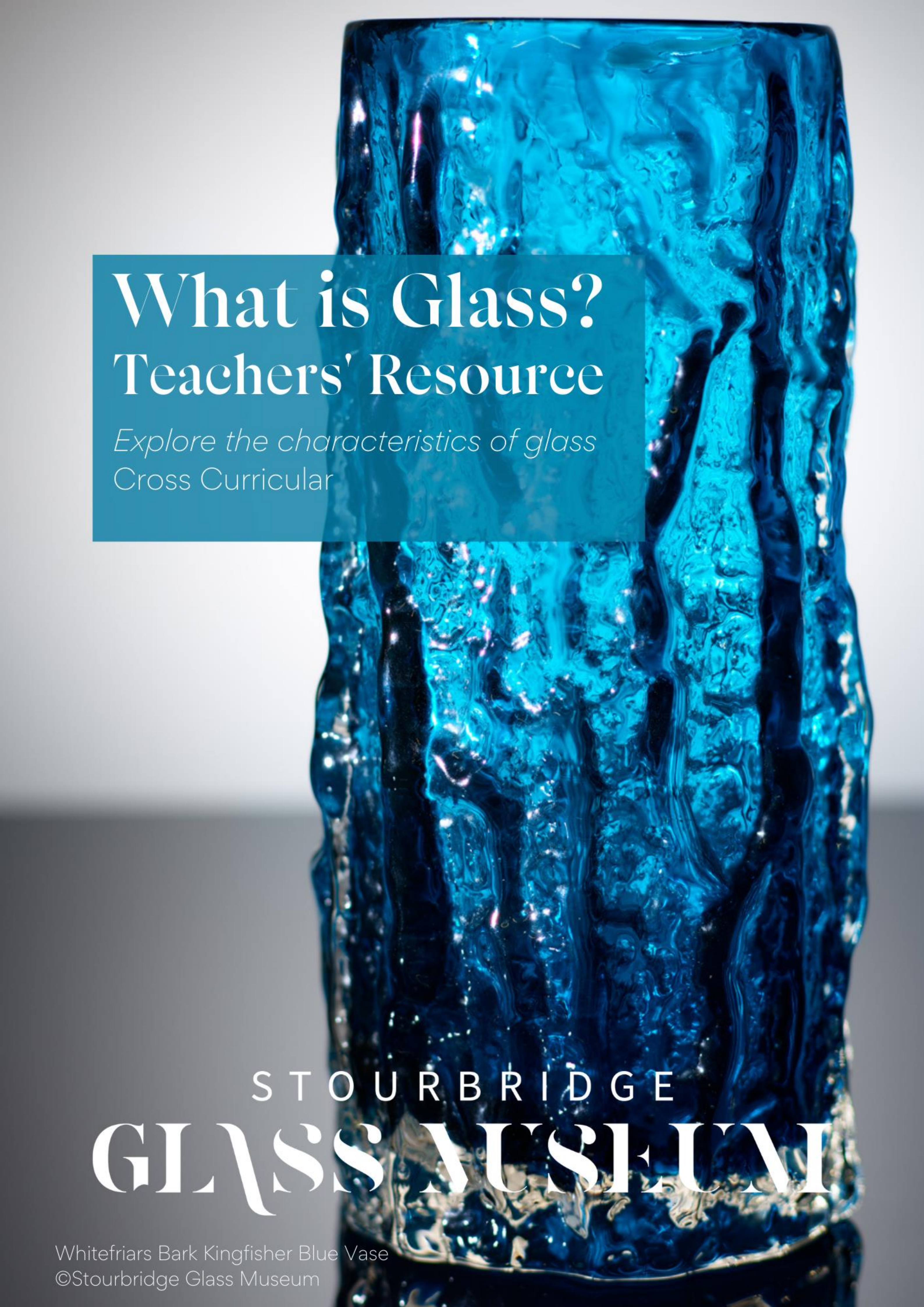


What is Glass?
Teachers' Resource

Explore the characteristics of glass

Cross Curricular

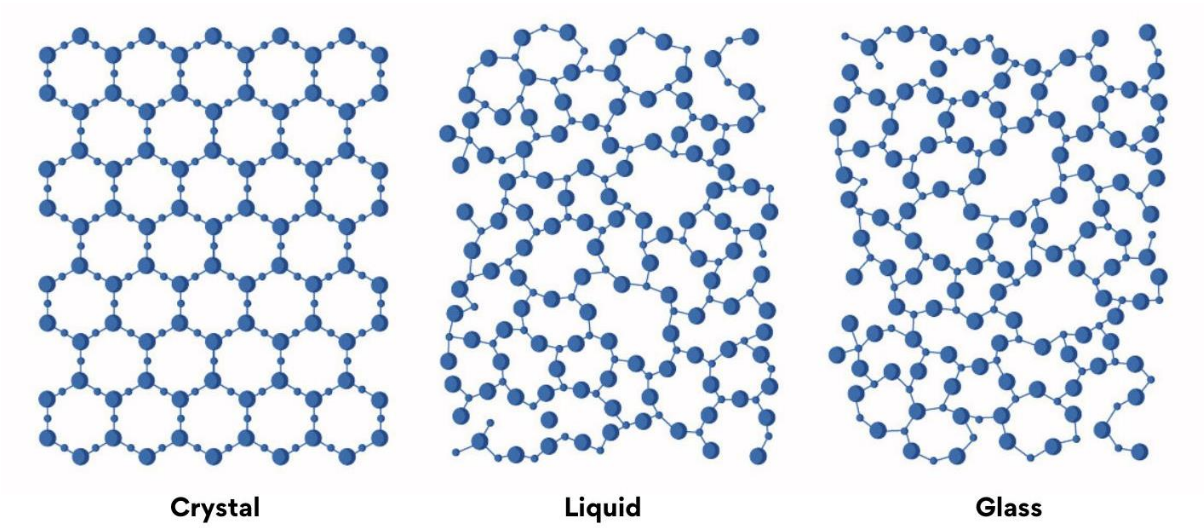
STOURBRIDGE GLASS MUSEUM

Whitefriars Bark Kingfisher Blue Vase

What is Glass?

Properties and Uses.

Glass is a special material that is not quite a solid and not quite a liquid. It's called an ***amorphous solid*** because its molecules aren't arranged in an orderly way like in crystals. ***Amorphous*** means something that doesn't have a clear or regular shape. Glass is made by heating solid materials, such as silica (a type of fine sand), until they melt. Other ingredients such as limestone, which acts as a stabiliser, and soda ash, are added to lower the melting point of glass to around 1200°C. At this temperature the ingredients become liquid, once removed from a heat source glass cools down quickly and was also known as a ***super cooled liquid***, and becomes hard and glassy.



1. In a **crystal**, the molecules are arranged in a neat and organised pattern, creating a strong and stable structure called a lattice. This orderly arrangement is what gives crystals their clear shapes and sharp edges.

2. In a **liquid**, the molecules are mixed up and can move around freely.

3. Interestingly, **glass** has molecules that are mixed up like a liquid, but it is solid and strong like a crystal.

When glass cools, the atoms inside slow down and don't move as much, turning the melted material into a solid.

What Is Glass Made From?

The main ingredients used to make glass are:

Silica (sand): 75% – this gives glass its structure.

Soda ash – Sodium carbonate: 12% – this lowers the melting point, so it's easier to work with.

Lime - calcium carbonate: 9% – this makes the glass stronger and more stable.

These ingredients don't add up to 100 percent because additional materials, such as decolourisers and colourising oxides, may be added to the batch ingredients to change in the final glass product.

Coloured Glass

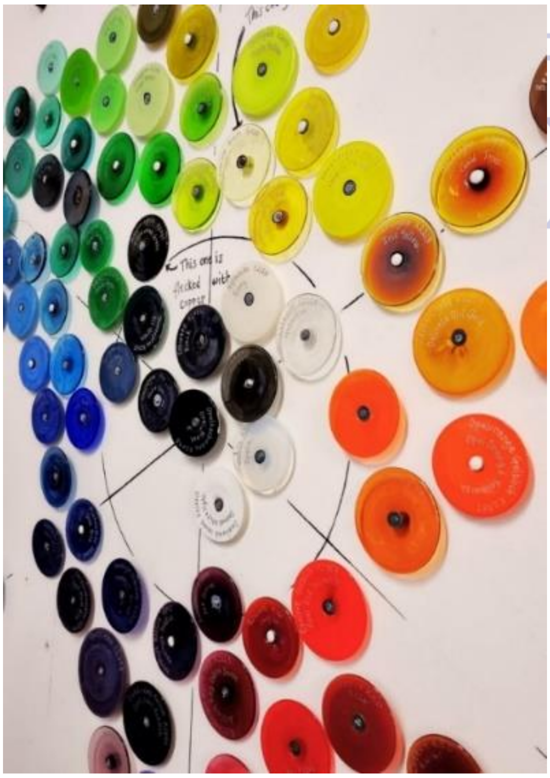


Figure 1, Wall colour chart, Allister Malcolm Glass

Coloured glass is famous for its beauty and wide variety of vibrant shades. The colour in glass comes from adding metallic oxides or other chemicals to the molten glass during its production. These special additives absorb certain parts of the light spectrum and reflect others, giving the glass its rich, brilliant hues. For example, adding **cobalt oxide** gives glass a **deep blue colour**, while **copper oxide** produces shades of **green**. **Iron oxide** results in **brown** or **amber** shades. **Silver nitrate** makes **yellow** glass, **gold chloride** can create a beautiful **red or pink** glass, this was known in the glassmaking industry as **Ruby glass**.

Figure 2, St Thomas' Church Window, Stourbridge

Stained glass windows are known for their vibrant colours and intricate designs, often found in churches and cathedrals. Stained glass became popular in the **Middle Ages** for its ability to tell stories through pictures and light, illuminating sacred spaces with its colourful imagery. The **Romans** were the first to create glass windows, but these were small and not easy to see through as the glass contained lots of tiny bubbles. The window were made larger by joining pieces of glass together with lead, a technique still used in stained glass windows today.

Did you know?

Ruby coloured glass was the most expensive glass colour to make. When factories used to make this colour, the glasshouse manager would pretend to throw a real **gold coin** into the furnace to fool the glassblowers into thinking it was more precious to work with. Only the best glassmakers would have been allowed to use that colour!

Figure 3, Ruby crystal hock glass, Thomas Webb & Sons, c.1889

The process of making coloured glass is precise, and the final colour depends on both the type of metal added and how much is used. The colours stay strong and vibrant because they are a part of the glass itself, not just a coating. This makes coloured glass perfect for stained glass windows, artwork, and even practical items like bottles and vases. Today several factories specialise in only making coloured glass and supply glassmakers all over the world with a wide range of colours.

Did you know?

Although people used to think the glass in old windows was thicker at the bottom because it was slowly flowing like a liquid, we now know that this isn't true. The glass was made unevenly and installed with the thicker part at the bottom, in order to better carry the whole weight of the window.

Figure 4, Allister Malcolm pouring molten glass

At its melting temperature, glass is a liquid. Before it can be shaped into objects, the temperature is reduced to around **1000°C**. At this point, the glass is still very hot but becomes thicker and flows more slowly, similar to how honey or treacle moves. This change in how easily it flows is due to its ***viscosity***—a term that describes how thick or thin a liquid is. When glass is hotter, it has a low viscosity, meaning it flows more easily, like water. As it cools, its viscosity increases, and the glass becomes thicker and harder to shape.

Glassmakers blow glass into shapes using a long, hollow metal rod called a **blowing iron.** They reheat the glass to keep it soft and flexible, allowing them to shape it. The glass stays flexible and can be worked until it reaches around **700°C**, but once it cools to **560°C**, it stops moving altogether and becomes solid. After shaping, the glass is cooled slowly in a kiln in a process called ***annealing*** to prevent it from cracking. Once it's cooled completely, the glass can be decorated using techniques like cut, engraved, etched, hand painted and sandblasted.

Where Does the Word *Glass* Come From?

The word glass comes from a long time ago, during the Late Roman Empire,(27 BCE – CE 395). In a place called Trier, in what is now Germany, people started using the word ***glesum***, which meant something shiny and clear.

What Makes Glass Special?

Because of how glass is made, which involves heating and cooling specific materials, it has some special properties:

Transparency – you can see through it.

Brittleness – it can break easily.

Elasticity – sometimes, thin glass can bend slightly without breaking.

Light Transmission – it lets light pass through.

Chemical Resistance – it doesn’t easily react with other substances.

High Melting Point – it takes a lot of heat to melt it.

Why Is Glass Transparent?

Glass is transparent because of how it interacts with light. When light hits an object, it can either pass through, bounce off, or be absorbed. In the case of glass, the arrangement of its atoms, allow most of the light to pass straight through without scattering or absorbing much.

Unlike other materials that may block or absorb light (such as wood or metal), the atoms in glass are spaced in such a way that they interfere only little with the light passing through. This is what makes glass clear, letting us see through it easily. Its smooth surface also helps light pass through without much reflection.

This ability to let light pass through is what makes glass useful for windows, lenses, and other things where we need to see clearly.

Did you know?

Before glass windows, gaps in buildings were left open to the elements, giving rise to the Old Norse ‘***vindauga***’, meaning ‘**wind eye’**, which evolved into the word window.

How Is Glass Different from Other Materials?

Glass has unique physical properties that make it both strong and brittle. This means that while glass can withstand a lot of pressure, it can break or shatter easily if struck or dropped. This is different from materials like metals, which are flexible and can bend without breaking, or plastics, which can melt at lower temperatures. Glass is also harder than many other materials, which is why it can be used in windows and containers. Interestingly, glass isn't only flexible when hot, when glass has cooled and is thin enough, it can still show some flexibility, and even glass marbles can bounce!

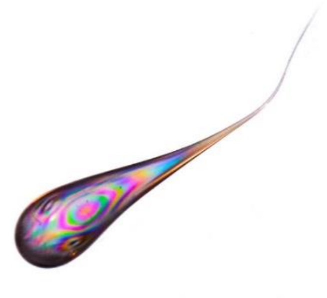


Figure 5, An example of a Prince Rupert's Drop

Prince Rupert's Drops: These are special glass objects that show just how strong and fragile glass can be. They are made by dropping hot, molten glass into cold water. The outer part cools and hardens quickly, while the inside takes longer to cool. This creates high tension in the drop. The head of the drop is so strong it can even resist a hammer blow! However, the tail is incredibly fragile—if you break the tail, the whole drop will shatter into tiny pieces instantly. This example helps to show how glass can have amazing strength but also fragility depending on how it's treated.

Did you know?

When glass cracks, the crack can travel as fast as a jet plane. It can move through the glass at up to **1,500 metres per second**, which is about as fast as a plane flying in the sky!

Types of Glass and Their Uses

The most common type of glass is called **Soda-Lime-Silica** glass. This basic composition, which includes silica (sand), soda ash, and lime, makes up the majority of all glass produced today. The ingredients can be slightly modified depending on what the glass is being used for, but soda-lime-silica glass is found in many everyday products.

One of the important properties of soda-lime-silica glass is its very low solubility, meaning it almost never dissolves in water or other substances. This makes it ideal for use in containers that store food and drinks because it won't react with its contents, keeping them safe and untainted.

Common Uses of Soda-Lime-Silica Glass

Containers – like bottles and jars for food, drinks, and other products.

Flat Glass – for windows in homes, including and buildings.

Toughened glass – is four times stronger than ordinary glass is used in car windscreens.

Laminated Glass – A thin layer of plastic between two sheets of glass; this is used as a safety glass, it insulates sound and is also used in bullet resistant glass.

Figure 6, Flat glass

Tableware – including drinking glasses and plates.

Fiberglass – used for insulation and sometimes in lightweight materials such as plastic for reinforcement.

Figure 7, Fibre glass insulation

Fibre optics – this technology uses thin strands of glass to transmit data as light signals. Used in, amongst many other things; telecommunications, cable TV, medical applications, robotics and automation, sensors.

Electrical Glass – found in things like light bulbs and other electronic devices.

Solar glass - used to harness solar energy.

Gorilla glass – Is a thin, light and scratch resistant glass used in smart phones, tablets, laptops and other devices.

Bio glass - is a type of glass that works with the body to help it heal. It's used in healthcare to help bones grow and repair, heal wounds, and even treat hearing and dental issues.

Other Types of Glass

Borosilicate Glass

Borosilicate glass, with the addition of boron, is more **heat resistant** than soda-lime-silica glass. This makes it more suitable for use in products that need to withstand high temperatures. It also has very low solubility, making it useful for storing chemicals and medicines without reacting with them.

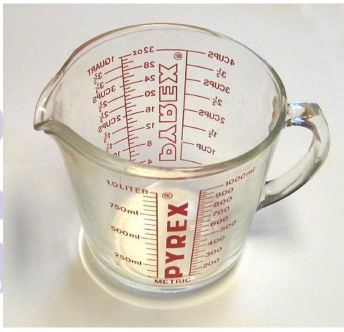


Figure 8, Heatproof Pyrex glass

Figure 9, Laboratory glass

Uses of Borosilicate Glass:

Heat-resistant cookware, like Pyrex dishes. Laboratory equipment, such as beakers and test tubes. Glassware for storing medicines and drugs. Some types of telescopes and camera lenses.

Did You Know?

Borosilicate glass is not only used in everyday items like kitchenware, but it's also been used in **rocket nose cones!** This special glass contains **boron trioxide**, which gives it excellent **heat resistance**. This means it can handle extreme temperatures and sudden changes in heat without cracking or breaking, making it perfect for **aerospace** uses. In rocket nose cones, borosilicate glass protects delicate instruments and components as rockets re-enter the atmosphere, keeping them safe from the intense heat and thermal shocks.

Lead Glass - Lead Crystal

Lead glass, also known as lead crystal, is famous for its high quality and **optical brilliance**. One of its key features is its high **refractive index**, which means it bends light more than regular glass. This property gives lead crystal its sparkly appearance, as it reflects and refracts light in many directions, making it look even brighter.

Figure 10, Lead crystal wine glasses, Stourbridge c. 1880

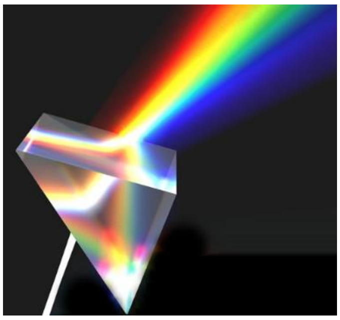
Because of its ability to bend and reflect light, lead crystal is often used in decorative objects, like fancy wine glasses, vases, and chandeliers. A key feature of lead crystal glass is its ability to be cut into fine patterns. These cuts are made at specific angles and depths, allowing artisans to create a variety of reflective effects. The precise cutting enhances the way light passes through the glass, making it sparkle and shine in unique ways, which is why lead crystal pieces are known for their iconic brilliance and decorative beauty.

Lead glass, also known as **optical glass** has special properties that make it useful in other ways:

Radiation shielding, where it helps block harmful radiation in places like hospitals (for X-ray machines) and scientific laboratories.

Optical lenses, such as those used in cameras, microscopes and telescopes, allow clear and precise vision.

Light and Lenses



In 1666**, Isaac Newton** experimented with light using a glass prism. He found that when light passes through the **prism**, it bends, or refracts, and splits into a rainbow of colours. This happens because the glass slows down the light and bends each colour by a different amount. Newton's experiment showed that white light is actually made up of many different colours. This discovery helped explain how lenses and glasses work—they bend light to help us see more clearly, just like the prism bends light to reveal the colours hidden inside.

Figure 11, The large lens of the Vera C, Rubin observatory camera. The lens measures 1.57 m, making it the largest optical lens in the world

Lenses are incredibly important in optical instruments like spectacles, microscopes and telescopes, they allow us to explore both the tiny and the vast. Microscopes use glass lenses to bend light and magnify small objects, enabling scientists to study cells and bacteria. This was crucial in the development of medicine because it helped us understand the causes of diseases and discover treatments. Telescopes, on the other hand, use lenses to magnify distant objects in space. **Galileo** was the first to use a telescope to observe the moons of Jupiter and make important discoveries about our solar system. These observations laid the foundation for our modern understanding of the universe.

Symmetry and Shape

Symmetry is a crucial aspect of glass design, particularly in the production of glass items. Skilled glassmakers can produce items that are symmetrical using hand tools. In the mass production of glass items, moulds are used. When using moulds in glassmaking, they are often symmetrical to ensure the final product is balanced, visually pleasing, and functional. The symmetrical shape allows for even distribution of molten glass and makes the items easier to produce in large quantities.

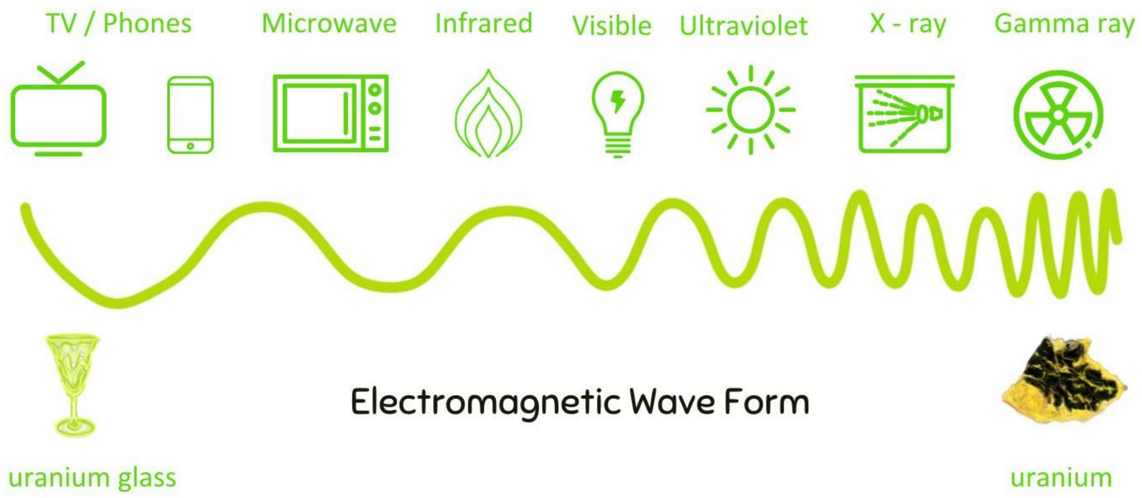
In designing moulds, one important factor is avoiding undercuts—areas where the mould curves back in on itself. Undercuts make it difficult to remove the hardened glass from the mould without damage.

Uranium Glass

Figure 12, Uranium glass

Uranium glass, also known as **Vaseline glass**, is notable for its unique green or yellow colour and its ability to glow under ultraviolet (UV) light. This glass is made by adding small amounts of **uranium oxide** to the glass mixture during production. The uranium gives the glass its distinctive colour and makes it slightly **radioactive**, but the levels are very low and generally considered safe for everyday use.

One of the most fascinating features of uranium glass is its ability to ***fluoresce*** when exposed to UV light. This characteristic makes it a popular choice for collectors and is often used in decorative items, like vases and dishes.



Although uranium glass was widely produced from the late 19th century to the mid-20th century, it is less common today. Collectors value it not only for its beauty and unique properties but also for its historical significance in glassmaking. Stourbridge Glass Museum has a large collection of uranium glass.

Dichroic Glass

Figure 13, Dichroic Glass Jewellery, by Amanda Gray

Dichroic glass is a fascinating type of glass that appears to change colour when viewed from different angles. This effect is achieved by coating the glass with thin layers of metallic oxides, such **as titanium, dichromium,** and **aluminium**, to the surface of the glass. These metallic oxides reflect light in unique ways. As you move around the glass, its colours shift and sparkle, displaying a range from deep blues and greens to vibrant reds and oranges.

Today, dichroic glass is widely used in art and jewellery, adding a striking, multi-colour element to designs. Its shimmering hues make each piece unique and especially popular for stained glass windows and sculptural art, where it can turn ordinary light into extraordinary displays of colour.

Neodymium Glass

Figure 14, Neodymium glass

Neodymium glass, also called '*alexandrite glass*,' is another type of colour-shifting glass, though its effect is based on the type of light rather than the viewing angle. In natural daylight, neodymium glass looks soft lavender or blue, but under incandescent light, it changes to a warmer pink or reddish-purple. This colour change happens due to the addition of neodymium, a rare earth element, which filters certain colours in light.

While neodymium glass is also considered dichroic because it shifts colours under different lighting, it differs from typical dichroic glass. Its colour-changing quality is embedded within the glass due to the neodymium content itself, rather than from an external coating.

Did you know?

Dichroic glass was developed by NASA to help protect astronauts' vision from the harsh glare of **unfiltered sunlight** in space. In the 1950s and 1960s, NASA revived the production of dichroic glass to keep its astronauts safe. Ordinary clear glass can't block the strong rays of sunlight in space, which can be harmful to both human eyes and sensitive spacecraft equipment. The tiny amounts of metal in dichroic glass create an effective barrier against this harmful radiation.

Natural Glasses

Did you know that not all glass is made by people? There are some **natural glasses** that form in nature due to extreme heat and conditions.

Here are a few examples:

Figure 15, Rainbow Obsidian

Obsidian: This type of glass is formed when **volcanic lava** cools down very quickly. It's usually black and shiny and has been used for thousands of years to make tools and decorative objects, especially Native Americans.

Fulgurite: This glass is created when **lightning strikes sand**. The heat from the lightning melts the sand, turning it into a glassy tube that looks like a rough, hollow stick. Fulgurite is rare and has a unique shape.

Libyan Desert Glass: Found in the **Sahara Desert**, this pale yellow glass was created millions of years ago, possibly by a meteorite impact that melted the sand. It has been used in ancient jewellery, including a piece in **King Tutankhamun's** necklace.

Figure 16, Desert glass scarab in King Tutankhamun's necklace

Figure 17, Moldavite

Moldavite: This green glass formed when a large **meteorite** crashed into the Earth around 15 million years ago. The heat and impact from the crash created this rare, glassy material, found mostly in Europe.

Volcanic Glass: Similar to obsidian, volcanic glass forms when **volcanoes** erupt, and the lava cools down too quickly for crystals to form. It's used to make tools and can sometimes be found in nature with a smooth, shiny surface.

Trinitite: This glass was created by humans. It was made during the first **nuclear bomb test in 1945**, when the extreme heat from the explosion melted the sand in the desert and turned it into a pink and greenish glass.

Figure 18, Trinitite

Did you know?

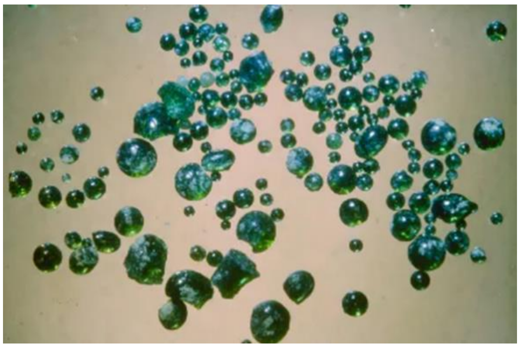


Figure 19, Regolith - glass spheres found on the moon.

Apollo astronauts brought back tiny **silica glass spheres,** known as ***regolith*** that were in the lunar soil. They were thought to be **three billion** years old. The glass spheres on the moon were made when something hit the moon with a lot of force, like a meteorite, or during volcanic eruptions. These impacts made the moon's rocks melt. As the melted rock cooled down quickly, it turned into tiny glass beads.

Recycled Glass

Recycled glass is an important part of environmental sustainability, helping to reduce waste and conserve resources.

Figure 20, Recyclable glass bottles

The recycling of glass began in the UK in the **1977**, when people started to recognise the benefits of reusing materials. Glass is a fantastic material to recycle because it can be melted down and remade into new products. In fact, up to **30% of recycled glass** can be included each time new glass materials are melted.

Many types of glass can be recycled from home, such as **bottles**, **jars**, and **containers** that hold food or drinks. However, not all glasses are suitable for recycling. **Window glass**, **drinking glasses**, **lightbulbs** and **heat resistant glass cookware** need to be taken to special recycling facilities. This is because these types of glass have different melting points and can contaminate the recycling process. Instead, they are often used for other purposes. They can be remelted and spun into glass fibre for home insulation, or crushed and used as **aggregate** for building roads. Recycling glass helps conserve resources and reduce waste. It also reduces energy use and lowers the amount of raw materials needed to make new glass products.

Figure 21, Milk float, 1960s

For centuries, glass bottles have been cleaned and reused due to the unique properties of glass. Being an inert material, glass doesn't react with or contaminate food and drink stored in it, making it ideal for reuse. This makes glass ideal for safely preserving contents without altering taste or quality. Glass bottles can be sterilised between uses, and can be safely reused again and again. In the UK, this method has been used for decades, men driving electric powered ***milk floats*** delivered milk directly to homes. This reduced the need for single-use packaging and helping to conserve resources while also cutting down on waste. Glass is the original sustainable material.

The Glass Age?

In 2021, the United Nations declared 2022 the International Year of Glass to celebrate how glass has shaped our lives and continues to help us explore and understand the world. Archaeologists study ancient glass to learn about early trade routes, while scientists use special optical glass in powerful telescopes like the James Webb Space Telescope to see light from the beginning of the universe. With uses in healthcare, buildings, space exploration, and more, some people think we are in a '***glass age***,' as glass continues to shape our past, present, and future.

Pre-Visit Activities

Glass Around Us: Everyday Objects

Objective: Recognize how glass is used in everyday life.

Activity: Ask students to make a list of everyday items made from glass (e.g., windows, mirrors, bottles). As a class, discuss what makes glass a good material for these objects (e.g., it's transparent, strong, and recyclable).

Task: Have students draw one object and label its features, explaining why glass is the best material for it.

Extension: Discuss how the recyclability of glass helps the environment, and why this material is used so widely.

The Ingredients of Glass

Objective: Learn about the materials used to make glass.

Activity: Introduce the basic ingredients of glass (silica, soda ash, lime). Show students images or samples of sand (for silica) and discuss how glass starts as raw materials and transforms into clear, solid glass.

Task: Ask students to create a poster showing the materials needed to make glass, labelling them with simple facts (e.g., 'Silica is a type of sand used to make glass!').

Extension: Research how each ingredient changes the properties of glass, such as soda ash lowering the melting point.

At the Museum Activities

Observe and Describe Glass Objects - Literacy

Objective: Develop observation and descriptive skills.

Activity: Have students choose their favourite glass object from the museum collection. Ask them to write a descriptive paragraph, focusing on the shape, colours, and textures. Encourage them to use sensory language (e.g., 'smooth,' 'shiny,' 'sparkling') to bring their description to life.

Extension: Students can compare their chosen object to others in the collection, identifying differences in glassmaking techniques and styles.

Glass Texture and Colour Observation - Literacy

Objective: Learn how glassmakers create different textures and colours.

Activity: As students move through the exhibits, encourage them to focus on the textures and colours of different glass objects.

Task: Give students a "texture and colour scavenger hunt" worksheet where they record examples of smooth glass, frosted glass, and coloured glass. Ask them to note down any interesting facts they learn about how these effects are achieved (e.g., adding metal oxides like cobalt for blue, or using sandblasting to frost the surface).

Extension: Students can pick their favourite glass piece and describe how the colours or textures might have been made.

Live Glassblowing Observation - Science

Objective: Observe the glassmaking process in real-time at the hot glass studio - Properties and Changes of Materials

Activity: In the hot glass studio, students will watch a live demonstration of glassblowing. Ask them to observe the following:

How the artist heats the glass and keeps it molten.

What tools are used to shape the glass.

How the glass changes state as it cools or is reheated.

Creative Thinking: After watching the demonstration, students can discuss:

How would you describe the texture and shape of the glass as it changes during the process?

Why is it important to keep reheating the glass as the artist works on it?

If you were a glassblower, what shape or object would you create?

Timeline of Techniques - History & Art

Objective: Explore different glassmaking techniques across history - Craftsmanship and Technology

Activity: In the gallery, provide students with a blank timeline and have them fill it with key glassmaking techniques they observe. Examples might include:

Cameo glass (19th century).

Brilliant cut crystal (Victorian era).

Copper wheel engraving (18th century).

Rock crystal or intaglio glass.

Contemporary studio glass (21st century).

Creative Thinking: For each entry, ask students to note:

How does this technique affect the look and feel of the glass?

What might have inspired glassmakers to develop this particular technique?

How do you think the technology available during each time period influenced the designs?

Storytelling through Cameo Glass - Literacy & Art

Objective: Engage students with the narrative aspect of glass, focusing on cameo glass - Storytelling through Art

Activity: As students observe cameo glass, encourage them to think about the stories being told through the designs carved into the glass.

Ask: What characters or scenes do you see? What might this piece of glass have been used for, and what story does it tell?

Creative Thinking: Have students write a short story inspired by one of the cameo glass pieces. The story can be set in the time period when the glass was made or in a modern context, imagining how the object might have been used over time.

The Art of Engraving: Focus on Intaglio and Copper Wheel Engraving - Technology & Art

Objective: Learn about the intricate craftsmanship behind engraved glass - Craftsmanship and Techniques

Activity: As students look at intaglio or copper wheel engraved glass, prompt them to consider the level of skill involved in the engraving process. Ask:

How do you think the engraver creates such precise designs?

What tools might have been used, and how do you think the artist kept control over the fine details?

Creative Thinking: Ask students to sketch a simple engraving design they might create on a piece of glass. What shapes or patterns would they use, and how would they make their design stand out?

Contemporary Glass Art: Expression through Glass - Art & Design

Objective: Understand the artistic expression in modern glassmaking - Modern and Contemporary Art

Activity: As students explore the contemporary pieces by Allister Malcolm, Madeleine Hughes, and Elliot Walker, encourage them to think about how these artists use glass to express ideas or emotions.

Ask: How do you think the artist uses colour, shape, and form to express something in their work?

How is the glass used differently than in older, more functional objects?

Creative Thinking: Have students imagine they are contemporary glass artists. What kind of sculpture or object would they create to express an idea, emotion, or story? They can draw their concept and explain why they chose certain shapes or colours.

Activity Sheet Ideas

Maths - Geometry in Glass Design

Objective: Identify geometric shapes and patterns in glass objects.

Title: Shapes in Glass

Task: Look closely at the glass objects in the museum. Can you find these shapes?

Circle or draw the objects you find that have these shapes:

Circle, Triangle, Hexagon, Oval, Square

Challenge: Look at one of the cut glass objects. How many lines of symmetry can you find in the design? Draw it below and label the lines of symmetry.

The Colours of Glass - Science - Materials, Art & Design - Colour

Objective: Explore how metal oxides create different colours in glass.

Title: Colour Detectives

Task: As pupils walk through the museum, they can match different glass objects to the metal oxides that were used to make them:

Cobalt creates blue glass. Can you find a blue glass object? (Draw it here).

Copper creates green glass. What green object can you find?

Gold Chloride creates red glass. Can you spot something red?

Challenge: Imagine you are designing your own glass object. What colours would you use, and why? Sketch your object and label the colours.

The History of Glassmaking History - Significant Individuals and Events

Objective: Learn about the evolution of glassmaking techniques and key historical figures.

Title: Glassmaking Through Time

Task: As pupils explore the museum, they will look for glass objects from different time periods:

Find a piece of glass from Ancient Egypt or Rome. What do you think it was used for?

Look for a piece of Victorian glass. What is special about the way it is decorated? (Hint: Look for cut or engraved patterns.)

Can you find a piece of contemporary glass by Allister Malcolm, Madeleine Hughes, or Elliot Walker? What do you notice about its design?

Challenge: Draw a timeline of the glass objects you found, from oldest to newest.

Light and Glass - Science | Light

Objective: Understand how glass interacts with light, focusing on transparency, refraction, and reflection.

Title: Light Through Glass

Task: Look at different glass objects and think about how light passes through them:

Can you find an object that is transparent (you can see through it)? (Draw it here).

Look for an object that is translucent (light passes through, but you can't see through it clearly). What does it look like?

Find a piece of glass that reflects light (it acts like a mirror). What kind of glass is this?

Challenge: Brilliant cut crystal glass creates rainbows when light passes through it. Can you find a crystal glass object and describe how the light looks when it shines on it?

Observing Glassblowing - Science - States of Matter, Changes of State

Objective: Watch the live glassblowing demonstration and make observations about the process.

Title: Hot Glass in Action

Task: While watching the live glassblowing demonstration, answer the following questions:

What temperature is the furnace where the glass is melted?

How does the glassblower shape the glass? What tools are used?

What happens to the glass as it cools down? Does it move faster or slower?

Challenge: Draw a picture of the glassblower at work, showing the different tools and the glass object they are making.

Ancient Glass Objects Scavenger Hunt History - Ancient Civilisations

Objective: Explore ancient glassmaking techniques and how glass was used in different civilisations.

Title: Glass in Ancient Times

Task: Look for the following ancient glass objects as you explore the museum:

An Egyptian glass amulet. What shape is it? What do you think it was used for?

A Roman glass vessel. What colour is it? What does it remind you of?

Challenge: Imagine you lived in Ancient Egypt or Rome. What kind of glass object would you want to use in your everyday life? (Draw it here).

Exploring Cameo Glass and Cut Glass - Art & Design - Design Techniques, History of Art

Objective: Learn about intricate glass techniques like cameo glass and cut glass, and how they add to the beauty of glass objects.

Title: Art in Glass

Task: Look for examples of cameo glass and brilliant cut crystal in the museum. Answer the following:

Cameo Glass: This type of glass has layers carved into different designs. Can you find a cameo glass object? What does the design look like?

Brilliant Cut Crystal: Cut glass has many facets. Can you count the number of facets on one piece of cut crystal? Draw a pattern you see in the cuts.

Challenge: Imagine you are designing your own piece of cut glass. What patterns or shapes would you carve into it? (Draw your idea here).

Back at School

Literacy: Descriptive Writing and Scientific Explanation

Activity: Writing about the Life of Glass.

Objective: Develop creative writing skills by imagining the journey of a piece of glass.

Task: Ask students to write a story from the perspective of a glass object, such as a stained glass window or a lead crystal glass. Have them describe how it was made, what it sees every day, and how it might feel when light passes through it.

Provide prompts related to the stages of glass production, including the melting, shaping, and cooling processes.

Extension: Write a factual report explaining why glass is transparent and how its molecular structure affects light transmission, as explained in the document.

Science

Activity: Exploring the Viscosity of Glass and Other Liquids.

Objective: Understand the concept of viscosity and how it changes depending on the state of a material, including glass. Compare the viscosity of different liquids and discuss how viscosity plays a role in glassmaking.

Materials:

Clear containers

Different liquids (water, oil, honey, treacle)

Stopwatch

Droppers or syringes

Task:

Introduce Viscosity: Explain that viscosity refers to how easily a liquid flows. The higher the viscosity, the slower the liquid moves. Discuss how glass, when it is hot and molten, flows like a very thick liquid, but when cooled, it becomes a rigid solid.

Comparing Liquids:

Provide students with samples of different liquids (e.g., water, oil, honey, treacle) in clear containers.

Have them predict which liquid will flow the fastest and which will flow the slowest when poured.

Use a dropper or syringe to release a few drops of each liquid down a sloped surface (like a piece of clear plastic or glass). Time how long each liquid takes to reach the bottom.

Record the results and rank the liquids from least viscous to most viscous.

Discussion:

Compare the viscosity of glass in its molten state to the liquids they tested. Explain that when glass is very hot (around 1000°C), it becomes thick and syrupy, much like treacle or honey, and can be shaped. As it cools, its viscosity increases until it becomes solid and no longer flows.

Relate this to how glassmakers gather and shape molten glass from the furnace.

Extension:

Experiment with heating honey (safely) and observe how its viscosity decreases as it warms up, mimicking how glass behaves in a furnace.

Science: Exploring the Properties of Glass - Properties and Changes of Materials

Objective: Investigate the unique properties of glass, focusing on transparency, brittleness, and elasticity.

Activity: Set up science stations where students can explore different materials, including glass (e.g., a piece of frosted glass, a glass bottle, a plastic cup, a metal spoon).

Task: Have students test and record whether each material is transparent, brittle, elastic, or flexible.

Discussion: After the activity, ask students to compare glass with other materials. Why is glass used for windows but not for making clothes? How does the properties of glass make it useful for everyday items?

Extension: Link to the concept of light transmission and discuss how glass allows light to pass through. Students can predict what happens to light when it hits frosted glass or coloured glass, compared to clear glass.

History: The Evolution of Glassmaking

Activity: Timeline of Glass

Objective: Explore the history of glass from the ancient Egyptians to modern times.

Task: Have students create a timeline that includes key developments in glassmaking (e.g., early Egyptian and Roman glass, lead crystal and cameo glass in the Victorian era, float and heat resistant in the 20th century, art and technological glass of the 21st century).

Discuss how the techniques have evolved and how innovations like float glass changed architecture and everyday life.

Extension: Research local glassmakers such as:

John Northwood: Known for reviving the ancient art of cameo glass and his reproduction of the Portland Vase.

Thomas Webb: Founder of Thomas Webb & Sons, renowned for high-quality glass and innovation in decorative glass techniques.

Benjamin Richardson: A key figure in Stourbridge glassmaking, known for advancing glass manufacturing techniques in the 19th century.

Frederick Carder: Born in Wordsley, he became a renowned glassmaker in England and America, famous for his contributions to Steuben Glass.

Science/History: The Life of a Prince Rupert's Drop - History of Technology

Objective: Learn about the fascinating strength and fragility of glass through Prince Rupert's Drops, as mentioned in the document.

Activity: Have students research Prince Rupert's Drops—glass drops that are incredibly strong but shatter when their tails are broken. Show them a video or demonstrate (if safe) how these drops behave.

Task: Ask students to draw a comic strip telling the story of a Prince Rupert's Drop, from how it is made to what happens when its tail is broken. They should use scientific terms like tension, fragility, and strength to explain what is happening.

Extension: Link the science of Prince Rupert's Drops to the development of strong, modern glass products, such as Gorilla Glass used in smartphones.

History: The Role of Glass in Ancient Civilisations

Objective: Research how ancient civilisations, such as Ancient Egypt and Rome, used glass.

Activity: Ask students to research the different ways Ancient Egyptians and Romans used glass, focusing on:

Glass amulets and their role in Egyptian mummification rituals.

Roman glass windows and decorative objects.

Task: Ask students to create a Venn diagram comparing how each civilisation used glass. What were the similarities and differences in the way glass was made and used?

Extension: Discuss how glassmaking techniques from ancient civilisations influenced later periods, such as the Venetians and the Victorian era.

Maths: Symmetry in Glass Design - Symmetry, Geometry

Objective: Explore the use of symmetry in glass designs, particularly in cut glass or stained glass.

Activity: Provide students with images of brilliant cut crystal or stained glass windows. Ask them to identify and draw the lines of symmetry in these designs.

Task: Challenge students to design their own symmetrical glass pattern, using shapes like diamonds, circles, or stars. Encourage them to make sure their design has at least two lines of symmetry.

Extension: Have students explore rotational symmetry in glass designs and create a design that rotates around a central point.