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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 5 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 5 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 1 of the **Living Systems Module**, students model a particular worm bin given variables that impact the composting of lunch scraps. In order to solve this, students reason quantitatively and use mathematics in the context of science. They can use drawings to determine the area of the bin, visually represent the amount of food worms eat, and the number of scraps students produce. Students can then reason quantitatively as they multiply or divide to answer questions.

In the **Mixtures and Solutions Module**, students are presented with a challenge to redistribute unequal amounts of liquid so each container has the same amount. The problem appears simple, but students can approach it in different ways. Students can combine the liquids in different containers to make full cups and then redistribute or they can reason abstractly to pour liquid from almost full cups to almost empty cups until they all have the same. Story problems provide opportunities for students to utilize tools to determine the solutions to two-step problems.

In the **Earth and Sun Module**, students are asked to use tools to solve a problem about the orbits of different fictional moons. This requires students to create a table to determine when the moons with different orbits will be lined up. Recording the orbit data in a table reveals common multiples which can then be used to answer various questions about the number of orbits and future alignment between the moons.

Mathematical Content

The mathematical content in fifth grade is organized around five concepts.

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

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 4. It lists the math content for some fourth and fifth grades and points out relevant opportunities in the three FOSS modules for grade 5.

OPERATIONS AND ALGEBRAIC THINKING FOR GRADES 4–5

	Standard	Mixtures and Solutions Module
Grade 4	Use the four operations with whole numbers to solve problems.	
	2. Multiply or divide to solve word problems involving multiplicative comparison, e.g., by using drawings and equations with a symbol for the unknown number to represent the problem, distinguishing multiplicative comparison from additive comparison.	Inv 3, Extension, Calculate drink cost
Grade 5	Write and interpret numerical expressions.	
	1. Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.	

Earth and Sun Module	Living Systems Module
	Inv 2, Problem of the week

NUMBER AND OPERATIONS IN BASE TEN FOR GRADE 5

	Standard	Mixtures and Solutions Module
Grade 5	Perform operations with multi-digit whole numbers and with decimals to hundredths.	
	5. Fluently multiply multi-digit whole numbers using the standard algorithm.	
	6. Find whole-number quotients of whole numbers with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, and/or the relationship between multiplication and division. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models.	Inv 4, Problem of the week
	7. Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.	Inv 5, Problem of the week

Earth and Sun Module	Living Systems Module
Inv 2, Part 2, Step 4, Provide size and distance data Inv 2, Part 2, Step 8, Introduce Sun model	
	Inv 1, Problem of the week Inv 2, Problem of the week

NUMBER AND OPERATIONS—FRACTIONS FOR GRADES 4–5

	Standard	Mixtures and Solutions Module
Grade 4	Extend understanding of fraction equivalence and ordering.	
	1. Explain why a fraction a/b is equivalent to a fraction $(n \times a)/(n \times b)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.	Inv 3, Part 2, Step 17, Assess progress: response sheet
Grade 5	Use equivalent fractions as a strategy to add and subtract fractions.	
	1. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators. <i>For example, $2/3 + 5/4 = 8/12 + 15/12 = 23/12$. (In general, $a/b + c/d = (ad + bc)/bd$.)</i>	Inv 3, Problem of the week

Earth and Sun Module	Living Systems Module

MEASUREMENT AND DATA FOR GRADES 4–5

	Standard	Mixtures and Solutions Module
Grade 4	Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.	
	3. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. <i>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.</i>	Inv 2, Problem of the week Inv 2, Extension, Draw blueprints
	Geometric measurement: understand concepts of angle and measure angles.	
	5. Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement: a. An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through $\frac{1}{360}$ of a circle is called a “one-degree angle,” and can be used to measure angles. b. An angle that turns through n one-degree angles is said to have an angle measure of n degrees.	
	6. Measure angles in whole-number degrees using a protractor. Sketch angles of specified measure.	

Earth and Sun Module	Living Systems Module
Inv 1, Part 2, Step 16, Replicate trackings	
Inv 1, Extension, Use circles and degrees	

MEASUREMENT AND DATA FOR GRADES 4–5 (CONT.)

		Standard	Mixtures and Solutions Module
Grade 5		Convert like measurement units within a given measurement system.	
		1. Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.	
		Represent and interpret data.	
		2. Make a line plot to display a data set of measurements in fractions of a unit ($\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$). Use operations on fractions for this grade to solve problems involving information presented in line plots. <i>For example, given different measurements of liquid in identical beakers, find the amount of liquid each beaker would contain if the total amount in all the beakers were redistributed equally.</i>	Inv 3, Problem of the week
		Geometric measurement: understand concepts of volume and relate volume to multiplication and to addition.	
	5. Relate volume to the operations of multiplication and addition and solve real world and mathematical problems involving volume. <ol style="list-style-type: none"> Find the volume of a right rectangular prism with whole-number side lengths by packing it with unit cubes, and show that the volume is the same as would be found by multiplying the edge lengths, equivalently by multiplying the height by the area of the base. Represent threefold whole-number products as volumes, e.g., to represent the associative property of multiplication. Apply the formulas $V = l \times w \times h$ and $V = b \times h$ for rectangular prisms to find volumes of right rectangular prisms with whole-number edge lengths in the context of solving real world and mathematical problems. Recognize volume as additive. Find volumes of solid figures composed of two non-overlapping right rectangular prisms by adding the volumes of the non-overlapping parts, applying this technique to solve real world problems. 		

Earth and Sun Module	Living Systems Module
	Inv 1, Problem of the week
Inv 3, Problem of the week Inv 3, Extension, Use spreadsheet to look at weather data	
Inv 4, Problem of the week	

GEOMETRY FOR GRADE 5

		Standard	Mixtures and Solutions Module
Grade 5		Graph points on the coordinate plane to solve real-world and mathematical problems.	
		1. Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x -axis and x -coordinate, y -axis and y -coordinate).	
		2. Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.	

Earth and Sun Module	Living Systems Module
<p>Inv 1, Problem of the week</p>	
<p>Inv 1, Extension, Match bar graphs to shadow scenarios Inv 3, Part 2, Step 12, Demonstrate weather monitoring and recording Inv 3, Problem of the week Inv 3, Extension, Use spreadsheet to look at weather data Inv 4, Part 1, Step 16, Graph and analyze the results Inv 4, Part 4, Step 19, Graph the data Inv 4, Extension, How does distance from the Sun affect a planet's temperature? Inv 5, Problem of the week</p>	

