CONNECTED MATHEMATICS PROJECT

MICHIGAN STATE
U N I V E R S I T Y

CMP4 GRADE 7

Mathematical Focus: Proportional reasoning in the context of number, similarity, algebra, measurement, probability, and statistics

Unit 1. Shapes and Designs: Generalizing and Using Properties of Geometric Shapes

This Unit develops students' ability to recognize, display, analyze, measure, and reason about the shapes and visual patterns that are important features of our world. It builds on students' early exposure to shapes, as they analyze the properties that make certain shapes unique.

Students focus on the side length and angle measure relationships of regular and irregular polygons. A central theme is designing shapes under constraints. As students learn important criteria that determine shape, they apply these understandings to design figures with specific criteria and solve real world problems.

Algebraic reasoning is also strengthened as students express relationships among shapes with expressions and equations.

Mathematical Reflection
What do you know about geometric shapes? How does this information help you design geometric shapes and solve problems?

Investigation 1. Designing Polygons: The Side Connection
Investigation 2. Designing With Angles
Investigation 3. Designing Polygons: The Angle Connection

Total Problems: 9

Unit 2. Completely Rational: A Focus on Integers

Students continue to develop understandings of rational numbers, by a exploring a series of contextual problems. In so doing they,
- Extend the number system to include the rational numbers;
- Locate and compare values of rational numbers using a number line;
- Use models to develop algorithms for adding, subtracting, multiplying, and dividing signed rational numbers;
- Extend the properties of positive rational numbers to the whole set of rational numbers; and
- Represent equality and inequality among numbers with expressions and number lines.

Mathematical Reflection
What do you know about rational numbers and their operations? How is this information useful in solving problems?

Investigation 1. Extending the Rational Number System
Investigation 2. Adding and Subtracting Rational Numbers
Investigation 3. Multiplying and Dividing Rational Numbers
Investigation 4. Multiplying and Dividing Rational Numbers

Total Problems: 12

Unit 3. Stretching and Shrinking: Developing Proportional Reasoning in the Context of Similarity (Scale Drawings)

In their immediate environment and in their studies of natural and social sciences, students frequently encounter phenomena that require familiarity with the ideas of enlargement, scale factors, area growth, indirect measurement, and other similarity-related concepts. Similar figures are another name for **scale drawings**.

Similarity is a context in which students' understanding of proportional reasoning continues to deepen. Students in the middle grades often experience difficulty with ideas of scale which is the heart of proportionality.

Students begin to accumulate the knowledge and experiences necessary to reason about scaling in geometry situations. The next Unit, *Comparing and Scaling*, will continue to deepen their reasoning with proportions in the context of quantities.

Mathematical Reflection
What do you know about similar figures? What do you know about proportional reasoning? How is this information useful in solving problems?

Investigation 1. Enlarging and Reducing Shapes
Investigation 2. The Mug Wump Family: Similar Figures
Investigation 3. Scaling Perimeter and Area
Investigation 4. Similar Figures and Ratios

Total Problems: 12

Unit 4. Comparing and Scaling: Developing Proportional Reasoning in the Context of Number (Quantities)

This unit continues to deepen the ideas of scaling and proportionality in numerical, rather than geometrical contexts. Students confront a series of mathematical tasks that encourage them to make decisions about the quantities relevant to each task, how those quantities can be compared most usefully, and what information is provided by various quantitative comparisons.

Students also continue to deepen their ability to make intelligent comparisons of quantitative information—using ratios, fractions, decimals, rates, unit rates, and percents. They use quantitative comparison information to make larger or smaller scale models of given situations or to scale rates and ratios up and down as needed. Students develop strategies to reason about proportional situations and to recognize when such reasoning is appropriate.

Mathematical Reflection
What does it mean to reason proportionally? How does this help you solve problems?

Investigation 1. Proportional Reasoning Using Ratio Comparisons
Investigation 2. Proportional Reasoning: Using Rate Comparisons
Investigation 3. 3 Pulling it all Together: Ratios, Rates, and Percent

Total Problems: 10

Unit 5. Moving Straight Ahead: Linear Relationships with Expressions and Equations

This unit uses linear relationships as a context to explore what it means to be linear and what it means to be proportional. In particular, they deepen their understanding of linear situations by exploring linear situations represented by $y = ax$, which are proportional, and linear situations represented by $y = ax + b$, where $b \neq 0$ which are not proportional.

Students strengthen their understanding of linear expressions, linear equations, and linear inequalities. This unit keeps the study of linear relationships to deepens students' understanding of linear expressions, equations $y = ax + b$, and inequalities $ax + b < c$ or $ax + b > c$. Throughout the unit students seek information about one variable given the value of the other variable. They can find the unknown value by using tables, graphs, or symbolic methods. The contextual situations provide students with a way to write, interpret, and manipulate symbolic linear expressions, equations, and inequalities.

Mathematical Reflection
What do you know about linear expressions, equations, inequalities, and relationships? How is this information useful in solving problems?

Investigation 1. Walking Rates
Investigation 2. Using Tables, Graphs, and Equations to Explore Linear Relationships
Investigation 3. Solving Linear Equations Symbolically
Investigation 4. Connecting Rates and Ratios

Total Problems: 14

Unit 6. How Likely Is It? Proportional Relationships in the Context of Probability

This is the only Unit in the curriculum that develops students' abilities to understand and reason about probability. An understanding of Probability is crucial in applying statistical ideas and being an informed citizen and consumer and to engage in STEM activities.

This Unit explores different types of probability questions in contexts that are interesting to students, such as games, advertising, contests, and sports. Both experimental and theoretical probabilities are explored as students design and analyze experiments and recognizing when experimental or theoretical data is appropriate. Through their work in this Unit, students deepen and expand their understanding of basic probability concepts.

Since probabilities are ratios which are scaled up and down to make predictions, students continue to strengthen their understanding of proportional relationships. The Unit makes important connections between probability and rational numbers, geometry, statistics, science, and business.

Mathematical Reflection
What do you know about probability? How is this information useful in solving problems?

Investigation 1. A First Look at Chance
Investigation 2. Experimental and Theoretical Probability
Investigation 3. Making Decisions with Probabilities
Investigation 4. Analyzing Compound Events Using an Area Model

Total Problems: 13

Unit 7. Filling and Wrapping: Three-Dimensional Measurement

The overarching goals of the Unit are to develop student's (1) understanding of surface area and volume for common three-dimensional shapes and of circumference and area of circles; (2) strategies for calculating those measures for prisms, circles, cylinders, spheres, and cones; and (3) skill in application of area and volume concepts to solving measurement problems.

There are three main structural parts of this Unit. First, students build on knowledge about surface area and volume of rectangular prisms and extend these understandings and skills to other three-dimensional shapes, including right prisms. Next, students develop and apply formulas for circumference and area of circles. To strengthen understanding of area and circumference of circles students use this knowledge to investigate cylinders. Finally, students deepen their understandings of prisms and circles to develop and apply formulas for surface area and volume of cylinders, spheres, and cones. These three-dimensional shapes will be revisited with more complexity in the 8th grade unit, *Say It With Symbols*.

Mathematical Reflection
What do you know about surface area and volume of three-dimensional figures? How is this information useful in solving problems?

Investigation 1. Building Smart Boxes: Rectangular Prisms
Investigation 2. Connecting Rectangular Prisms to Polygonal Prisms
Investigation 3. Area and Circumference of Circles
Investigation 4. Designing Packages: More Three-Dimensional Shapes

Total Problems: 13

Unit 8. Samples and Populations: Making Comparisons and Predictions

Concepts from probability are used as tools for understanding sampling procedures in statistics. This Unit help students make connections among probability concepts, statistics concepts, and proportional reasoning. The focus is on the use of summary statistics to describe and on comparing samples and populations.

Students are introduced to the concept of sampling. They extend their understanding by exploring samples and populations in a variety of problem contexts. They define samples, describe how samples are related to populations, determine what sampling procedures are best to use, select random samples, and compare samples. In the process they apply their proportional reasoning strategies. Students also discuss representative samples. Students consider the statistical distinctions between samples and populations. They also use results of data analyses from samples to draw conclusions about characteristics or behaviors of a population. Students apply what they have learned about samples and populations to engaging real-world problems.

Mathematical Reflection
How can you use samples to draw conclusions about the populations from which they are selected? How is this information useful in solving problems?

Investigation 1. Making Sense of Samples
Investigation 2. Choosing a Sample from a Population
Investigation 3. Using Samples to Draw Conclusions

Total Problems: 10

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