Goals: To understand the meaning and application of ratios and rates.

- Purpose and value of using ratios.
  - Definition and application.
  - Proper notation.
- Types of Rates and How to Use them
  - Definition and applications.
  - Unit Rates.

Purpose and Value of Using Ratios:

Purpose:
A **ratio** is defined as a quantitative relationship between two values with the **same physical units**.

More specifically, a ratio can show the value of one measurement in comparison to another that has the same units. For example, we use one cup of butter for every two cups of sugar in a recipe. One very interesting and famous ratio is called the Golden Ratio. The Golden Ratio, φ (approximately equal to 1.618), represents the ratio of the sides of what the ancient Greeks believed to be the most eye-pleasing form of a rectangle.

Can you think of two examples that would be considered ratios?
1.

2.

Note: The numerator and denominator of a ratio must have the same units. This means that a ratio does not have units in and of itself. For example,

Ex.1 Say we want to compare the number of friends that we have at school versus the number of friends we have at work. Let's say we have 12 friends at school and 5 friends at work. If we want to make a ratio out of this, we would write it as so,
$\frac{12\,friends}{5\,friends} = \frac{12}{5}$. The units "friends" at the top and the bottom of the ratio, cancel leaving us with the final answer!

Notation:
There are several different ways to notate the use of a Ratio.

- ***Fraction Notation:*** For example, "the ratio of 3 to 4" could be notated as $\frac{3}{4}$.
- ***"to" notation:*** In "to" notation, the same ratio would be notated as "3 to 4".
- ***"colon" notation:*** Last, we notate ratios using colons. Our example ratio could also be written as "3:4".

Examples:

Write each ratio in fraction notation and then reduce to lowest terms.

1. 35 to 60 *2. 0.12: 0.3*

3. A rectangle has length $8\frac{1}{4}$ *inches and width* $3\frac{1}{2}$ *inches. Express the ratio of length to width as a fraction in lowest terms.*

What is the difference between a ratio and a rate?

Definition:

A **rate** is a special kind of ratio in which we are comparing two values that have **different units**.

For example, if we want to compare the number of miles we have driven to the amount of time we have traveled, we will use a rate. For example, we traveled 120 miles in two hours. This rate can be written as follows, $\frac{120\ miles}{2\ hours}$. We can reduce this ratio to get the following,

$$\frac{120\ miles}{2\ hours} = \frac{60\ miles}{1\ hours}\ or\ 60mph.$$

List five different rates that we use on a daily basis and then write them in fraction form:

1. I pay $3.25 per gallon.

2. I walk 5 miles every two days.

3. I pay $1.21 per pound of vegetables.

4.

5.

Unit Rates:
Note that some of the rates listed above have denominators of 1. These are special rates called **Unit Rates**.

It is very helpful to use unit rates because this comparison tells us the number of items we need for each unit. For example, say we know we have driven 120 miles in 4 hours. If we wanted to predict the number of miles that we might travel in the next 5 hours, it would be helpful to use a unit rate.

We travel $\frac{120\ miles}{4\ hours} = \frac{30\ miles}{1\ hour}$. Knowing this, we can now just multiply by 5 to determine the number of miles we would travel for 5 hours as long as we continued at the same rate!

$$\frac{30\ miles}{1\ hour} \times 5\ hours = 150\ miles.$$

Examples:

1. Lanny travels 180 kilometers on 14 liters of gasoline. Express the ratio of distance traveled to gas consumed as a fraction reduced to the lowest terms.
2. Frannie works 5.5 hours and receives $120 for her efforts. What is her hourly salary rate? Round your answer to the nearest penny. Is this a unit rate?
3. John works 8 hours and makes $100. Frankie works 10 hours and makes $122. Which one of them works at the larger hourly rate?