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## **Objectives**

This workshop builds on the statutory requirements of the Primary National Curriculum for science and aims to ensure children:

- Understand the basic principles of gears and gearing including:
  - Gear trains
  - Compound gears
  - Simple gear ratios (e.g. 1:2, 1:3, 1:9)
  - Rotational direction
  - Rotational speed
- Leave with a greater appreciation of the importance of gears.
- Extend specific technical vocabulary related to gears.
- Showcase a range of mechanical engineering careers available to young people

### Activities

Introduction and context

A short introduction to the workshop leader and their work.

#### Exploring gears, gear trains and rotation

Children begin by discussing gears and feeding back their current understanding either to a small group or the whole class.

The children are given a set of gears and time to explore how they can be combined. The workshop leader moves around groups to gauge the level of understanding throughout the class. Through this activity the children will find:

- When two gears mesh they rotate in opposite directions.
- Gears of different sizes will rotate at different speeds when meshed together.

#### **Calculating gear ratios**

The workshop leader should demonstrate how to calculate a gear ratio through counting the number of rotations of one gear needed to fully rotate the second gear. The presentation contains animations to support the explanation of this process.







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The children use the technique to calculate ratios for a red+blue gear and yellow+red combinations. These combinations present integer ratios, appropriate for the age group.

#### Compound gear trains and coaxial gears

The workshop leader shows the children how gears can be mounted coaxially.

The children now calculate the gear ratio of a yellow+red/yellow+red compound gear train and a yellow+red/blue+red gear train.

The workshop leader uses these findings to show children how to calculate the gear ratios of compound gear trains by multiplying gear ratios.

#### The power of gears

The workshop leader runs through the learning points that have been covered in the session so far.

At this point, it would be good for the workshop leader to demonstrate, preferably with a working model or video, an example of gears from their workplace.

The children are given a diagram from which to build a set of compound gears. In pairs they build their gear train, then pair it with the other on their table. They then use the multiplication method to calculate the gear ratio of their combined train.

Once all the systems are built, the workshop leader combines them in stages to create an ever-large gear train. They calculate the gear ratio with the children, arriving at a *very* large number.

The workshop leader invites children to turn the first gear in the train demonstrating the effect on the last gear: it appears not to move at all. They group then calculates how long it would take for the final gear to make a complete turn, if the first gear were turned once per second.

The answer to this activity will depend on the number of children in the class and will therefore differ between deliveries. For a typical class the result will be around 27 thousand years.

#### And finally

The workshop leader runs through the learning points that have been covered in the session, then showcases a few local mechanical engineering companies that use gears in their work.

Depending on time, there may also be an opportunity for the workshop leader to conduct a question and answer session at the end of the workshop.





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### **Resources**

For a class of up to 30 children:

- PowerPoint presentation which includes animations on calculating gear ratio.
- Gear kits for the practical activities.
- Construction guides and ratio worksheets.
- An example of gears as used in the workshop leader's field of work.
- Take-home postcards to develop the learning at home.

## Vocabulary

The vocabulary used by the workshop leader will need to be chosen carefully. Terms such as 'increased by a factor of...' will not be understood by a primary aged audience.

Gears, gearing. Rotation, clockwise, anti-clockwise. Gear train, idler gear, driver, driven. Gear ratio, coaxial, compound gear train.

## The BGA Workshop training

A bespoke training session has been developed to enable BGA members to successfully deliver the BGA Primary Gears Workshops in primary schools.

The training covers:

- Introduction and discussion of where gears fit in the national curriculum.
- Detailed practice of the session delivery
- Classroom management techniques to ensure the session runs smoothly.
- The practicalities of getting into schools
- Unconscious bias and strategies for improving gender diversity in engineering.
- All the printed, construction and presentation materials needed to deliver the workshop to a class of 30.



