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| **Make a model hydraulic boat lift** |
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| Making a model of a hydraulic boat lift using syringes |
| **Subject(s):** Design & Technology, Engineering, Science**Approx time:** 45 - 70 minutes |  | **Key words / Topics:** * boat lift
* force
* hydraulic systems
* pneumatic systems
* syringe
* template
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| **Stay safe** Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for: •        ensuring that any equipment used for this activity is in good working condition•        behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others  Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠  |
| **Suggested Learning Outcomes**  |  |  |
| * To know the difference between pneumatic and hydraulic systems
* To know that 3D shapes can be constructed using templates
* To be able to make a model of a simple boat lift model using syringes
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| **Introduction** |  |  |
| This is one of a series of resources produced in association with Fairfield Control Systems that are designed to allow learners to use the theme of waterways to develop their knowledge and skills in Design & Technology, Engineering and Science. This resource is based on the Anderton boat lift and the use of hydraulic systems. |
| **Purpose of this activity**In this activity learners will focus on the Anderton boat lift, which was restored by Fairfield Engineering. They will make a working model of a boat lift using syringes and test it to see how well it works.This activity could be used as a main lesson activity to teach learners how energy is used to create movement, to develop understanding of pneumatic and hydraulic systems, or as a graphics activity to practice modelling using card.It could also be used within a wider scheme of learning in science to develop understanding of forces, or to contribute to developing making skills in Graphics. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (5-10 minutes)**Teacher to introduce the activity, making a working model of a boat lift using syringes. Teacher to explain that templates will be used to produce each part of the model. Teacher to discuss what is meant by a hydraulic system and how they are used in engineering applications such as cranes and brakes.**Demonstration (10-15 minutes)**Teacher to demonstrate the steps shown in the presentation to make the model boat lift.* Step 1 – Learners to safely cut out the templates for the model boat lift parts (A-E). ⚠
* Step 2 – Learners to use a glue stick to attach the templates to corrugated cardboard. ⚠
* Step 3 – Learners to safely cut out each template using scissors. Care should be taken cutting out the slots for Sides B and C. ⚠
* Step 4 – Learners to pierce the eight holes with a sharp pencil, pushing the pencil through the cardboard into sticky tack. ⚠
* Step 5 – Learners to remove the paper templates. Learners to cut two 120 mm lengths of 3 mm clear plastic tube and attach clear tubes to the syringes, then attach the 10 ml syringes with cable ties to sides B and C. ⚠
* Step 6 – Learners to glue side B to base A, then glue back D to side B and base A. Next glue Side C to base A and back D, then glue Lift E to the syringe tops. ⚠
* Step 7 – Pull out the plungers and attach two syringes to the tubes. Cut out the boat picture and glue to Lift E. Learners then to test the model by pressing the syringe plungers. Does the lift work? ⚠
* Step 8 – To increase the power of the boat lift water can be added to the syringes. Fill a measuring jug with water and add a food dye for colour. ⚠
* Step 9 – Learners to reattach the water filled syringes to the lift syringes. Retest the boat lift to find out the difference in operation. ⚠

**Performing the Activity (25 - 35 minutes)**Learners to carry out the activity and produce their own models.**Plenary (5-10 minutes)**Learners could show their boat lift models to their peers and ask what could be improved. How much weight were the hydraulic lifts able to lift? |  | This activity could be done as individuals or in small groups. Print out the boat lift templates and hand out to the learners.Additional guidance for making:* To cut out the slots on Sides B and C the teacher could assist by using a craft knife to cut out the inner piece.
* To glue corrugated cardboard together, use an all-purpose clear non-toxic adhesive and secure with masking tape until set.
* To speed up the gluing process, the teacher could use a hot-glue gun. In this case the schools risk assessment for that process must be followed..

Step 4 – Foam rubber could be used instead of sticky tack.Step 5 – It is easiest to attach the syringes to the sides before the box is constructed.Step 6 - Use tape for support if needed.Step 7 – Teachers may use the opportunity to discuss pneumatics. Discuss how air is compressible so the lift may work slowly.Step 8 – The purpose of the food dye is to increase the visibility of the water inside the system. Ensure food dye is used in small amounts to protect from staining surfaces and clothes. When filling the syringes with water make sure it is done at a sink or plastic covered tables. Teacher may discuss how hydraulic systems are more powerful as the liquid (water) is not compressible. |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * The templates and corrugated cardboard could be pre-cut to size.
* An exemplar model could be used to illustrate what the final boat lift should look like.
 |  | * Investigate how much the boat lift can lift.
* Watchthe video YouTube- Air and Waterpower - Primary Science: <https://www.youtube.com/watch?v=BFYkCz1q-b0>
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Corrugated cardboard sheets
* 10 ml syringes
* Cable ties (Size: 20 cm length)
* 3 mm clear plastic tube
* Water and measuring jugs
* Food dye
* Pencils
* Sticky tack
* Adhesive
* Masking tape, sticky tape or hot glue gun (optional)
* Craft knife and cutting mat (teacher only)
 |  |  Make a model hydraulic boat lift presentationicon-doc Make a model hydraulic boat lift templates |
| **Additional websites** |  |  |
| * **YouTube** - Anderton Boat Lift: <https://www.youtube.com/watch?v=31TIxKPgp04>
* **YouTube** - Air and Waterpower - Primary Science: <https://www.youtube.com/watch?v=BFYkCz1q-b0>
* **Fairfield Control systems website:** [https://www.fairfields.co.uk/](https://emea01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.fairfields.co.uk%2F&data=05%7C01%7C%7C4dc3028e5da442738d9f08dad86492aa%7C84df9e7fe9f640afb435aaaaaaaaaaaa%7C1%7C0%7C638060223713198401%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=HArsg5SYyeH3563Zd3%2ByRwiYrh8tbOAi2tWit%2BsWM5w%3D&reserved=0) , <https://www.fairfields.co.uk/fcs/sectors/waterways/>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * Discuss the Anderton boat lift and watch the video:

**YouTube** - Anderton Boat Lift: <https://www.youtube.com/watch?v=31TIxKPgp04>  | **Plenary*** Peer review of the boat lift models and discuss how much weight were the hydraulic lifts able to lift?
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| **Assessment opportunities** |
| * Informal formative assessment of the making activity.
* Formal teacher assessment of the completed hydraulic boat lift models.
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| **The Engineering Context** film |
| * The waterways (including their protection, maintenance and control) is an excellent context to explore opportunities that working in the engineering industry presents. For example, constructing locks, building narrowboats or making and maintaining boat lifts.
* Engineers often make models of working systems to test how they function. For example, a crane designer will make models of different crane designs to see which structures can provide the best support and which designs can lift the heaviest object.
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| **Curriculum links**  |
| **England: National Curriculum**Design & Technology Key Stage 1Make* select from and use a range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing]
 | **Northern Ireland Curriculum**The Arts / Art and Design Key Stage 1* use modelling and construction techniques to make three-dimensional work, for example, experiment with cutting, folding and joining methods to make a model building from thick paper or thin card.

KS2 – Science and technologyMovement and energy* The uses of energy in a variety of models and machines and ways in which energy is used to create movement, for example, pneumatics and hydraulics.
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| **Scotland: Curriculum for Excellence**Craft, Design, Engineering and GraphicsDesign and construct models/products* TCH1-09a I can design and construct models and explain my solutions

Representing ideas, concepts and products through a variety of graphic media* TCH 2-11a I can use a range of graphic techniques, manually and digitally, to communicate ideas, concepts or products, experimenting with the use of shape, colour and texture to enhance my work.

Application of Engineering* TCH1-12a I explore and discover engineering disciplines and can create solutions.

SciencesForces, electricity and waves* SCN 2-07a understanding of how friction and air resistance can both be useful, for example, in braking systems
 | **Wales: National Curriculum** Design and Technology Key Stage 2Making* 1. work to their specification/recipe to make products
* 3. measure, mark out, cut, shape, join, weigh and mix a range of materials and ingredients, using appropriate tools/utensils, equipment and techniques

Range* tasks in which they explore and investigate simple products in order to acquire technological knowledge and understanding that can be applied in their designing and making
* tasks in which they develop and practise particular skills and techniques that can be applied in their designing and making

ScienceHow things work* KS2 – forces of different kinds
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