved.
- Determine the meaning of quantities, not just how to compute them.
- Construct viable arguments and critique the reasoning of others.
- Analyze situations.
- Justify conclusions for unit rate problems (i.e., “Which is the better buy?”)

Model with mathematics.
- Apply known mathematics to solve real-world problems involving rates and unit rates in everyday life, society, and the workplace.
- Interpret mathematical results in context, reflecting on whether the results make sense.

Essential questions
- How can you use percents to compare survey responses from samples of unequal size?
- How do you determine whether two rates are proportional?
- If you know 10% of a number how could you find 15% of the same number?
- How do you know whether a ratio is written as a unit rate?
- What mental math strategies can be used to determine if an answer is reasonable?
Written Curriculum

Grade-Level Expectations

M(N&O)–7–1 Demonstrates conceptual understanding of rational numbers with respect to percents as a means of comparing the same or different parts of the whole when the wholes vary in magnitude (e.g., 8 girls in a classroom of 16 students compared to 8 girls in a classroom of 20 students, or 20% of 400 compared to 50% of 100), and percents as a way of expressing multiples of a number (e.g., 200% of 50) using models, explanations, or other representations. (State)

M(N&O)–7–1 Demonstrates conceptual understanding of rational numbers with respect to square roots of perfect squares, rates, and proportional reasoning. (Local)

M(N&O)–7–6 Uses a variety of mental computation strategies to solve problems (e.g., using compatible numbers, applying properties of operations, using mental imagery, using patterns) and to determine the reasonableness of answers; and mentally calculates benchmark perfect squares and related square roots (e.g., $1^2, 2^2, ..., 12^2, 15^2, 20^2, 25^2, 100^2, 1000^2$), determines the part of a number using benchmark percents and related fractions ($1\%$, $10\%$, $25\%$, $33\frac{1}{3}\%$, $50\%$, $66\frac{2}{3}\%$, $75\%$, and $100\%$) (e.g., $25\%$ of 16; $33\frac{1}{3}\%$ of 330). (Local)

(IMPORTANT: The intent of this GSE is to embed mental arithmetic throughout the instructional program, not to teach it as a separate unit.)

Clarifying the Standards

Prior Learning

Demonstrating conceptual understanding of rational numbers with respect to benchmark percents began in grade 5, where students used models, explanations, and other representations to show part-to-whole relationships. In grade 6, their understanding was expanded to include ratios and rates. Mental arithmetic is embedded throughout grades K–12.

Current Learning

Students demonstrate a conceptual understanding of percents to compare parts of a whole when the wholes vary in magnitude. They use percents to express multiples of a number and begin proportional reasoning. Students use mental computation strategies to determine parts of a number using benchmark percents and related fractions. These concepts are taught for mastery.

Future Learning

In grade 8, students will describe change using percent increase and decrease. Since there is no GSE after this grade, this concept will be taught for mastery.
Additional Research Findings

According to Principles and Standards for School Mathematics, students in grades 6–8 should acquire computational fluency—the ability to compute efficiently and accurately… (p. 220).

Notes About Resources and Materials
## Overview

| Number of instructional days: | 10 | (1 day = 45–60 minutes) |

### Content to be learned

- Estimate tips, taxes, and discounts in real-world situations.
- Apply understanding of benchmark percents and related fractions.
- Accurately solve problems involving proportional reasoning.
- Accurately solve problems involving percents (discounts, tax, tips, and rates).
- Use mental computation strategies to solve problems and determine the reasonableness of answers.

### Mathematical practices to be integrated

- **Model with mathematics.**
  - Apply known mathematics to solve real-world problems that arise in everyday life, society, and the workplace (i.e., cost per student, restaurant taxes and tips, store discounts).

- **Attend to precision.**
  - Communicate thoughts and ideas to others with precision.
  - Calculate accurately and efficiently, expressing numerical answers with a degree of precision appropriate to the problem context.

- **Use appropriate tools strategically.**
  - Consider and select tools including pencil and paper, calculator, spreadsheets, and other technology when solving a problem.
  - Make sound decisions about when a tool is helpful, recognizing both the insight to be gained and the tool’s limitations.

### Essential questions

- How would you determine the final sale price of an item being discounted 30%?
- How would you mentally calculate a 15% tip?
- How do I know when an estimate is reasonable?
- How do you know if two quantities have a proportional relationship?
Written Curriculum

Grade-Level Expectations

M(N&O)–7–7 **Makes estimates** in a given situation (including tips, discounts, and tax) by identifying when estimation is appropriate, selecting the appropriate method of estimation, determining the level of accuracy needed given the situation, analyzing the effect of the estimation method on the accuracy of results, and evaluating the reasonableness of solutions appropriate to grade level GLEs across content strands. (Local)

(IMPORTANT: *The intent of this GLE is to embed estimation throughout the instructional program, not to teach it as a separate unit.*)

M(N&O)–7–4 **Accurately solves problems involving** proportional reasoning; percents involving discounts, tax, or tips; and rates. (State)

(IMPORTANT: *Applies the conventions of order of operations including parentheses, brackets, or exponents.*)

M(N&O)–7–6 **Uses a variety of mental computation strategies to solve problems** (e.g., using compatible numbers, applying properties of operations, using mental imagery, using patterns) and to determine the reasonableness of answers; and mentally calculates benchmark perfect squares and related square roots (e.g., $1^2, 2^2, 12^2, 15^2, 20^2, 25^2, 100^2, 1000^2$); determines the part of a number using benchmark percents and related fractions (1%, 10%, 25%, $\frac{1}{3}$%, 50%, $\frac{2}{3}$%, 75%, and 100%) (e.g., 25% of 16; $\frac{1}{3}$% of 330). (Local)

(IMPORTANT: *The intent of this GSE is to embed mental arithmetic throughout the instructional program, not to teach it as a separate unit.*)

Clarifying the Standards

**Prior Learning**

Mental computation and estimation with increasing levels of complexity are embedded throughout grades K–12. Students solved problems using percent of a whole and mentally calculated benchmark percents in grade 6.

**Current Learning**

Students include estimates for situations involving tips, discounts, and tax. They calculate accurate solutions for percent problems involving discounts, tax, tips, and rates. They accurately solve problems involving proportional reasoning. Students also use mental-computation strategies to determine parts of a number using benchmark percents and related fractions. These particular mental-computation strategies are being taught for mastery in grade 7.
Future Learning

Students’ solving of problems that involve proportional reasoning will be reinforced through grade 10.

Additional Research Findings

According to Principles and Standards for School Mathematics, students in grades 6–8 should acquire computational fluency—the ability to compute efficiently and accurately… (p. 220).

Notes About Resources and Materials