

WATER TURBINE

In this challenge, we will learn about the engineering behind turbines and explore how they harness energy to create power.

TEACHING NOTES

SUMMARY

This project will introduce students to turbines, their inner workings and why they are an incredibly useful tool used by engineers across the world for harnessing energy to create power.

Using household items and craft materials, students will work in teams, or with help from an adult, to design and build a water turbine model, then use their creativity to decide what it will power.

Taking inspiration from hydroelectric power stations, students will learn about renewable resources and sustainable power sources.

LEARNING OUTCOMES

Students will learn:

- How to test and refine their designs.
- What sustainable resources are and why are they important.
- What turbines can be used for and their role in the generation of electricity.
- The definition of gravitational potential and kinetic energy.
- How energy is conserved and exchanged.
- Teamwork and problem solving.

LESSON PLAN

ACTIVITY	DESCRIPTION	TIMING
Getting Started	Introduce the goal of the session and hand out the student worksheet. Divide students into teams of 4 students, providing a set of materials to each.	5-10m
Warm-up Activity A	Introduce the Sustainable Power exercise to students and ensure they have the necessary resources.	5-10m
Warm-up Activity B	Introduce the Turbines Research exercise to students and ensure they have the resources to complete it.	10-15m
Main Challenge	Explain to students that they should use the instruction sheet as a guide, however also encourage creativity if students think of design improvements or additions.	30-40m
Measuring Up	When the teams have finished building, they need to test their build to ensure that their design was successful.	10-15m
Extension Activities	If any of your teams finish their build early, get them to try one of the extension activities.	5-20m
Understanding the Science	Additional educational content for those with enquiring minds.	10-15m
Quiz	Ask your students to complete this quick quiz to test their knowledge.	15-20m
Wrapping Up	Cover the discussion points with the students to close the session.	10-15m

TOP TIP

To help minimise mess, make sure each team has a large tray to contain the water once they start testing their turbine.

DOWNLOAD

Download and print student worksheets from imeche.org/stemathome

CURRICULUM

KS2 Science

- Living Things and Their Habitats - Recognise that environments can change and that this can sometimes pose dangers to living things.
- Forces - Recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.
- Forces - Explain that unsupported objects fall towards the Earth because of the fall of gravity acting between Earth and the falling object.

KS1 Design and Technology

- Make - select from and use a range of tools and equipment to perform practical tasks (for example, cutting, shaping, joining and finishing).
- Make - Select from and use a wide range of materials and components, including construction materials, textiles and ingredients, according to characteristics.
- Technical Knowledge - Explore and use mechanisms (for example, levers, sliders, wheels and axles) in their products.

KS2 Design and Technology

- Make - Select from and use a wider range of tools and equipment to perform practical tasks (for example, cutting, shaping, joining and finishing), accurately.
- Make - Select from and use a wider range of materials and components, including construction materials, textiles, and ingredients, according to their functional properties and aesthetic qualities.
- Technical Knowledge - Understand and use mechanical systems in their products (for example, gears, pulleys, cams, levers, and linkages).

KS3 Design and Technology

- Design - Identify and solve their own design problems and understand how to reformulate problems given to them.
- Make - Select from and use specialist tools, techniques, processes, equipment and machinery precisely.
- Technical Knowledge - Understand how more advanced mechanical systems used in their products.

KS3 Science

- Chemistry - Earth and Atmosphere - Earth as a source of limited resources, the carbon cycle, the production of carbon dioxide by human activity and the impact on climate.
- Physics - Energy changes and transfers - Simple machines give a bigger force.
- Physics - Energy changes and transfers - Changing motion.

WRAPPING UP

MEASURING UP



10-15m

In this challenge, the winning group of students will be the one with the most efficient turbine model. Encourage the students to test, adapt and improve their design as they go to achieve the fastest spin.

EXTENSION ACTIVITIES

The model provides lots of scope for additional investigation and engineering. Encourage students who finish early to have a go at one of the extension activities.

A



5-10m

Ask the students to consider what their turbine could be used for. By attaching a string to the cotton reel next to the disc the turbine's rotational movement is changed to linear. This could then be used as a lifting or pulling device. Encourage the students to use their creativity to come up with their own ideas.

B



10-15m

Ask the students to use their Working Scientifically skills to design an investigation using their turbine model. For example they could ask:

- What happens when the height of the turbine is changed?
- What happens when the height the water is poured from is changed?

Remind students to control the variables and change only the independent variable (e.g. height of turbine).

To collect numerical data, attach a string to the cotton reel closest to the cardboard disc and time how long it takes for the string to wind around the reel.

DISCUSSION POINTS



10-15m

To close the session, hold a class discussion and cover the following points:

- Did the teams successfully build a working water turbine?
- If not, why did it not work?
- Did they draw inspiration from existing designs that they researched? If so, which ones?
- Do the teams think it would have been easier to work alone? Why?
- What would the teams change if they were to attempt the task again?
- What additional materials would the teams need to improve their designs?