



## Narrative – Using data (friction and shoes)

<b>Year group and curriculum area</b>	Year 9 or 10. Science/physics/mathematics.
<b>Activity</b>	<p>This activity is based on:</p> <ul style="list-style-type: none"><li>• querying the repeatability of a set of collected data and what this means in terms of the quality of the evidence collected and making valid conclusions</li><li>• exploring and gaining an understanding of the reasons for the use of certain techniques to improve repeatability and reproducibility</li><li>• drawing evidence-based conclusions from data and expressing this coherently.</li></ul> <p>This is a problem-solving exercise.</p>
<b>Topic</b>	Analysing and processing collected data from scientific investigations.
<b>Lesson plan</b>	<p><b>Whole lesson/part of topic</b></p> <p>Querying and processing collected evidence from science investigations, analysing the raw and processed data in terms of reproducibility, and drawing an evidence-based conclusion from the data.</p> <p><b>Requirements</b></p> <ul style="list-style-type: none"><li>• Use the activity sheet (including the data presented on page 1 and the questions on page 2) for 'Friction and shoes'.</li></ul> <p>Learners are introduced to the question/problem. Can the data collected lead to valid evidence-based conclusions being made?</p> <p>The questions in this activity are largely generic and could be used with learners' own data or with data from other experiments (collected or secondary data).</p>

<p><b>Possible strategy/solutions</b></p>	<p><b>Introduction</b></p> <p>The aim of this activity is for learners to establish a strategy that they understand when viewing any evidence/data collected. Most learners are able to carry out scientific processes correctly but do not understand why, for example they can repeat readings and spot anomalies but often do not understand why or fail to take appropriate action when dealing with these issues. Many learners rely on formulaic frameworks, given by the teacher and directive questions. While these are useful lower down the age range, for example in Key Stage 3 learners should now become more independent.</p> <p><b>Differentiation</b></p> <p>With more able and talented learners this could be treated as an open activity, asking them for a strategy rather than presenting the ‘guiding questions’ for them to work through. However the teacher would need to mindmap possible strategies with the class and share them. This will give learners ownership of the task.</p> <p>For learners with lower abilities, the given questions are designed as prompts for initial discussion in groups. Each group then shares their understanding with the whole class. This helps to establish that learners’ views are important and that they can learn from each other as well as from the teacher. This also helps to establish periods of reflection and consolidation <b>during</b> the lesson and not just at the end.</p> <p>A suggested sequence might include the following.</p> <ol style="list-style-type: none"> <li>1. Learners are presented with the data in the context of investigating the force produced by different types of shoe when a runner starts a race. They should explore and evaluate (either individually or in groups) the data that has been collected, using the first four questions on the activity sheet.</li> <li>2. Learners should then process the data in order to establish whether the calculated means help to combat uncertainty in the data. The difference between ‘most likely value’ and ‘mean value’ can then be explored and why both are helpful, when analysing results. The idea of identifying anomalies and how to deal with them can also be explored.</li> <li>3. The next series of questions are designed to help learners come to an evidence-based conclusion. The format of the questions is such that it supports the understanding of why readings are repeated, how to deal with anomalies, and whether anomalies should be included when calculating means. It also offers the opportunity to consider how the effect</li> </ol>
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	<p>of interpreting the data at different stages can lead to different conclusions.</p> <p>4. Evaluate the strategy used to reduce uncertainty in data and improve validity in terms of evidence-based conclusions. The 'Things to think about' questions might help here. Depending on ability, learners could be challenged to articulate their evaluation in a coherently written paragraph, e.g. learners evaluate their steps and likely sources of information and their reliability against known research on the topic from a reliable source. They consider what is a reliable source. These and other questions are part of understanding the learning process.</p> <p>5. Finally learners arrive at a series of conclusions supported by evidence. The conclusion should be more than a simple statement such as 'The better the grip between the shoe and ground the more force applied'. Conclusions should explore the issues using prior knowledge as well as evidence from the investigation, e.g. without any friction/grip between the shoe and the ground we could not start (reference to known science, e.g. icy roads).</p>
<b>Links with the LNF</b>	<p><b>Skills</b></p> <ul style="list-style-type: none"> <li>• Generating and using a strategy to solve problems.</li> <li>• Working collaboratively to solve a problem.</li> </ul> <p><b>Numeracy component</b></p> <p><b>Strand: Developing numerical reasoning (Year 9/10)</b></p> <p><b>Element: Identify processes and connections (Year 9/10)</b> Learners are able to:</p> <ul style="list-style-type: none"> <li>• transfer mathematical skills across the curriculum in a variety of contexts and everyday situations</li> <li>• select, trial and evaluate a variety of possible approaches and break complex problems into a series of tasks</li> <li>• prioritise and organise the relevant steps needed to complete the task or reach a solution</li> <li>• choose an appropriate mental or written strategy and know when it is appropriate to use a calculator</li> <li>• identify what further information might be required and select what information is most appropriate</li> <li>• select appropriate mathematics and techniques to use.</li> </ul> <p><b>Element: Represent and communicate (Year 9/10)</b> Learners are able to:</p> <ul style="list-style-type: none"> <li>• explain results and procedures precisely using appropriate mathematical language</li> <li>• refine methods of recording calculations</li> <li>• select and construct appropriate charts, diagrams and</li> </ul>

graphs with suitable scales.

**Element: Review (Year 9/10)**

Learners are able to:

- interpret answers within the context of the problem and consider whether answers, including calculator, analogue and digital displays, are sensible
- interpret mathematical information; draw inferences from diagrams and data, including discussion on limitations of data
- draw conclusions from data and recognise that some conclusions may be misleading or uncertain.

**Strand: Using number skills (Year 9)**

**Element: Calculate using mental and written methods (Year 9)**

Learners are able to:

- use efficient written methods to add and subtract numbers and decimals of any size, including a mixture of large and small numbers with differing numbers of decimal places
- multiply and divide whole numbers and decimals.

**Element: Estimate and check (Year 9)**

Learners are able to:

- make and justify estimates and approximations of calculations
- choose the appropriate degree of accuracy to present answers.

**Strand: Using data skills (Year 9)**

**Element: Collect and record data, Present and analyse data, Interpret results (Year 9)**

Learners are able to:

- select and justify statistics most appropriate to the problem considering extreme values (outliers)
- examine results critically, select and justify choice of statistics recognising the limitations of any assumptions and their effect on the conclusions drawn.

**Literacy component**

**Strand: Writing across the curriculum**

**Element: Organising ideas and information (Year 10)**

**Aspect: Meaning, purposes, readers (Year 10)**

Learners are able to:

- write both extended pieces, which include detailed evidence and information, and shorter pieces which summarise concisely, showing clear awareness of the reader or intended audience

	<ul style="list-style-type: none"> <li>construct responses that connect and develop ideas to fully cover the topic.</li> </ul> <p><b>Aspect: Structure and organisation (Year 10)</b></p> <p>Learners are able to:</p> <ul style="list-style-type: none"> <li>improve the content, structure and accuracy of their writing through independent review and editing</li> <li>write independently in an appropriate form with increasing confidence, ensuring content is organised, detailed and relevant, <i>e.g. how best to present opinions, information and explanations</i></li> <li>organise writing in an appropriate form, ensuring content is detailed within and between paragraphs or sections.</li> </ul> <p><b>Element: Writing accurately (Year 10)</b></p> <p><b>Aspect: Grammar, Punctuation, Spelling, Handwriting</b></p> <p>Learners are able to:</p> <ul style="list-style-type: none"> <li>vary sentence structures to engage and sustain the reader's interest and write with grammatical accuracy</li> <li>use the full range of punctuation in order to vary pace, clarify meaning, avoid ambiguity and create deliberate effects</li> <li>use a variety of strategies and resources to accurately spell an increasing range of familiar, unfamiliar and subject-specific words</li> <li>present their handwritten or on-screen work effectively, choosing form, images and graphics to enhance meaning</li> <li>Welsh-medium statement: write grammatically accurate sentences ensuring that the verb tense and person is correct in context</li> <li>Welsh-medium statement: use a range of mutations correctly (soft, nasal and aspirate mutations) in context.</li> </ul>
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