Title: Fractions and Percent in Soil Science	SOL: Review of 6.2, 6.5, 7.3

Teacher: **School:**

PRE-PLAN

Mathematics Content *What mathematical concepts and procedures will students learn?* *How are these mathematical ideas important and useful? (Real-world, classroom contexts)*	This lesson will occur near the beginning of the Algebra 1 school year and provide an opportunity for students to review the concepts of fraction and percent, make calculations with these numbers, and use them to solve problems in proportional a proportional relationship. Students will use the context of soil composition, where different relative amounts of sand, clay, and silt affect the ability of the soil to sustain plant life. They will examine different soil samples to determine the type of soil and use the ratios of sand, clay, and silt in those samples to determine the respective amounts needed to create large amounts of that type of soil.	
Prior Topics *What mathematical concepts and procedures must students understand in order to be successful with this topic?*	Students have learned that fractions are numbers with two parts, the numerator (representing the number of pieces) and the denominator (representing the size of the piece with respect to the whole). They know that a percent is a number representing the numerator of a fraction whose denominator is 100. They have knowledge and experience in performing calculations involving fractions and percentages. They have also had experience with proportionality, using the properties of equivalent fractions to determine unknown quantities.	
Mathematical Understanding *In what ways can students understand (or misunderstand) the mathematics in this lesson? (Common strategies, explanations, and errors.)*	Some key understandings needed in this lesson are: • When breaking down a whole into different components, the fractions or percentages representing those components must sum to 1 or 100%. • Multiplying the fraction or percent of one component of soil by the total amount of soil will determine the amount of that component. • When trying to determine a proportional amount, multiplicative relationships should be used. Some key student misconceptions or errors with these ideas: • Multiplying by a percent without taking into account that it is out of 100 (e.g., that 78% = 0.78) • Adding the same value to both parts of a ratio to determine an equivalent ratio 5/8 = (5 + 2)/(8 + 2)	
Learning Goals* *What observable outcomes will the students demonstrate as a result of the lesson? How will these outcomes be individually*	***Learning Goal***	***Formative Assessment***
	Students compute sums and products involving fractions and percentages.	Soil sample activity
	Students will determine unknown quantities using	Soil proportion task

formatively assessed? *One Learning Goal should be motivational, focusing on Expectancy or Value.	proportional reasoning.	
	Students will apply pre-algebra concepts to a STEM-related context (soil science) and solve practical and important problems in that context.	Soil sample activity
	Students will communicate their strategies and solutions to a mathematical task and assist each other with evaluating and further developing their ideas.	Group discussion after soil proportion task.

LESSON PLAN	
Segment Name (Time)	***Segment Description (Teacher and Student Actions)***
Pre-Lesson Preparation (N/A)	The teacher should prepare the following materials for the lesson: • (Optional, but a helpful visual) Two example soil samples. The day before the lesson, fill one jar halfway with water and then add soil. Shake vigorously and let settle overnight. The larger particles (sand), medium particles (silt), and small particles (clay) will separate. The second sample will be created during the lesson introduction. • Also needed: Rulers or Micrometers, Copies of Handouts, Introduction Slides
Introduction (5-10 minutes)	The teacher will use the introductory slides on Soil Science to introduce the work for the day. The teacher begins by asking the question: “Why do plants grow in some places, but not others?” The students should briefly discuss this question with their partner or group, followed by a brief whole group sharing of brainstorms. If students struggle with this question, the teacher might ask about places where a lot of plants grow, places where no plants grow, etc. The goal is to introduce the main idea that the type of soil can influence plant growth. For example, few plants grow in the desert where the soil is sandy and rocky. The teacher should briefly introduce the remainder of the slides with these main ideas: • Soil scientists analyze soil for a variety of interesting purposes. • Soil texture is determined by the relative amounts of sand, silt, and clay. • Sand allows for airflow but does not retain water and clay has the opposite effect, making each type of soil poor for growing plants. A mixture of these soil types, called “loam”, however enables both water retention and air flow. • We can analyze the amounts of sand, silt, and clay in a sample of soil using a jar half-filled with water by measuring and calculating the fraction or percent of each type of particle.
Examining Samples (15 minutes)	The students will work in groups to determine the amount of sand, clay, and silt in each sample as a fraction and percent of the entire sample. The students should accomplish this by measuring the relative sizes of the rectangles for each particle type within the jar. The teacher will monitor the group work, asking questions that prompt the students to clarify and explain their thinking. The teacher should check that student solutions for a given sample add to 1 or 100% for fractions and percentages, respectively. At the conclusion, the teacher should ask the students which sample they believe would be the best for plants to grow and to explain their reasoning.

Main Task (25 minutes)	The teacher will introduce the main task, which requires students to determine the relative amounts of each type of component (sand, silt, clay) would be needed to make a large amount of soil, such as for a garden. The students will use a soil sample of their choice from the previous activity to work on one of the parallel tasks specified on the handout. Students should work in groups to develop a strategy for this activity. Students could solve the tasks in a variety of ways, such as looking for a scale factor between the sample and the total amount, building up ratios to achieve the desired amount, setting up equivalent ratios, etc. As important as having time to work on the task, the teacher should also provide time for each group to share their strategy, work, and solutions, even if the group did not reach an answer or knows they made a mistake in their work. By identifying connections between their strategies and what other groups have done, students can help each other to inspect their work and resolve any issues that arise. If groups finish early, the teacher can give them the Soil Triangle Handout as an extension. This handout could also be used as a homework assignment or a warm-up activity the following day.
Conclusion and Formative Assessment (10 minutes)	At the conclusion of the activity and discussion, the teacher should summarize the solutions presented and identify any key connections or main ideas that are common across solutions. Students should then complete a brief exit card: • Three things I learned today… • Two things I found interesting… • One question I have…

Post-Plan	
Learners' Mathematical Actions *Briefly describe how this lesson intentionally enables students to:* • *formulate, represent, and solve challenging problems?* • *reason about the mathematical idea and procedures?* • *communicate their reasoning?*	The students will need to determine a way to scale up the relative quantities of soil found in their samples to determine the appropriate mixture for the larger batch of soil. There are multiple ways of doing this and students should have an opportunity to explore and discuss these options in a collaborative setting. At the conclusion of work on the parallel tasks, each group should have an opportunity to share how they determined the different quantities to create the proper soil texture. The Soil Triangle handout provides the opportunity for students to reason about their fractions/percentages using an additional (visual) representation.
Learners' Motivation towards Mathematics *Briefly describe how this lesson intentionally enables students to:* • *develop growth mindset and self-efficacy in mathematics (Expectancy)* • *identify why achieving the learning objectives is important, useful, and worthwhile (Value)*	This lesson plan focuses on the Value part of the motivation equation, show students how skills they learned in previous years (and important to success in Algebra 1) can be used to solve practical problems in an accessible STEM-based real-world context that would be particularly relevant to students in a rural setting where agriculture is more prevalent. All mathematical tasks in the lesson are embedded in this context and the students are prompted to interpret the results of those tasks with respect to the soil science context. In terms of Expectancy, the sharing of strategies and solutions to the main task enables students to help each other work through any mistakes they may have made and gives them ownership of their ideas.
Learner and Situational Factors *Briefly describe how this lesson addresses any potentially relevant individual and/or contextual factors that may impact students' learning.*	This lesson is differentiated for students with varying levels of readiness through the use of parallel tasks with varying levels of scaffolding. Supplemental questions involving the Soil Triangle can be used with students who finish early or need additional challenge. The tasks are presented in a visual fashion as much as possible to optimize understanding for students with varying levels of reading and language proficiency.