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| **Density using Archimedes principle** |
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| Working out the density of materials using Archimedes principle |
| **Subject(s):** Design and Technology, Science, Maths**Approx. time:** 45 – 60 minutes |  | **Key words / Topics:** * Ancient Greece
* Materials
* Density
* Weight
* Volume
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| Stay safe Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for: • ensuring that any equipment used for this activity is in good working condition• behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others  Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠**Suggested learning outcomes**  |  |

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| * To know that materials have different properties.
* To be able to measure weights and volumes.
* To be able to work out the density of a material.
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| **Introduction** |  |  |
| This is one of a set of resources designed to allow learners to use practical methods to support the delivery of the primary national curriculum. They are designed to support the delivery of key topics within design and technology, science and mathematics. This resource was inspired by the achievements of ancient Greece and how these have affected the modern world. It is based on Archimedes Principle and involves working out the density of a range of provided materials. |
| **Purpose of this activity**In this activity learners will find out about the density of materials through testing. Learners will have an opportunity to weigh and work out the volume of a material. They will use this information and their number skills to calculate the density. They will then repeat this for other materials and discuss their results as a class.This activity could be used as a main lesson activity, to teach learners how to collect data through testing and measurement and to use number skills in a practical context. It could also be used as one of several activities within a wider scheme of learning focussing on the use of maths and science to further understand the properties of materials. |
| **Activity** |  | **Teacher notes** |
| **Introduction (10 -15 minutes)**Teacher to use the presentation to tell the story of Archimedes and the crown, then explain to learners what is meant by density and how it is calculated.Teacher to explain that learners are going to use the same method as Archimedes to measure the density of materials. **Measuring density (30 – 40 minutes)**Teacher to show the presentation demonstrating the method to measure density. Learners to carry out the measurements and record the results on the activity sheet:* Weigh each object, writing down the weight in **g**
* Next work out the volume of the object
* Place a bowl on a tray
* Fill the bowl to the brim with water
* Put the object in the water. The tray will catch all the water that overflows
* Carefully take the bowl from the tray and pour the water on the tray into a jug. Write down how much water has been collected in **ml** on the activity sheet
* Calculate the density and write it down on the activity sheet in **g/cm3**
* Repeat the process for each material

**Review (5 minutes)**Peer review – learners to share their results. How similar were the results? Which materials were the most and least dense? |  | This activity is best carried out in pairs or small groups, with one pupil recording results whilst the others carry out the measurement (to prevent the activity sheets becoming wet).Access is required to water, an area suitable for wet work and appropriate clothing/aprons/overalls for activities using water.Learners could be asked to bring in materials or materials could be provided by the teacher. The range of materials used must fit in the bowls or beakers used.Learners need to understand how to correctly weigh the materials and then fully immerse them in water to work out the volume.Learners may use bowls with trays underneath to catch the water to be measured or use large beakers and just observe the increase in volume. Ensure plastic sheets are used to cover tables as this can be a messy activity.The example in the presentation can be used to demonstrate how to calculate the density of the materials. The calculation example also appears on the worksheet as a reminder. |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| * Provide learners with pre-cut materials of the same volume.
 |  | * **BBC Bitesize** – How to work out density:
* <https://www.bbc.co.uk/bitesize/topics/z4vg9j6/articles/z9bgpbk>
* Find other materials to test and compare with these results.
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| **Resources** |  | **Required files** icon-docicon-ppticon-pdf |
| * Weighing scales.
* Water.
* Small bowl.
* Waterproof tray.
* Measuring jug.
* Calculators.
* Hand towels/drying facilities.
* A selection of different shaped and sized items made from different materials.
 |  | icon-ppt Density using Archimedes principle presentation icon-doc  Density using Archimedes principle worksheet |
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| **Additional websites** |  |  |
| * **BBC Bitesize** **–** How to work out density**:** <https://www.bbc.co.uk/bitesize/topics/z4vg9j6/articles/z9bgpbk>
* **BBC Bitesize** **–** What is Volume:<https://www.bbc.co.uk/bitesize/topics/zjbg87h/articles/zcrxtyc>
* **YouTube –** Materials for kids: <https://www.youtube.com/watch?v=JCKSMsbpn1Y>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters** (Options) * Show the video: **YouTube –** Materials for kids: <https://www.youtube.com/watch?v=JCKSMsbpn1Y>
* Ask learners to state three things they already know about weight, mass and volume.
* Discuss what is meant by ‘density’.
 | **Extension** (Options)* **BBC Bitesize** – How to work out density: <https://www.bbc.co.uk/bitesize/topics/z4vg9j6/articles/z9bgpbk>
* Find other materials to test and compare with these results.

**Plenary*** Peer review – learners to share their results. How did their calculated values compare? Which materials were the most and least dense?
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| **The Engineering Context** film |
| Engineers must have a good understanding of material properties when they design and make a product. For example, when aerospace engineers design a new plane they have to select materials that are both light in weight and strong, otherwise the plane may be too heavy to fly! |

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| **Curriculum links** |
| **England: National Curriculum**MathsKS2 – Measurements* Estimate volume [for example, using 1cm3 blocks to build cuboids (including cubes)] and capacity [for example, using water].

ScienceKS2 - Properties and changes of materials* Compare and group together everyday materials on the basis of their properties.
 | **Northern Ireland Curriculum**KS2 – Mathematics and numeracy measures* Develop skills in estimation of length, weight, volume/capacity, time, area and temperature.
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| **Scotland: Curriculum for Excellence**Maths - Number, money and measureMeasurement* MNU 4-11a.

Sciences – Materials, properties and uses of substances * SCN 3-15a.
 | **Wales: National Curriculum** KS2 - Mathematics Programme of StudyUsing measuring skills - Length, weight/mass, capacity* Make estimates of length, weight/mass and capacity based on knowledge of the size of real-life objects.

KS2 – Science The Sustainable Earth* A comparison of the features and properties of some natural and made materials.
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| **Assessment opportunities** |
| * Informal teacher assessment of practical measurement skills through observation of learners.
* Formal teacher assessment of results on the activity sheets.
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