

# Gear Ratio

## Making a gear train

**Subject(s):** Design and Technology, Maths

**Approx time:** 50 – 80 minutes

**Key words / Topics:**

- > Gears
- > Mesh
- > Driver
- > Driven
- > Revolve/revolution
- > Ratio

**Stay safe**

Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for:

- ensuring that any equipment used for this activity is in good working condition
- behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others

Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠

## Suggested Learning Outcomes

- > To be able to calculate gear ratios
- > To be able to assemble a gear train to provide a specified gear ratio

## Introduction

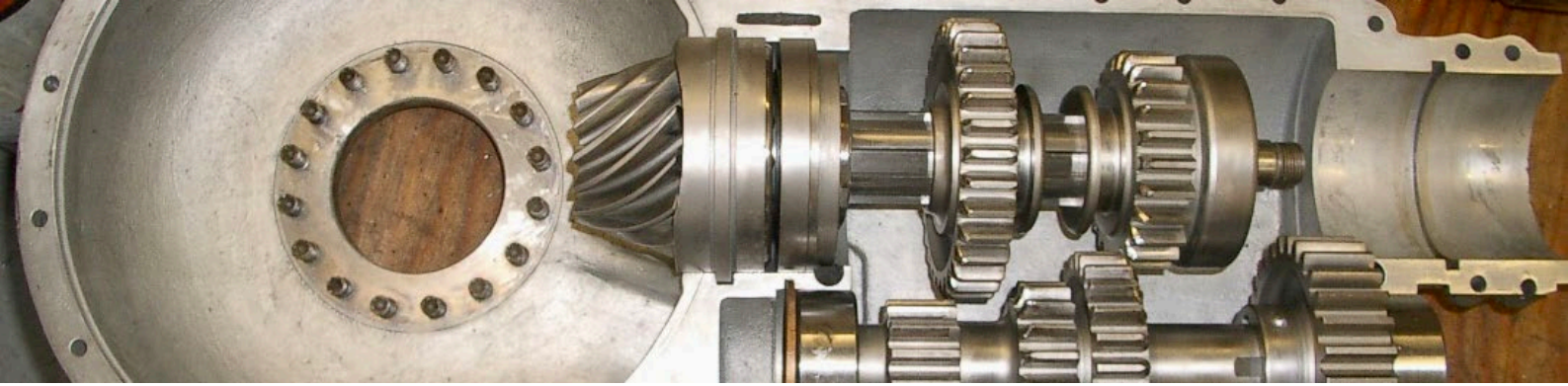
This is one of a set of resources designed to allow learners to develop their knowledge and skills in Design & Technology, Engineering and Mathematics. This resource has been developed with the support of the Bugatti Trust and focusses on the role of gears in a mechanism. The main activity involves making a series of spur gears to calculate gear ratios and see them working.

## Purpose of this activity

In this activity learners will carry out a practical investigation of investigate how spur gears work, including calculation of simple gear ratios and assembling models of simple gear trains.

This activity could be used as a main lesson activity, to introduce the concept of gears in D&T or the practical use of ratios in maths, or as part of a project/series of lessons creating a mechanised object.





## Activity

### Introduction (5-10 minutes)

Teacher to explain what gears are and how they are used using the presentation.

### Gear Ratios (10-20 minutes)

Teacher to explain how gear ratios are calculated, using the presentation to model the calculation. Learners to carry out calculations on slide 10.

### Making gear trains (30-40 minutes) ⚠

Teacher to demonstrate steps shown below and on the presentation. Learners to then follow these steps to make their own gear trains.

- > Step 1 – Mounting. Glue the activity sheets onto card.
- > Step 2 – Cutting. Cut round the gear shapes and make a hole in the centre of each gear by placing sticky tack on the rear face and pushing a sharp pencil through the gear. ⚠
- > Step 3 – Gear ratios. Create gear trains achieve the ratios given on the worksheet.
- > Step 4 - Modelling. Using a split pin, fix the selected gears to a piece of cardboard. The gears must mesh (the teeth must fit together). ⚠
- > Checking the results. Learners to check results by rotating the driver gear and seeing how many rotations the driven gear makes.

### Plenary (5-10 minutes)

Learners to discuss their results. What gear sizes did they use? What alternatives were possible?

## Teacher notes

The practical part of this activity could be carried out individually or in small teams.

### Making gear trains

Two of each gear size are included to allow the learners to have some variety of choice. Solutions are feasible without using all of the provided gears.

Corrugated card is particularly effective for the gears due to the thickness. Laser cut wood/MDF templates could be used as an alternative if this activity is to be repeated.

Step 2 – a hole punch could be used to make the hole if one with a suitable throat is available.

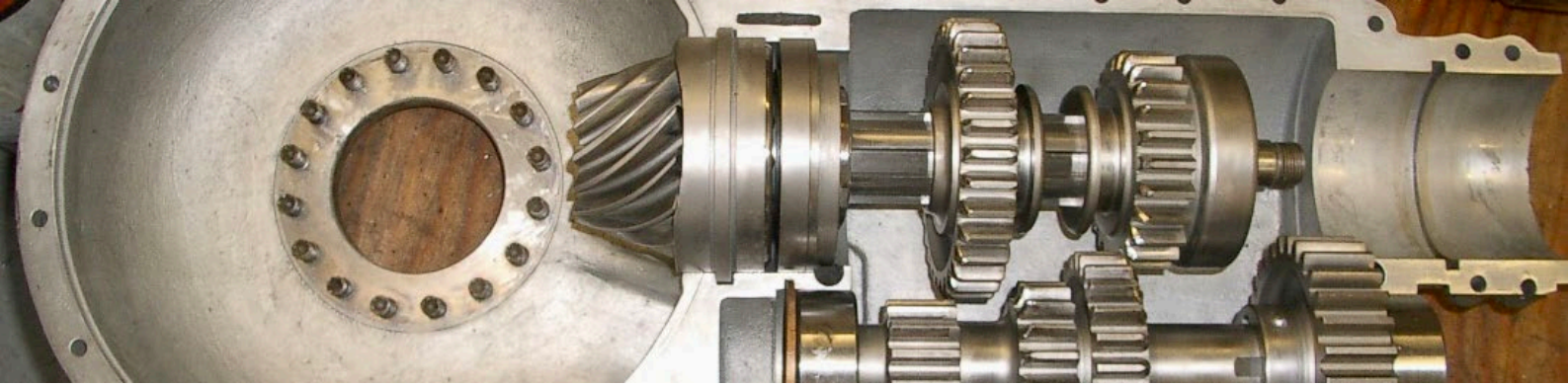
Step 3 – learners could investigate the different combinations from which each ratio could be achieved.

Step 4 – alternatively, foam board and thumb tacks could be used to mount the gears.

Checking the results – the lines on the gears can be used to make counting the revolutions easier.







## Differentiation

### Basic

- > Provide learners with pre-cut templates of the gears
- > Specify one of the gears to be used for each ratio.

### Extension

- > Create gear trains with three or more gears
- > Create gear train solutions which will work in the same direction as the driver gear turns

### Resources

- > Scissors
- > Glue sticks
- > Sharp pencil
- > Card and Split pins
- > Blu Tack (for piercing the card safely)
- > Cardboard (Alternative: foam board and thumb tacks)

### Required files



Presentation Gear Ratio



Gear Ratio activity sheet

### Additional websites

- > Official Bugatti website: <https://www.bugatti.com/>
- > Gear ratios: <https://science.howstuffworks.com/transport/engines-equipment/gear-ratio.htm>
- > Car gear ratios explained: <https://learndriving.tips/learning-to-drive/how-to-change-gear-in-manual-car/learning-car-gears-faq/car-gear-ratios-explained/>

### Related activities (to build a full lesson)

#### Starters (Options)

Discuss ways of speeding a mechanism up or slowing it down – link to learners bicycles they may have

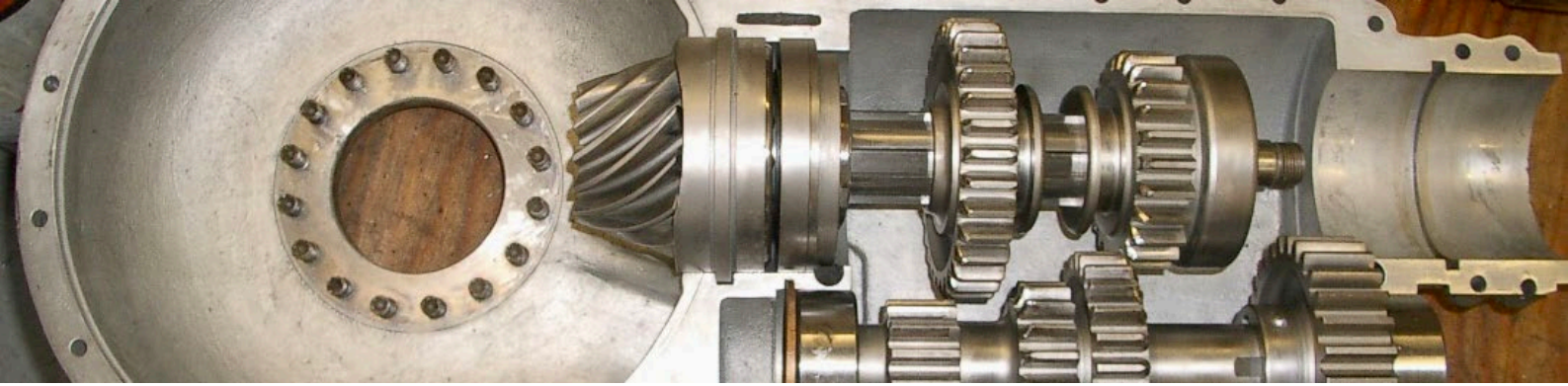
#### Plenary

Check understanding by quick fire questioning of what a given ratio would do, speed up/increase torque

### The Engineering Context

Gears are an important component of many mechanical devices. They are found in the mechanisms of cars, trucks, bikes, pumps, wind turbines and most engineering machines.





## Curriculum links

### England: National Curriculum

#### D&T KS2

- > select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- > understand and use mechanical systems in their products [for example, gears, pulleys, cams, levers and linkages]

#### Science KS2

##### Forces

- > design and make products that use levers, pulleys, gears and/or springs and explore their effects

#### Maths KS2

##### Ratio and proportion

- > solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts

### Scotland: Curriculum for Excellence

#### Maths

##### Fractions, decimal fractions and percentages including ratio and proportion

- > I have investigated the everyday contexts in which simple fractions, percentages or decimal fractions are used and can carry out the necessary calculations to solve related problems. MNU 2-07a

### Northern Ireland Curriculum

#### Maths KS2

- > Appreciate important ideas about measurement, including the continuous nature of measurement and the need for appropriate accuracy

### Wales: National Curriculum

#### Science and Technologies KS2

- > I can use a variety of simple *models* to describe the forces acting on an object.

#### Maths KS2

- > Y5: share objects in a given ratio, e.g. red blocks and blue blocks in a ratio of 1:2.
- > Y6: use ratio to express two or more quantities in words.
- > Progression step 4: I have demonstrated an understanding of ratio and proportion and can solve numerical problems that involve direct and inverse proportion

## Assessment opportunities

Summative assessment of the completed table of results.

