Contents

INTRODUCTION

The adoption of the Common Core State Standards for Mathematics calls for shifts in focus, coherence, and rigor. The teaching of the standards should be focused on the important content, coherent from one grade level to the next, and rigorous in requiring conceptual understanding, fluency, and application. Within this area of application, FOSS provides fertile ground for the use of mathematics.

The FOSS Program integrates mathematics with science in two ways throughout the grade 4 modules. In active investigations, students apply mathematics during data gathering and analysis. In addition, the Interdisciplinary Extensions at the end of each investigation usually include a math problem of the week. These problems enhance the science learning by providing hypothetical data for students to analyze or in some way relate to the context of the investigation. The notes explain for the teacher the problem and describe how students might approach its solution. The problems are prepared for distribution to students on duplication masters in the Teacher Masters chapter of *Teacher Resources*.

This chapter gives an overview of how FOSS addresses the Common Core State Standards for Mathematics through science. It also points out specific instances in which students exercise those skills during science instruction.

Mathematical Practices

Mathematical practices consist of eight processes and proficiencies that are important for all students.

1. Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3. Construct viable arguments and critique the reasoning of others.

4. Model with mathematics.

5. Use appropriate tools strategically.

6. Attend to precision.

7. Look for and make use of structure.

8. Look for and express regularity in repeated reasoning.

Within the context of science, students use some of these mathematical practices on a regular basis. According to *Next Generation Science Standards* (volume 2, appendix L, p. 138),

The three CCSSM practice standards most directly relevant to science are:

• MP.2. Reason abstractly and quantitatively.

• MP.4. Model with mathematics.

• MP.5. Use appropriate tools strategically.

When students reason abstractly and quantitatively and model with mathematics, they are using math in context. They work with symbols and their meanings and represent and solve word problems. Students choose and correctly use the available tools to collect data and solve problems. In the grade 4 modules, students engage with these three practices during the active investigation and by completing the problems at the end of each investigation. Here are some examples.

In solving the Math Problem of the week for Investigation 3 of the **Environments Module**, students model a particular recipe using a given amount of water and changing amount of salt. In order to solve this, students reason quantitatively and use mathematics in the context of science. They can use drawings as they multiply or divide fractional amounts of salt in different recipes.

In the **Soils, Rocks, and Landforms Module**, students are presented with a challenge about a traditional game, Rock, Paper, Scissors. The problem appears simple, but requires students to create a model to

determine how many games were played. Story problems provide opportunities for students to utilize tools to determine the solutions to two-step problems.

In the **Energy Module**, students are asked to reason abstractly to determine the number of wires needed to create series or parallel circuits for a given number of bulbs. This requires students to determine the type of pattern that exists between the number of bulbs and wires for each type of circuit and represent that pattern mathematically. Using this pattern, they can then determine the number of wires or bulbs needed.

Mathematical Content

The mathematical content in fourth grade is organized around four concepts.

- Operations and algebraic thinking
- Number and operations in base 10
- Number and operations in fractions
- Measurement and data

The following pages have a table that identifies the opportunities to engage students in developing these mathematical concepts as well as those learned in grade 3. It lists the math content for some third and fourth grades and points out relevant opportunities in the three FOSS modules for grade 4.

OPERATIONS AND ALGEBRAIC THINKING

Standard	Energy Module
Use the four operations with whole numbers to solve problems.	
3. Solve multistep word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding.	
Generate and analyze patterns.	
5. Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.*	Inv 1, Problem of the week

From Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects (by National Governors Association Center for Best Practices and Council of Chief State School Officers, (Washington, DC: authors, 2010).

Environments Module	Soils, Rocks, and Landforms Module
Inv 2, Problem of the week	Inv 4, Problem of the week
Inv 4, Problem of the week	

NUMBER AND OPERATIONS IN BASE 10

Standard	Energy Module
Use place value understanding and properties of operations to perform multi-digit arithmetic.	
5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	

Grade 4

Environments Module	Soils, Rocks, and Landforms Module
Inv 1, Problem of the week	

NUMBER AND OPERATIONS IN FRACTIONS

Standard	Energy Module
Build fractions from unit fractions by applying and extending previous understandings of operations on whole numbers.	

3. Understand a fraction a/b with $a > 1$ as a sum of fractions $1/b$.
  a. Understand addition and subtraction of fractions as joining and separating parts referring to the same whole.
  b. Decompose a fraction into a sum of fractions with the same denominator in more than one way, recording each decomposition by an equation. Justify decompositions, e.g., by using a visual fraction model. *Examples: 3/8 = 1/8 + 1/8 + 1/8; 3/8 = 1/8 + 2/8 ; 2 1/8 = 1 + 1 + 1/8 = 8/8 + 8/8 + 1/8.*
  c. Add and subtract mixed numbers with like denominators, e.g., by replacing each mixed number with an equivalent fraction, and/or by using properties of operations and the relationship between addition and subtraction.
  d. Solve word problems involving addition and subtraction of fractions referring to the same whole and having like denominators, e.g., by using visual fraction models and equations to represent the problem.	

4. Apply and extend previous understandings of multiplication to multiply a fraction by a whole number.
  a. Understand a fraction a/b as a multiple of $1/b$. *For example, use a visual fraction model to represent 5/4 as the product 5 × (1/4), recording the conclusion by the equation 5/4 = 5 × (1/4).*
  b. Understand a multiple of a/b as a multiple of $1/b$, and use this understanding to multiply a fraction by a whole number.
  c. Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem.	

Grade 4

Environments Module	Soils, Rocks, and Landforms Module
Inv 3, Problem of the week	
Inv 3, Problem of the week	

MEASUREMENT AND DATA

Standard	Energy Module
Solve problems involving measurement and estimation of intervals of time, liquid volumes, and masses of objects.	
2. Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem.	
Represent and interpret data.	
3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. *For example, draw a bar graph in which each square in the bar graph might represent 5 pets.*	
Geometric measurement: recognize perimeter as an attribute of plane figures and distinguish between linear and area measures.	
8. Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.	Inv 5, Problem of the week

Grade 3

Environments Module	Soils, Rocks, and Landforms Module
Inv 3, Part 1, Step 8, Set up the hatching experiment Inv 3, Part 3, Step 4, Formulate a prediction and test it Inv 4, Part 1, Step 10, Set up the water experiment Inv 4, Part 1, Step 25, Water the seeds	Inv 1, Part 1, Step 9, Add water Inv 1, Part 3, Step 6, Conduct the investigation Inv 1, Part 4, Step 11, Discuss further separation
	Inv 3, Problem of the week
Inv 1, Problem of the week	

MEASUREMENT AND DATA (*continued*)

Standard	Energy Module
Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	
1. Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz.; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), ...*	
2. Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale.	Inv 3, Problem of the week
3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.*	

Grade 4

Environments Module	Soils, Rocks, and Landforms Module
Inv 4, Home/School Connection	
	Inv 4, Problem of the week
Inv 1, Problem of the week Inv 4, Home/School Connection	