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| **DIY winter window decorations** | | |
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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: ⚠ | | |
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| **Age range:** 11-14-year-olds or younger with adult supervision  **Approx. time:** 45 minutes – 1 hour (plus overnight to dry) |  | **Key words / Topics:**   * materials * bonds * glue * adhesives * molecular bonds * stickiness |
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| **Introduction** |  |  |
| One of the traditions at Christmas time is to decorate our houses. In this activity learners are going to make wintery window decorations which will stick to a windowpane all by themselves! | | |
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| **Equipment** ⚠ |  |  |
| * Four small bottles of white PVA glue * Green, red, blue, and yellow food colouring (or whatever colours you like) * Washing up liquid * A plastic chopping board, plastic tray * Biodegradable glitter * Four small bowls * A mixing spoon | | |

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| **Instructions** ⚠ |  |  |
| **Step 1**  Learners should pour the whole content of each bottle of PVA glue into the four-separate bowls.  **Step 2**  Add some washing up liquid to each dish and stir well. Approximately one drop of washing up liquid will be needed for each tablespoon of glue. If learners want their designs to be solid use a little less – if they want their designs to be transparent use a little more.  **Step 3**  Add a different colour of food colouring to each bowl and stir well. If they want to have white, then leave the food colouring out altogether.  **Step 4**  Pour the coloured glue back into the small bottles and screw on the lids tightly.  **Step 5**  Learners decide what their Christmas decoration will be – for example, they could create holly leaves, snowmen, Christmas trees and snowflakes. Using the bottles of PVA like felt tip pens, they slowly squeeze out glue to draw their design onto the plastic chopping board or tray. (Alternatively, they can draw onto the plastic pockets that go in lever arch files).  **Step 6**  Leave the creations overnight to dry. In the morning learners can peel them off the plastic board and they will be ready to stick to the window! | | |
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| **Science and maths** |  |  |
| The function of **glue** – or **adhesives** – is to hold things together. Adhesives come in many diverse types: some are runny like the PVA we used in our challenge, whilst others come in the form of sprays, twist-up sticks, or sticky tape, like the sort we use to wrap presents.  The stickiness of the adhesive is caused by **molecular bonds**. The stronger the bonds between the molecules, the stronger the adhesive will be and the more force will be needed to pull those bonds apart.Before manufactured adhesives existed people found other ways to make things stick together. This was possible because a number of natural substances similarly create **bonds** with surfaces, although in a number of different ways. These substances range from foods such as honey and animal fat, to substances derived from hooves and skin, to beeswax and even egg whites.  Some adhesives form chemical bonds with the parts they are being used to join. Others may form mechanical bonds, by keying to the surface or polarised bonds due to chemical dipoles (which is why the decorations produced here stick to the glass). As different materials react differently with each other and have different surface characteristics, this means that there is no one-size-fits-all perfect adhesive – consideration needs to be given to the choice of adhesive to use in each different application. Some adhesives can be so strong that the things they are sticking together will break before the adhesive breaks! | | |

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| **The Engineering Context** | |
| The use of adhesives opens up new design possibilities, by allowing different materials to be joined together so that their unique properties can be used in a single product. They also allow different shapes to be joined together (or parts to be repaired) with minimal changes to their form (such as drilling holes, adding bolts etc.). | |
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| **Curriculum links** | |
| **England: National Curriculum**   * **Science: upper KS2** * Demonstrate that dissolving, mixing and changes of state are reversible changes | **Northern Ireland Curriculum**   * **Primary: the world around us** * How knowledge in science supports technological inventions, for example, robots in space. |
| **Scotland: Curriculum for Excellence**   * **Science: Materials – Properties and uses of substances: Second** * By contributing to investigations into familiar changes in substances to produce other substances, I can describe how their characteristics have changed. | **Wales: National Curriculum**   * **Science KS3** * Use a range of apparatus and equipment safely and with skill, taking action to control the risks to themselves and others |