

Strong Structures: Make a mini zip-line



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Curriculum links: Key Stage 2 Design and technology: Design, make, evaluate

Learning Outcomes:

In this activity pupils work as part of a team to design and make a miniature zip-line. They plan the steps required and conduct preliminary tests to identify successful elements. After constructing and testing the zip-line, they evaluate their projects, comparing them with the designs of others in order to discuss what could be improved.

- Have generated ideas to solve a specific problem, modelled these and created a product that is fit for purpose.
- Used appropriate tools and techniques to build their designs, testing their effectiveness and resolving problems through an iterative process of evaluation and design.

What you'll need:

- rope or thick string for your zip-line (about 10 metres should be adequate)
- a miniature hero (plastic action figures are ideal)
- sticks or garden canes
- string
- cardboard
- sticky tape
- small weights

Activity:

Introduce...

What? The forms that make a strong structure. For example, triangles are often used, as this is a strong shape that works well under compression. Triangles can be joined together to form much bigger structures too.

How? Give the class cardboard, sticky tape and some small weights. Working in groups, ask them to compare different shapes to test their relative strengths by making triangles, squares, circles and so on. Alternatively, find photos and video clips of structures built with triangles, such as bridges, cranes and pyramids. Ask pupils to identify the factors that make a strong design.

Demonstrate...

What? A zip-line in action and show that it can be made using triangles.

How? Set up a zip-line in the classroom by securing a length of rope or string to coat hooks or furniture placed at different sides of the room. Show the class your miniature hero zipping across the room. Explain that they can build their own mini zip-lines using triangles rather than coat hooks. Alternatively, show some zip-line videos – try searching YouTube for the world's fastest.

Explain...

What? How to make the basic structures required.

How? Explain the principle of an A-frame and ask the class to practise making them from pencils and elastic bands. Explain that when bigger A-frames are made, a type of knot called a lashing is used. Show them how to make a lashing – demonstrate this in groups or ask them to follow an instruction sheet. With a group, this is best done as a step-by-step 'repeat after me' activity so you can check progress at each stage. Show the class a finished zip-line, with the zip rope tensioned over the top of the two A-frames and a trolley or cradle for their hero to sit in. Ask pupils to draw a plan of their design first, making sure they have considered all the elements. Then annotate the designs to show the different components of the project and create a list of construction materials.

Apply...

What? Build the zip-lines.

How? Give groups the raw materials needed. Provide assistance, guidance and advice as they make their zip-lines. Allow groups to make practice attempts to fine-tune their designs.

Summarise...

What? Test the zip-lines.

How? When all the groups have finished building their projects, hold a zip-line competition. Score groups by comparing their finished zip-lines to their original designs, the quality of build and of course the speed of the zip-line. To conclude the activity, ask groups to produce an evaluation of their project, which could be written, photographic or video-based. You can even keep one of the zip-lines strung up across the classroom, attaching each group's evaluation to the zip-line using clothes pegs.

Activity notes

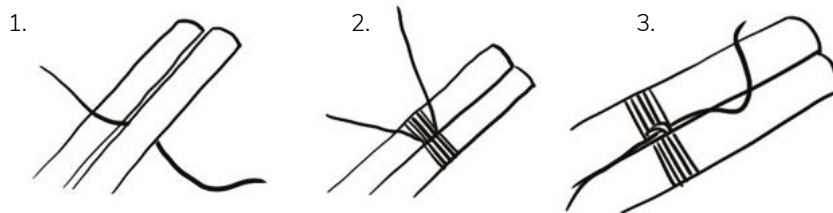
A zip-line is made by building two A-frames and pulling a length of rope or string taut between them. To give it some 'zip' you need to angle the line, using a natural hill or by making one of the A-frames much taller than the other.



Tying it all together – lashings

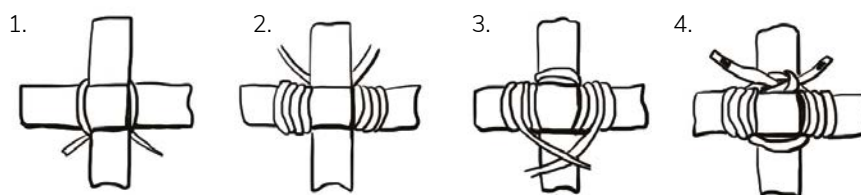
An A-frame is made of two long poles tied at the top so that they open like scissors. To keep them open a third pole is tied across the middle. Tying poles together in this way is called pioneering, and the knots are called lashings.

The top lashing is called a sheer lashing. It is tied like this:



1. Tuck string between sticks.
2. Wrap around both sticks five times and tuck end between.
3. Tie both ends together with a reef knot and open the sticks out.

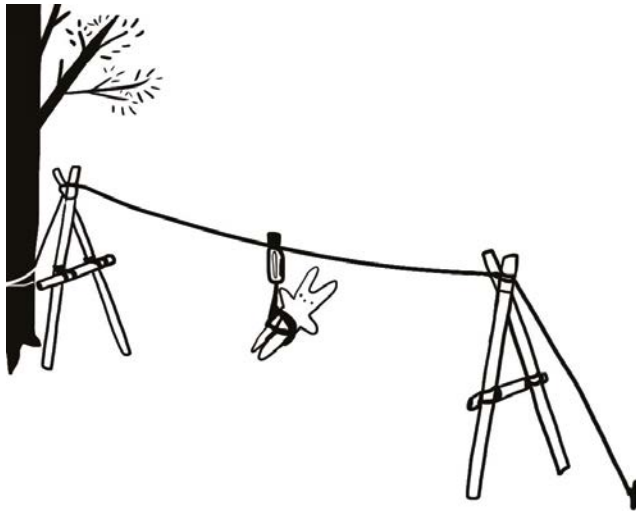
The bottom lashings are called Japanese square lashings. These are simpler to tie than traditional square lashings.



1. Start from the middle of the string. Wrap both ends under the bottom stick, over the top stick and under again, crossing the strings over.
2. Continue wrapping both ends under and over five times.
3. Wrap the string around the middle of the lashing, between the sticks.
4. Tie off tightly with a reef knot.

Setting up the zip-line step-by-step

1. You will need two pegs or fixed points to anchor the zip-line. Make a loop in the end of your line and hook it over one of the pegs.
2. Run the rope over the top of your tallest A-frame – the frame should lean back slightly so the tension of the line keeps it upright.
3. At the other end of the zip-line, loop the rope twice around the top of the shorter A-frame and tie it off securely to the second peg.
4. Your miniature hero will need a trolley or cradle to zip down the line. This could simply be a bent coat hanger or you could experiment with cotton reel 'wheels' to get more zip.



Reef knot

