Topic B:

Percent Problems Including More Than One Whole

7.RP.A.1, 7.RP.A.2, 7.RP.A.3, 7.EE.B.3

Focus Standard:	7.RP.A.1	Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks $\frac{1}{2}$ mile in each $\frac{1}{4}$ hour, compute the unit rate as the complex fraction $\frac{1}{2}/\frac{1}{4}$ miles per hour, equivalently 2 miles per hour.*
	7.RP.A.2	Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total cost and the number of items can be expressed as $t = pn$.* d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points $(0, 0)$ and $(1, r)$, where r is the unit rate.
	7.RP.A.3	Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.*
	7.EE.B.3	Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess

the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making* $\$25$ *an hour gets a* 10% *raise, she will make an additional* $\frac{1}{10}$ *of her salary an hour, or* $\$2.50$*, for a new salary of* $\$27.50$*. If you want to place a towel bar* $9\frac{3}{4}$ *inches long in the center of a door that is* $27\frac{1}{2}$ *inches wide, you will need to place the bar about* 9 *inches from each edge; this estimate can be used as a check on the exact computation.*

Instructional Days: 5

Lesson 7: Markup and Markdown Problems (P)[1]

Lesson 8: Percent Error Problems (S)

Lesson 9: Problem Solving When the Percent Changes (P)

Lesson 10: Simple Interest (P)

Lesson 11: Tax, Commissions, Fees, and Other Real-World Percent Problems (P)

In Topic B, students understand and interpret the elements of increasingly complex real-world problems and directly connect elements in these contexts to concepts covered in Topic A (**7.RP.A.2**, **7.RP.A.3**, **7.EE.B.3**) as well as how the part, whole, and percent equation can be applied as such. The topic begins in Lesson 7, with students solving markup and markdown problems. They understand that the markup price will be more than the whole or more than 100% of the original price. And similarly, they know that the markdown price or discount price will be less than 100% of the whole. This conceptual understanding supports students' algebraic representations. To find a markup price, they multiply the whole by $(1+m)$, where m is the markup rate, and to find a markdown price, they multiply the whole by $(1-m)$, where m is the markdown rate. They write and solve algebraic equations, working backward, for instance, to find a price before a markup when given the percent increase and markup price. Students relate percent markup or markdown to proportional relationships as they consider cases where items of varying initial prices undergo a markup (or markdown). They create an equation, a table, and a graph relating the initial prices to the prices after markup (or markdown). They relate the constant of proportionality to the markup or markdown rate, m, using the value of $(1+m)$ in the case of a markup or $(1-m)$ in the case of a markdown. Students also identify and describe in context the meaning of the point $\big(1,(1+m)\big)$ or $\big(1,(1-m)\big)$ on the graph.

Students continue to apply their conceptual understanding of the relationship between *part*, *whole*, and *percent* as they are introduced to *percent error* in Lesson 8. Additionally, they draw upon prior experiences with absolute value to make sense of the percent error formula and relate it to the elements of a word problem. Given an exact value, x, of a quantity and an approximate value, a, of the quantity, students use absolute value to represent the *absolute error* as $|a-x|$, and then use that to compute the *percent error* with the formula: $\frac{|a-x|}{|x|}\cdot 100\%$. Students understand that even when an exact value is not known, an estimate of the percent error can still be computed when given an inclusive range of values in which the exact value lies.

[1] Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson

In Lesson 9, students solve multi-step word problems related to percents that change. They identify the quantities that represent the part and the whole and recognize when the whole changes based on the context of a word problem. For instance, to find the sale price of a $\$65.00$ item that is discounted 20%, and then an extra 15% discount is applied, students create more than one equation to solve the problem. First, they identify 65 as the whole, and then write and solve the equation $Q = (1 - 0.20)(65)$ to arrive at a price of $\$52.00$ before they apply the extra discount of 15%. They then identify 52 as the whole, and then write and solve the equation $Q = (1 - 0.15)(52)$ to arrive at a final sale price of $\$44.20$.

In Lesson 10, students use the formula $\text{interest} = \text{principal} \times \text{rate} \times \text{time}$ to solve problems involving simple interest, and they relate principal to the whole, the interest rate to the percent, and the amount of interest to the part. When solving an interest problem, students pay close attention to the unit provided for the interest rate as well as the unit of time and are able to convert when necessary so that they remain compatible. Topic B concludes with Lesson 11, which involves percents related to other rates, such as tax, commission, and fees. Students apply their conceptual understanding of the part, whole, and percent to a real-life scenario related to the formation of a new sports team in a school district. In Lessons 10 and 11, students interpret and represent these proportional relationships through equations, graphs, and tables (**7.RP.A.1**, **7.RP.A.2**), recognizing where the constant of proportionality is present in their equations and graphs and connecting it to the value $(1 + m)$ or $(1 - m)$, where m is the rate given as a percentage.