national science week 2022

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13-21 AUGUST 2022

GLASS

More than meets the eye

RESOURCE BOOK OF IDEAS BY

Australian Science Teachers Association

An Australian Government Initiative

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THE WAY GLASS SHATTERS MATTERS
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Acknowledgements

This online curriculum-linked resource was produced by the Australian Science Teachers Association (ASTA).

The materials in this educational resource have been developed and written by Sarah Kellett, edited by Dr Kath Kovac and designed by Elise Adams.

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Notes

Cover image: Pouring melted glass into a graphite mould.
Credit: Adobe Stock / aetb.

All links to websites were valid in February 2022.
As content on the websites used in this resource book might be updated or moved, hyperlinks may cease to function.

CONTENTS

01 INTRODUCTION

02 ACTIVITIES FOR ALL YEAR LEVELS

03 ACTIVITIES FOR FOUNDATION TO YEAR 2

04 ACTIVITIES FOR YEAR 3 TO YEAR 6

05 ACTIVITIES FOR YEAR 7 TO YEAR 10

FOREWORD

The Hon Melissa Price MP.

In 2022, the world observes the UN-declared International Year of Glass, celebrating what the UN describes as one of the most important, versatile and transformative materials of history. Glass will continue to have an enormous impact into our future, not only for its many applications, but also for the integral role it will play in sustainable development.

The Australian Government's commitment to building Australia's future through science and technology will see our glass-related industries, including the resources and manufacturing sectors, play a critical part in providing the elements needed for development and innovation. From aerospace to energy and research laboratories to medicine, there is definitely 'more than meets the eye' to glass.

The Hon Melissa Price MP. Credit: Supplied

When Australia launches its first mission to the Moon, we will be watching through the lenses of telescopes and on the screens of our televisions and devices, using power collected from our solar panels and communicating with each other via fibreoptic cables, while toasting the Australian Space Agency's success with our recycled drinkware. Today, glass touches virtually every aspect of our lives, and it holds a myriad of possibilities for the future.

Glass: More Than Meets the Eye brings many of these concepts to life, with opportunities to explore chemistry, bending light, technology and sustainability, and to undertake creative and engaging hands-on experiments using microscopes, kaleidoscopes and even optical fibre jelly. I encourage teachers to delve into this Resource Book to discover ways to excite and amaze your students with STEM.

The Australian Government is proud to be the major supporter of National Science Week, recognising the importance of our children as our future innovators and celebrating the scientists who are lighting the path today.

The Honourable Melissa Price MP,

Minister for Defence Industry, Minister for Science and Technology

PRESIDENT'S MESSAGE

Rosemary Anderson

Australian Science Teachers Association (ASTA) is a federation of Science Teachers Associations from all Australian states and territories. ASTA is the national voice of science teachers representing their interests at the highest levels, promoting the profession and enriching science teaching.

We are proud to present this resource book to all teachers of science and STEM and their students. We hope that the ideas and activities presented in this resource will inspire you.

Glass: More Than Meets the Eye provides an excellent opportunity to understand a household item in a new light. Glass has many useful properties, which has led to it being used in various applications from kitchenware to telescopes. The resource book explores various aspects of glass with opportunities to explore chemistry, light, technology and sustainability, and to undertake creative and engaging hands-on experiments using microscopes, kaleidoscopes and even optical fibre jelly. This resource book is a fantastic resource to ignite the creative spark among young students about STEM.

Glass is chemically inert. It is composed of silicon dioxide, the same as sand. It is also infinitely recyclable. Glass can be blown and crafted into intricate shapes, which is useful not only for making laboratory glassware but also for artistic pieces. Glass can also be made into fibreglass, which is an excellent insulation material, and also used in the aerospace industry for making fibreglass composite. The chemistry, material science and engineering of glass is fascinating, and this book highlights many aspects of this ubiquitous material.

In 2022, the world observes the United Nations International Year of Glass, celebrating what the United Nations describes as one of the most important, versatile and transformative materials of history. Glass will without a doubt continue to have an enormous impact into our future.

Rosemary Anderson

President

Australian Science Teachers Association

01

INTRODUCTION

National Science Week is Australia's annual celebration of science and technology.

'Glass: More than meets the eye' is the school theme for National Science Week in 2022 to celebrate the United Nations International Year of Glass.

This Resource Book of Ideas for National Science Week offers teachers and students an opportunity to explore the properties of glass and how it is used in the world around us. The book is reaching you through glass. It was written on computers with glass screens, and transported across the internet by glass optical fibres. Perhaps you are reading it through eyeglasses, or on a mobile phone with a glass touchscreen. And that's just the start!

Given the importance and prevalence of glass, it might seem surprising that it is difficult to pin down exactly what it is. When we talk about glass, we usually mean silica glass, such as windows and lenses. But honey and thermoplastics, such as hot glue, acrylic and spinifex resin, are glasses too. The 'What is Glass?' primer on page 8 includes a definition and guide for teaching and learning about glass.

The following 3 themes found in this resource book each contain a wealth of knowledge and inquiry-based classroom activities.

All activities are linked to the Australian Curriculum and content descriptions are in the appendix for easy reference.

Making glass: Glass can be heated to soften and shape it to create containers, beakers and flasks. Students can explore states of matter and properties of glass through hands-on activities with sugar, honey and hot glue glassmaking.

Glass viles of COVID-19 vaccine on a table   Credit: Unsplash / Brano

Bending light: Discover a wide range of hands-on activities using mirrors, lenses and the concepts of reflection and refraction. Glass allows people to see the world differently through telescopes, magnifying glasses, kaleidoscopes and optical fibres.

Window to the world: Many technologies around us use glass, from phone screens to solar panels. Students can learn about the role of glass in everyday life and use design thinking to create their own innovative ideas.

This resource also contains many opportunities to incorporate cross-curriculum priorities. First Nations connections are included throughout; we thank Aleryk Fricker for reviewing these sections. There is also a section on sustainability and glass recycling, where children from all year levels can engage in answering the question: 'How can we improve glass recycling in our community?'

As school closures may continue to impact Australia in 2022 due to COVID-19, icons identify activities that can be used in remote-learning situations. (Did you know that glass vials are used to transport the vaccines?)

We hope you enjoy exploring glass in your classroom and would love to see what you do. Share photos and students' work samples via National Science Week's online community, using #scienceweek on social media, or by emailing ASTA (nscwk@asta.edu.au). Please ensure that you have parental permission prior to posting any images of students.

WHAT IS GLASS?

The glass used in windows and drinking glasses is made by heating and mixing silica (quartz sand) with limestone, soda ash and other ingredients, and then cooling it so quickly that an orderly crystal structure can't form. Instead, the particles are spread out randomly. This gives glass its properties as a hard, yet brittle material with a smooth surface.

From solar panels to phone screens, glass is manufactured into different shapes for a huge range of uses – you'll discover many of these in this resource book. It is resistant to most chemical reactions (an advantage when making laboratory glassware and food containers), and is a poor conductor of heat and electricity.

Glass can also be made naturally. Lightning strikes on beach sand create natural glass structures called fulgurites. Meteorite impacts melt silica in Earth's crust that rains down as glassy pebbles called tektites. Lava, when cooled quickly, forms volcanic glass called obsidian.

Structure and states of matter

When water is cooled below its melting point, it freezes to ice – a crystalline solid. All the water molecules arrange themselves neatly into a pattern. Glass is not like that.

To make a glass, you need to prevent crystals forming as the liquid cools, until it is colder than its 'glass transition temperature'. At this temperature, the particles are still randomly scattered, but are stuck in place so they can't move. Glass is not a crystalline solid, it is an amorphous solid. Amorphous means 'without shape' and describes the structure of glass at an atomic level.

Glass acts differently from ice and other crystalline solids. When you heat glass above its glass transition temperature, it flows slowly. Continue to heat it and it flows faster. In other words, its viscosity changes with temperature.

Key concepts

- Glass is an amorphous solid – all its particles (molecules, atoms and ions) are jumbled up at random. This makes glass smooth, hard and brittle. Although it is strong, it can shatter.
- When glass is heated, it softens and starts to flow. Hot glass is like honey because its viscosity (thickness and stickiness) changes with temperature. It is thicker when cold and runnier when hot.
- The viscosity of molten glass allows people to shape it into big sheets for windows, draw out fine threads for optical fibre, or blow it to form bottles..
- People have been making and using glass for thousands of years.

Common ingredients of silicate glasses

Silicate glasses are used in windows, drinking glasses, laboratory glassware and more.

Silica (silicon dioxide, SiO_2) – essentially quartz sand – is the main ingredient of silicate glasses. Fused quartz is a glass made only of silica and is used occasionally, but the melting point is so hot it is expensive to make.

Other chemicals can be added to silica. Soda-lime glass, the kind used in windows, jars, bottles and drinking glasses, contains silica, soda (sodium oxide Na_2O) and lime (calcium oxide CaO). The additives make glass more durable, as well as making it easier to work with at lower temperatures.

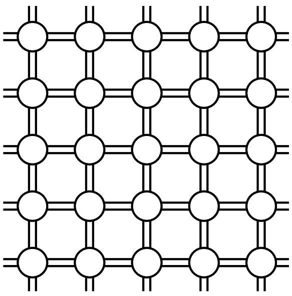
Silica sand
Credit: Envato / Coprid

Laboratory glassware and Pyrex glass is made of borosilicate glass, which contains boron trioxide (BO_3). It is less likely to shatter when rapidly heated or cooled.

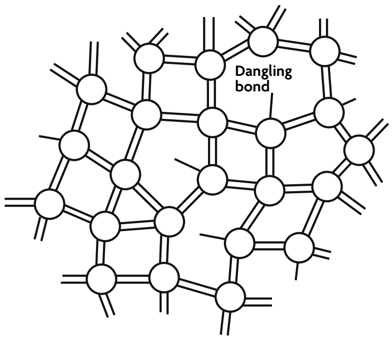
Beyond silicate

Other materials can be classed as types of glass, because they are amorphous solids with glass transition temperatures. Examples include thermoplastics, such as acrylic, hot glue, spinifex resin and plastic milk containers. Honey is a solid glass below −50 °C . This table shows the structure and composition of common glass-like materials.

Material	Amorphous solid with a glass transition temperature?	Contains silica?
Windows	✓	✓
Crystal glassware	✓	✓
Glass-ceramic stove top	Partially	✓
Acrylic	✓	✗
Spinifex resin	✓	✗
Hot glue	✓	✗
Honey	✓	✗
Sugar glass	✓	✗
Obsidian	✓	✓
Quartz	✗	✓
Fused quartz	✓	✓



Quartz (crystalline silica).
Credit: Wikipedia / Tem5psu CC-BY-SA 4.0



Glass (amorphous silica).

Tektites are a natural source of glass
Credit: Envato / eastmanphoto

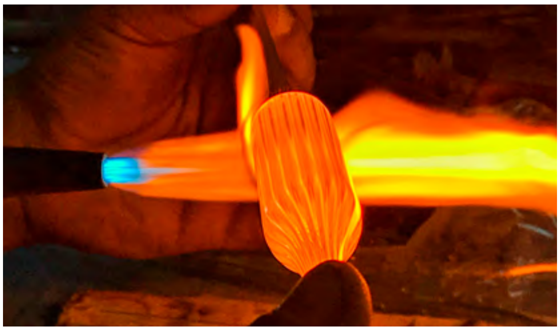
Addressing misconceptions of solids and liquids

Glass is sometimes described as a supercooled liquid, because its particles are 'frozen' in place but jumbled up like those in a liquid. This is likely to confuse students.

It is preferable to define solids as objects that keep their shape (such as a window), and liquids as substances that flow and spread out to fill a container (such as molten glass). The phrase amorphous solid is recommended to further define glass as a special type of solid.

Adding to the confusion is the myth that medieval windows are thicker at the bottom because the glass has flowed down over the years. Don't be fooled. Medieval glassmakers couldn't make windows that were the same thickness all over. They just installed the thickest end on the bottom. Researchers calculated that glass particles may theoretically be able to move slightly in the solid form, but only over millions of years. Still, stick with defining glass as a solid!

CONTENT MAP



Consider Safety

Involve students in a discussion about safety and managing risks at the start of activities.

Discover the activities in this resource book. The following icons are used throughout:

- First Nations: Activity includes material about Aboriginal and Torres Strait Islander histories and cultures
- Sustainability: Activity includes material about sustainability
- Remote learning: Students can do this activity at home with support from an adult
- Design thinking: Activity promotes design thinking and a STEM approach to learning

	Foundation – Year 2	Year 3 – Year 6	Year 7 – Year 10
For all year levels	First Nations connections (First Nations) Glassmaking in Australia Sustainability (Remote learning, Design thinking)		
Making glass Glass can be heated and shaped	Sugar glass decorations	Cold honey, hot honey (Remote learning)	Hot glue glass fibres (First Nations)
Bending light Explore reflection and refraction through mirrors, lenses and optical fibre	Explore with a magnifying glass (First Nations, Remote learning) Turn a window into a mirror Make a kaleidoscope	Invisible glass Make a telescope (First Nations)	Jelly optical fibre
Window to the world Investigate the role glass plays in our daily lives	Glass at home (First Nations, Sustainability, Remote learning, Design thinking)	Solar panels (First Nations, Sustainability) Marble run challenge (Design thinking, Remote learning)	Make a light bulb (First Nations) Glass in technology (Remote learning) Tools for touchscreens Design mini-challenge (Sustainability, Remote learning, Design thinking)

Logos for cross-curriculum priorities: credit: ACARA

Questacon

The National Science and Technology Centre

Spark Your Students' Curiosity!

In Canberra

Explore the mysteries of science through interactive and engaging experiences in themed exhibition galleries. Perfect for self-guided exploration, the galleries encourage discovery and curiosity as students explore the science behind our world. Students can watch live science demonstrations, experience science in exciting new ways and take a piece of Questacon home with them from the Questacon Shop. Guided Q by Night experiences are also available after hours.

Professional Development Workshops

Engineering is Elementary is an exciting and immersive professional development opportunity for primary school teachers. The free inquiry learning workshop builds teacher capacity to deliver STEM units of work with a multidisciplinary approach, while also providing practical experience and resources. The teacher developed and delivered workshops provide assessment strategies and activities to engage students in engineering education in the classroom.

The *Questacon Cyber Ready Program* is designed to improve teacher skills, perceptions and confidence with the digital technologies curriculum. The workshops are a fun and valuable opportunity for teachers to engage professionally with colleagues and community to build digital technologies skills for the future. The program explore a range of exciting topics through creative and collaborative activities at after-school workshops, whole-school multi-day programs, and national conferences.

Questacon's professional development workshops will be delivered across Australia in 2022 through in-school or online workshops. For more information and to register for the workshops, visit the Questacon website.

National Programs

Questacon is touring in regional Australia in 2022! With exciting and educational science shows for primary students, and workshops for high school students and teachers, there is something for your whole community. For further information on specific programs and tour dates, visit the Questacon website.

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Bookings are essential for all Questacon programs including gallery experiences.

Contact us at **bookings@questacon.edu.au** or visit our website for more information.

Program delivery dates and locations are subject to change in line with public health guidelines and travel restrictions.

www.questacon.edu.au

Australian Government

Questacon
The National Science and Technology Centre

Credit: Envato / Twenty20Photos

02

ACTIVITIES

FOR ALL YEAR LEVELS

First Nations connections

Across Australia, First Nations peoples have used and worked with glass for thousands of years and continue to do so today.

Opportunities abound to bring First Nations knowledges about glass into classes. Ideas are included throughout the book and this section summarises key ideas.

Overview and student handout

The handout on the next page can be given to students to spark a discussion or a project about materials, culture and innovation.

The following resources can accompany the handout:

- The First Scientists: Deadly Inventions and Innovations from Australia's First Peoples, a new book by Corey Tutt aimed at upper-primary students (Purchase required).
- Technological process of stone tools [PDF] curriculum resources from the Tasmanian Department of Education, part of a series related to stone tools on The Orb.
- Rare 110-year-old glass spearhead found on Rottnest Island from ABC News.

Spinifex. Spinifex resin is used as an adhesive   Credit: National Science Week

These activities contain more First Nations connections:

- Glassmaking in Australia
- Explore with a magnifying glass
- Glass at home
- Make a telescope
- Solar panels
- Hot glue glass fibres
- Make a light bulb

This spearhead is made from red glass and black spinifex resin, which is also a type of glass.   Credit: Museums Victoria Photographer Rodney Start

Professional development

If you would like to gain more confidence and capability when including First Nations connections in your practice, the following organisations have professional development courses and resources:

- Narragunnawali supports schools to introduce meaningful reconciliation initiatives.
- Australians Together has a Building Confidence Workshop and an online course on exploring culture.
- The National Museum of Australia has an online professional learning course on First Nations histories and cultures in schools.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Handout: First Nations knowledges

Aboriginal and Torres Strait Islander cultures across Australia have a long history of innovation and knowledge of materials that continues today.

Architect Jefa Greenaway is a descendant of the Wailwan and Kamilaroi people of northwest New South Wales. Glass plays an important role in architecture, because the placement and size of windows changes how the inside of a building connects to the outdoor environment.

Jefa runs Indigenous Architecture Victoria, a centre promoting the knowledge that the Indigenous community and architects share, such as connections to place.

Glass lenses and mirrors are also used in telescopes to investigate the sky. Karlie Noon, a Gomeroi woman and astronomer, is studying gas clouds outside the Milky Way. She often gives talks to share her knowledge and First Nations stories about stars and planets.

This Australite was found in Victoria.
Credit: Museums Victoria Photographer Ralph Uhlherr

Glass from volcanoes, meteorites and spinifex

Aboriginal and Torres Strait Islander peoples have used natural forms of glass to make cutting tools for many thousands of years. These tools were used for a variety of tasks, including preparing food, creating clothing, and for warfare and ceremonial purposes.

Volcanic glass, called obsidian, is one example of natural glass. Another is Australites, which are made during meteorite impacts when molten material splashes into the sky and falls back to Earth.

A close-up of spinifex showing the resin it contains.
Credit: Wikipedia / Mark Marathon CC-BY-SA 4.0

A third type of natural glass is Darwin glass, which is found in Tasmania and probably formed in a meteorite impact crater. Tasmanian Aboriginal peoples have used this glass to make incredibly sharp tools. The oldest Darwin glass tool dates from 27,000 years ago.

Spinifex resin is a type of glass too – though it is quite different from window glass. It is a type of thermoplastic, a glassy polymer similar to acrylic and hot glue. Spinifex resin is made by processing and heating spinifex grass. When it is hot, the resin is a thick liquid. It cools into a hard, smooth solid. First Nations peoples have used spinifex resin as a glue, to make objects waterproof and to make beads for thousands of years. It is still used today.

Glassmaking in Australia

Excursions

Glassmaking studios are found across Australia. This is a fantastic way to engage students with the science of glass. For the International Year of Glass, some studios may be offering additional activities. Reach out to one near you.

Some offer tours and activities where students can watch glassblowing, enter a design competition or make their own glass-fused artworks. The heat from furnaces, glow of molten glass and skilled artists make it a memorable experience.

To link learning from an excursion to the curriculum, include a discussion on states of matter and how the viscosity of glass changes with heat.

Artists blowing glass. Credit: Envato / aetb

Art and science

When it comes to glass, there are many ways to bring art and science together. Glass artists use their knowledge of materials and techniques to make sculptures. And some artisans work directly with scientists, using their skills to create bespoke glass laboratory equipment.

Videos of glassmaking

Robert Wynne, glass artist in Sydney, creates a vase and talks about the properties of glass.

Oliver Hoglund, glass artist in Queensland, demonstrates glass blowing.

Fused glass can be made in a ceramics kiln.
Credit: Flickr.com / Meriwether Lewis Elementary School CC-BY-NC-ND 2.0

First Nations glass artists

Jenni Kemarre Martiniello of Arrernte, Chinese and Anglo-Celtic descent, makes glass sculptures of woven objects, such as eel traps and dilly bags.

Yhonnie Scarce was born in Woomera, South Australia, and belongs to the Kokatha and Nukunu peoples. She makes glass sculptures relating to the effects of colonisation on Aboriginal people, including relocation of people from their homelands and families.

Using a kiln

If your school has a kiln for ceramics, you may be able to use it to fuse marbles or small glass pieces into jewellery, or slump glass pieces over a mould to make a bowl. Focus learning around states of matter and the way glass viscosity changes with heat.
Read more about how to fuse glass in your ceramics kiln and shaping glass bowls.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Sustainability

In this Project-Based Learning (PBL) activity, students investigate glass recycling and ways they can make a difference to their community. Small groups, a class or a whole school can work together to petition for a local glass container collection service, create an educational campaign about recycling, or work with local businesses that could reuse glass containers.

Safety

Glass can break. Be prepared and approach this as a learning opportunity for students to manage the risk of glass breakage.

Getting started with PBLs

PBLs are a student-led approach to teaching and learning based on authentic, real-world contexts. There is a useful PBL Resource Guide on the New South Wales Department of Education website, which includes downloadable templates on the Making a Plan page.

The PBL Resource Guide lists the core elements of PBL as: a driving question, an entry event, connections with the community, possible products and a culminating event. This activity is structured with ideas under these subheadings to help you build your own activity based on the interests of your students and opportunities in your community.

Activity length

From one week to one term

Driving question

How can we make glass more sustainable in our community?

This is all about recycling of bottles and jars – glass packaging. Glass can be endlessly recycled, as it can be heated and reformed without losing quality. But in Australia, only about one-third of the glass we consume is recycled into glass products, and about 10 per cent is crushed and used in construction. That means a lot of glass ends up in landfill.

Glass can be endlessly recycled.
Credit: Envato / twenty20photos

The CSIRO Circular Economy Roadmap explains the fate of glass packaging used at home.

- 50 per cent goes to landfill
  - 22 per cent not collected for recycling (e.g. bottles may be thrown into the rubbish instead of the recycling bin)
  - 28 per cent lost during the collection and recycling process (e.g. when the mixed recycling bin is collected, glass smashes, which makes it hard to separate and process)
- 50 per cent re-used in some form
  - 10 per cent crushed and used to replace sand in construction or to make roads
  - 4 per cent stockpiled or exported
  - 36 per cent recycled to create more glass packaging and other products.

Broken glass is an environmental hazard. Credit: Envato / cristi180884

Entry event

Ask each student to record all the glass containers their house uses over a week. At the end of the week, bring in a box of glass bottles and jars that you have collected yourself. Count and weigh them together. Go through the students' records and add up how many bottles and jars the class used over a week.

Older students could work out an average per student, and estimate a total for the school or town, or the total for a year. Now divide the bottles and jars into two groups – roughly half would be recycled or used in construction, and the other half would go to landfill. This gives students a sense of the scale of the problem.

Connections with the community

Students may like to visit a recycling centre (some run tours for National Science Week) or ask if they can talk to your class. Companies such as Cleanaway do educational sessions in some locations.

You could engage with volunteers who collect glass bottles and jars, or people who upcycle them into new items. Local businesses that create beverages, bath salts or anything sold in glass containers might be interested to explore ways that local glass waste could be collected and cleaned as packaging.

In Lismore, New South Wales, Northern Rivers Waste has started a local glass-processing plant that recycles glass into sand for building roads. In far north Queensland recycled glass sourced locally through the Containers for Change refund deposit scheme was used to make a section of road. Enviro Sand uses recycled glass to make pool filtration media, countertops and more.

If your class explores the use of crushed glass as a replacement for sand in construction, perhaps they could develop their ideas with someone from a local construction company.

Possible products

Create or contribute to a container collection service

Some communities can get a 10-cent deposit for bottles and cans. Can your community access this scheme? If so, how can your class educate the community or provide a container collection service? If not, your class could lobby local council or government to introduce one.

Reuse glass bottles and jars

Reusing bottles and jars is better than recycling, because it requires less energy to transport and create the new object. What could you do with bottles and jars? Can you design a system to reuse bottles and jars endlessly?

Culminating events

If students are upcycling or reusing glass bottles and jars, they could have an exhibition as their final event. If they are campaigning to start a container collection service, they could have a public debate to raise awareness and get people to sign a petition. If you use a return-and-earn recycling scheme to make money, it could be spent to buy something special for the school, and your culminating event could be a grand opening.

Glass jars can be endlessly recycled.
Credit: Envato / wolfhound9111

More resources

- The Story of Waste [PDF] by the New South Wales Environmental Protection Authority is a resource for First Nations communities and learning.
- Combine this with Planet Ark's Schools Recycle Right Challenge, which runs in October. They have lesson plans and a school's guide on how to set up a recycling system [PDF].
- Check your local or state council for waste education programs. For example, Cairns Regional Council's Waste Education Program has resources, colouring in sheets, and offers guided tours and in-school presentations for the region.
- Try the ANSTO Design Thinking Challenge (link TBA) on glass recycling.
- Watch how glass bottles and jars are made at Visy Recycling.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Handout: Making glass sustainable

Pasta sauce, fancy fizzy drinks, olives – you can buy all these in glass bottles and jars. But once you've finished the food or drink, what happens to the glass?

Say you throw it in the rubbish. It gets collected by a big truck and taken to landfill. End of story.

Or maybe you wash it and put it in the recycling bin. It gets collected by a different big truck and taken to a sorting centre. On the way, some of the glass breaks into small pieces that are hard to sort, and that bit ends up in landfill. The rest of the glass makes it safely to the sorting centre, where it is processed into small chunks of glass, heated to a liquid and formed into new bottles and jars. Huzzah!


Milk used to be delivered in glass bottles and were picked up for recycling.
Credit: Envato / DragonImages

Better yet, if it's a bottle, you wash it and put it in a big box. Once a month, you take the box of bottles to a recycling centre and exchange them for money – 10 cents a bottle. This way, none of the glass breaks and it all gets recycled into new bottles.

Best of all, you keep the jar and reuse it. After a really good wash, you fill it with rice or nuts or sultanas and keep it in your pantry. This saves all the energy of recycling.

"Glass is wonderfully recyclable," says Dr Tim Baynes, a scientist at Australia's national science agency, CSIRO. "Each time you recycle it you get the same quality again and again."

Yet across Australia, only one of every 3 glass containers are actually recycled to create a new glass container. Tim says there are a few places where people can make a difference.

First, don't put it in the rubbish bin!

"Use a recycling bin, or even better a dedicated glass-recycling bin," says Tim. "See if your community has a container deposit scheme, where you can return and earn."

Glass can also be crushed and used instead of sand to make roads and concrete paths. Clean bottles and jars could be refilled by local businesses. Many years ago, milk was delivered to homes in glass bottles and the empty bottles were collected, cleaned and re-used.

"I don't know why they stopped," says Tim. "It was a good idea!"


Recycled glass sand in Wyong, NSW.
Credit: iQ Renew CC BY-NC-SA 4.0

Making glass bottles and jars

It starts with sand. Glass bottles and jars are made by mixing sand with limestone, soda ash and other ingredients and heating the mixture at incredibly high temperatures (around 1500 °C) until it becomes a liquid. Then the bottles and jars are shaped and cooled until they become solid.

03

ACTIVITIES

FOR FOUNDATION TO YEAR 2

Credit: Adobe Stock / Myst

Sugar glass decorations

Crushed lollies change from a solid to a liquid and back to a solid to create beautiful decorations. This cooking activity uses a technique of glassmaking called fusing.

Learning objective

We are learning to make stained-glass decorations.

Success criteria

What I'm looking for is a description of how materials change during the activity.

Activity length

40 minutes to make the dough shapes in class (plus 2 hours baking time);
30 minutes to fill the dough decorations with sugar (plus 10 minutes baking time)

Credit: Elise Adams

Context

Materials change during the activity. The dough starts soft and can be pulled, pushed, rolled and bent into shapes. After baking, the dough is hard and cannot be moulded. The sugar starts hard, then is crushed into a powder. While baking, the sugar becomes a liquid and fuses into one big piece. After the sugar cools, it becomes hard and transparent again. Sugar glass is an amorphous solid, like the glass in bottles and jars.

Materials to prepare in advance

- Clear, hard lollies, such as boiled sweets in a variety of colours (crystal mints for clear). Separate the lollies into colours, then crush them into a powder in a food processor and put them into small bowls.
- Access to an oven (this can be done after school or in the staff room or canteen).

More resources

- Make edible sugar glass biscuits instead. Ensure food safety principles are used throughout the activity and check for food allergies to egg or gluten.
- Explore early glassmaking online at Corning Museum of Glass. They used moulds, sticking and grinding to make beautiful objects. Can your class create their own examples? What materials might you use?
- Enter the Canberra Glassworks Kids' Design Competition. It runs between June and mid-August each year and is open to children under 12 years of age.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Tips for teachers

- You can pre-make and bake the dough shapes instead of doing this in class.
- If you want to be able to hang the decorations, poke a hole in the dough shapes.
- Labelled squares of baking paper can help identify which dough decorations belong to each child. Take care when sliding the baking paper onto the oven tray so the sugar doesn't escape (a spatula might be handy).

Curriculum links for this activity are in the appendix.

Worksheet: Sugar glass decorations

Dough decorations

Materials

- 4 cups plain flour and extra to dust (makes about 25 decorations)
- 1 cup salt
- 1 ½ cups water
- Mixing bowl
- Chopping board
- Baking paper
- Oven trays

Instructions

1. Put the ingredients into the bowl and stir to mix into a dough.
2. Dust the chopping board with flour and put the dough on it.
   Knead the dough for 5 minutes until smooth. It will feel like firm playdough.
3. Make shapes with dough on baking paper. Each shape should have a hole in the middle – in the next lesson you will fill this hole with sugar to make a glass window.
4. Keeping the shapes on the baking paper, slide them onto an oven tray. Bake for 2 hours at 120 °C.
   Allow the dough decorations to cool completely.

Sugar glass

Materials

- Dough decorations, still on the baking paper
- 40 hard lollies, separated into colours and crushed (makes about 25 decorations)

Instructions

1. Fill the hole of your dough decoration with a thick layer of crushed lollies. You can use all one colour, make stripes or create a rainbow.
2. Keeping the decorations on the baking paper, slide them onto an oven tray.
3. Bake for 10 minutes at 180 °C or until the sugar becomes a liquid. Do not over bake or the sugar might go brown.
4. Allow to cool completely.

Making glass – then and now

The first time people made glass was about 4000 years ago. Over time, people experimented with heating sand until it melted, then cooling it into hard, shiny glass.

Glass jars are recycled by crushing them into small pieces. The pieces are heated until they become a liquid. The liquid is shaped into new jars and cooled to a solid. How is this similar to making sugar glass decorations? Do your sugar glass decorations look and feel like the glass in a window?

Explore with a magnifying glass

This activity introduces children to the wonderful world of lenses. When they were first invented, magnifying glasses allowed people to see details that had been invisible before. Today scientists still use magnifying glasses to identify animals, plants and rocks.

Learning objective

We are learning to use magnifying glasses to see the features of living things and the environment.

Success criteria

What I'm looking for is drawings of your observations.

Activity length

40 minutes

Safety

Do not allow students to look at the Sun through a magnifying glass or focus the Sun's light onto skin.

Explanation

We see objects when light bounces off them and enters our eyes. A magnifying glass is made using a lens that bulges outwards in the middle, called a convex lens. When light bounces off an object and enters the lens, the shape of the lens makes the light bend. The light then exits the lens and enters our eyes. This bending of light creates a virtual image that is bigger than the actual object.

Magnifying glasses are a tool for scientists and doctors. Plant biologists use them to identify plants and diseases. Geologists use them to identify rocks and study fossils. And doctors use them to look at spots or sores on skin.

Materials to prepare in advance

- Magnifying glasses for each child. Note that many are made with plastic lenses because they don't smash. This is okay, but one with a glass lens would be great for demonstration and you could discuss the differences between plastic and glass in your class.
- Items to look at, such as:
  - seeds, seed pods, leaves, bark
  - insects, feathers, shells, or students could look at their own hands
  - rocks, wood, fabric and items made with a combination of materials
  - sand – this is an interesting one, because sand is the main ingredient of glass!

Tips for teachers

- Magnifying glasses work best when you hold them close (but not too close) to the object you are looking at. Some children will hold the magnifying glass up to their eye like a detective, without realising it can magnify objects.
- Some students might be curious about using a magnifying glass to light a fire or burn ants. This happens because light waves bend through the lens and meet in a spot called the focal point. When the focal point captures light from the Sun, it becomes very hot.
- If you hold the magnifying glass too far from your eye, the object will appear upside down. When light waves bend through the lens, they meet at the focal point and then cross over, so the light that was at the top of the object is now at the bottom of the image.


Credit: Elise Adams

More magnifying ideas

As well as a magnifying glass with a handle, you could also try a:

- magnifying glass dome (sometimes sold as a paperweight)
- drop of water
- digital microscope plugged into a computer. For example, use this Year 1 Learning Activity by ICT in Everyday Learning (login required to access this resource).

First Nations connections

- Combine this activity with a visit with an Indigenous Elder who can share Traditional Knowledge about plants or animals. When engaging First Nations people, pay for their time and expertise.
- Label the leaves and seeds using a First Nations language, ideally the language of the Country your school is on. Generally this will need to be done in partnership with a First Nations person or organisation. If a species cannot be named, talk about how language has been lost and is being reclaimed.

Did you know?

Eyeglasses are lenses. One early use of the magnifying glass was to help people read. Many other objects use magnifying lenses, including cameras, binoculars, telescopes and microscopes.

More resources

- Watch How magnifying glasses work at Optics Mag.
- Through the Looking Glass by Early Years Educator has more ideas and suggested books.

Printing? Find links for these resources at sciencweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Turn a window into a mirror

Sticking a silver film to your classroom window gives it a reflective surface, and demonstrates how mirrors work. The film is easy to stick on and remove. You could follow this activity with an exploration of mirrors, such as the kaleidoscope activity on page 27.

Learning objective

We are learning to change the properties of a window by adding another material.

Success criteria

What I'm looking for is to observe and describe the properties of glass and plastic film separately and together.

Activity length

30 minutes

Credit: Elise Adams

Materials to prepare in advance

- Mirror-tinted window film, available in hardware stores and online retailers. Before class, cut it into shapes about 20 cm wide.
- Spray bottle of water or wet cloth
- Squeegee

More ideas

Colourful cellophane can be stuck to windows with sticky tape. See what the world looks like through red or blue tinting, and try mixing colours. Search online for other options, such as gold or colour-shifting glass films.

Tips for teachers

- Sticking a large piece of film to the window is very challenging – it takes a long time to smooth away bubbles. Cutting the film into smaller shapes (about 20 cm) makes it easier to work with.
- The trickiest part of this activity is peeling the backing away from the film. To save time in the classroom, peel a corner of the backing and trim it with scissors beforehand.

Caution

Do not do this experiment on tinted windows, as the tint may be damaged when the film is removed.

Curriculum links for this activity are in the appendix.

Worksheet: Turn a window into a mirror

Materials

- Mirror-tinted window film
- Spray bottle of water, or a wet cloth
- Squeegee

Instructions

1. Choose a window that is at eye level from both inside and outside. Note that when you stick the film on one side of the glass, the mirror effect will be seen on the other side.
2. Clean the window first for best results.
3. Spray the clean window with water or wipe with a wet cloth.
4. While the window is still damp, peel the backing off the mirror-tinted window film.
5. Carefully stick the film to the window. Smooth away any air bubbles with the squeegee.
6. Check out the other side of the window to see your reflection.

Explanation

Mirrors need 3 things to work: a smooth surface, a shiny surface and light. In this activity, the window is the smooth surface. The film is the shiny surface. The light comes from the Sun or a light globe. When the light hits the mirror, it bounces off the smooth and shiny surfaces without being disturbed or scattered. This lets you see your reflection clearly.

Did you know?

Glass films are used on car and home windows for privacy, to keep heat out, and because it looks appealing.

Make a kaleidoscope

Explore mirrors and reflection with a fun, hands-on activity where students can make their own kaleidoscope using mirrored acrylic. Technically, the kaleidoscope in this activity is a teleidoscope, because instead of containing coloured beads at one end, it has an open view that can be used to form kaleidoscopic patterns from external objects. Keeping the end open allows more investigation with the real world.

Learning objective

We are learning to make a kaleidoscope with a mirror.

Success criteria

What I'm looking for is to explore how a kaleidoscope works.

Activity length

40 minutes

Credit: Elise Adams

Concepts

Mirrors are usually made of hard, smooth glass with a shiny back. But they can be made from different materials with the same properties. Ask students: Is the mirrored acrylic in this activity plastic or glass? How can you test it to find out? (Hint: it is plastic and can be bent and be cut with scissors. This makes it safer and easier to use in this activity.)

Discuss the shape of the kaleidoscope (a triangle at one end, or a triangular prism for older students). Mirrors reflect light. The mirrors in a kaleidoscope reflect the reflections over and over, and this makes a pattern.

Tips for teachers

Holding the mirrors in a triangular prism shape can be fiddly. Younger students may need one-on-one help. Older students may have more success if they work in pairs (one person to hold the mirrors, the other to attach the sticky tape).

Materials to prepare in advance

- Acrylic mirror of 1 mm thickness, available at hardware stores or online. We bought a 3-pack of 20 x 20 cm mirrors for $13, which is enough for 20 students to have 3 strips and make one kaleidoscope each. Before class, cut each sheet into 2 x 10 cm strips using a utility knife. You may also like a larger piece of mirrored acrylic to use to demonstrate the material to the whole class.
- Thin cardboard cut into 10 x 10 cm squares. The cardboard should be thin enough that it can be rolled into a cylinder, like a toilet roll.
- Paint or coloured markers to decorate the outside of the kaleidoscope (optional).

More resources

Watch What's inside a Kaleidoscope by What's Inside? on YouTube.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

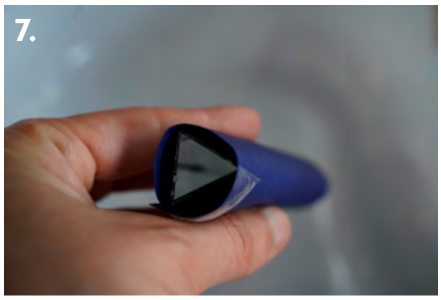
Worksheet: Make a kaleidoscope

Materials

- 3 pieces of acrylic mirror
- Sticky tape, in pieces 10 cm long
- Square of thin cardboard

Instructions

1. Get two 10 cm long pieces of sticky tape ready to use.
2. Peel the protective plastic off the 3 mirrors.
3. Put the mirrors on your desk with the reflective side down and long edges together.
4. Put 2 long pieces of sticky tape across the mirrors.
5. Flip the mirrors over so they are reflective side up.
6. Make the mirrors into the shape of a triangular prism with the reflective sides in the middle. Wrap sticky tape around the mirrors.
7. Put the triangular prism mirrors onto the cardboard square. Roll the cardboard tightly around the mirrors and use sticky tape to hold it in place.
8. Look through the kaleidoscope. What do you see?



Credit: Elise Adams

Explanation

The 3 mirrors form a triangular prism. When light enters through the end of the kaleidoscope, it bounces back and forth between the mirrors, creating a pattern.

Credit: Elise Adams

Did you know?

Cars have mirrors so the driver can see what's behind and around them. The side mirrors and rear-view mirror can all be adjusted so the driver can see and be safe on the road.

Glass at home

This activity explores how glass and other materials are used in buildings. Students can investigate the properties of glass around their home and school, and create a design for a new classroom.

Learning objective

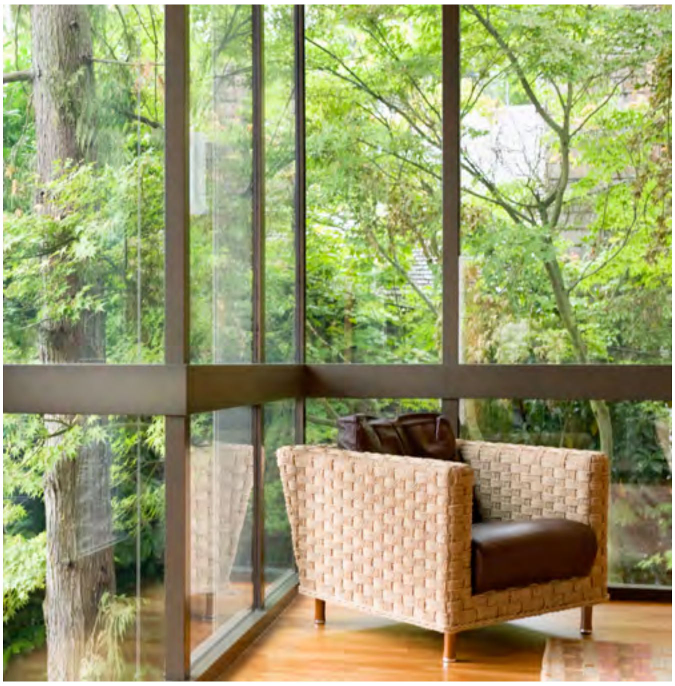
We are learning to observe and describe the properties of materials in the classroom and home.

Success criteria

What I'm looking for is a description of what materials are used in objects and why.

Activity length

One hour; if desired, the design thinking challenge can extend for one week



Credit: Envato / Mint_Images

Context

Glass is a material found throughout the home because it is strong, waterproof, has a smooth surface, is not damaged by sunlight and can be formed into many different shapes.

This activity has 2 parts, which can be done together or separately:

- Glass treasure hunt – students search for different types of glass around the classroom or at home
- Design thinking challenge – students act like an architect and design a new classroom. Encourage them to consider what materials they would use and why.

Materials to prepare in advance

- None.

Tips for teachers

- Is it glass? It's not always easy to know. See 'What is glass?' on page 8 of this resource book for guidance.
- The worksheets for this activity ask students to draw pictures. In addition, you could ask them to take photos to share with the class to build skills in using technology to collect data.
- The design thinking challenge worksheet is intended as a single lesson. To extend it into a 5-day activity, look at the design challenge worksheet on page 64. This contains a guide to addressing 5 stages of design thinking (empathise, define, ideate, prototype and test) with links to downloadable templates. Students can work in small groups to encourage collaboration and build communication skills.

Curriculum links for this activity are in the appendix.

Worksheet: Glass treasure hunt

Look around the room. How many different materials can you see? Circle the ones you find and write down any others.

Glass Fabric Wood Brick Metal Plastic

Because it is the International Year of Glass, let's look at glass in our buildings. It is used in lots of places. Find examples of glass from the following list and draw a picture below.

Something you drink from

Something lighting the room without sunlight

Something that lets sunlight into a room

Something else made of glass

Something that works as a screen

What are the properties of glass? Circle below.

Smooth	Bumpy	Rough
Soft	Squishy	Hard
Waterproof	Leaks	Transparent

Is it glass or plastic?

Plastic and glass objects can look so similar, that sometimes your eyesight can't tell them apart. Your other senses can help you test which is which. Use your hearing by tapping an object gently with something metal and listening to the sound. Glass goes 'tink', while plastic is quieter and sounds more like 'thud'. Use your sense of touch to find out how cold an object feels. Glass feels colder than plastic.

Worksheet: Design thinking challenge

Imagine you are an architect. Your job is to design a new classroom in a different part of the school. Think about...

Who will use the classroom? What will they use it for?

Where will you build the classroom?

How will you use glass in the building? For example, which walls would have windows, and why?

On a separate piece of paper, draw a picture of the classroom you are designing. Label the types of materials you will use. For ideas, look at the materials used to make your own classroom.

HEALTHCARE HUB OF EARTH, METAL AND GLASS

Credit: Kaunitz Yeung Architecture

The walls of this Healthcare Hub in Newman, Western Australia, are made of earth from the site. In this remote area in the desert, it is a long way to transport materials and using earth connects the building to Country for the Martu and Niaboli Aboriginal people who live here.

“We’ve been working with desert communities in this area for over a decade,” says David Kaunitz, the architect who designed the building. “The process starts by talking with the community about where the building should be placed and what it should respond to.”

As well as earth, the building is made of glass and metal. “Glass is a fantastic material for creating a feeling of bringing the outside in,” says David. “But it’s not very environmentally friendly. It takes a lot of energy to make glass.”

“We put metal art screens near the glass to give people privacy,” says David. The metal screens were designed by local artists. The roof has solar panels to generate electricity from sunlight. Solar panels are covered in glass to protect them from rain and dust.

“Glass should be used in a thoughtful and careful way,” says David. His advice is to consider questions like: Is it shaded? Is it facing west, where the setting Sun will be hottest? Are there special trees you want to see through the window? What experience do you want to create?

04

ACTIVITIES

FOR YEAR 3 TO YEAR 6

Credit: Envato / Mint_Images

Cold honey, hot honey

Honey and molten glass share an interesting property. They are both thicker when cold, and runny when hot. In this activity, students explore the viscosity of honey at different temperatures. They will notice that cold honey is thick and hard to stir.

Safety

Do not do this activity if you have a student allergic to honey.

Learning objective

Learn about states of matter and transfer of heat.

Success criteria

Students can describe the properties of honey at different temperatures.

Activity length

One hour

Credit: Elise Adams

Context

When ice melts into liquid water, the transition is clear – one moment solid, the next liquid. Glass is different. As it is heated, the solid form of glass gradually softens. With more heat, it can stretch and be worked into different shapes. Add even more heat, and it flows and drips. The gradual change of glass from solid to liquid is why molten glass can be blown into shapes such as bottles and vases.

Honey is like molten glass. At room temperature, it can flow and drip onto your toast. With more heat, it becomes very runny. When it is cold, it is thick and firm. The 'glass transition' of honey occurs at approximately −50 °C, at which point it becomes an amorphous solid. In other words: a glass! Find out more about glass transitions and amorphous solids in 'What is glass?' on page 8 of this resource book.

Tips for teachers

Add thermometers to the water baths to include measurement in this activity.

Materials to prepare in advance

- Small containers for the honey that will fit inside bowls of water. Each student will need one container of honey and 2 bowls of water.
- Access to ice and cold and warm water (for safety, the water does not need to be too hot)

More resources

- Watch a glass drop explode in slow motion in the Mystery of Prince Rupert's Drop by Smarter Every Day.
- Watch Crushing Frozen Honey with Hydraulic Press by The Action Lab.
- Enter the Canberra Glassworks Kids' Design Competition. It runs between June and mid-August each year and is open to children under 12 years of age.

Printing? Find links for these resources at sciencweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Worksheet: Cold honey, hot honey

Materials

- Honey in a small container
- Bowl of warm water
- Bowl of cold water with ice cubes
- Spoon
- Straw

Safety

Never eat or taste an experiment.
Do not do this activity if you are allergic to honey.

Instructions

Write down your observations after each step.

1. Put the container of honey into the bowl of warm water without submerging it. Stir the honey with the spoon for 2 minutes. Try blowing bubbles into the honey using the straw.

2. Repeat Step 1 with the bowl of cold water.

3. Take the container of honey out and try stirring the water in the bowls. Stir the warm water and then the cold water.

4. Try blowing bubbles in the warm water and the cold water.

Questions

Was the honey easier to stir when it was hot or cold?

Could you blow bigger bubbles when the honey was hot or cold?

Was the water easier to stir when it was hot or cold?

Could you blow bigger bubbles when the water was hot or cold?

Challenge

Try your hand at 'glass blowing'! Put a blob of honey on the end of a straw and roll the straw around to try and keep the honey from dripping off.

Invisible glass

Watch Pyrex glass disappear when it is placed in vegetable oil. This happens because Pyrex and vegetable oil both have the same refractive index – they both bend light by the same amount. This activity is best done as a demonstration as oily glass is too slippery for students.

Learning objective

Students explore the refraction of light through solids and liquids.

Success criteria

Students can explain their observation.

Activity length

40 minutes

Materials to prepare in advance

- Small Pyrex (also known as borosilicate) glass items, such as stirring rods, beakers or test tubes, available at department stores and scientific supply stores

To do the demonstration you'll need:

Materials

- 2 clear glass cups
- Vegetable oil
- Water
- 2 identical Pyrex glass items that will fit in the glass cups
- Paper towel

Instructions

1. Fill one glass cup with water, and the other one with vegetable oil.
2. Put a Pyrex glass item into the cup of water. Ask the class what they observe.
3. Put the other Pyrex glass item into the cup of vegetable oil. Ask the class what they observe. The item in the oil has disappeared!
4. Use the student worksheet to explain the refraction of light and why the glass item disappears. Allow time for students to draw, as this encourages close observation.

This borosilicate glass stirring rod is invisible in the oil. Credit: Elise Adams

Tips for teachers

If using a Pyrex bowl or test tube, it needs to be filled with oil for it to disappear.

More resources

The accompanying student worksheet explores an application in forensics. This textbook sample chapter [PDF] about forensic glass testing will give you a good background in the topic if you want to explore it in more detail.

Printing? Find links for these resources at sciencweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Worksheet: Invisible glass

Draw your observations of this experiment below.

Why did this happen?

When the Pyrex glass item was placed into the bowl of water, you may have noticed it looked different from how it looks in air. This is because light moves more slowly in water than in air. When light enters the water and slows down, the light bends. This is called refraction. The amount that light bends through a substance or an object is called its refractive index.

When light enters the Pyrex object, it travels at a lower speed than it does through the water, so it is refracted further. This allows us to see the Pyrex object in the bowl of water.

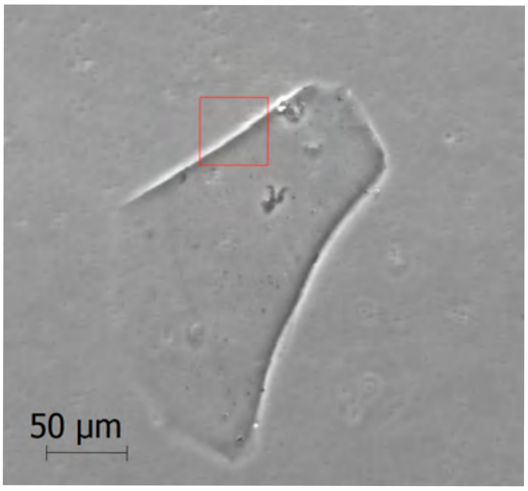
However, it just so happens that light travels through Pyrex glass at exactly the same speed as through vegetable oil. This means they have the same refractive index. So when the Pyrex is in vegetable oil, light from the air enters the oil and refracts. But when it enters the Pyrex, it doesn't refract any further, and keeps going at the same speed in the same direction. So to our eyes, the Pyrex object is invisible.

Glass, oil and crime scenes

Forensic scientists use an experiment like this to solve crimes when the crime scene includes glass fragments from smashed windows or windscreens.

"I had a case where 3 windows were allegedly smashed with a hockey stick," says Dr Kari Pitts, forensic chemist at ChemCentre. "We took tiny glass fragments from the hockey stick and compared them with glass from the crime scene."

In the lab, Kari put a glass fragment on a microscope slide with silicone oil and slowly heated it in a machine. "Heating the oil changes its refractive index," she says. "At a certain temperature, the edges of the glass fragment disappear."



This is what Kari sees when a fragment of glass is on a microcope slide with silicone oil. The edges of the glass are white because the oil is slightly too hot. Credit: ChemCentre

Using maths, Kari worked out the refractive index of the oil based on its temperature. This revealed the refractive index of the glass fragment. "There were about 20 or 30 fragments of glass on the hockey stick," she says. "They all had the same refractive index as windows from the crime scene!"

Make a telescope

In this activity, students make a refracting telescope like the one Galileo used to study the planets. This is a great STEM activity, as you can incorporate maths to calculate magnification and take engineering approaches to tinker and iterate on designs.

Learning objective

Create and test a telescope and calculate its focal length.

Success criteria

Students understand the purpose of lenses in telescopes.

Activity length

One hour

Tips for teachers

This activity is best suited to Years 5 and 6. For Years 3 and 4, you may like to complete steps 1, 2 and 3 in the worksheet before the lesson. Instead of planets, discuss how the rotation of Earth on its axis changes the section of sky we see between evening and morning. Telescopes have to be adjusted regularly to keep them pointed towards the same star.

Context

Telescopes have made it possible to investigate stars and planets, showing details that are invisible to the naked eye. They come in many types, but perhaps the most iconic is the optical refractor telescope, which uses lenses to refract light and make faraway objects seem larger.

Galileo Galilei built an optical refractor telescope to study the planets. Glass was pivotal to Galileo's research, as the glass lenses he used had to be carefully shaped and of high quality to enable his observations. His findings led him to support the Copernican model of the solar system, in which planets orbit the Sun.

Materials to prepare in advance

- A biconvex lens of 50 mm diameter and 1000 mm focal length
- A biconcave lens of 50 mm diameter and 150 mm focal length. This creates a magnification of approximately 7x. Lenses can be purchased online at school scientific supply stores.
- Cardboard tube 50 mm in diameter, 850 cm long

First Nations connections

- Listen to Cosmic Vertigo, a podcast by Karlie Noon, Gomeroi woman and astrophysicist, and Corey Tutt, Kamilaroi man and CEO of Deadly Science.

Extension ideas

- Buy or borrow a telescope and view the Moon and planets at night. Ask students to identify the parts of the telescope – eyepiece, optical tube and objective lens.
- Visit or take a virtual excursion to an observatory.
- Create a class collage of favourite photos from the NASA image of the day gallery.
- Build a telescope with 20x magnification, equal to Galileo's best, with instructions from BBC Sky at Night Magazine.
- Research the new James Webb Space Telescope. The telescope uses a mirror made of gold-coated beryllium instead of glass because it is light, strong and can withstand the cold of space. Compare it with the Giant Magellan Telescope currently under construction in Chile, which uses enormous glass mirrors. Explore the difference between reflector (mirror) and refractor (lens) telescopes.

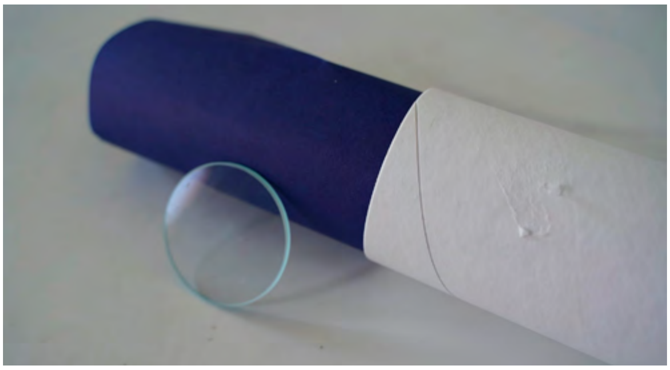
Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Worksheet: Make a telescope

Materials

- 2 lenses with different focal lengths
- Cardboard tube
- Thin cardboard
- Scissors
- Sticky tape

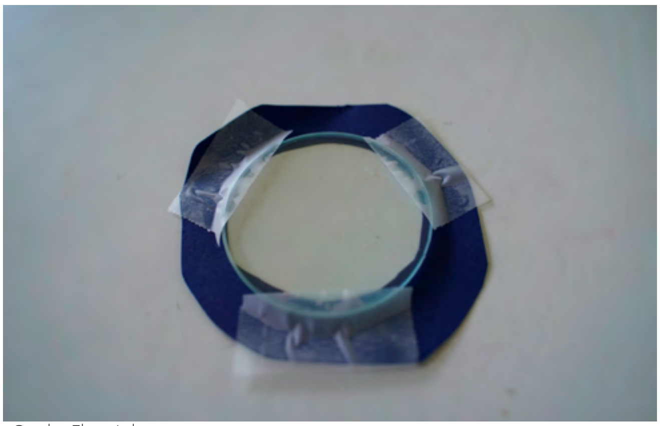


Credit: Elise Adams

Instructions

1. The optical tube of this telescope (where light travels between the lenses) is made from 2 parts – an outer tube and an inner tube. The cardboard tube will be the telescope's outer tube. To make the inner tube, roll up the sheet of thin cardboard lengthwise so it forms a tube that fits snugly inside the outer tube. Tape the thin cardboard to itself so it forms a tube that can slide in and out of the cardboard tube.
   Take them apart to do Step 2.
2. Use tape to attach the lens with the smaller focal length to one end of the inner tube (thin cardboard). Try not to cover too much of the lens with tape. This is the eyepiece lens.
3. Use tape to attach the lens with the larger focal length to one end of the outer tube (cardboard tube). This is the objective lens.
4. Slide the empty end of the inner tube into the empty end of outer tube.
5. Look through the eyepiece in the inner tube and point the telescope at a distant object. Slide the inner tube in and out until the object is in focus.
6. Tinker to improve the telescope. If it won't focus, you could try making the tube longer. Try making the room darker. Try looking at something far away from you.

Tip: If your lens is too small to fit in the cardboard tube, cut a ring of cardboard and stick the lens to the ring. Then stick the ring to the tube. The images below show how to do this.



Credit: Elise Adams

Credit: Elise Adams

Explanation

The lens next to your eye is called the eyepiece, and the other lens is called the objective lens. The eyepiece magnifies the image, while the objective lens focuses light from an object to form an image in front of the eyepiece. You may notice it is difficult to aim the telescope at the right place as you can only see a small area through the lens.

Results

What focal lengths were your lenses?

Eyepiece lens (the one close to your eye) _____

Objective lens (the one far away from your eye) _____

Calculate the magnification of your telescope by dividing the focal length of the objective lens by the focal length of the eyepiece.

Credit: University of Newcastle

MEET KARLIE NOON

Yaama (hello)!

My name is Karlie Noon. I am a Gomeroi woman from north-west New South Wales and am researching astrophysics at The Australian National University. I use both observations and simulations to conduct my research, which will hopefully help us understand the processes and evolution of our galaxy.

Glass allows me to peer into the deepest reaches of our galaxy, looking through telescopic eyes to see the changing nature of our galaxy and universe. I also give lectures on Aboriginal and Torres Strait Islander peoples' different views of the sky.

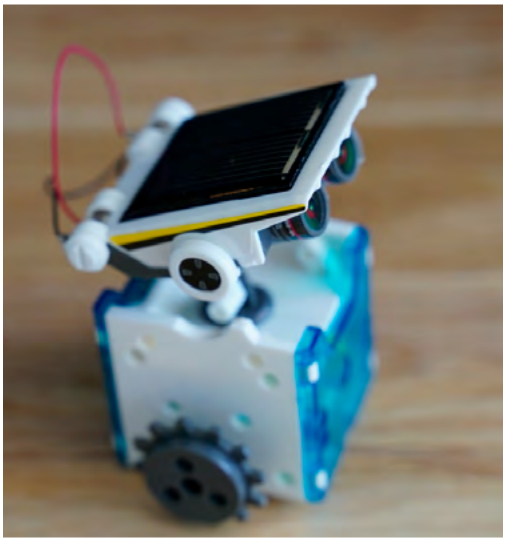
You can find lots about this at www.aboriginalastronomy.com.au.

Here are some questions to think about:

- Why is the sky important to Indigenous Australians?
- What is light pollution? Is it an issue for all people or just astronomers?
- Does anyone own space or the sky, and do humans have a right to colonise it? Did the British Empire have a right to colonise Australia? Are these situations the same?

Solar panels

Students investigate the role of glass to protect solar panels from the weather. Many of the interior components of solar panels are made from silica, the main ingredient of glass.



Credit: Elise Adams

Learning objective

Students learn how solar panels work and the role of glass in the panels.

Success criteria

Students record their observations from testing the solar panels.

Activity length

40 minutes

Context

Solar panels are covered with glass to protect the electronics and other components from water. Generally, this is safety glass, also known as tempered glass. Safety glass is much stronger than normal glass, and breaks into small pieces that are safer than sharp shards.

Glass is used because it is transparent and lets light through to the panel components that generate electricity. It is also durable and can last a long time in wind, rain, hail and sunlight without breaking down.

Materials to prepare in advance

- Solar panel kits, available in toy stores, educational stores and online. Follow the instructions in your kit to set it up, then use the worksheet on the next page.

First Nations connections

Discuss how solar panels can provide renewable energy in remote communities that rely on diesel power, such as the solar for remote communities initiative by the Queensland Government.

Listen to an interview with Kylie Chalmers from Pilbara Solar about the importance of negotiation with traditional owners.

Extension ideas

Does your school have solar panels? If so, can you access an app to see how much energy they produce over the day? If not, can your students research how to get solar power at your school?

Do your students have solar panels at home?

How many houses around your school have solar panels? (Hint: you might be able to see them on Google Maps.)

More resources

The solar power educational resources from Energy Matters include a calculator to work out the number of solar panels needed to power your home and a series of videos that explain solar power.

Explore solar panels in space, such as the solar arrays on the International Space Station that make it bright like a star. Visit Spot the Station to find out when to see it.

Combine this with an inquiry into light reflection. Can students make sunlight reflect off a mirror and power a solar panel in the shade?

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Tips for teachers

You can connect a multimeter to the solar panel so students can measure the amount of energy it generates under different conditions.

Curriculum links for this activity are in the appendix.

Worksheet: Solar panels

Solar panels create electricity from sunlight. They are covered in glass to protect them from rain and damage. Many of the interior components are made from silica, the main ingredient of glass.

Test the effect of glass on the solar panel. Try it:

- outside in sunlight
- outside in the shade
- inside in sunlight coming through a window
- inside in the shade.

Credit: Elise Adams

Did the solar panel work as well with sunlight coming through the window as it did in the sunlight outside?

What properties of glass make it a good material for protecting a solar panel?

Read about solar panels on Country at https://cfat.org.au/toc-energy-renewables and answer these questions.

Why is solar energy a benefit to remote communities?

Why do you think some people in remote communities would not want a solar farm on their land?

Marble run challenge

There are so many ways to build a marble run, and it's a great STEM activity. You can use materials from around the classroom or home. Be as creative as you want!

Learning objective

Students design and make a marble run.

Success criteria

Students are able to test and improve the marble run.

Activity length

One hour or one week

Safety

Marbles are a choking hazard.

Context

Marbles are made of glass and have been popular toys for many years. Making a path for a marble to travel down engages students with physics, and explores the concepts of gravity, friction and angles.

This is a creative activity that can be taken in different directions depending on your learning objectives and the interests of your students.

Materials to prepare in advance

- Glass marbles
- Variety of materials that could be used for making a marble run, such as cardboard, cups and tubes

Ideas to get started

- Stick marble run pieces on a wall or a desk tipped on its side with Blu-Tack or masking tape.
- Make a marble run from cardboard or paper, shaped into a half-pipe or bent into an open square.
- Use recycled objects to make the marble run, such as paper towel rolls, used sandpaper, bottles or scraps of fabric.
- Make a musical marble run by incorporating glass or metal objects. Upside-down saucepans work well as a landing place at the end.
- Head outside and make a marble run on a hill or slope, or in a sandpit. Use shovels or spoons to dig a road for the marbles to zoom down.
- Make a waterslide and see what happens.

Credit: Elise Adams

Tips for teachers

For the International Year of Glass, the main objective is to use glass marbles and notice the properties of glass. Glass marbles are hard, heavy, smooth and clink when they bump together. How do they compare with wooden beads, small stones or plastic balls?

Curriculum links for this activity are in the appendix.

Highlight the STEM in this activity

- Notice designs and materials. Encourage observation, planning and tinkering to improve the designs. What parts are working well? What could you do to make it faster, stronger or more reliable (for example, to stop the marble falling off at a tricky bit?).
- Encourage perseverance when the marble run doesn't work. Setbacks are part of the process of creating something new. If you feel frustrated, sometimes stepping back and taking a break helps. Can you see exactly what the problem is, or is it not clear? How can you find out what the problem is? Once you know the problem, can you think of a solution together, or something new to try?
- Experiment with marbles of different sizes or materials. What do you think will happen? Do the experiment and observe what happens. Was it the same as your idea at the start, or did it surprise you? If you do the whole experiment again, do you get the same results?
- Count and write numbers into a table. How many marbles? How many pieces in the marble run? How many seconds until the marble gets to the end?
- Add a challenge:
  - Can you make the marble land in a cup?
  - Can you make the marble do a jump?
  - Who can make the fastest/longest/slowest/loudest marble run?

Watch these videos

Glass artists at work in the Magic of Making Glass Marbles by BBC.

History of glass and modern glassmaking at How Marbles are Made by How&Why.

A huge marble run outside in the Sand Marble Rally by Jelle's Marble Runs, who also has the Marble Olympics.

Listen to the musical stylings of the Marble Machine by Wintergatan.

A marble run made after 3 months of work and more than 500 fails: The Blue Marble: A One Marble Path Chain Reaction by Kaplamino.

A Year 7 science project that made a Simple Rube Goldberg Machine by Luke McHale.

Glass marbles are used in spray cans to stir the paint when you shake the can – that's what makes the rattling noise. Watch an Industrial Glass Marble Extraction by New Screwdriver.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Credit: Envato / twenty20photos

05

ACTIVITIES

FOR YEAR 7 TO YEAR 10

Credit: Envato / twenty20photos

Hot glue glass fibres

Glass optical fibres are long and thin. In this activity, students can try 'drawing', which is a way of creating glass fibres. Hot glue guns create impressively long fibres and are used here as a model for glass fibres.

Safety

lasers should only be used for demonstration.

Learning objective

Students model the process of making optical fibres, and compare the properties of thermoplastics and silica glass.

Success criteria

Students can describe the technique they used to make the longest fibre, thickest fibre and thinnest fibre.

Activity length

One hour


Credit: Elise Adams

Context

Hot glue is a thermoplastic and its viscosity changes with temperature. It has a glass transition temperature of approximately 100 °C. The glue is heated as it is pushed through the glue gun. As it cools, it can be manipulated to draw it into a long plastic fibre.

Glass fibres are widely used as optical fibre. To make long fibres without defects, people must use the right temperature for the chemical composition of the glass.

Materials to prepare in advance

- Hot glue guns and glue sticks (a class could share 3 glue guns or have one per pair of students). We used low-temperature hot glue guns to make it safer.
- Optional: A laser pointer and real optical fibre, available online or in hardware stores, to demonstrate what optical fibre looks like and how light travels through it. Alternatively, Christmas ornaments or desktop toys contain optical fibre and lights.

More resources

- This activity can be combined with the 'Jelly optical fibre' activity on page 51.
- The student worksheet on the next page explains how hot glue and spinifex resin are both types of thermoplastic, which can be considered types of glass (see 'What is glass?' on page 8). The source for the glass transition temperature is The Point of Spinifex: Aboriginal Uses of Spinifex Grasses in Australia by Pitman and Wallis.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Tips for teachers

To create a longer, thicker or thinner fibre, students can change the draw speed (how fast they pull the fibre) and the temperature of the glue (by letting it cool for a while before they pull the fibre). Our method was to wait 10, 20, 30, 40, 50 and 60 seconds before pulling the fibre. The fibres were long and very fine until 50 seconds, and then they were thick, uneven and broke. We found the longest fibres were made by pulling the fibre quickly but steadily.

Curriculum links for this activity are in the appendix.

Worksheet: Hot glue glass fibres

Materials

- Hot glue gun and glue sticks (low temperature)
- Milk bottle lids
- Disposable chopstick
- Measuring tape

Safety

This activity uses hot equipment. Be careful to avoid burns.

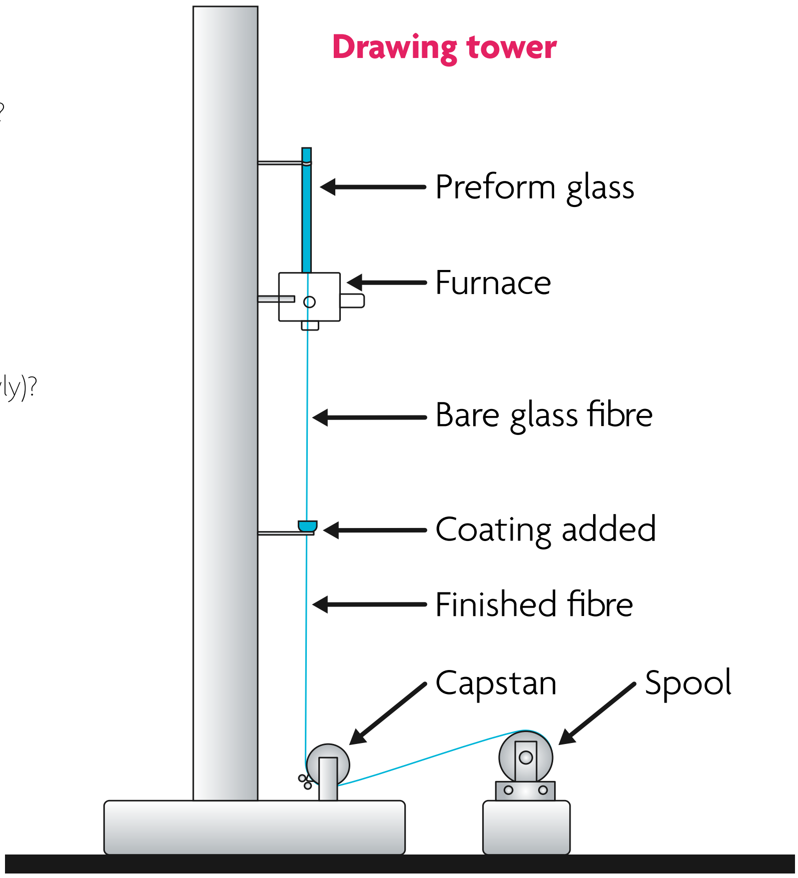
Instructions

1. Work in pairs. One person will hold the milk bottle lid (the furnace), while the other person will hold the chopstick (the capstan).
2. The furnace person puts a blob of hot glue in the middle of the milk bottle lid (hold the lid by the sides to avoid burns).
3. The capstan person uses the chopstick to touch the hot glue on the milk bottle lid and pulls the chopstick away to draw out a glue fibre.
4. When the fibre breaks, measure how long it is. Remove the dry glue from the milk bottle lid.
5. Repeat steps 2–4 and try to optimise your process to create the:
   a. longest possible fibre
   b. thickest possible fibre
   c. thinnest possible fibre.

Results

How long was the longest fibre you could draw?

What technique made longer fibres
(e.g. hot glue or cold glue, pulling quickly or slowly)?



Explanation

Hot glue is a thermoplastic. Like glass, its viscosity, or thickness, changes with temperature. The glue is runnier when hot and gets thicker when cold until it is so cold it becomes a solid.

Spinifex resin

Spinifex is a type of spiky, clumping grass. Its thin leaves are coated with a gummy, sticky resin. Like hot glue, spinifex resin is a thermoplastic material. Indigenous Australians traditionally used spinifex resin as a glue for ornaments and spear throwers, and to craft beads. It is still used today.

The glass transition temperature of spinifex resin, or the point that it becomes solid, is about 25 °C. Heated above this temperature, the resin is soft and can be shaped. When cooled below this temperature it is hard and brittle. This means that spinifex resin, like hot glue, can be considered a form of glass!

Credit: Olivia Towers

MEET HEIKE

Hi there, I am Professor Heike Ebendorff-Heidepriem from the University of Adelaide. My team researches special glass that can be shaped into various forms – from glass blocks that you can hold in your hands to glass fibre as thin as a human hair.

The high-speed internet we use today is possible thanks to fibres made of silica glass. These fibres can transport information over long distances at almost the speed of light, but they are reaching a bottleneck.

We're developing fibres from another type of glass – fluoride glass – which will be made in space with our industry partner, Flawless Photonics. The microgravity in space allows us to fabricate fibres that can transport 10 times more data over 10 times longer distances. This will enable the next generation of ultra-speed internet (Internet 2.0) and even quantum internet in the future.

This is just one of the many exciting things that new types of glass fibres can achieve. Others are helping monitor the environment, enabling laser surgery and advanced manufacturing, all to create a better and smarter future.

Jelly optical fibre

In this activity, students make a strip of firm jelly. By shining a light through the jelly strip, they can see how light bounces off the sides and travels through the strip, and even around corners. The jelly strip models how glass optical fibres transmit light.

Learning objective

To understand total internal reflection of light through optical fibre.

Success criteria

Students can describe how light moves through the jelly model and apply this understanding to glass optical fibre.

Activity length

30 minutes to make the jelly (plus 2 hours to set in the fridge after class). One hour to cut the jelly and shine a laser through it. If using extension ideas, allow a week.

Safety

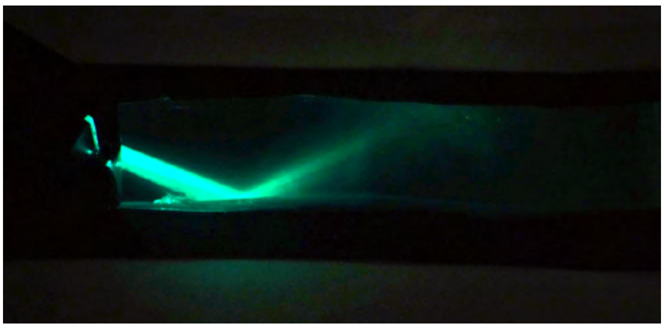
Lasers are dangerous and the use of lasers is best done as a demonstration, especially with younger students. An LED light source with a slit cap or other cover is a safer alternative.

Context

To link this activity to the curriculum for Year 7 and 8 and to reinforce learning for later years, include discussion about pure substances, mixtures and solutions. Jelly is an amorphous solid, like glass.

Materials to prepare in advance

- You may like to make the jelly in advance (see instructions on the next page)
- A laser pointer or LED light source device with slit cap



These are the results of using a laser pointer (red) and an LED light source (green). The effect is best with lasers but LEDs are safer. Credit: CSIRO Double Helix / Elise Adams

Extension ideas

- Investigate with real optical fibres. Fibre optic kits for students are available that can be used to capture sound or data and create circuits.
- Research the role of optical fibre in the National Broadband Network.
- Make it a challenge! Split into teams and see who can make a jelly optical fibre that lets light travel the farthest. Discuss together how you will make this a fair test. Ideas include:
  - add food dye to the gelatine
  - use different amounts of gelatine
  - cut the jelly differently
  - swap gelatine for agar (this is a vegan-friendly option, but the amount of agar and water will need to be tested).

More resources

- Read about the history of optical fibre.
- More than 400 optical fibre cables run underwater to connect countries to the internet. Explore the submarine cable map and read all about it in the FAQ section.

Printing? Find links for these resources at sciencweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Worksheet: Jelly optical fibre

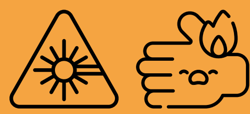
Optical fibres transmit data in the form of light. A network of optical fibres connects Australia to the internet. Some of these cables are thousands of kilometres long, stretching along the seabed from Australia to the rest of the world. They can be made of glass or plastic, but glass is the best material for transmitting light over long distances.

Optical fibres are also used in medicine to see inside the body, using devices called endoscopes. Endoscopes are thin tubes that can bend and twist and are connected to a video camera. They help doctors perform keyhole surgery through a small cut in the skin.

In this activity, you can make a model of an optical fibre from jelly and investigate how far light travels through it.

Materials

- 2 tablespoons plain gelatine powder
- 1 ½ cups boiling water
- Mixing bowl
- Container (about 15 cm long, flat bottomed)
- Baking paper
- Fridge
- Sharp, non-serrated knife
- Cutting board
- Black paper
- Clear plastic (e.g. overhead transparency sheet)
- Light source with a narrow beam



Safety

The light source used can be an LED with a slit cap or a laser pointer. Never look directly at a laser pointer, as it can cause eye damage.

Boiling water can cause burns.

Instructions

1. Mix 2 tablespoons of gelatine powder with 1 ½ cups of boiling water. Stir until dissolved. Let the jelly rest for 2 minutes and pop any bubbles.
2. Line the container with baking paper.
3. Pour the jelly into the lined container. Check the jelly is at least 1 cm deep or more. If it is not deep enough, repeat Step 1 and add that jelly to the container.
4. Put the jelly into the fridge for 2 hours to set.
5. Take the jelly out of container and place it on the cutting board. Cut a strip of jelly 2 cm wide and 15 cm long. Trim to make all the sides of the jelly strip smooth and flat. It might help to heat the knife under hot water first.
6. Put black paper on a table and put a piece of clear plastic on top. Place the jelly strip on the plastic.
7. Make the room dark and shine a laser pointer through one end of the jelly strip. Try to bounce the light off the sides of the strip.

Credit: Elise Adams

Results

Draw a diagram of the light moving through the jelly strip.

Gelatine crystals are a mixture, not a pure substance, because they contain different proteins and chemicals. What about water and jelly? Circle the correct answers.

Water:	Pure substance	Mixture
Jelly:	Pure substance	Mixture

When you put the gelatine crystals into water, you have made a solution. A solution is a liquid mixture containing a small amount of one substance (the solute) dissolved in a large amount of another substance (the solvent). In this activity:

Which is the solvent?	Water	Gelatine
Which is the solute?	Water	Gelatine

Explanation

Light moves more slowly through jelly than through air. At the edges of the jelly strip, light is refracted and reflected. If you aim the light at the edge of the strip at a critical angle, it will bounce off the side of the jelly. This is known as total internal reflection.

Optical fibres are long and thin, like a hair, and act like a pipe for light to travel through. Light goes in one end and total internal reflection keeps it going inside the fibre until it comes out at the other end.

Make a light bulb

This classic activity demonstrates how old-fashioned incandescent light bulbs convert electrical energy into heat and light. In real life, the glass bulb is essential to keep air away from the circuit and stop the filament burning.

Learning objective

Students learn about electricity and circuits, the chemical reaction of burning, and the role of glass in incandescent light bulbs.

Success criteria

Students can describe the role of glass in incandescent light bulbs.

Activity length

One hour

Credit: Elise Adams

Context

Though LED light bulbs are common now, the incandescent light bulb was such a useful invention it has come to symbolise innovation itself. It's even on the National Science Week logo! Much attention is paid to the material used in the light bulb filament. Edison famously tried hundreds before having success with carbonised bamboo. Tungsten filaments have been in use in light bulbs since 1904. These are brighter and lasted longer than carbon, and are still used in incandescent bulbs today.

Less attention is paid to the glass bulb. But the glass serves an important purpose – it keeps oxygen in the air away from the filament. If the hot filament encountered oxygen, it would burn. The chemical reaction is

$C_{(solid)} + O_{2\,(gas)} \rightarrow CO_{2\,(gas)}$ or

$2W_{(solid)} + 3O_{2(gas)} \rightarrow 2WO_{3(solid)}$.

The air inside the bulb is replaced with argon gas during manufacturing to prevent the burning reaction.

First Nations connections

The Ngalya lighting collection was created as a collaboration between First Nations women and Australian brand Koskela. Colourful lamps were woven from pandanus grass and bush string gathered, processed and dyed using traditional practices. The link has a video of Yolgnu artists creating lamps – ask students to notice possible chemical reactions and the steps required to make a lamp. This is a great example of First Nations knowledge being used in contemporary contexts to keep traditional practices strong so they can be passed on to the next generation.

More resources

- Watch a YouTube video of this activity by Steve Spangler Science.
- Watch How It's Made – Incandescent Light Bulb.

Printing? Find links for these resources at sciencweek.net.au/schools/2022-resource-book-links/

Tips for teachers

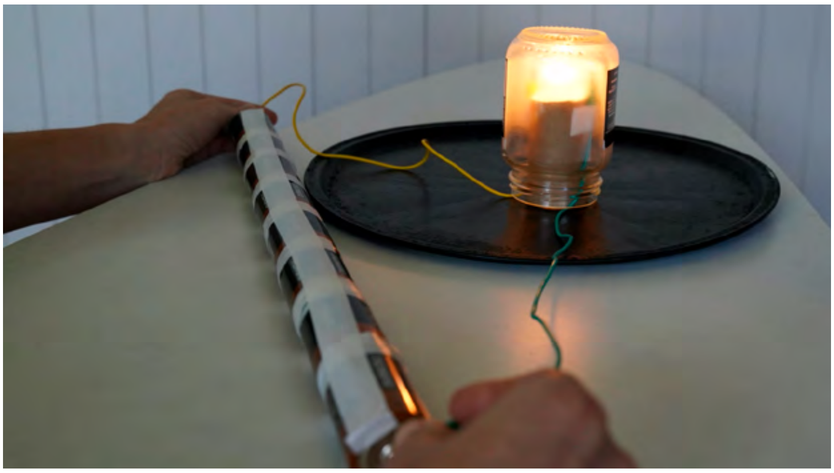
- This activity can be done by demonstration, or by students working in pairs.
- When the circuit is closed, you will see smoke coming off the pencil refill straight away. It will glow after about five seconds, and stop when the pencil refill breaks.
- If nothing happens when you complete the circuit, there is a problem with the circuit (most likely the battery terminals are not touching. You may need to squeeze them together and tape it again.)

Curriculum links for this activity are in the appendix.

Worksheet: Make a light bulb

Materials

- Paper towel tube
- Scissors
- Electrical tape
- Alligator clips with wires
- Oven tray
- Mechanical pencil refill (size 0.5 mm)
- Glass jar
- 8 D-sized batteries



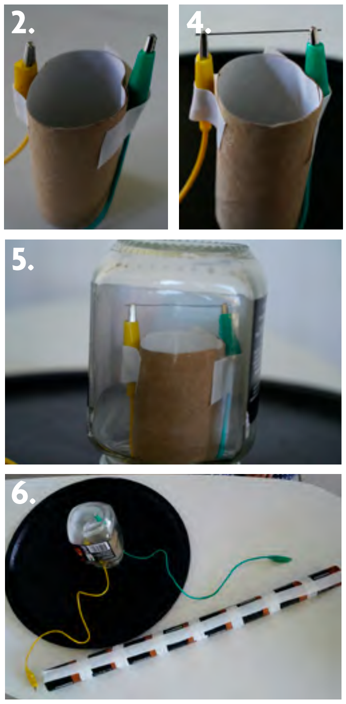
Credit: Elise Adams

Instructions

Safety

The graphite in this activity gets hot.

1. Cut a paper towel tube into 3 equal pieces.
2. Tape the wires of 2 alligator clips to a short paper tube as shown in the image.
3. Stand the paper tube on the oven tray with the taped end of the alligator clips pointing up.
4. Gently clip the mechanical pencil refill between the alligator clips that are closest to the end of the tube. Avoid breaking the pencil refill.
5. Place the jar upside down over the pencil refill and paper tube, leaving the free ends of the alligator clips outside the jar.
6. Place 8 D-sized batteries in a line with the positive terminals touching the negative terminals. Stick them all together with electrical tape.
7. Touch the free end of each alligator clip to each end of the line of batteries.
8. Watch what happens. (If nothing happens, take the alligator clips off the batteries and check the circuit. Are there any gaps between the batteries? Is the pencil refill broken? Fix the circuit and then try again).
9. To clean up, disconnect the alligator clips from the batteries. Wait 5 minutes before taking off the jar and disconnecting the alligator clips from the pencil refill, as it will be hot.



Explanation

When you touch the alligator clips to the batteries, you complete an electrical circuit. Electricity flows through the pencil refill, which is made of graphite – a form of carbon. When electricity flows through the graphite, it bumps into atoms and makes them vibrate. This produces heat. The graphite gets so hot, it glows. It also smokes as the graphite combusts. A chemical reaction is taking place.

The glow from this light bulb is much the same as an old-fashioned incandescent light bulb, which uses tungsten metal as the filament instead of graphite. When a light bulb is manufactured, the air inside the glass bulb is sucked out and replaced with argon gas. As there is no oxygen inside the bulb, the burning reaction cannot occur. This makes the filament last longer.

Glass in technology

As a science fair or poster presentation, students investigate one high-tech application of glass. They research how the glass is special in terms of its properties and how it is made.

Learning objective

Students explore how glass is manufactured and how its chemical composition is linked to its properties.

Success criteria

Students communicate the properties and manufacturing of glass in a real-world application.

Activity length

One week


Safety glass Credit: Envato / twenty20photos

Context

Glass is used in many different technologies. To give glass the properties it needs, people adjust its composition and the manufacturing process.

There are two parts to this activity. The first is a poster presentation that can be done individually or in teams and involves students researching an interesting case of glass in technology.

The second is a reflective exercise to explore how Australian researchers are innovating with glass to reduce the amount of toxic chemicals entering the environment.

More resources

Inspire students with innovations in glass with A Day Made of Glass (Years 7 and 8) and The Glass Age (Years 9 and 10). Both include a suite of videos with additional online resources by Corning and Young Minds Inspired.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Tips for teachers

- As a kick-off to this lesson, start with brainstorming items made of glass in the home or classroom. Expand the brainstorm into objects that are outside, such as car windshields, plane windows and telescopes.
- The 'What is glass?' section of this resource book gives some useful background information, see page 8.
- Use Handout 2 of this activity to incorporate sustainability into this activity. This gives you the option to make the activity a poster or oral presentation about glass technology and sustainability

Curriculum links for this activity are in the appendix.

Worksheet: Glass in technology

Glass is used in a huge range of technologies. Create a poster about one of the following:

- safety glass
- solar panels
- optical fibre
- car windshields
- aeroplane windows
- electrochromic glass
- deep sea submersible portholes
- Gorilla Glass in phones
- Xensation Flex foldable glass
- glass on the International Space Station
- vials for transporting the COVID-19 vaccine.

The poster should include the following information.

- What object or objects is the glass used in?
- What are the properties of the glass?
- What are the benefits and limitations of the glass in that object?
- How is the glass made (e.g. does it have a particular shape, thickness or chemicals added)?

Include images and captions to make the poster appealing.

Windows on the International Space Station Credit: NASA

Worksheet 2: Glass in technology

Read these two profiles of scientists working with glass. Write a paragraph about each of them to answer the question: 'How is this technology keeping toxic chemicals out of the environment?'

Credit: University of Adelaide

MEET YUNLE

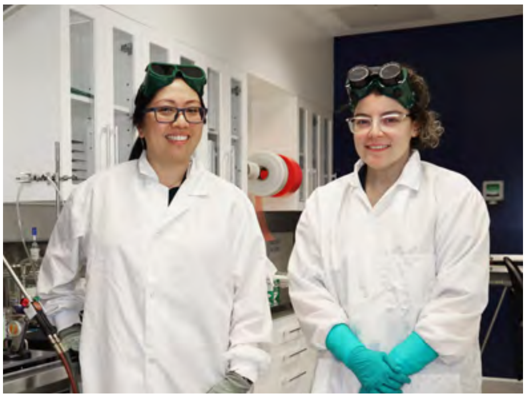
Hi, I am Dr Yunle Wei. I work at the University of Adelaide researching various types of glass. I have a particular interest in making coloured glass. Coloured glass is used all around us as figurines, vases, windows, cups and more.

Several warm colours, such as red, orange and yellow, in these glass items are currently made with toxic metals that are harmful to us and the environment. I work with Professor Heike Ebendorff-Heidepriem and Dr Jiangbo Zhao – a friend at University of Hull in England – and we have developed an eco-friendly technology to create any colour in glass.

Instead of toxic metals, we use tiny, non-toxic, metal particles to give glass amazing colours. We have just established a start-up company called EZY-GLAS Technology so people can use our technology in glass art and printing for a more colourful and sustainable future.

Glass and nuclear medicine

Jermaine Abano and Alystra Redmayne produce nuclear medicine at the Australian Nuclear Science and Technology Organisation (ANSTO).



Jermaine Abano and Alystra Redmayne Credit: ANSTO

"Part of our role is sealing raw materials (ytterbium-176) into vials made of ultra-pure glass," says Jermaine. "The vial goes through the reactor at OPAL, Australia's only research reactor, and the material inside becomes a product called lutetium-177, which is used to treat a variety of cancers."

The glass they use is pure silicon dioxide, also known as fused quartz.

"This is important, because other glasses (particularly those containing boron) absorb radiation and become very hot," says Alystra. "After that we can start to work with the material that's gone through the reactor and make the medicines used in cancer treatments."

The by-product of nuclear medicine is radioactive waste, which requires safe treatment. Dr Pranesh Dayal at ANSTO helps solve this problem.

"Synroc Technology is an Australian innovation that mimics Mother Nature by using pressure and temperature to lock the waste into a solid and insoluble form," says Pranesh. "The solid product can be a type of glass, glass-ceramic or ceramic."

Tools for touchscreens

In this activity, students will investigate how touchscreens work using fruit, vegetables, fabric and nuts. A variety of fruits are provided to test whether they operate a touchscreen on a phone, tablet or computer. The worksheet explains capacitive technology: the science behind a touchscreen.

Learning objective

Students learn how capacitive touchscreens work and gain experience with the scientific method.

Success criteria

Students conduct a fair test to check which objects can operate a touchscreen.

Activity length

40 minutes

Credit: Elise Adams

Materials to prepare in advance

- Variety of fruit, vegetables, fabric and seeds (such as dried lentils, sunflower seeds and pepitas). We suggest 3 different types of each category.
- Devices with a touchscreen (test the touchscreen works with a banana first).

Context

Glass is used for touchscreens because it is transparent, durable and smooth. It is also an electrical insulator. Most touchscreens used today are capacitive.

In a capacitive touchscreen, the glass is coated with a thin layer of a conductor – usually indium tin oxide. When the layer is touched by another conductor, such as your finger or a banana, it changes the electric field of the screen. This information is sent to software in the device to make the display change.

Touchscreens use strengthened glass to make them less likely to shatter and scratch, but they are not perfect – as you'll know if you've dropped a phone and smashed the screen.

Making better glass for touchscreens is an area of active research. Most phones and tablets use Gorilla Glass, which is a glass that has been altered to make it more durable. The screens of the iPhone 12 and many smart watches are made of other materials, such as sapphire crystal (a crystalline material) or Ceramic Shield (a glass-ceramic).

More resources

- The Glass and Ceramics Industry Foundation has a poster about toughened glass [PDF].

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Curriculum links for this activity are in the appendix.

Worksheet: Tools for touchscreens

Have you ever tried to use a smartphone or tablet while wearing gloves? It doesn't work so well, unless you buy special gloves made to do just that. Or have you ever tried to use fruit to swipe a phone? You might be surprised what happens when you do!

Materials

- A variety of fruits, vegetables, fabric and seeds
- A device with a soft-touch capacitive touchscreen, such as a phone, tablet or computer (not a resistive touchscreen that requires a hard touch to work)

Instructions

1. Before you start, think about how you can make this a fair test. Perhaps you will check each fruit on the same screen. Maybe you will try each fruit for swiping only. Maybe you will try each fruit for the same amount of time.
2. Test each fruit, vegetable, fabric and seed on the touchscreen to see if it can tap or swipe effectively.
3. Write up your method and put your results in a table showing each object you tried, the category of the object (fruit, vegetable, fabric or seed) and whether it operated the touchscreen.

Explanation

There are a few different types of touchscreen. The kind you are using today is a capacitive touchscreen.

Your fingers – and some fruit – can operate touchscreens. Why? It's all to do with electricity. The glass surface of the touchscreen does not conduct electricity, but is coated with a thin layer of transparent material that can conduct electricity. In the device you are using, the conducting material is probably indium tin oxide.

When you touch the touchscreen with your finger, which is conductive, this changes the electric field on the screen. Around the edge of the screen are detectors that notice exactly where the charge has changed, and therefore which point was touched. This information is sent to the software in the device, and makes it respond by opening an app when you tap, or scrolling when you swipe.

Some fruits can also conduct electricity. That's why they can operate a touchscreen, just like your fingers.

Wearing gloves stops the touchscreen responding because the glove material is an insulator, just like glass. It does not conduct electricity. The special gloves you can buy to use with a phone have electrically conducting material on their fingers.

Answer the following questions.

Is glass a conductor or insulator?

To operate a capacitive touchscreen, do you need to touch it with a conductor or insulator?

From your results, which categories of objects conduct electricity?

What properties of glass make it suitable for a touchscreen?

Australian Government

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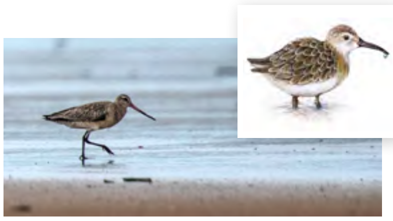
ANSTO STEAM Club Online

Our online STEAM Club enables creative exploration of varied STEM topics during the school holidays. Suitable for Year 3 to 8 students across Australia.

Find out more



ANSTO Shorebirds Competition

Year 3 to 6 students learn about shorebirds and wetland environments in our popular annual poster competition focused on science and sustainability. There are free lesson plans for teachers and great prizes on offer.

Find out more

national science week 2022

In partnership with the **Design Factory Global Network**

DF GN

Australian Science Teachers Association

Design mini-challenge

In this activity, students will be introduced to the process of design thinking and have an opportunity to apply this process to a mini-challenge based on reusing and repurposing glass waste from their school or classroom. The templates provided in the ANSTO Design Mini-Challenge Tool Kit guide you through the process.

Learning objective

Students apply design thinking methods to a problem that requires them to work collaboratively, combine scientific and design skills, and communicate ideas.

Success criteria

Students come up with tangible solutions to decrease glass waste in their school or classroom.

Activity length

Flexible; can be completed in one hour or as a whole-day activity

Credit: Envato / Edalin

Materials to prepare in advance

- Printed copies of the Design Mini-Challenge Tool Kit – Student Edition
- Whiteboard or butcher's paper
- Markers
- Post-it notes
- Blu-Tack
- Assorted optional prototyping material (e.g. coloured paper, glue, scissors, pipe-cleaners, wire, styrofoam shapes, paint, playdough, ice block sticks)

More resources

- The Sustainability activity on page 16 has useful background information on glass recycling in Australia.
- Design thinking across the curriculum is a virtual, cross-curriculum resource by the New South Wales Government Department of Education that includes videos and interactive activities.

Printing? Find links for these resources at scienceweek.net.au/schools/2022-resource-book-links/

Tips for teachers

- The teacher's edition of the design toolkit includes sample lesson plans, ideas on how to facilitate design thinking in the classroom, detailed notes for each stage of the process and worked examples of the student templates.
- ANSTO will be running free teacher professional development sessions in Term 2 2022, and a larger, free version of this activity (including industry mentors and prizes) during National Science Week 2022 called the ANSTO National Science Week Hackathon.

Curriculum links for this activity are in the appendix.

Doing design thinking

Design thinking is a process that uses empathy, creativity and innovation to solve complex problems.

The keystone to this process is the opportunity for students to identify and consider people who are experiencing a problem and give them a chance to be heard. This allows the students to discover the root problem that they will try and solve. Often, the root problem is more than meets the eye.

The stages of design thinking are:

EMPATHISE: understand your end-users. Who are they? What do they do? Why do they do it? What do they need?

DEFINE: uncover the real problem. This is where the students will attempt to make sense of a complex problem and identify the most important root problem. If they can already think of a solution or if there is only one pathway to solve it, it's not the right problem!

IDEATE: challenge assumptions and generate ideas. Try to think outside the box and be as creative as possible. It might be helpful to sort and group ideas based on their feasibility, importance to the user and relevance to the problem.

PROTOTYPE: make and break solutions. Prototypes don't have to be polished models – and they usually shouldn't be! They can be sketches, role plays, cardboard cut-outs, wireframes – anything that helps you communicate concepts and receive feedback.

TEST: bring it to users for feedback. This is how we understand if the idea has truly solved the problem and met the end-user's needs. This is also the stage where students will pitch their ideas to the class.

These stages generally follow each other but can work in back-and-forth feedback loops. Repetition of the process is key. You might start with understanding your end-users, define a problem, brainstorm some solutions, and then realise you need to do more user research. This is all part of the process.

Worksheet: Design mini-challenge

Problem:

Australia generates more glass waste then it can recycle or reuse.

Investigation and background:

How much glass waste does your school generate? How about your classroom? How much of this waste gets sorted and recycled properly?

Challenge:

Design an innovative solution to decrease glass waste generated by your school or community, centred on reusing and repurposing glass containers in a creative way.

Your solution should:

- show evidence that you have investigated and understood how much glass waste is generated by your school or community and where it is coming from. What systems are currently in place to deal with glass waste? Are they effective?
- clearly define your end-users (who are you solving this problem for?) and your root problem
- be beneficial in some way – for example, will your solution or product
  - solve another issue?
  - decrease another type of waste?
  - generate income or raise awareness about glass waste and glass recycling?
  - influence long-term change at your school?

Straight out of the furnace, new glass bottles move down the manufacturing line.

Appendix: Curriculum links

Activities for all Year levels

First Nations connections

Elaborations

F: Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013: Recognising how Aboriginal and Torres Strait Islander Peoples gain knowledge about the land and its vital resources, such as water and food, through observation (OI.3, OI.5)
Year 1: Everyday materials can be physically changed in a variety of ways ACSSU018: Exploring how Aboriginal and Torres Strait Islander Peoples apply physical changes to natural materials to render them useful for particular purposes (OI.2 OI.5)
Year 2: Different materials can be combined for a particular purpose ACSSU031: Investigating the ways in which Aboriginal and Torres Strait Islander Peoples combine different materials to produce utensils (hafting, weaving, sewing and gluing) (OI.2, OI.5)
Year 2: Earth's resources are used in a variety of ways ACSSU032: Considering how Aboriginal and Torres Strait Islander Peoples live in regions with scarce resources or in sensitive environments (OI.2, OI.5)
Year 3: A change of state between solid and liquid can be caused by adding or removing heat ACSSU046: Investigating how changes of state in materials used by Aboriginal and Torres Strait Islander Peoples, such as beeswax or resins, are important for their use (OI.5)
Year 4: Natural and processed materials have a range of physical properties that can influence their use ACSSU074: Considering how Aboriginal and Torres Strait Islander Peoples use natural and processed materials for different purposes, such as tools, clothing and shelter, based on their properties (OI.5)
Year 6: Sudden geological changes and extreme weather events can affect Earth's surface ACSSU096: Researching Aboriginal and Torres Strait Islander peoples' cultural stories that provide evidence of geological events (OI.3)
Year 8: Sedimentary, igneous and metamorphic rocks contain minerals and are formed by processes that occur within Earth over a variety of timescales ACSSU153: Exploring the traditional geological knowledge of Aboriginal and Torres Strait Islander Peoples that is used in the selection of different rock types for different purposes (OI.2, OI.5)

Glassmaking in Australia

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 1: Everyday materials can be physically changed in a variety of ways ACSSU018
Year 3: A change of state between solid and liquid can be caused by adding or removing heat ACSSU046
Year 4: Natural and processed materials have a range of physical properties that can influence their use ACSSU074
Year 5: Solids, liquids and gases have different observable properties and behave in different ways ACSSU077
Year 8: Properties of the different states of matter can be explained in terms of the motion and arrangement of particles ACSSU151

Sustainability

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 1: Everyday materials can be physically changed in a variety of ways ACSSU018
Year 2: Earth's resources are used in a variety of ways ACSSU032
Year 3: A change of state between solid and liquid can be caused by adding or removing heat ACSSU046
Year 6: Changes to materials can be reversible or irreversible ACSSU095
Year 7: Some of Earth's resources are renewable, including water that cycles through the environment, but others are non-renewable ACSSU116

Activities for Foundation to Year 2

Sugar glass decorations

Science understanding

Year 1: Everyday materials can be physically changed in a variety of ways ACSSU018
Year 2: A push or a pull affects how an object moves or changes shape ACSSU033

Science as a human endeavour

F, Year 1 and 2: Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013, ACSHE021, ACSHE034

Science inquiry skills

F: Pose and respond to questions about familiar objects and events ACSIS014
F: Participate in guided investigations and make observations using the senses ACSIS011
F: Engage in discussions about observations and represent ideas ACSIS233

F: Share observations and ideas ACSIS012
Year 1 and 2: Pose and respond to questions, and make predictions about familiar objects and events ACSIS024, ACSIS037
Year 1 and 2: Participate in guided investigations to explore and answer questions ACSIS025, ACSIS038
Year 1 and 2: Represent and communicate observations and ideas in a variety of ways ACSIS029, ACSIS042

Explore with a magnifying glass

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 1: Living things have a variety of external features ACSSU017
Year 1: Light and sound are produced by a range of sources and can be sensed ACSSU020
Year 2: Living things grow, change and have offspring similar to themselves ACSSU030
Year 2: Different materials can be combined for a particular purpose ACSSU031

Science as a human endeavour

F, Year 1 and 2: Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013, ACSHE021, ACSHE034

Science inquiry skills

F: Engage in discussions about observations and represent ideas ACSIS233
F: Share observations and ideas ACSIS012
Year 1 and 2: Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions ACSIS027, ACSIS040
Year 1 and 2: Compare observations with those of others ACSIS213, ACSIS041
Year 1 and 2: Represent and communicate observations and ideas in a variety of ways ACSIS029, ACSIS042

Turn a window into a mirror

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 1: Light and sound are produced by a range of sources and can be sensed ACSSU020
Year 2: Different materials can be combined for a particular purpose ACSSU031

Science as a human endeavour

F, Year 1 and 2: Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013, ACSHE021, ACSHE034

Science inquiry skills

F: Pose and respond to questions about familiar objects and events ACSIS014
Year 1 and 2: Pose and respond to questions, and make predictions about familiar objects and events ACSIS024, ACSIS037
F: Participate in guided investigations and make observations using the senses ACSIS011
F: Engage in discussions about observations and represent ideas ACSIS233
F: Share observations and ideas ACSIS012
Year 1 and 2: Participate in guided investigations to explore and answer questions ACSIS025, ACSIS038
Year 1 and 2: Represent and communicate observations and ideas in a variety of ways ACSIS029, ACSIS042

Make a kaleidoscope

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 1: Light and sound are produced by a range of sources and can be sensed ACSSU020
Year 2: Different materials can be combined for a particular purpose ACSSU031

Glass at home

Science understanding

F: Objects are made of materials that have observable properties ACSSU003
Year 2: Different materials can be combined for a particular purpose ACSSU031

Science inquiry skills

F: Pose and respond to questions about familiar objects and events ACSIS014
F: Share observations and ideas ACSIS012
Year 1 and 2: Pose and respond to questions, and make predictions about familiar objects and events ACSIS024, ACSIS037
Year 1 and 2: Compare observations with those of others ACSIS213, ACSIS041
Year 1 and 2: Represent and communicate observations and ideas in a variety of ways ACSIS029, ACSIS042

Activities for Years 3–6

Cold honey, hot honey

Science understanding

Year 3: A change of state between solid and liquid can be caused by adding or removing heat ACSSU046
Year 3: Heat can be produced in many ways and can move from one object to another ACSSU049
Year 5: Solids, liquids and gases have different observable properties and behave in different ways ACSSU077
Year 6: Changes to materials can be reversible or irreversible ACSSU095

Science as a human endeavour

Year 3 and 4: Science involves making predictions and describing patterns and relationships ACSHE050, ACSHE061

Science inquiry skills

Year 3 and 4: With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment ACSIS054, ACSIS065
Year 3 and 4: Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately ACSIS055, ACSIS066
Year 3 and 4: Represent and communicate observations, ideas and findings using formal and informal representations ACSIS060, ACSIS071
Year 5 and 6: With guidance, pose clarifying questions and make predictions about scientific investigations ACSIS231, ACSIS232
Year 5 and 6: Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks ACSIS086, ACSIS103
Year 5 and 6: Decide variables to be changed and measured in fair tests, and observe measure and record data with accuracy using digital technologies as appropriate ACSIS087, ACSIS104
Year 5 and 6: Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate ACSIS090, ACSIS107
Year 5 and 6: Compare data with predictions and use as evidence in developing explanations ACSIS218, ACSIS221

Invisible glass

Science understanding

Year 5: Light from a source forms shadows and can be absorbed, reflected and refracted ACSSU080

Science as a human endeavour

Year 5 and 6: Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE083, ACSHE100

Science skills

Year 3 and 4: Reflect on investigations, including whether a test was fair or not ACSIS058, ACSIS069
Year 5 and 6: Reflect on and suggest improvements to scientific investigations ACSIS091, ACSIS108

Make a telescope

Science understanding Year 3: Earth's rotation on its axis causes regular changes, including night and day ACSSU048

Year 4: Natural and processed materials have a range of physical properties that can influence their use ACSSU074
Year 5: The Earth is part of a system of planets orbiting around a star. the sun. ACSSU078
Year 5: Light from a source forms shadows and can be absorbed, reflected and refracted ACSSU080

Science as a human endeavour

Year 3 and 4: Science involves making predictions and describing patterns and relationships ACSHE050, ACSHE061
Year 5 and 6: Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions ACSHE081, ACSHE098

Science inquiry skills

Year 3 and 4: Represent and communicate observations, ideas and findings using formal and informal representations ACSIS060, ACSIS071
Year 5 and 6: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts ACSIS093, ACSIS110

Solar panels

Science understanding

Year 4: Natural and processed materials have a range of physical properties that can influence their use ACSSU074
Year 5: Light from a source forms shadows and can be absorbed, reflected and refracted ACSSU080
Year 6: Electrical energy can be transferred and transformed in electrical circuits and can be generated from a range of sources ACSSU097

Science as a human endeavour

Year 5 and 6: Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE083, ACSHE100

Science inquiry skills

Year 3 and 4: With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment ACSIS054, ACSIS065
Year 3 and 4: Consider the elements of fair tests and use formal measurements and digital technologies as appropriate, to make and record observations accurately ACSIS055, ACSIS066
Year 3 and 4: Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends ACSIS057, ACSIS068
Year 5 and 6: With guidance, pose clarifying questions and make predictions about scientific investigations ACSIS231, ACSIS232
Year 5 and 6: Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks ACSIS086, ACSIS103
Year 5 and 6: Decide variables to be changed and measured in fair tests, and observe measure and record data with accuracy using digital technologies as appropriate ACSIS087, ACSIS104
Year 5 and 6: Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate ACSIS090, ACSIS107
Year 5 and 6: Compare data with predictions and use as evidence in developing explanations ACSIS218, ACSIS221

Marble run challenge

Science inquiry skills

Year 4: Natural and processed materials have a range of physical properties that can influence their use ACSSU074
Year 4: Forces can be exerted by one object on another through direct contact or from a distance ACSSU076

Science as a human endeavour

Year 3 and 4: Science involves making predictions and describing patterns and relationships ACSHE050, ACSHE061

Science inquiry skills

Year 3 and 4: With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment ACSIS054, ACSIS065
Year 3 and 4: Compare results with predictions, suggesting possible reasons for findings ACSIS215, ACSIS216
Year 3 and 4: Represent and communicate observations, ideas and findings using formal and informal representations ACSIS060, ACSIS071
Year 5 and 6: Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks ACSIS086, ACSIS103
Year 5 and 6: Reflect on and suggest improvements to scientific investigations

Activities for Years 7–10

Hot glue glass fibres

Science understanding

Year 8: Properties of the different states of matter can be explained in terms of the motion and arrangement of particles ACSSU151

Science as a human endeavour

Year 7 and 8: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223, ACSHE226
Year 7 and 8: People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136
Year 9 and 10: Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries. ACSHE158, ACSHE192

Science inquiry skills

Year 7 and 8: Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed ACSIS125, ACSIS140
Year 7 and 8: Measure and control variables, select equipment appropriate to the task and collect data with accuracy ACSIS126, ACSIS141
Year 7 and 8: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence ACSIS130, ACSIS145
Year 7 and 8: Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements ACSIS131, ACSIS146
Year 9 and 10: Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods ACSIS165, ACSIS199
Year 9 and 10: Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies ACSIS169, ACSIS203
Year 9 and 10: Use knowledge of scientific concepts to draw conclusions that are consistent with evidence ACSIS170, ACSIS204
Year 9 and 10: Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data ACSIS171, ACSIS205

Jelly optical fibre

Science understanding

Year 7: Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques ACSSU113
Year 8: Properties of the different states of matter can be explained in terms of the motion and arrangement of particles ACSSU151
Year 9: Energy transfer through different mediums can be explained using wave and particle models ACSSU182

Science as a human endeavour

Year 7 and 8: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223, ACSHE226
Year 7 and 8: People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136
Year 9 and 10: Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries ACSHE158, ACSHE192

Science inquiry skills

Year 7 and 8: Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge ACSIS124, ACSIS139
Year 7 and 8: Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed ACSIS125, ACSIS140
Year 7 and 8: Measure and control variables, select equipment appropriate to the task and collect data with accuracy ACSIS126, ACSIS141
Year 7 and 8: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence ACSIS130, ACSIS145

Year 7 and 8: Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements ACSIS131, ACSIS146
Year 9 and 10: Formulate questions or hypotheses that can be investigated scientifically ACSIS164, ACSIS198
Year 9 and 10: Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods ACSIS165, ACSIS199
Year 9 and 10: Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately ACSIS166, ACSIS200
Year 9 and 10: Use knowledge of scientific concepts to draw conclusions that are consistent with evidence ACSIS170, ACSIS204
Year 9 and 10: Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data ACSIS171, ACSIS205

Make a light bulb

Science understanding

Year 8: Chemical change involves substances reacting to form new substances ACSSU225
Year 9: Chemical reactions involve rearranging atoms to form new substances; during a chemical reaction mass is not created or destroyed ACSSU178
Year 9: Chemical reactions, including combustion and the reactions of acids, are important in both non-living and living systems and involve energy transfer ACSSU179
Year 9: Energy transfer through different mediums can be explained using wave and particle models ACSSU182
Year 10: Different types of chemical reactions are used to produce a range of products and can occur at different rates ACSSU187

Science as a human endeavour

Year 7 and 8: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223, ACSHE226
Year 7 and 8: Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations ACSHE120, ACSHE135
Year 7 and 8: People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136
Year 9 and 10: Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries ACSHE158, ACSHE192

Science inquiry skills

Year 7 and 8: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence ACSIS130, ACSIS145
Year 9 and 10: Use knowledge of scientific concepts to draw conclusions that are consistent with evidence ACSIS170, ACSIS204

Glass in technology

Science understanding

Year 9: All matter is made of atoms that are composed of protons, neutrons and electrons; natural radioactivity arises from the decay of nuclei in atoms ACSSU177

Science as a human endeavour

Year 7 and 8: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223, ACSHE226
Year 7 and 8: Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations ACSHE120, ACSHE135
Year 7 and 8: People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136
Year 9 and 10: Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries ACSHE158, ACSHE192
Year 9 and 10: People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science can affect people's lives, including generating new career opportunities ACSHE160, ACSHE194
Year 9 and 10: Values and needs of contemporary society can influence the focus of scientific research ACSHE228, ACSHE230

Science inquiry skills

Year 7 and 8: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence ACSIS130, ACSIS145
Year 7 and 8: Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate ACSIS133, ACSIS172
Year 9 and 10: Critically analyse the validity of information in primary and secondary sources and evaluate the approaches used to solve problems ACSIS172, ACSIS206
Year 9 and 10: Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations ACSIS174, ACSIS208

Tools for touchscreens

Science understanding

Year 9: Energy transfer through different mediums can be explained using wave and particle models ACSSU182

Science as a human endeavour

Year 7 and 8: Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223, ACSHE226
Year 9 and 10: Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries ACSHE158, ACSHE192

Science inquiry skills

Year 7 and 8: Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge ACSIS124, ACSIS139
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Year 9 and 10: Evaluate conclusions, including identifying sources of uncertainty and possible alternative explanations, and describe specific ways to improve the quality of the data ACSIS171, ACSIS205

Design mini-challenge

Science understanding

Year 7: Some of Earth's resources are renewable, including water that cycles through the environment, but others are non-renewable ACSSU116

Science as a human endeavour

Year 7 and 8: Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations ACSHE120, ACSHE135
Year 7 and 8: People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121, ACSHE136

Science inquiry skills

Year 7 and 8: Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge ACSIS124, ACSIS139
Year 7 and 8: Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence ACSIS130, ACSIS145
Year 7 and 8: Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate ACSIS133, ACSIS148
Year 9 and 10: Formulate questions or hypotheses that can be investigated scientifically ACSIS164, ACSIS198
Year 9 and 10: Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations ACSIS174, ACSIS208


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