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| **Testing material properties** | | | |
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| Working out what materials are used in everyday products | | | |
| **Subject(s):** Mathematics, Science  **Approx. time:** 40 – 60 minutes |  | **Key words / Topics:**   * Materials * Density * Transparency * Flexibility * Weight/Mass * Volume * Magnetic/magnetism * Metal * Paper * Plastic | |
| **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** | | | |
| * To know that materials have different properties * To be able to test materials and work out what they are made from * To be able to work out the density of a material | | | |
| **Introduction** |  |  | |
| This is one of a set of resources developed to support the teaching of the primary national curriculum. They are designed to support the delivery of key topics within design & technology, science and mathematics. This resource is part of a group for the plastic free month that could be carried out either in school or at home. It involves finding out what materials are made from by carrying out a series of tests and working out the density of the material. | | |
| **Purpose of this activity**  In this activity learners will learn about the properties 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 (5 -10 minutes)**  Teacher to explain that learners are going to test the properties of materials. They will work with a variety of materials and test them to work out if they are magnetic, flexible, transparent, and how dense they are.  **Materials testing activity (30 – 40 minutes)**  Teacher to show the presentation explaining the tests and demonstrate each test.  Learners to carry out each test and record the results on activity sheet 1:   * Step 1 – magnetic test. Does the magnet attach, yes or no? * Step 2 – flexibility test. Learners should hold the material between their hands and gently bend. How easily does the material bend? * Step 3 – transparency test. How easily can they see through the material? * Step 4 – density test. Learners to 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 (5-10 minutes)**  Peer review – learners to share their experiences of testing materials. What testing results did they find out? Answer the questions on the teacher presentation. |  | 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 in step 4.  This activity could be carried out individually or in pairs.  Step 2 – demonstrate how to safely and gently flex the material. Learners need to understand that some brittle materials my shatter it bent too forcefully.  Step 3 – you may wish to use the opportunity to discuss the meaning of opaque and translucent.  Step 4 - Learners may use bowls with trays underneath to catch the water to be measured or use large beakers from science and just observe the increase in volume. Ensure plastic sheets are used to cover tables as this may be a messy activity.  At step 4 learners need to understand how to correctly weigh the materials and then fully immerse them in water to work out the volume.  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. |  | | * What video: **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 |
| * Lemons or bottle of lemon juice * Water * Small bowls * Cotton buds/paint brushes * White paper * Hairdryer or lamp |  | | icon-ppt Testing material properties presentation  icon-doc  Testing material properties worksheets 1 & 2 |
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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)   * What video: **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 experiences of testing materials. What testing results did they find out? | |
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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 space engineers designed the Mars rover, they used materials that can withstand great heat and radiation as Mars is a very difficult planet to work on. |

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| **Curriculum links** | |
| **England: National Curriculum**  Maths  KS2 – Measurements   * estimate volume [for example, using 1 cm3 blocks to build cuboids (including cubes)] and capacity [for example, using water]   Science  KS2 - 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. |
| **Scotland: Curriculum for Excellence**  Maths - Number, money and measure  Measurement   * MNU 4-11a   Sciences - Materials  Properties and uses of substances  SCN 3-15a | **Wales: National Curriculum**  KS2 - Mathematics Programme of Study  Using 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 testing skills through observation of learners. * Formal teacher assessment of results on the activity sheets. | | |
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