Purpose: The purpose of this lab is to successfully use the concepts of ratio and proportion. 
Outline: Use proportion to increase the serving size of a cookie recipe. 
Content Objectives: Problem solving, proportion, percent, fractions. 
Materials Needed: None (calculator optional). 
Instructions: Answer the following questions. Show all work.

Background:

Ratio:
• The ratio has the forms \( \frac{a}{b} \) or \( a/b \) or \( a:b \)

• It represents a relationship between quantities \( a \) and \( b \).

• For example, the ratio of eighth graders at Middle School who are in the school band (40) to those who are not (110) can be represented by the ratio \( \frac{40}{110} \), \( 40/110 \) or \( 40:110 \)

• Question: What is the ratio of students who are not in the school band to those who are?
  
  Solution: \( 110:40 \)

Recall Fractions:
• A fraction is the quotient of two quantities – a relationship between a part (\( a \)) and the whole (\( b \)). It is written as \( \frac{a}{b} \) or \( a/b \)

• By definition, a fraction is a ratio (but a ratio need not be a fraction)

• The numerator (number on top) indicates the number of parts of the whole (number on the bottom, or denominator) to be considered.

• For example, if a cake is cut into 12 equal pieces and 5 pieces remain, the part-whole meaning of a fraction is given as \( \frac{5}{12} \) of the cake remains.

• Question: In the band example in the previous section, what is the fraction of students who are in the band? Hint: you will first need to find the total number of students.
  
  Solution: \( \frac{40}{150} = \frac{4}{15} \)

Proportion:
• A direction proportion is a relation between two quantities whose ratio remains constant

• When \( A \) changes, then \( B \) changes by the same factor

• We express this mathematically by saying that \( A = kB \), where \( k \) is the constant of variation (any nonzero number).
• We can solve the above equation for $k$ and find that $k = \frac{A}{B}$. So we see clearly that the ratio of $A$ over $B$ is constant ($k$).
• Example. When baking, use 2 cups of flour for every 1 cup of sugar
  Questions:
  – Are sugar and flour proportional in this example? Solution: yes
  – What is the constant of variation, $k$, in the equation $Sugar = k(\text{Flour})$ Solution: $\frac{1}{2}$
  – What is the ratio of flour to sugar? Solution: 2:1
  – What is the ratio of sugar to flour? Solution: 1:2
  – If you use 6 cups of flour, you will need how many cups of sugar? Solution: 3
  – If you use 8 cups of sugar you will need how many cups of flour? Solution: 16

Percent:
• A percent is a fraction or ratio in which the denominator is 100
• Questions:
  In the band example above, what percent of students are in band? Solution: 26.6%
  What percent are not? Solution: 73.3%
• Percents are useful because it has a built in ‘scale’ and is commonly used.

Converting Fractions-Decimals-Percents:
• Converting Decimals to Percent
  1. Move decimal point two places to the right (multiply by 100)
  2. Tack a % sign onto the end
     Example: 0.25 = 25%
     Example: 1.2 = 120%
• Converting Fractions to Percent (you must convert to a decimal first):
  1. Divide the fraction, it is now a decimal.
  2. Move decimal point two places to the right (multiply by 100)
  3. Tack a % sign onto the end
     Example: $\frac{1}{8} = 0.125 = 12.5$
     Example: $0.023 = 2.3$
• Converting Percent to Decimals
  1. Move the decimal point two places to the left (divide by 100)
  2. Remove the percent sign
     Example: 67% = 0.67

Percent of a Value, Discounts and Taxes:
• Recall that 'of' in math is multiplication. To find 'percent of' a number, change the percent to a decimal and multiply
  Example. Each year 8000 Americans suffer spinal cord injuries. 13% of these are due to sports injuries. How many spinal cord injuries are due to sports injuries each year?
  13% of 8000 = 0.13 (8000) = 1040 injuries due to sports
• **Sales Tax** is a tax rate (as a percentage) times purchase price

  *Example. What is the tax of an item for $1260 if the sales tax is 6%?*
  
  \[
  \text{tax} = 6\% \times 1260 = 0.06 \times 1260 = 75.60
  \]

• **Discounts** are percentage amounts taken off of the sales price

  *Example. A CD player is originally $380, with 35% off. Find the purchase price*

  \[
  \text{original price} - \text{discount} = 380 - 0.35 \times 380 = 380 (1 - 0.35) = 247
  \]

**Activity:**
You found the best recipe for chocolate chip cookies below, which makes 24 servings.

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**Absolutely the Best Chocolate Chip Cookies**

**INGREDIENTS:**
- 1 cup butter flavored shortening
- 3/4 cup white sugar
- 3/4 cup brown sugar
- 2 eggs
- 2 teaspoons Mexican vanilla extract
- 2 1/4 cups all-purpose flour
- 1 teaspoon baking soda
- 1 teaspoon salt
- 2 cups milk chocolate chips

**DIRECTIONS:**

1. Preheat oven to 350 degrees F (175 degrees C). Grease cookie sheets.
2. In a large bowl, cream together the butter flavored shortening, brown sugar and white sugar until light and fluffy. Add the eggs one at a time, beating well with each addition, then stir in the vanilla. Combine the flour, baking soda and salt; gradually stir into the creamed mixture. Finally, fold in the chocolate chips. Drop by rounded spoonfuls onto the prepared cookie sheets.
3. Bake for 8 to 10 minutes in the preheated oven, until light brown. Allow cookies to cool on baking sheet for 5 minutes before removing to a wire rack to cool completely.

1. If you wanted to double the recipe, the ‘scale factor’ would be 2.
   a. This means you would need \(1 \times 2 = 2\) cups shortening
   b. Convert the rest of the recipe

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   \begin{align*}
   &\text{2 cups butter flavored shortening} \\
   &\text{1 1/2 cups white sugar} \\
   &\text{1 1/2 cup brown sugar} \\
   &\text{4 eggs} \\
   &\text{4 teaspoons Mexican vanilla extract} \\
   &\text{4 1/2 cups all-purpose flour} \\
   &\text{2 teaspoon baking soda} \\
   &\text{2 teaspoon salt} \\
   &\text{4 cups milk chocolate chips}
   \end{align*}
   \]
2. You decide you want more! 36 servings.
   a. Determine the scale factor needed to go from 24 to 36 servings
      Note: This can be found by solving $24x = 36$ for $x$.
   b. Convert the rest of the recipe

   $1 \frac{1}{2}$ cup butter flavored shortening
   $1 \frac{1}{8}$ cup white sugar
   $1 \frac{1}{8}$ cup brown sugar
   3 eggs
   3 teaspoons Mexican vanilla extract
   $3 \frac{3}{8}$ cups all-purpose flour
   $1 \frac{1}{2}$ teaspoon baking soda
   $1 \frac{1}{2}$ teaspoon salt
   3 cups milk chocolate chips