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| **Zip line challenge** |
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| Designing and making a zip line for a toy |
| **Subject(s):** Design & Technology, Mathematics **Approx. time:** 60 - 90 minutes |  | **Key words / Topics:** * Zip line
* Experiment
* Calculate
* Excitement
* Gravity
* Friction
* Time
* Speed
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| **Suggested Learning Outcomes**  |  |  |
| * Understand how gravity and friction affect a body falling in a controlled manner.
* Be able to record data and draw conclusions.
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| **Introduction** |  |  |
| This is one of a set of resources designed to allow learners to use seasonal themes to support the delivery of key topics within maths, design & technology and engineering. This resource is part of a group for the Summer that could be carried out either in school or at home and involves the construction of a zip line for a toy. It is targeted at Year9 (S2 in Scotland) but would be suitable for other year groups. |
| **Purpose of this activity**This is a project to build a model of a zip Line. It could be carried out in pairs but will work for individuals. It requires some space to complete successfully but can be executed both indoors and outdoors.This activity could be used as a main lesson activity to teach learners about the effect of gravity on a body falling in a controlled manner, friction or the practical application of trigonometry. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (5 minutes)**Teacher to explain that learners are going build and test a zip Line for a small ‘passenger’.**What is required? (5-10 minutes)**Discuss the Science (see the science slide in the presentation) so that the learners understand what forces they are dealing with.**Making the Zip Line (30-65 minutes)**Teacher to hand out resources required for the task to learners. Learners to carry out the tasks outlined in the presentation:* Step 1 – making the harness. A Paperclip bent into a triangle works well for a small plastic figure. The passenger needs to be fastened to the harness with a small amount of sticky tape.
* Step 2/3 - Setting up the zip line. Both ends of the zip line (string) need to be fastened tightly. This could be achieved with knots or weights. Make sure the passenger’s harness is over the line before it is fastened. Some may make a harness that can be hooked onto the line.
* Step 4 – Carry out a trial run and adjust the tension and/or angle of the slope as required to achieve an operational zip line.
* Step 5 – Testing. Measure the angle of the zip line using the protractor. Bring the passenger to the top of the zip line. Using the stopwatch, time how long the passenger takes to get from the top to the bottom. Learners should create a table and write down the time and the angle, then repeat the test with different angles.

**Plenary (5-10 minutes)**Class comparison of results – how did the angle affect the time? |  | This activity could be carried out either individually or in pairs.A video of a zip line could be shown at the start of the activity to give context. There are links in the additional websites section. The main activity is covered by PowerPoint slides 1 to10. Finding suitable places for the zip line can be a challenge. In a classroom context it can quickly become difficult to allow every team access to a high-level fixing point. The class may have to work in a larger area or outside with access to trees, fences etc. If there is access to a sports hall the wall bars can be a solution.At step 1, The choice of passenger is not important to the experiment but using small figures adds to the feeling of reality.At steps 2 and 3 the longer the run of the zip line the better. It not only allows for a better ‘ride’ for the passenger but also makes accurately timing the runs easier. It is particularly important that the line (string) be pulled taught so stretchy string will not work well. |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * The paperclips could be bent into shape in advance..
 |  | * Learners could make a zip line that takes a specified time to complete (e.g. 15 seconds).
* They could also investigate how the weight of the passenger affects the performance.
* Learners could calculate the angle or the height and length using trigonometry.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * String or thin rope. 10m should be enough.
* A ‘passenger’ for the zip Line.
* Paper clips or stiff wire.
* Sticky tape.
* A stopwatch or a stopwatch App on a phone.
* A ruler or tape measure
* A protractor
* Some paper and a pen to take notes.
 |  | icon-ppt Teacher presentation – Zip Line Challenge  |
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| **Additional websites** |  |  |
| * The Zip Line in North Wales [https://www.youtube.com/watch?v=35D7rpxjeqo](https://www.zipworld.co.uk/adventure/velocity) <https://www.zipworld.co.uk/adventure/velocity>
* The new Zip Line in Cornwall [https://www.edenproject.com/visit/whats-here/zip-line-adventure-activities](https://www.edenproject.com/visit/whats-here/zip-wire-adventure-activities)
* The longest Zip Line in the world (so far) <https://www.bbc.co.uk/news/av/world-middle-east-42911788>
* The physics behind a Zip Line from a US Physics blog. <https://www.zipkokanee.com/blog/2015/zipline-physics-what-goes-into-planning-your-thrill-ride/>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * The learners could be shown the video that explains the physics. <https://www.zipkokanee.com/blog/2015/zipline-physics-what-goes-into-planning-your-thrill-ride/>
 | **Extension** (Options)* Learners could make a zip line that takes a specified time to complete (e.g. 15 seconds).
* They could also investigate how the weight of the passenger affects the performance.
* Learners could calculate the angle or the height and length using trigonometry.

**Plenary** (Options)* Class comparison of results – how did the angle affect the time?
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| **The Engineering Context** film |
| * Designing for Theme parks is a new and evolving area of Engineering. The rides have to be enjoyable, sometimes extreme but always safe. This means careful design and thorough and regular testing of the installations.
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| **Curriculum links** |
| **England: National Curriculum**Design & Technology * KS3 1a, 2a, 4a
 | **Northern Ireland Curriculum**Technology & Design* KS3 Developing pupils’ Knowledge, Understanding and Skills
* Demonstrate practical skills in the safe use of a range of tools, machines and equipment;
* Demonstrate creativity and initiative when developing ideas and following them through.
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| **Scotland: Curriculum for Excellence**Technologies* TCH 1-09a, TCH 2-10a, TCH 2-12a
 | **Wales: National Curriculum** Design and Technology* KS3 Skills: Designing 4,8,9
* Making 1, 2, 3
* Reference to the Zip Line in Snowdonia.
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| **Assessment opportunities** |
| * Informal teacher assessment of practical skills through observation of learners.
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