

Activity Plan & Guidance (KS3 & KS4)

Learning Objectives

- Understand how mechanical advantage can make work easier.
- See how rotary motion can be converted to linear motion through a rack and pinion mechanism.
- Use models to convey mechanical systems.

Resources

- [Gears PowerPoint Presentation](#)
- [Gears Micro-lesson](#)
- [Paddle Gear Activity](#)

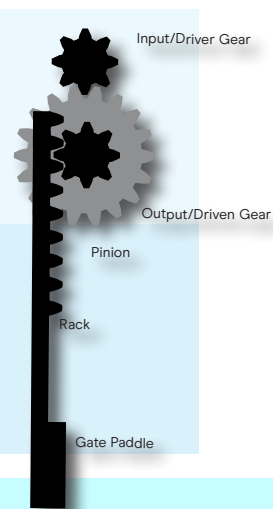
Activities

Starter

- Use the 'Gears PowerPoint Presentation' slides 1 to 5 to introduce how and why gears are used in everyday life.
- Watch the 'Gears Micro-lesson' so see how gears are used for increasing torque.
- Use the 'Gears PowerPoint Presentation' slides 6 to 10 to explain how the rotational motion of a gear can be turned into linear motion and introduce the task.

Task

- Use the 'Paddle Gear Activity' to create a paper model showing how the paddle gears on a lock gate work. Students can use the printable template with gear outlines or they create their own model from scratch. Encourage students to add movement arrows to their paper model along with labels including driver gear, driven gear, pinion and rack.



Suggestions

- For a more advanced activity, students can make the model movable and robust by sticking the template shapes onto card. Split pins/cocktail sticks and paper braces could be used to allow for dynamic movement.
- Don't worry too much about cutting out gears in detail. The aim is to explore how the mechanism moves, label the parts and use arrows to show the direction of a movement.

Plenary

- Try experimenting by placing the gears in different orders or in different positions. How might this affect the system?
- Talk about or research where else rack and pinion mechanisms might be used (car steering systems and stairlifts are good examples).

KS3/4 Curriculum Links

KS3 Science (Energy changes and transfers)

- Simple machines give bigger force but at the expense of smaller movement (and vice versa).

KS3 Science (Forces)

- Using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces.

KS4 Engineering (Systems)

- Including linkages, gear trains, cam and follower, pulleys...

Useful links/extra resources

- [Canal Crane Presentation](#)
- <https://www.youtube.com/watch?v=dmZ7hBMTY8Q>

Paddle Gear Mechanism

Fact File

Canal locks have big wooden gates that hold back water.

Paddles are small doors built into the lock gates. They control the flow of water in and out of the lock chamber.

[Watch this video to see how a lock works.](#)

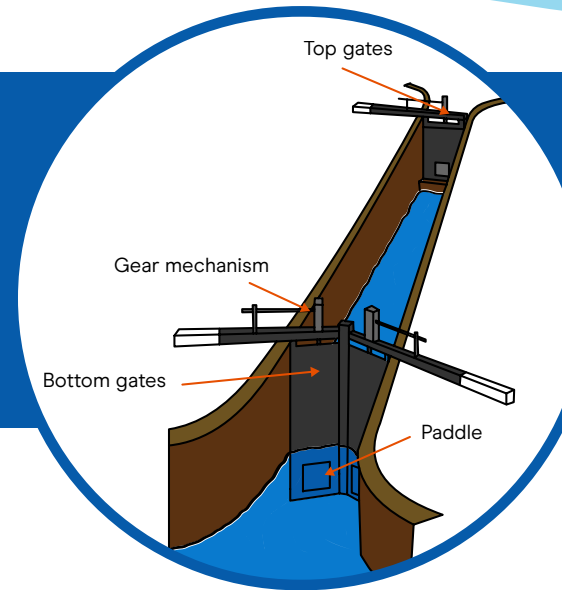
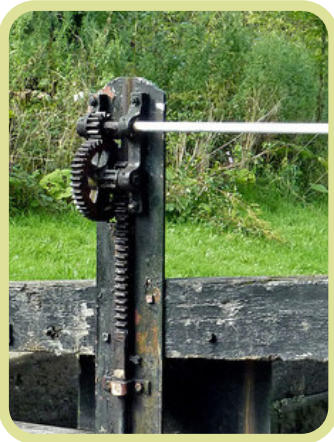


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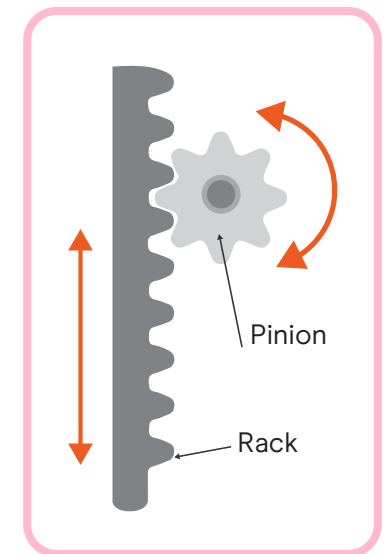
A **gear mechanism** is used to open and close the paddles.

Remember gears can help to increase torque and change the direction of a force.



The mechanism contains a **rack & pinion** gear that changes the rotational force into a linear force.

The pinion rotates making the rack move up and down.



Paddle Gear Mechanism Task

Use your knowledge of gears to construct a paper model that demonstrates how a paddle gear mechanism works. Don't forget to label your model and add force arrows to show how the gears will move.

Instructions

1. Cut out the 4 gear template parts (A–D). If you have time, stick the templates to card first to make your model more robust.
2. Arrange the gears to visually describe how the mechanism works. Use the reference photo to help you.
3. Cut out and attach the 5 labels to your model.
4. Add arrows to show the **direction of movement when raising the paddle up**.

Extra Challenge!

Make the parts 'movable'. You could use split pins, thread or even cocktail sticks to enable the parts to move.

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