STEAM: GEARS

Gears have been in use since ancient times. Their main purpose is to absorb the gap in torque or rotating speed between the prime movers such as motors and engines and the driven mechanisms.

Gears have projections or “teeth”. When gears or other toothed parts fit together or mesh they transmit force and motion from one gear to another. The gear transmitting the force or motion is called the drive gear and the gear connected to the drive gear is called the driven gear.

Two or more meshing gears, working in a sequence, are called a gear train.

THE FUNDAMENTALS

Q. What materials are used to make gears?

A. Gears are made from a wide variety of materials. The three factors that determine gear material are strength, durability, and cost of material and of manufacturing.

METAL GEARS

Steel - carbon steel or alloy steel	Bronze & phosphor bronze
Cast iron	Brass
Ductile iron	Aluminium
Powdered metals	Stainless steel

Metalic gears are made by cutting, rolling, casting and forging. Metal spur gears not requiring high accuracy and hardness are usually made using round rod material. The blanks are turned on a lathe. The teeth are cut using a hobbing machine. They are then deburred.

Brass Pinion Gears are specially made for Faulhaber motors. Used in Solar Challenge models.

NON-METAL GEARS

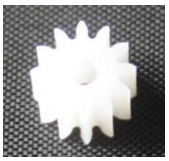
Compressed and synthetic resins like nylon	Acetal (a plastic polymer)
Polycarbonate	Ceramic
Wood	Rawhide

Plastic gears are made by injection moulding which allows for manufacture of large quantities.

Q. What types of gears do you stock?

A. Scorpio kits contain 4 main types of gears: These are available with different hole sizes and number of teeth.

Spur Gear



Pinion Gear

Worm Gears

Gear Rack

SCORPIO TECHNOLOGY Vic Pty Ltd
1/31 Dalgety St. Oakleigh Vic 3166
www.scorpiotechnology.com.au
June 2018

STEAM: GEARS

Spur gears have a second (smaller) gear. When two spur gears mesh, the gear with more teeth is called the “gear” and the one with the smaller number of teeth is called the “pinion.

Q. What does “Module” mean when talking about gears?

A. “Module” is the Metric unit of size that indicates how big or small a gear is. As the gear teeth get larger, the module value goes up. Thus:

$m = d/z$
$\text{Module} = \frac{\text{Reference diameter}}{\text{Number of teeth}}$

For example:

- a 1.0 Module 50 Tooth gear will have a diameter of 50mm
- a 0.5 Module 50 Tooth gear will have a diameter of 25mm

Q. Gears have different hole sizes. Where are they used?

A. The hole size depends on the usage:

Hole size	Useage
1.9mm	Press fit onto a 2.0mm motor shaft
2.4mm	Press fit onto a 2.5mm shaft. 12T / 2.4 mm hole Pinion gears can be used as retainers on a 2.5mm rod.
2.6mm	Free spinning on a 2.5mm shaft (Yellow gears)
2.9mm	Press fit onto a 3.0mm shaft

Q. Where are spur gears used?

A. The most common type of gear is the spur gear. They are used in a wide range of applications from domestic to industrial such as:

- Washing machines
- Clothes dryers
- Blenders
- Mechanical clocks and watches
- Engines
- Construction equipment
- Fuel pumps
- Power plants

Each time a gear tooth on a Spur gear engages a tooth on the other gear, the teeth collide, and this impact makes a noise. This is why they are not commonly used in cars.

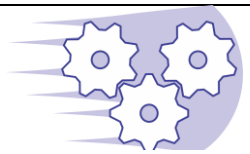
Q. Where are gear racks used?

A. A gear rack is a linear gear. The gear rack meshes with round gears. Two or more racks can be interlocked to make a longer rack. Gears move sideways instead of rotating.

Gear racks are frequently used in large gantry systems for material handling, machining, welding and assembly, especially in the automotive, machine tool, and packaging industries. In some of our kits they are used for steering.

GLOSSARY OF TERMS:

Diameter	Gear ratio	Rotation
Driven gear	Hole Size	Speed



SCORPIO TECHNOLOGY Vic Pty Ltd
1/31 Dalgety St. Oakleigh Vic 3166
www.scorpiotechnology.com.au
June 2018

STEAM: GEARS

Driver gear	**Mesh**	**Spur gear**
Free spinning	Module Gears	Teeth
Gear	Pinion gear	Torque
Gear rack	Press fit	Worm gear

INVESTIGATION

Try these activities with your students.

- In hand-held eggbeaters, spur gears are used to increase the
- speed of the eggbeater so it can be used more effectively.
- Investigate gear ratios and the effect of vehicle weight using **Crocodile Technology** (a commercially available software product). NOTE: further investigations can be found in the DRAGSTER Teaching Unit.
- Assemble Scorpio's SHALLOW GEARBOX or BASIC GEARBOX KIT to see a Gearbox working. As it does not have a wall on both sides of the gearbox the gears can be observed.

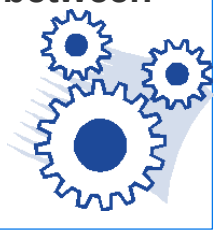
SCORPIO KITS

Many of Scorpio's kits use gears and gearboxes.

Our most popular kit **DRAGSTER** is a battery powered vehicle with a choice of gearing. The students carry out calculation on the various combinations of gears, to look at speed vs acceleration. Code: DRAG (Solder version)/ DRAG-NS (No Solder version)

Simple Safety Reminder!

Your safety gears are between your ears. (Unknown)



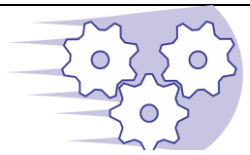
REFERENCES:

- https://science.howstuffworks.com/transport/engines-equipment/gear2.htm
- https://www.motioncontroltips.com/spur-gears-what-are-they-and-where-are-they-used/
- https://sciencing.com/materials-used-spur-gears-7194660.html
- https://khkgears.net/new/spur_gears.html

Check out our website for new catalogues and updates.

- Chemistry clearance
- Biology clearance
- Primary clearance
- Whiteboard accessories
- Coming soon – Physics, Primary STEAM

Please pass this information to colleagues in other departments.



SCORPIO TECHNOLOGY Vic Pty Ltd
1/31 Dalgety St. Oakleigh Vic 3166
www.scorpiotechnology.com.au

June 2018