RATIOS AND PERCENT

Ratios and Proportions

As we mentioned in Fraction Models, a **ratio** is a way to compare two quantities. The image below shows a comparison of several sharks, and a human figure. The largest shark (Megalodon) is ten times larger than the human figure.

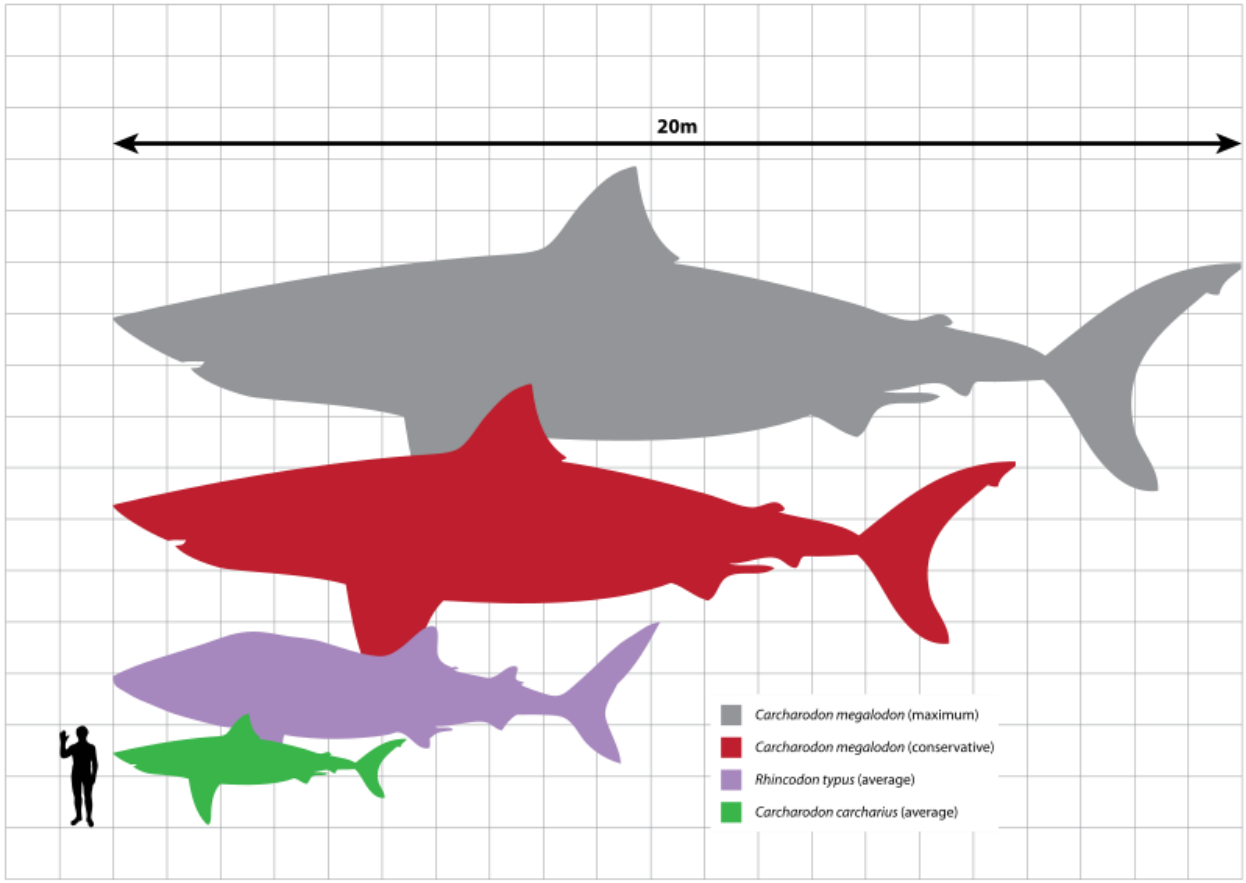

Figure 1: Shark Size Comparison
https://commons.wikimedia.org/wiki/File:Megalodon_scale.svg
CC BY-SA 3.0

Ratios can be written in words, with a colon, or as a fraction. The following ratios are equivalent. Note that ratios are typically written in reduced from; the last two examples are not reduced.

2 to 3	2:3	2/3	4 to 6	8:12

In the shark image, we can say there's a ratio of 1:5 for man to the purple shark (Rhincodon), 1:8 from man to the red (Megalodon conservative), and 5:8 from purple to red.

Ratios can compare part to part within a group, or part to whole. It's important to know which type of comparison your ratio uses. A ratio by itself only compares the size of groups—it doesn't give the total number of items within a group.

Ratio 1A:

If the ratio of boys to girls in a classroom is

2:3,

that means for every 2 boys there's 3 girls.

That doesn't tell us any information about how many children are in the classroom, however, just that it's a multiple of 5 (assuming everyone in the classroom is either a boy or a girl). This is a part:part ratio.

Ratio 1B:

We could write the above ratio as

2:5

if it's interpreted as the number of boys to the total number of students in the class. This is a part:whole ratio. This tells us there are 2 boys for every student; it doesn't tell us who the other group of students is (just not boys) or the total number of students in the class.

Ratio 1C:

If we have the boys to girls ratio of 2:3, and they give us a little more information, we can get somewhere:

a. If there are 8 boys, that tells us there are 12 girls.
b. If there are 15 girls, that tells us there are 15 boys.
c. If there are 40 students, that tells us there are 16 boys and 24 girls.

Ratio 1D:

If we have the boys to students ratio of 2:5, and they give us a little more information we can get somewhere:

a. If there are 10 boys, then there are 25 students.
b. If there are 30 students, then there are 12 boys.
c. If there are 14 boys, then there are 35 students, and 21 are not boys.

When we set two ratios equal to each other, we get a **proportion**. This is really how we solved examples 1C and 1D. Typically, students are taught to cross multiply to solve a proportion, although that's not the only method. (Others are equivalent, however.)

Ratio 1C revisited:

a. $\frac{2}{3} = \frac{8}{x}$ We could cross multiply, or just create equivalent fractions. To get from 2 to 8, we multiply by 4, so we multiply the 3 by 4 to get 12.
b. $\frac{2}{3} = \frac{x}{15}$ To get from 3 to 15, we multiply by 5. So 2 x 5 gives us 10.
c. $\frac{2}{3} = \frac{2x}{3x}$ We have a total of 40, so

$$2x + 3x = 40$$
$$5x = 40$$
$$x = 8$$

So 2 x 8 is 16 boys and 3 x 8 is 24 girls.

Ratio 1D revisited:

a. $\frac{2}{5} = \frac{10}{x}$ 2 x 5 = 10, so 5 x 5 =25
b. $\frac{2}{5} = \frac{x}{30}$ 5 x 6 = 30, so 2 x 6 = 12
c. $\frac{2}{5} = \frac{14}{x}$ 2 x 7 = 14, so 5 x 7 = 35 and 35 – 14 = 21

Percent

A **percent** is literally a number out of 100. So 45% is 45/100=0.45. Models for percent look like the hundredths grid used with decimals. Below are a blank percent grid and a grid showing 23%.

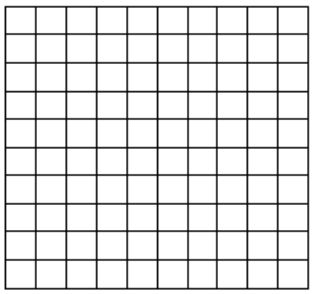

Figure 2: Blank percent grid

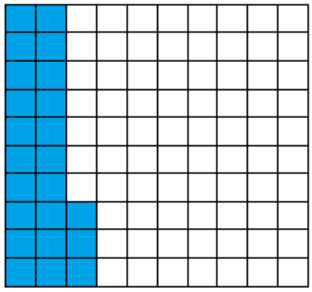

Figure 3: Representation of 23%

Any percentage problem can be solved by using the following proportion:

$$\frac{part}{whole} = \frac{percent}{100}$$

In general, they all boil down to solving for either the part, the whole, or the percent. Sometimes this is "is/of" instead of part/whole. Below are examples of each of the three types of problems.

Solve for part

What is 30% of 70?

$$\frac{x}{70} = \frac{30}{100}$$
$$100x = 2100$$
$$x = 21$$

Solve for percent

What percent of 50 is 23?

$$\frac{23}{50} = \frac{x}{100}$$
$$2300 = 50x$$
$$x = 46\%$$

Solve for whole

12 is 40% of what number?

$$\frac{12}{x} = \frac{40}{100}$$
$$1200 = 40x$$
$$x = 30$$