

Basic Sciences in Glass

Continuing ideas for exploring the environment through International Years
- in 2022, the IY Basic Sciences for Sustainable Development and of Glass.

By Jeanie Clark

Glass is all around us! Do your young people notice it in its various forms? Have you considered 'glass' as a focus for learning about Science and sustainability? This article aims to put a spotlight on glass, with



suggestions for online resources and activities to explore it as a part of 2022's

International Years of Glass (IYoG) [1] in the IY of Basic

Sciences for Sustainability for Development (IYBSSD) [2]. (Square brackets indicate web references found at this article's end.) In August, the IYoG is also the focus of Australia's National Science Week[3].



Glass around us

Let's start with some basic scientific activities. First, observation: Can your learners find five items made of glass in the two photos at right? Can they make a list of the different glass items around them? (This list will be used again in this article.)

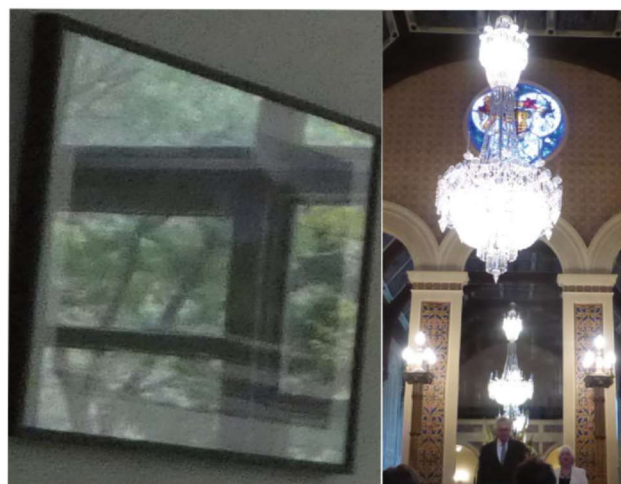
What glass items are noticed in their surroundings? Probably windows, picture glass, drinking glasses and reading glasses. Maybe vases, drink bottles, Pyrex, mirrors, lights, and a variety of IT screens? Perhaps a hand blown glass decoration, stained glass windows, optic fibres, or a 'sensitive' toothpaste? Can this list be grouped in any ways? Chemistry student Sarah put her grouped list as a visual record online [4.] It might inspire your learners to turn their list into a visual communication.

Scientific description

Once your learners have identified glass around them, they can conduct another basic science activity - describing materials. A table could be made from the list above with rows for each glass item and columns to describe each glass item by size, shape, colour, function, etc.?

So far, we have only used the sense of sight. Could any more information be added about each item if any other sense was used? If so, add it.

How is 'glass' described? Review the list of glass items above for commonly used words to form a description. Then compare it with others, e.g. in a dictionary, or the adjectives on *Britannica Kids'* webpage *Glass: Introduction* [5]. For older learners, use *Encyclopedia Britannica's* 'Glass' one [6].



Five glass items: picture glass, window, chandelier, mirror and stained glass window.

Another aspect of basic science description is identifying the material's state: solid, liquid or gas? The *Britannica Kids'* webpage [5] above mentions that glass internally is structured more like a liquid. It is an 'amorphous solid'. *Rice University* has a diagram to show the structure of solids and amorphous solids [7] *PhysicsOpenLab's* diagram shows this difference in two materials made of Silicon Oxide: quartz (solid) and glass (amorphous solid) [8] .

The making of glass

How is glass made? Basically sand is heated, then shaped as it cools. Science teacher *Mystery Doug's* four minute video 'How is glass made?' has good visuals and easy commentary to show this [9]. *Massachusetts Institute of Technology MITK12 Videos* has a four minute video 'Fire+Sand=Glass!' which shows techniques for more advanced glass making [10] . Both cover some glass uses and some history of glass making.

We think of glass as being man-made, but can glass occur naturally? Where could great heat come from? Lightning? Volcanic explosions? Meteorites? Where could Silica sand be found? Beaches? Deserts? Yes, these can make several natural glasses.

Obsidian is the most common natural glass rock. It is formed in magma, where Silica is melted. Fulgurites come from lightning hitting sand. Tektites come from meteorite impacts on sand. The *Rock Seeker* website has photos of obsidian, fulgurite and moldavite (a tektite) rocks [11] .

Were such natural glasses used? Yes, our First Nations people used glasses: obsidian; tektites (Australite and Darwin); and spinifex resin, a glass from the Spinifex plant [12] .

Can living things make and be made of glass? Among the amazing deep ocean creatures is *Hexactinellida*, a silica based glass sponge. A photo and description is shown on the *National Oceanic and Atmospheric Administration* webpage 'What is a glass sponge?' [13]

Types of glass

Did your learners notice different glass types when they made their list? There are many types of traditional glass. Ranga lists ten at *StudyRead* [14]. Several are covered in 'Glass Types' video/powerpoint from *DeBacco's University* [15] . (This is not a true university but a channel providing videos on a wide range of scientific topics.) A more detailed list is given on *Simplicable's* 'Glass' webpage [16]. It also covers uses and advantages and disadvantages of different types. How many types of glasses can your learners now name around them?

Have your learners noticed glass in art? There is incredible variety in the artistic uses of glass, e.g. the welcome window at Samoa's airport (photo right). At *Arts Hub*, Fairley lists a variety of glass art types [17].

Comic books

Do your learners enjoy learning from comic book stories? Brazil's *Centre for Research, Technology and Education in Vitreous Material (CERTEV)* has created a series of comic books about glass for science education. Called "Glass World" [18] the series of four books has a common theme 'Glass is complex' :
1 *Glass world* – covers amorphous solids, natural and man-made history, uses, some different types of modern glass and their uses
2 *Glass recycling* – focusses on glass as a recyclable material and the manufacturing process.
3. *Optical fibre* – explains how (glass) optical fibre works and its use in telecommunications.
4 *Bioactive glasses* – covers bioglass in dentistry, medical and veterinary uses and the difference between bioglass and optical glass.
Books 2-4 include puzzles of the content.

National Science Week

The *Australian Science Teachers Association* has created an on-line *National Science Week* Resource Book 'Glass: more than meets the eye' [19]. It has many clearly explained activities on glass for years K-10, and in subgroups for F-2, 3-6 and 7-10. There are also links for a student book and a page of weblinks to support further explorations of glass.

This resource has many glass things to make, with increasing difficulty: sugar glass decorations from lollies (pp 21-22); mirrors and kaleidoscopes (pp 26-28) ; honey as a glass (pp 34-35); a telescope (pp 38-40); a marble run (pp 44-45); hot glass glue fibres (pp 47-49); jelly as an optical fibre (pp 51-53); and a light bulb (pp 54-55). Specialised glasses are also covered. Safety instructions are included as needed.

Glass Hackathon

The final activity in this resource book is a design mini-challenge on reducing waste from glass (pp 61-64). It is linked to the *Australian Nuclear Science and Technology Organisation's (ANSTO)* 'hackathon' design competition from August 15-17 [20] . What is a 'hackathon'? Secondary students in teams work quickly to design and build something to solve the target problem. This ANSTO webpage includes links for registration, teacher's and student's resources for training and 2021's hackathon as examples.

Sustainability through recycling

As noted in an earlier article, the 2022 *IYBSSD* supports the *United Nations Sustainable Development*



to be used for SDGs [21]. Does the IYOG fit into this too? Yes, it's in SDG12, and



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specifically in 'Target 12.5- By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse' [22]. Glass 'advance[s] innovative pathways to achieving sustainable consumption and production; and promot[ing] sustainable consumer behaviour, including glass reuse and recycling' [23].

The second *Glass Story* comic book mentioned earlier is a starting point for exploring glass recycling. What is the position in Victoria? In 2021, the Victorian government announced funding for

[24]. What happens in your neighbourhood? This is something your learners could explore. Are there personal changes that come out of this?



Glass is complex

Glass is a complex, incredibly diverse material well suited for a more sustainable world. When using it for basic science, there is much to explore. How it is made and used, a part of so many jobs, is amazing! The basic scientific description of glass as an amorphous solid helps explain why it is so suited to reuse and recycling – critical for a more sustainable future. Choosing and recycling glass containers, whenever possible can become positive actions from exploring this IYOG, in this IYBSSD, that contribute personally to the UN 2030 SDG's.

IYBSSD and IYOG logos used with IYBSSD and IYOG permissions

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Direct links to webpages in this article

- [1] IYOG <https://iyog2022.org/>
- [2] IYBSSD <https://www.iybssd2022.org/en/home/>
- [3] National Science Week, 2022, [Home - National Science Week](https://www.scienceweek.net.au/) <https://www.scienceweek.net.au/>
- [4] Diagram Glass 2 at <http://1.bp.blogspot.com/-nvpJdWFawl/TeW7ZoKIZNI/AAAAAAAAACM/XnJ218HXgb0/s640/glass2.png>
- [5] Britannica Kids 'Glass Introduction' 2022 at <https://kids.britannica.com/kids/article/glass/399483>
- [6] Encyclopedia Britannica 'glass' [glass | Definition, Composition, Material, Types, & Facts | Britannica](https://www.britannica.com/technology/glass) <https://www.britannica.com/technology/glass>
- [7] Rice University, Open Stax Figure 10.37,
- [8] PhysicsOpenLab 'Crystalline and Amorphous Solids' 2018 at <https://physicsopenlab.org/2018/02/13/crystalline-and-amorphous-solids/>
- <https://openstax.org/apps/archive/20220509.174553/resources/22fa43a8f8f1c4aef372d93f91a5acffdf33caac> in Chemistry 2e 2022 '10.5 The solid state of matter' <https://openstax.org/books/chemistry-2e/pages/10-5-the-solid-state-of-matter>
- [9] Mystery Doug, 'How is glass made?' at <https://www.youtube.com/watch?v=UOWk2QIfDqY>
- [10] MITVK12 Videos 'Fire+Sand=Glass' <https://www.youtube.com/watch?v=1VrdUYbHvyo>
- [11] Rock Seeker webpages are at <https://www.rockseeker.com/different-types-of-obsidian/> <https://www.rockseeker.com/lightning-glass-fulgurite/> <https://www.rockseeker.com/moldavite/>
- [12] Australian Science Teachers Association, 2022, 'First Nations Connections' in 'Glass: more than meets the eye'. Pages 13-14 at <https://www.scienceweek.net.au/wp-content/uploads/2022/03/science-week-glass-teacher-resource-book-2022.pdf>
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- [14] Ranga, Uses of Glass and 10 Applications to Man, (2022) in Study Read, at <https://www.studyread.com/uses-of-glass-applications/>
- [15] DeBacco University, 'Glass types', at <https://www.youtube.com/watch?v=nNryvVRO2Hs> and <https://drive.google.com/file/d/1FBhg06Ca5YalUJG2yTNMLVO-qHNOX9ZW/view>
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- [17] Fairley, Gina, 'Understanding the year of glass in 2022' in Arts Hub at <https://www.artshub.com.au/news/features/understanding-the-year-of-glass-in-2022-2523591/>
- [18] Centre for Research, Technology and Education in Vitreous Material (CERTEV) "Glass World", 2019, links at <https://www.certeve.ufscar.br/en/education/science-diffusion/glass-comics> or individually at :
Book1 Glass World <https://static1.squarespace.com/static/5aea9f2cb40b9db1988dd977/t/616f8e5715b51f78323fc502/1634700949978/ICG+Comic+book+1.pdf>, Book 2 Glass Recycling <https://static1.squarespace.com/static/5aea9f2cb40b9db1988dd977/t/61e36f4a4781ee0cea3d9aaf/1642295302868/ICG+Comic2.pdf>, Book 3 Optic Fibres <https://static1.squarespace.com/static/5aea9f2cb40b9db1988dd977/t/61e37035e327b82e152f6982/1642295436548/ICG+Comic3.pdf>,
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- [24] Eddie, Rachel, 'Victoria doubles capacity to recycle glass into jars and bottles' 2021 in *the Age* at <https://www.theage.com.au/national/victoria/victoria-doubles-capacity-to-recycle-glass-into-jars-and-bottles-20210118->