

# Gear Ratios and Machines Lab

Name \_\_\_\_\_ Date \_\_\_\_\_ Group \_\_\_\_\_ Period \_\_\_\_\_

When a pair of gears are working together, knowing how many teeth are on each gear, will let you calculate the number of turns each gear will make. This is known as a single gear ratio (see below for details). Many machines though, have two or more pairs of gears working together, such as a clock. As a result, you end up with two or more single gear ratios.

The ratio between the number of turns for the output gear over the input gear is known as the total gear ratio.

**Problem:** How is the total gear ratio calculated, from knowing just the single gear ratios?

**Variables:** By the time you finish this experiment, you will need to identify the different types of variables present in this investigation. Consult your notes for definitions of the types of variables.

**Independent Variables:** \_\_\_\_\_

**Dependent Variables:** \_\_\_\_\_ Total gear ratio for each combination of gears

**Controlled Variables:** \_\_\_\_\_ Same sizes of gears

The rule which relates the turns in one gear to the turns in another is:

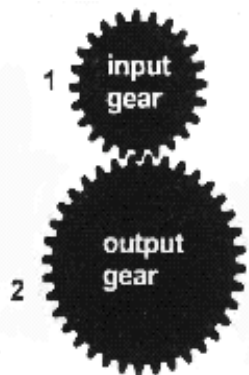
$$(\text{Turns of Gear 1}) \times (\text{teeth in Gear 1}) = (\text{Turns of Gear 2}) \times (\text{teeth in Gear 2})$$

The gear ratio is the number of turns of one gear divided by the number of turns in the second gear.

$$\text{Gear Ratio} = \frac{\text{Turns of Output Gear}}{\text{Turns of Input Gear}}$$

The top gear (Gear 1) will be the input gear. The bottom gear (Gear 2) is the output gear.

$$\text{Gear Ratio} = \frac{\text{Turns in Gear 2}}{\text{Turns in Gear 1}} = \frac{\text{Teeth in Gear 1}}{\text{Teeth in Gear 2}}$$



**Question 1:** What is the *simplified* gear ratio for the two gears in the picture at left.

(24 teeth input and 36 teeth output)? \_\_\_\_\_

In this activity you will make machines with different gear ratios.

Each machine **must** have **at least 5 gears**.

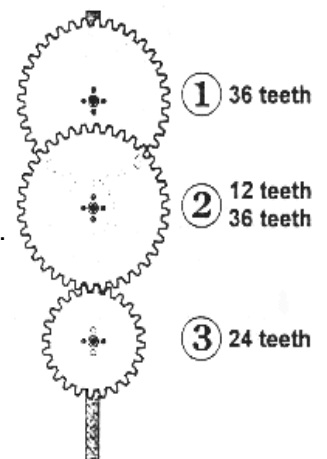
### Compound Gear Machines

You can make a **compound gear machine** by stacking two gears on the same axle. When two gears are stacked they both turn together.

For the machine on the right:

- There is a gear ratio of 3/1 from Gear 1 to Gear 2.
- The gear ratio is 3/2 from Gear 2 to Gear 3.
- The total gear ratio from Gear 1 to Gear 3 is then.

$$\text{ratio} = \frac{3}{1} \times \frac{3}{2} = \frac{9}{2}$$

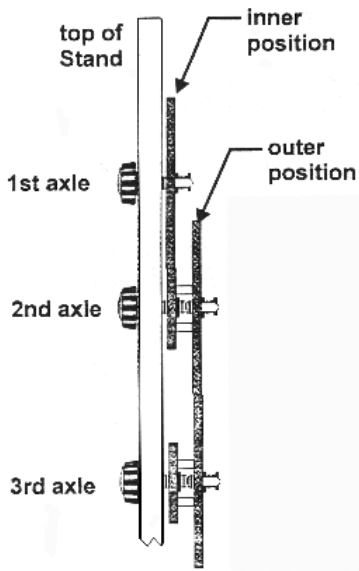


Gear 3 will turn 9 times for every 2 turns of Gear 1.

**To do the experiment**

**Question 2:** You will need to work with a second set of gears to make your machine since you will need more than three gears. Record your design in the chart below.

Each axle can have a gear in the **inner** position and/or the **outer** position. The topmost and bottom most axles can only have a **single** gear on them. Use the table to write down the number of teeth in the gear you have put in each position. Put an **X** in positions where you have no gears.



**Circle on the chart those pairs of gears which mesh together.**

axle	Inner Position "X", or number of teeth	Outer Position "X", or number of teeth
1		
2		
3		
4		
5		
6		

**Question 3:** Each place where the Gears mesh defines a gear ratio. Use the space below to write down the gear ratios in your machine. Multiply the individual gear ratios to calculate the total gear ratio.

**Gear Ratio**

**Sources of Error:** Identify **two** things that people may have done incorrectly that would have caused them to get totally different answers from the rest of the class. These errors must be unique, in other words they have not been applicable in previous labs. They must be **new** sources of error. Be **specific** about what might have been done.

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