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| **Comparing the Carbon Footprint of Transportation** |
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| A maths-based challenge to calculate the journey times and carbon footprint of different methods of travel  |
| **Subject(s):** Maths, Engineering**Approx. time:** 50 - 70 minutes |  | **Key words / Topics:** * Sustainable transport
* Carbon footprint
* Carbon dioxide
* Climate change
* Speed
* Distance
* Time
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| **Suggested Learning Outcomes**  |  |  |
| * To be able to solve a contextual problem using division and multiplication
* To understand how to calculate journey times and the carbon footprint for alternative modes of transport.
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| **Introduction** |  |  |
| This is one of a series of resources designed in conjunction with Network Rail to develop understanding and skills in key maths, science and engineering concepts. This resource focusses on the calculation of journey times and the carbon footprint of alternative modes of transport.This maths-based challenge highlights the issue of sustainable travel and allows the learners to make comparisons of different methods of transport. |
| **Purpose of this activity**In this activity, learners will look at a range of alternative transport methods and calculate journey times and their carbon footprints. It will also develop their skills in understanding the effects that some modes of transport have on the environment. This could also be used as a one-off main lesson activity to use maths skills in context, or as part of a scheme of work on sustainability, to build knowledge and understanding of climate change and ways of reducing it. |
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| **Activity** |  | **Teacher notes** |
| **Introduction (5-10 mins)**Teacher to explain that learners are going to perform an activity to calculate different journey times and the carbon footprint for alternative modes of transport. **Transport and carbon footprint (10 mins)**Short class discussion to share what learners know about climate change and ways of reducing it. Using the presentation, teacher to introduce the contribution of transport to climate change and what is meant by carbon footprint.**Carbon footprint (10 mins)**Teacher to present the carbon footprint of alternative modes of transport and the speeds of each mode of transport with the learners. Teacher to demonstrate how to use the formulae to calculate journey time using distance and speed and how to calculate the carbon footprint.**Activity sheet (20-30 mins)**Learners to follow the instructions on the activity sheet, working out the journey time and carbon footprint of the different methods of transport for each journey.**Plenary (5-10 mins)**Peer discussion: which method of transport is the most sustainable? |  | Learners could work as individuals or in small groups.The modes of transport could be edited as required to fit in with other activities.The carbon footprints in the presentation are based on per passenger values published by BEIS/Defra Greenhouse Gas Conversion Factors 2019. The transport speeds are estimates based on typical values, found using the most common search engine. Any statistics or data on transport speeds used in this activity are solely for the purpose of this activity and may not be an accurate reflection of actual current times, which may vary due to seasonal, environmental or legal limitations, for example.When using the activity sheet, learners could create a table for each journey to show the results (as illustrated on the sheet). The time for the aircraft should allow 3 hours for check in, security and boarding at the airport.An additional level of complexity could be added by allowing for transit times to airports and rail stations.The presentation contains two additional slides allowing km to be used in place of miles, if this is preferred. |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Watch the video - BBC Bitesize: Distance, Speed and Time. <https://www.bbc.co.uk/bitesize/guides/z4swxnb/revision/1>.
 |  | * Learners could work out the time for a journey of their own choice. For example, a longer journey into other countries, such as a foreign holiday.
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Projector/Whiteboard
* Pens, pencils and paper
* Calculators
 |  | icon-ppt Comparing the carbon footprint of transportation presentationicon-doc Comparing the carbon footprint of transportation worksheet |
| **Additional websites** |  |  |
| * **YouTube: Transportation 101 -** https://www.youtube.com/watch?v=c4iVCJ00BYA
* **BBC Bitesize: Distance, Speed and Time:** https://www.bbc.co.uk/bitesize/guides/z4swxnb/revision/1
* **YouTube: Transport carbon footprints -** <https://www.youtube.com/watch?v=Heqd7IH7ZTA>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * ACTIVITY: Show video **YouTube: Transportation 101** - <https://www.youtube.com/watch?v=c4iVCJ00BYA>
 | **Extension** (Options)* > Learners could work out the time for a journey of their own choice. For example, a longer journey into other countries, such as a foreign holiday.

**Plenary*** Peer discussion: which method of transport is the most sustainable?
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| **The Engineering Context** film |
| Engineers need to understand how products affect the environment – this applies not just to methods of transport, but also to the manufacture of new products. They can use this knowledge to balance the environmental impact with the function carried out by the product. They can also develop new or improved designs to reduce the impact on the environment, such as trains powered using electricity from renewable sources. |

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| **Curriculum links** |
| **England: National Curriculum**KS3 Mathsdevelop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems**GCSE D&T**AQA D&T3.1.1, 3.1.2, 3.2.1, 3.2.3, 3.3.2Edexcel D&T1.1.3, 1.2.2c, d, 1.2.4, 1.3.1Eduqas D&TCore: 1, 2, 3OCR D&T2.1vi, 3.1, 3.2, 3.3**GCSE Engineering**AQA Engineering3.1.3, 3.4.1 | **Northern Ireland Curriculum**MathsKS3 Knowledge, Understanding and Skills:Learning Outcomes:the application of mathematical skills to real life and work situations; **Scotland: Curriculum for Excellence**Number, money, and measureMNU 4-03a**Wales: National Curriculum** MathsUsing algebra skillsshow and use rules that involve the multiplication, division and use of brackets with index variables |

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| **Assessment opportunities** |
| * Formal teacher assessment of completed calculations.
* Informal teacher assessment of learner’s contributions to the plenary discussion.
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