CHALLENGE 1

HYDRAULIC PROPAGATOR

In this challenge, we will combine engineering with sustainability by incorporating hydraulics into a propagator to grow seeds.

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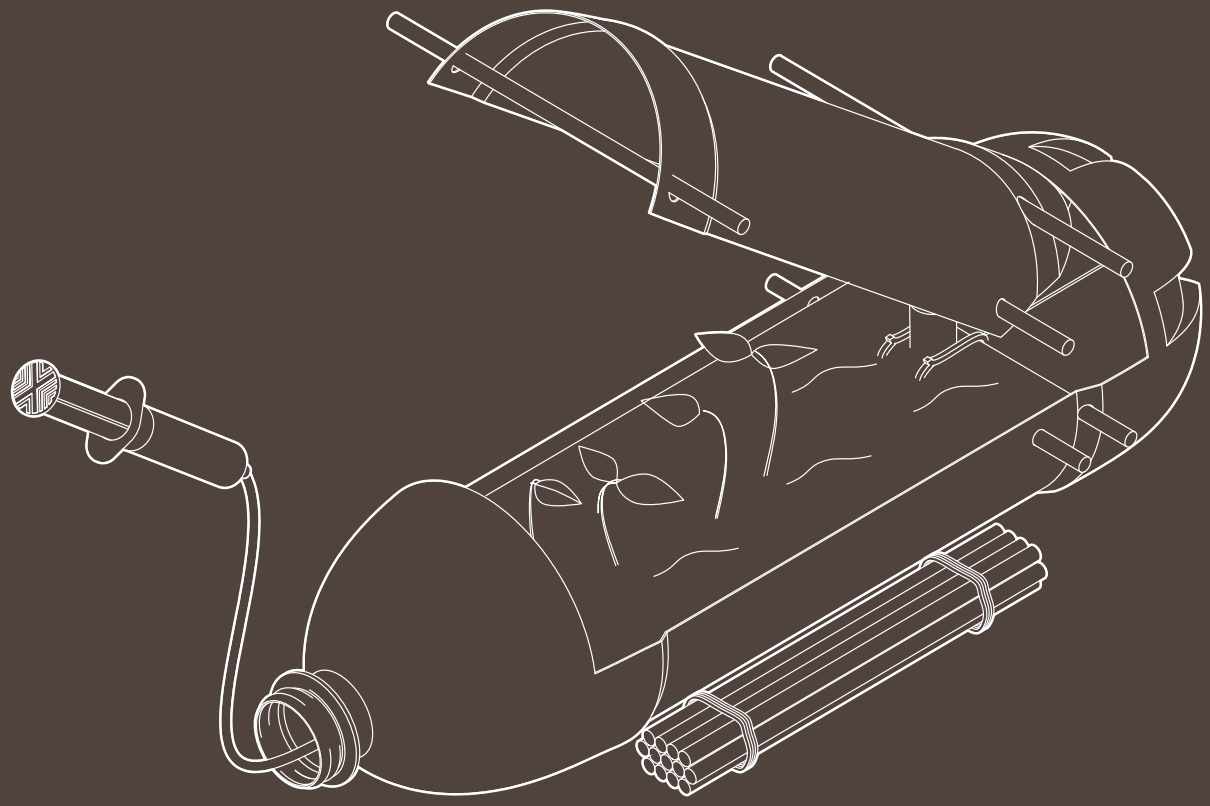

TEACHING NOTES

SUMMARY

The Propagator project will introduce students to hydraulic systems, their inner workings and why they are an incredibly useful tool used by engineers across the world.

Using a few household items and craft materials, students will work in teams, or with help from an adult, to design and build a propagator with a basic hydraulic system that will help them care for their seedlings.

Combining the ideas of sustainability and hydraulics, students will learn about Pascal's Law, the effect this has on hydraulic systems, and how these can impact social and economic factors.

LESSON PLAN

ACTIVITY	DESCRIPTION	TIMING
Introduction	Introduce the goal of the session and hand out the student resource sheet. Divide students into teams of 4 students, providing a set of materials to each.	5-10m
Warm-up Activity A	Introduce the Carbon Footprint and Sustainability exercise to students and ensure they have the necessary resources.	5-10m
Warm-up Activity B	Introduce the Hydraulics exercise to students and ensure they have the resources to complete it.	10-15m
Main Challenge	Explain to students that their propagator designs have to include a hydraulics system to help them care for their seedlings.	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.	5-15m
Extra Content	Additional educational content for those with enquiring minds.	10-15m
Quiz	Ask your students to complete this quick quiz to test their knowledge.	10-15m
Wrapping Up	Cover the discussion points with the students to close the session.	10-15m

LEARNING OUTCOMES

Students will learn:

- How to test and refine their designs.
- Pascal's Law and how this impacts their hydraulic system.
- How to explain the basic concepts of a hydraulic system.
- Why hydraulics is an important engineering tool.
- What sustainability is and why it is important.
- What a propagator is used for; and their role in the global food supply chain.
- Teamwork and problem solving.

CURRICULUM

KS1 Science

- Year 2 - Plants - observe and describe how seeds grow into mature plants.
- Year 2 - Plants - find out and describe how plants need water, light and a suitable temperature to grow and stay healthy.

KS2 Science

- Year 3 - Plants - identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers.
- Year 3 - Plants - explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant.
- Year 4 - States of Matter - compare and group materials together, according to whether they are solids, liquids or gases.
- Year 5 - Forces - recognise that some mechanisms, including levers, pulleys and gears, allow a smaller force to have a greater effect.

KS1 Design & Technology

- Design - design purposeful, functional, appealing products for themselves and other users based on design criteria.
- 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 their characteristics.

Technical - explore and use mechanisms [for example, levers, sliders, wheels and axles], in their products.

KS2 Design & 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 Science

- Chemistry - The particulate nature of matter - the properties of the different states of matter (solid, liquid and gas) in terms of the particle model.
- Physics - Energy changes and transfers - simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged.
- Physics - Pressure in fluids - pressure measured by ratio of force over area – acting normal to any surface.

KS4 Science

- Physics - Forces - pressure in fluids acts in all directions

KS3 Design & 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 enable.

TOP TIP

To help minimise mess, set up a station where teams can fill their propagators with soil and plant their seedlings.

DOWNLOAD

Download and print student worksheets from imeche.org/stemathome

WRAPPING UP

MEASURING UP

10-15m

In this challenge, the winning student will be the one with the most creative hydraulics system. Encourage the students to customise and personalise their creations as they go.

EXTENSION ACTIVITIES

There are plenty of extra considerations that engineers need to take into account when designing hydraulic systems. If students finish early, here are a few ideas for extension activities.

A

5-10m

Ask students to alter their design, so that both sides of the propagator lift either at the same time, or separately.

B

10-15m

Ask teams to design and incorporate another hydraulic system into their propagator to help them care for their seedlings.

DISCUSSION POINTS

10-15m

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

- Did the teams successfully build a working hydraulics system for their propagator?
- If not, why didn't it 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?

REMEMBER

Provide a recap or short summary to the class, highlighting the key engineering skills and what has been learnt during this activity.