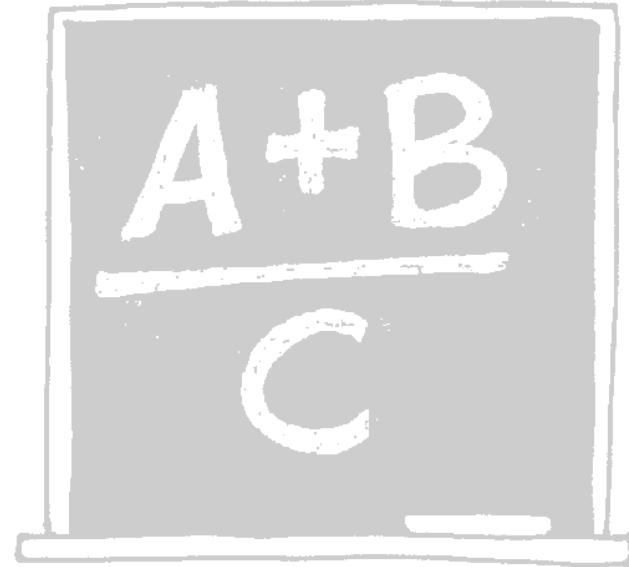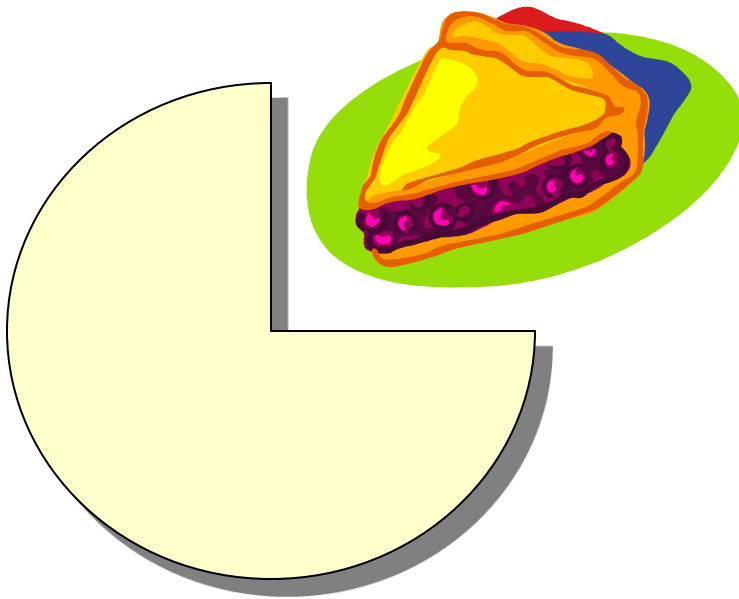# Ratios and Proportions

Outline:

- **Ratios!**
    - What is a Ratio?
    - How to Use Ratios?
    - How to Simplify?
    - **Proportions!**
    - What is a proportion?
    - Properties of proportions?
    - How to use proportions?
- **Mysterious Problems…**

What is a Ratio?

- A ratio is a comparison of two numbers.
- Ratios can be written in three different ways:

a to b

a:b

$$\frac{a}{b}$$ ← Because a ratio is a fraction, b can not be zero

Ratios are expressed in simplest form

How to Use Ratios?

- The ratio of boys and girls in the class is 12 to 11.

- The ratio of le[...] rectangle is 4 to 1.

This means, for every 12 boys you [...] find 11 girls [...]

gi[...]

gi[...]

[...] a huge class

How many dogs and cats do I have? We don't know, all we know is if they'd start a fight, each dog has to fight 2 cats.

What is the ratio if the rectangle is 8cm long and 2cm wide?

Still 4 to 1, because for every 4cm, you can find 1cm to match

- The ratio of cats and dogs at my home is 2 to 1

How to simplify ratios?

- The ratios we saw on last slide were all simplified. How was it done?

Ratios can be expressed in fraction form… $\dfrac{a}{b}$
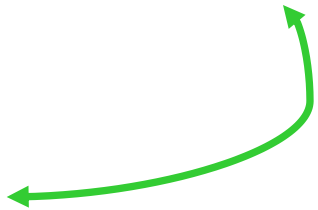
This allows us to do math on them.

The ratio of boys and girls in the class is $\dfrac{12}{11}$

The ratio of the rectangle is $\dfrac{4}{1}$

The ratio of cats and dogs in my house is $\dfrac{2}{1}$

How to simplify ratios?

- Now I tell you I have 12 cats and 6 dogs. Can you simplify the ratio of cats and dogs to 2 to 1?

$$\frac{12}{6} = \frac{12/6}{6/6} = \frac{2}{1}$$

Divide both numerator and denominator by their Greatest Common Factor 6.

How to simplify ratios?

A person's arm is 80cm, he is 2m tall.

Find the ratio of the length of his arm to his total height

To compare them, we need to convert both numbers into the same unit …either cm or m.

● Let's try *cm* first!

$$\frac{arm}{height} \quad = \quad \frac{80cm}{2m} \quad = \quad \frac{80cm}{200cm}$$

Once we have the same units, we can simplify them.

$$= \quad \frac{80}{200} \quad = \quad \frac{2}{5}$$

How to simplify ratios?

- Let's try m now!

$$\frac{arm}{height} = \frac{80cm}{2m} = \frac{0.8m}{2m}$$

$$= \frac{8}{20} = \frac{2}{5}$$

Once we have the same units, they simplify to 1.

To make both numbers integers, we multiplied both numerator and denominator by 10

How to simplify ratios?

- If the numerator and denominator do not have the same units it may be easier to convert to the smaller unit so we don't have to work with decimals…

3cm/12m = 3cm/1200cm = 1/400

2kg/15g = 2000g/15g = 400/3

5ft/70in = (5*12)in / 70 in = 60in/70in = 6/7

2g/8g = 1/4

Of course, if they are already in the same units, we don't have to worry about converting. Good deal☺

More examples…

$$\frac{8}{24} = \frac{1}{3} \qquad \frac{12}{50} = \frac{6}{25}$$

$$\frac{40}{200} = \frac{1}{5} \qquad \frac{27}{18} = \frac{3}{2}$$

$$\frac{27}{9} = \frac{3}{1}$$

Now, on to proportions!

What is a proportion?

$$\frac{a}{b} = \frac{c}{d}$$

A proportion is an equation that equates two ratios

The ratio of dogs and cats was **3/2**

The ratio of dogs and cats now is **6/4**=3/2

So we have a proportion : $\frac{3}{2} = \frac{6}{4}$

Properties of a proportion?

$$\frac{3}{2} = \frac{6}{4}$$

Cross Product Property

2x6=12

3x4 = 12

3x4 = 2x6

Properties of a proportion?

- **Cross Product Property**

$$\frac{a}{b} = \frac{c}{d} \longrightarrow ad = bc$$

means

extremes

Properties of a proportion?

Let's make sense of the Cross Product Property…

For any numbers a, b, c, d:

$$\frac{a}{b} = \frac{c}{d} \qquad \Longrightarrow \qquad \frac{a}{b} \times d = \frac{c}{d} \times d$$

$$\frac{a}{b} \times d = c \qquad \Longrightarrow \qquad \frac{a}{b} \times d \times b = b \times c$$

$$ad = bc$$

How about an example?

$$\frac{7}{2} = \frac{x}{6}$$ Solve for x:

7(6) = 2x ⟵ Cross Product Property

42 = 2x

21 = x

How about another example?

$$\frac{7}{2} = \frac{12}{x}$$ Solve for x:

7x = 2(12) ← Cross Product Property

7x = 24

x = $\frac{24}{7}$

Can you solve it using Reciprocal Property? If yes, would it be easier?