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| **Gravity free water** | | | |
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| Using the effects of air pressure to defy gravity | | | |
| **Subject(s):** Science  **Approx time:** 25 - 40 minutes |  | | **Key words / Topics:**   * Air * Air pressure * Force * Glass * Gravity * Water |
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| **Suggested Learning Outcomes** |  | |  |
| * To understand the effects of air pressure. * To understand how differences in air pressure can create the illusion of zero gravity. * To use the effects of air pressure to keep water inside an upside-down glass. | | | |
| **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 maths and science. This resource focusses on using the effects of air pressure to make it look as though there is no gravity in an upside-down glass of water.  Gravity is a really important force that makes sure everything stays on the ground, but can it be defied?! | | | |
| **Purpose of this activity**  In this activity learners will perform an experiment showing how the effects of air pressure can be used to seemingly defy gravity. They will fill a glass with water, place a piece of card over it and turn it upside down, discussing how and why the water stays in the glass.  This activity could be used as a starter or main activity to introduce the effects of gravity and air pressure, or as one of several activities within a wider scheme of learning focussing on different types of forces. | | | |
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| **Activity** |  | | **Teacher notes** |
| **Introduction (2-5 minutes)**  Teacher to explain that learners are going to perform an experiment to see if water can stay in a glass when turned upside down, hence defying gravity! Teacher to hand out equipment needed for the task to learners.  **Performing the experiment (10-20 minutes)**  Teacher to demonstrate the steps shown in the teacher presentation and listed below.   * Step 1 - fill the glass all the way to the top with water. * Step 2 - put the piece of card over the top of the glass, making sure it is fully covered. Make sure that there are no air bubbles in the glass or the experiment will not work. * Step 3 - turn the glass upside down whilst holding the piece of card in place. Then take hands holding the card away from it.   Learners to complete each step to conduct the experiment for themselves. The teacher presentation can be left on the whiteboard as a supporting guide as they do this.  **Discussing the results of the experiment (10-15 minutes)**  Learners should observe the piece of card sticking to the glass and the water remaining inside it.  Teacher to discuss with learners how and why they think this happens.  Learners could write down their findings and the explanation of why this occurs in their exercise books or on paper. This could be in the form of a short scientific report. |  | | **Filling the glass with water**  If there is not easy access to a sink then this step could be done in advance with glasses pre-filled with water.  If there are only one or two sinks within easy access the learners may need to perform this experiment a few at a time whilst another activity is taking place.  The drinking glasses used must have a top that can be completely covered by a piece of card without letting any air in. Alternatively, an open water bottle could also be used.  **Covering the glass of water**  Get learners to check there are no air bubbles in the glass as this could lead to the experiment failing and water going everywhere. Teacher may wish to check this to make sure before learners turn the glass over.  The card used should be cut into small pieces that are just large enough to completely cover the whole of the top of the glass.  **Turning the glass upside down**  This part can be tricky so may need a bit of practice to get completely right. Learners should do this over a sink in case the experiment fails and there are spillages. This may need to be done in pairs where one learner turns the glass upside down whilst the other holds and then removes their hand from the piece of card.  **Results of the experiment and how/why it works**  Learners could write down their findings or teacher could lead a class discussion.  Explain that there is no air inside the glass and so the air pressure is higher outside it than inside it. Therefore the card and water stays where it is, making it look like there is no gravity! |
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| **Differentiation** |  | |  |
| **Basic** |  | | **Extension** |
| Walk through the experiment with learners step by step, so they complete each stage as it is demonstrated. |  | | Investigate how decreasing the size of the opening or increasing the size of the (excess) card affects the experiment.  Using the internet, investigate:   * other effects of changes in air pressure, such as to the weather and human body. * other possible methods of overcoming or changing the effects of gravity and their potential uses, such as in aircraft or in space. |
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| **Resources** |  | | **Required files** icon-docicon-pdficon-ppt |
| * Drinking glasses * Access to a sink and/or source of water * Small pieces of thick card (preferably coated/shiny) to cover the glass |  | | Teacher presentation – Gravity free water |
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| **Additional websites** |  | |  |
| * **Bitesize – Air pressure and space:** Video of astronaut Tim Peake explaining how his spacesuit regulates the pressure around his body, and the differences in air pressure when in space compared to on Earth. <https://www.bbc.co.uk/bitesize/clips/z8wqp39> * **Bitesize – What is gravity?:** A video presenting an introduction to the force of gravity and its effects. <https://www.bbc.co.uk/bitesize/topics/zf66fg8/articles/zqbm3k7> * **Forecast – Air pressure:** Weather forecasts for the air pressure in the UK and Europe. <https://www.forecast.co.uk/pressure/> | | | |
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| **Related activities (to build a full lesson)** |  | |  |
| **Starters** (Options)   * Show the video <https://www.bbc.co.uk/bitesize/topics/zf66fg8/articles/zqbm3k7> introducing the force of gravity and its effects. * Discuss what is meant by high and low air pressure. | | **Extension** (Options)   * Investigate how decreasing the size of the opening or increasing the size of the (excess) card affects the experiment * Investigate other effects of changes in air pressure, such as to the weather and human body. * Using the internet, investigate other possible methods of overcoming or changing the effects of gravity and their potential uses. * ACTIVITY – half empty or half full?   **Plenary**   * Discuss the outcome of the experiment and why this happens. * Write a short scientific report of the experiment and findings. | |
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| **The Engineering Context** film |
| * An understanding of air pressure and gravity are vital to the development of air travel and space travel. Understanding of air pressure contributes to many products ranging from vacuum cleaners to sub-aqua equipment. |

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| **Curriculum links** | |
| **England: National Curriculum**  Science  KS2 Year 5 Forces:   * explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object * identify the effects of air resistance, water resistance and friction, that act between moving surfaces. | **Northern Ireland Curriculum**  KS2 – The world around us  Movement and energy:   * the causes and effect of energy, forces and movement. |
| **Scotland: Curriculum for Excellence**  Sciences  Forces:   * SCN 2-08a | **Wales: National Curriculum**  Science  KS2 – How things work:   * forces of different kinds, e.g. gravity * the ways in which forces can affect movement. |
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| **Assessment opportunities** | | |
| * Formal teacher assessment of experiment results and written findings. * Formal teacher assessment of practical Science skills through observation of learners. | | |
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