



Thames Sailing Barge Trust
Pudge Project
Upper Key Stage 2 Science: Forces



Levers and Pulleys (40 mins + practical)

Objectives:

- recognise that some mechanisms, including levers and pulleys, allow a smaller force to have a greater effect
- investigate how levers work; exploring how the position of fulcrum, load and effort impacts on use
- investigate how pulleys work and how the number of pulleys used changes the effort required
- draw diagrams that explain the forces, loads, weights and efforts for levers and pulleys

Working Scientifically:

- plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
- take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
- record data and results of increasing complexity using scientific diagrams and labels and tables
- use test results to make predictions to set up further comparative and fair tests
- report and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in written forms

Curriculum Links: Maths:

- Use all four operations to solve problems involving measure using decimal notation, including scaling
- Scale weights and lengths using appropriate calculations

Resources: Laptop, screen, pulleys, cotton reels, dowling, rope, mini buckets, toys/multilink cubes (X15 to allow for partner work). (Provided in the TSBT Bargeman's Box to be checked and returned if borrowed from the Trust. Available by emailing education@bargetrust.org)

Introduction: SLIDE 1 Following on from your previous session (History of the Barges), we're going to be looking at how FORCES help the barges with their work. Discuss: What happens when unsupported objects fall towards the Earth: because of the force of gravity acting between the Earth and the falling object. SLIDE 2 What direction do forces pull in?

Today we will be discovering that some mechanisms, including levers and pulleys, allow a smaller force to have a greater effect. Why do you think this will be useful on the Thames Sailing Barges? Where do you think levers and pulleys are used on the Barges? (Possible answers: SLIDE 3 to row the barge boat to get to shore, SLIDE 4 to hoist the sails)

1. The TSBs were designed to be sailed with a Skipper and a Mate, and sometimes a boy of around 14/15 years of age. Their payment was passage on board (around 2 shillings (25p)) whilst delivering the various cargo (Name some from the History lesson SLIDE 5) and food. Imagine having to heave up the sails on the Barge, SLIDE 6 the topsail being the first to go up and the heaviest as there was no winch. SLIDE 7 When the sails get taken off the barges every year to be repaired and re-painted, it takes 7 or 8 people to carry it! There were no engines on the barges when they were first made and carrying cargo so they had to sail in all weathers, with the tide, day or night.

2. SO: onto today's learning: SLIDE 8 What is a Pulley? *Noun* a wheel with a grooved rim around which a cord passes, which acts to change the direction of a force applied to the cord and is used to raise heavy weights.

How does a pulley work? A pulley is one of many simple machines that can make life easier. Hand out the equipment into groups of two or three (one cotton reel, a length of doweling, one piece of string/rope, one

bucket) You have two minutes to set up a simple pulley with your partner/group: see if you can lift the bucket! **(Two minute timer on screen SLIDE 9)**

3. **SLIDE 10** The pulley you just made is the simplest kind of pulley: a **fixed pulley**.

In this fixed pulley system, you pull down on one side of the rope and the other side goes up. You use the same amount of force to pull down as you would to lift the bucket yourself. However, you have *changed the direction of the force*. A pulley can change the direction a force acts in, making a small input force sufficient to lift a heavy object.

4. A fixed pulley is useful because when you pull down, you can use your body's own weight to add to the push. In contrast, when you exert a force upwards by lifting something, you also have to lift the weight of your own arms. Imagine that you had a sail to hoist. What if that sail was wet and you were out in a storm? Would you prefer to lift it overhead with your arms, or hoist it up with a pulley system?

Remember, a fixed pulley changes the direction of the pull, but it doesn't change the amount of force you use to pull. If you have a very heavy object, you could consider building a **moveable pulley**. **(Show the barge pulley in the Bargeman's Box)** To help lift the weight of the sails on board the Barges, they have HUGE block and tackle pulleys. What do you think happens when you use one of these? **SLIDE 11**

A moveable pulley supports an object with two ropes, placing the pulley in the middle. Since the pulley is being supported by two ropes, the amount of force you need to move an object is cut in half.

Simple machines can make life a lot easier. What other simple machines can you create? Are there others that could help you lift a heavy load? Keep exploring to find out! (Using the equipment, with an extra dowling rod and cotton reel, make a moveable pulley and feel the difference as you lift an increasingly heavy load with bricks. **(Five minute timer on screen SLIDE 12)**

PART TWO

5. Another type of force used on the barges are **LEVERS**: **SLIDE 13** What are levers? Show me the action with your arms for how a lever moves. Lever: *Noun*: a rigid bar resting on a pivot, used to move a heavy or firmly fixed load with one end when pressure is applied to the other. Levers use forces to move heavier objects. Look at the diagrams of levers, with the effort/load and fulcrum labels. **SLIDE 14**

A lever helps your effort with lifting a load on a fulcrum (New word?). Definition of a *fulcrum*: *Noun*: the point against which a lever is placed to get a purchase, or on which it turns or is supported. **SLIDE 15** Where would you put the labels on the diagram for a rowing boat? **SLIDE 16**

6. **SLIDE 17** Using the equipment in groups of two or three (one lolly stick, one cotton reel, some bricks) You have two minutes to set up a simple lever with your partner/group: see if you can lift the bricks! What happens if you move the position of the fulcrum? (Show diagram) **(Two minute timer on screen SLIDE 18)**

If time, or later, move on to the Investigation sheet to record your findings to make a lever more efficient.

Work together to record your results (Enclosed with this pack).

What could they do to work this out through investigation (see questions)?

Work thought the initial sections with your teacher to get started.

Conclusion SLIDE 19 From today's session, tell your partner two ways forces are used on the barges to help make their work easier. Any questions from what you've learned today? **SLIDE 20**

Class Teachers: We want these resources to work for you – please do give us any feedback on the lessons: were they pitched at the right level? Did some parts drag? Could we have spent more time on other parts? Any suggestions are really appreciated. Email: education@bargetrust.org

Reference materials: Provided by STEM and Hamilton Trust.

<https://www.hamilton-trust.org.uk/science/year-5-science/forces-may-forces-be-you/>

These sessions have been written in line with the new national curriculum (published in 2014)

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