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| **Science of snowflakes** | | | |
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| Why has a snowflake got 6 sides? | | | |
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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: ⚠ | | | |
| **Subject(s):** Design & Technology, Science  **Approx. time:** 50 -60 minutes |  | | **Key words / Topics:**   * snowflake * hydrogen * oxygen * molecule * hexagon * electron * polar charge * crystallise * tesselate |
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| **Suggested learning outcomes** | | | |
| * To know why a snowflake has 6 sides and is always flat * To know that H2O contains 2 hydrogen molecules and 1 oxygen molecule * To know how a polar charge is created * To know that water freezes below 4oC * To be able to make a paper snowflake with a repeat pattern | | | |
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| **Introduction** | | | |
| This is one of a series of resources designed to allow learners to use the theme of the Christmas period to develop their knowledge and skills in Mathematics, Design & Technology and Science. This resource focuses on snowflakes and why they are always flat and have 6 sides. It looks at the molecules within a snowflake and how they bind together above and below 4oC. To reinforce the learning, a 6-sided paper snowflake will be designed and made.  A video presentation of this activity can be found [here](https://www.youtube.com/watch?v=_oQFoKY7k3I&list=PLS_EtymQc9PMPa2ALIwrAL-pInR5A27lr&index=10). | | | |
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| **Purpose of this activity** | | | |
| In this activity learners will study the types of molecules within a snowflake, so they understand how they bind together at different temperatures. They will also learn how the electrons and protons have a polar charge and how they form a hexagon shape. Learners will also design and make a folded paper snowflake to reinforce the learning.  This activity could be used as a main lesson activity, to introduce learners to atoms, molecules and bonding. It could also be used as one of several activities within a wider scheme of learning focusing on the use of science to understand how molecules behave at different temperatures, or as an activity to teach how paper can be folded and cut to create many unique snowflake designs. | | | |
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| **Activity** |  | | **Teacher notes** |
| **Introduction (5 minutes)**  Teacher to explain that learners are going to find out why snowflakes are always flat and have 6 sides. They will also design and make a paper snowflake.  **Snowflakes (10 minutes)**  Teacher to use the teacher presentation to explain the main characteristics of snowflakes.   * They are always flat with 6 sides * They are made from H2O (Water):   + 2 molecules of hydrogen   + 1 molecule of oxygen * They have molecules that move freely above 4oC * Below 4oC the molecules freeze in the air making hexagon shapes   **Snowflakes - why a hexagon shape? (10 minutes)**  Teacher to explain that there are electrons and protons in the oxygen and hydrogen molecules. This creates a polar charge. The hydrogen molecules are attracted to the oxygen molecules. This is called hydrogen bonding. So below 4oC the hydrogen bonds crystallise to form snow, snowflakes, and ice.  **Snowflakes Activity – make a snowflake (20 minutes)**  Teacher to demonstrate the steps shown in the teacher presentation and listed below.   * **Step 1** – Fold the paper to make an equilateral triangle, fold over the end of the page and carefully cut the end off at the fold. * **Step 2** – Fold the triangle into thirds. First fold on the right side and then the left side. * **Step 3** – Carefully cut off the 2 folds on the bottom of the triangle. Draw a snowflake design on the remaining triangle. * **Step 4** - Carefully cut out the design and then unfold the paper to reveal a 6-sided snowflake.   Teacher to hand out equipment needed for the task. Learners to complete each step to conduct the activity for themselves. The teacher presentation could be left on the whiteboard as a supporting guide as they do this. |  | | This activity focuses on why snowflakes always have 6 sides and are flat.  Explain to the learners what molecules are in water and how when the temperature is below 4oC water begins the freezing process as the molecules become denser.  Explain that the polar charge holds the molecules together and as they crystallise, they create a hexagon lattice. The hexagons then tesselate to make snow, snowflakes, and ice.  Training aides, such as plastic atoms from science or marshmallows and bamboo skewers, could be used to show how the hydrogen and oxygen molecules bind together to form a hexagon shape.  Slides 6-9 of the teacher presentation show the steps needed for the learners to make their own paper snowflake.  Teacher may wish to demonstrate the first steps to allow the learners to fold and make the snowflake in the correct way. |
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| **Discussing the results of the activity (5 - 10 minutes)**  Teacher to discuss the results of the activity with learners. Learners to share their snowflake designs with the class and what repeat patterns they achieved.  **Differentiation** |  | |  |
| **Basic** |  | | **Extension** |
| * Watch the video **BBC Bitesize** – Solids, liquids and gases, to help understand how water molecules freeze: <https://www.bbc.co.uk/bitesize/topics/zkgg87h>/articles/z9ck9qt |  | | * Learners to create several designs of paper snowflake. E.g. different shapes and sizes. * Learners to add design complexity, colour or decoration to the snowflakes. * Watch video **BBC Bitesize** –Atoms, elements and compounds: <https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/5> |
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| **Resources** |  | | **Required files** icon-docicon-pdficon-ppt |
| * Scissors * A4 paper * Pens and/or pencils |  | | Teacher presentation – science of snowflakes |
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| **Additional websites** |  | |  |
| * **YouTube** – Santa Loves STEM: [Why does a snowflake have 6 sides?](https://www.youtube.com/watch?v=_oQFoKY7k3I&list=PLS_EtymQc9PMPa2ALIwrAL-pInR5A27lr&index=10) * **BBC Bitesize** – Solids, liquids and gases: <https://www.bbc.co.uk/bitesize/topics/zkgg87h>/articles/z9ck9qt * **BBC Bitesize** –Atoms, elements and compounds: <https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/5> * **YouTube** – How to make a snowflake out of paper: <https://www.youtube.com/watch?v=U32IwBAh1OU> | | | |
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| **Related activities (to build a full lesson)** |  | |  |
| **Starters** (Options)   * Discuss why snowflakes always have 6 sides and are flat. * Watch the video on **YouTube** – Santa Loves STEM: [Why does a snowflake have 6 sides?](https://www.youtube.com/watch?v=_oQFoKY7k3I&list=PLS_EtymQc9PMPa2ALIwrAL-pInR5A27lr&index=10) | | **Extension** (Options)   * Learners to create several designs of paper snowflake. * Add design complexity or decoration to the snowflakes. * Watch video **BBC Bitesize** –Atoms, elements and compounds: <https://www.bbc.co.uk/bitesize/guides/zt2hpv4/revision/5>   **Plenary**  Teacher to discuss the results of the activity with learners. Learners to share their snowflake designs with the class and what repeat patterns they achieved. | |
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| **The Engineering Context** film |
| Engineers are required to use scientific knowledge and skills regularly as part of their everyday job. It is therefore essential that they are able to work out how different molecules react at different temperatures. For example, how do engine oils work differently in hot desert or cold polar regions. |

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| **Curriculum links** | | | |
| **England: National Curriculum**  Science  KS3 Chemistry  Atoms, elements and compounds   * differences between atoms, elements and compounds.   Particle model   * atoms and molecules as particles. | **Northern Ireland Curriculum**  KS3 Science and Technology: Science  Developing pupils’ Knowledge, Understanding and Skills  Chemical and material behaviour   * Atoms and chemical changes * Structures, properties, uses of materials * Elements, compounds and mixtures | | |
| **Scotland: Curriculum for Excellence**  Sciences  Materials   * SCN 4-15a | **Wales: National Curriculum**  Science   * KS3 The sustainable earth: 1, 2 | | |
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| **Assessment opportunities** | | | |
| * Oral teacher feedback whilst making the snowflakes and the repeat patterns achieved. * Formal teacher marking and assessment of the finished snowflakes. | | | |
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