light through lead glass and soda lime glass

Refraction of Light *from the Light and Color website*

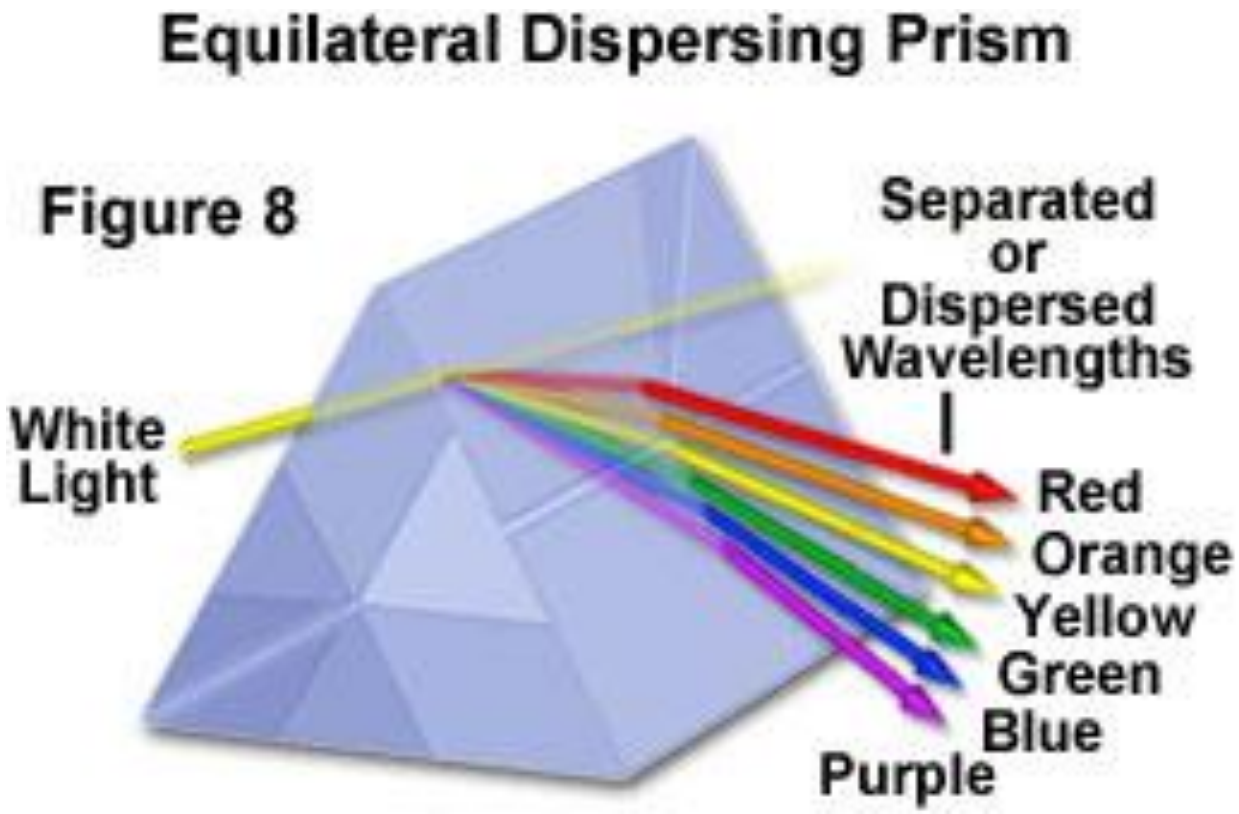
Figure 2

Refraction, or bending of light, occurs as light passes from one medium into another medium with a different refractive index.

Refraction is an important characteristic of lenses, allowing them to focus a beam of light onto a single point, and is also responsible for a variety of familiar phenomena, such as the apparent distortion of objects partially submerged in water.

Dispersion refractive index varies with wavelength

Material	Blue (486 nm)	Red (656 nm)
Water	1.337	1.331
Crown Glass Na^+, Ca^{2+}	**1.524**	**1.515**
"Flint" Glass Pb^{2+}	**1.639**	**1.622**



short wavelength light is refracted at a greater angle than long wavelength light

a higher refractive index disperses colors more widely

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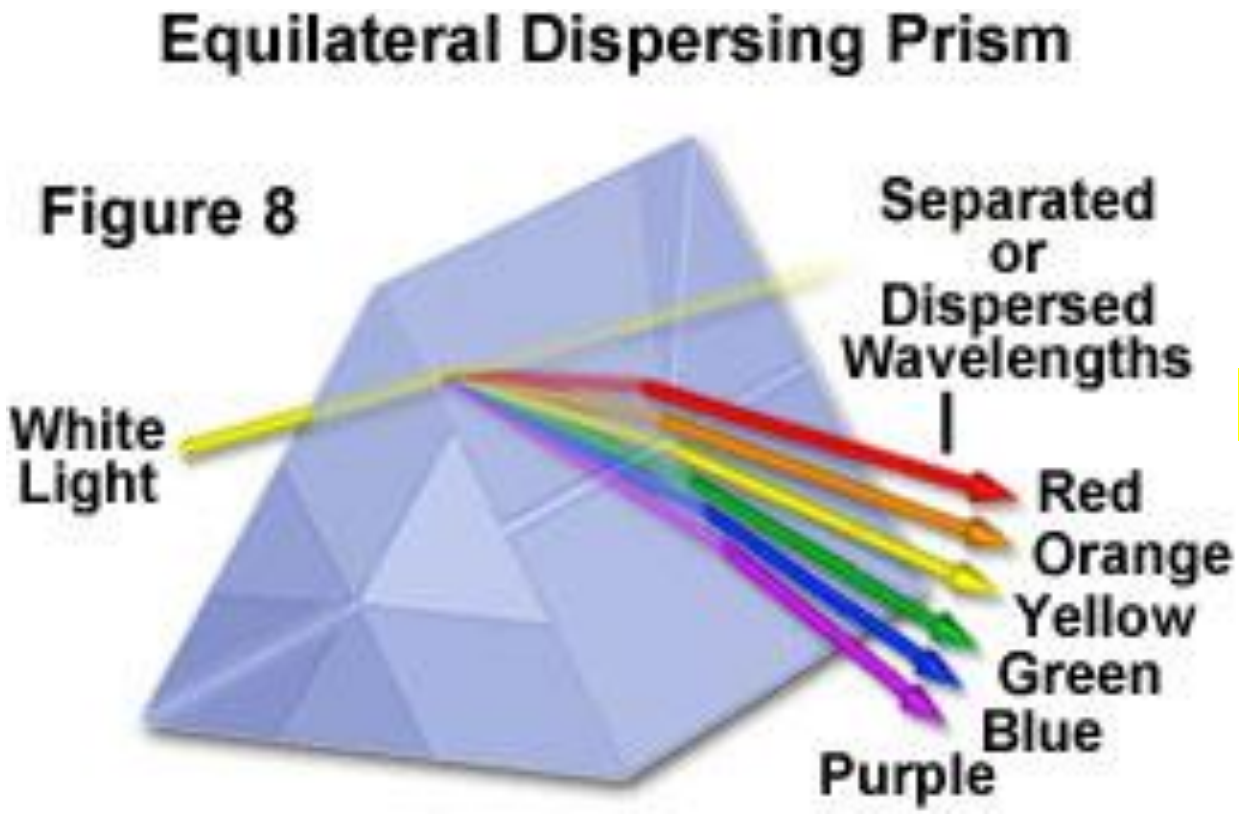

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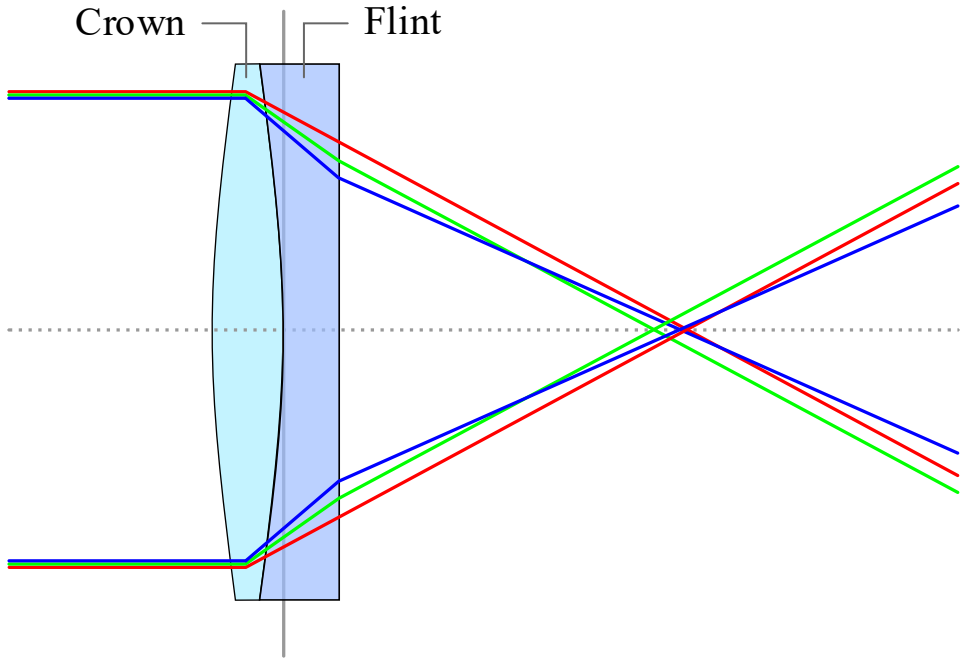
chromatic aberration



SCHOTT
glass made of ideas

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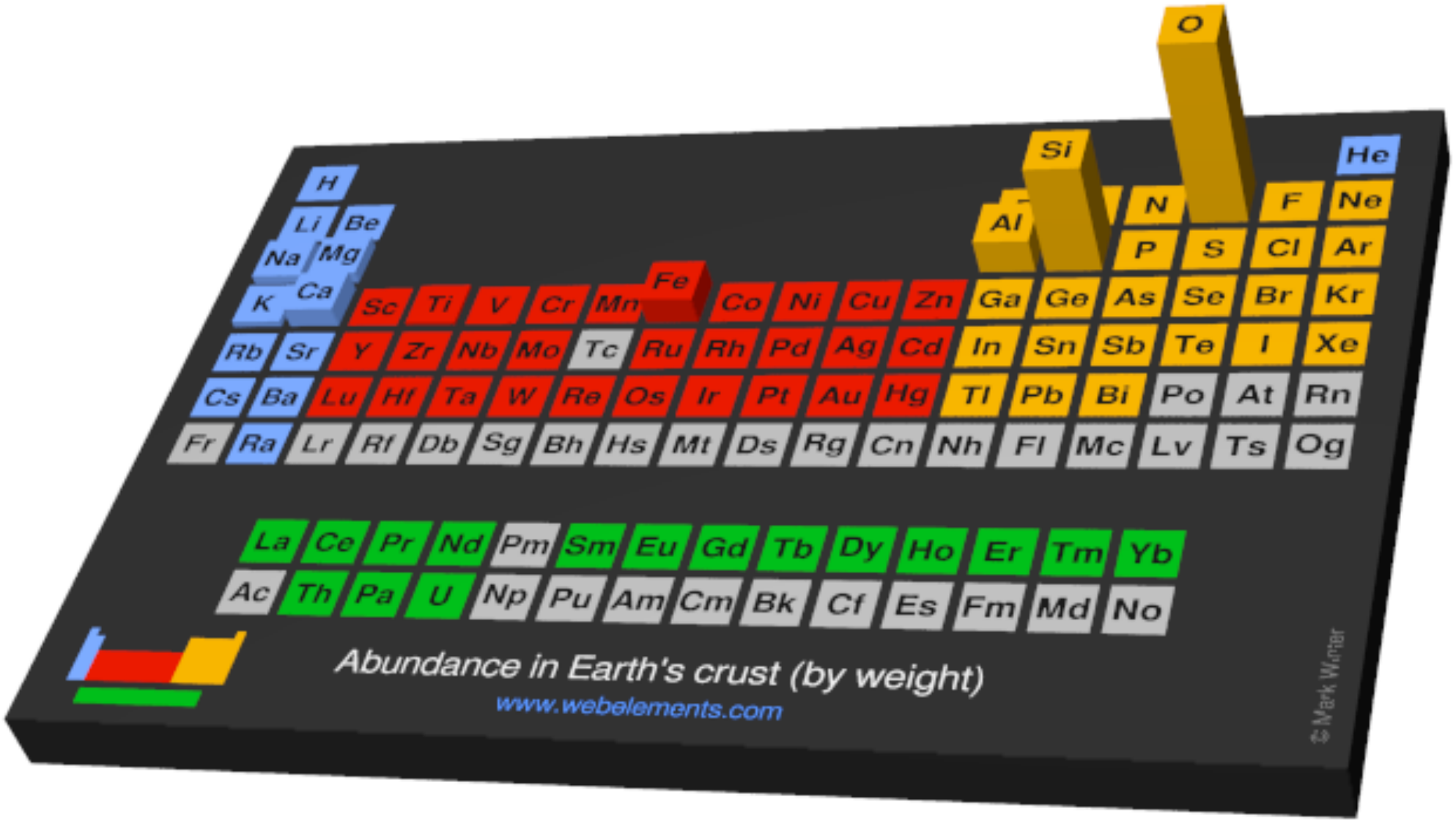
Materials

Since the 1880s, SCHOTT experts have been finding new ways to develop and process glass, unlocking new properties and realizing its potential as one of the world's most versatile materials. From the resilience of borosilicate glass via the strength of toughened aluminosilicate glass to the near-zero expansion of glass-ceramic, it has a vital role in a huge range of global industries.

colored glass



Pigments through the Ages

WebExhibits

Home | Introduction | Choose a pigment | Browse colors | Time periods | Make paint

Smalt

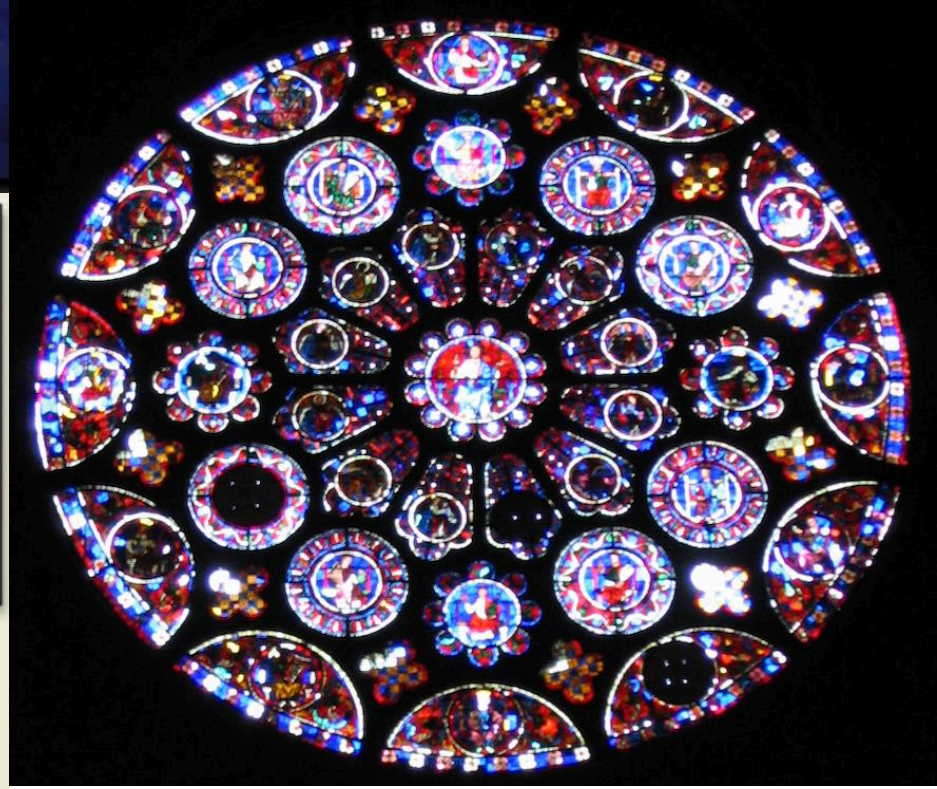
/ smalt /

Overview | History of use | Making the pigment | Technical details

Painted swatch of Smalt.

Brief description of Smalt:

It's a ground blue potassium glass containing cobalt used among the 15th and the 18th centuries. In Europe the use of smalt as an artist's pigment was widespread certainly as early as the late sixteenth century. Smalt was popular because of its low cost and its manufacture became a specialty of the Dutch and Flemish in the 17th century. Smalt is a very good dryer and was used for this purpose and also to give bulk to thick glazes containing lake pigments which are poor dryers.



Chartres cathedral's rose window, famous for its **cobalt blue** color

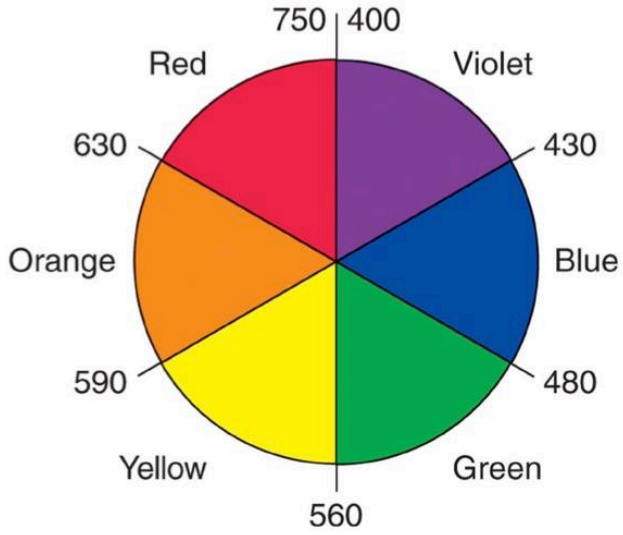
POPULAR COLORED GLASS from *The Glass Encyclopedia*

name of glass	color	coloring agent
milk	opaque white	tin oxide
milk-and-water or opal	semi-opaque white	calcium oxide (bone ash)
mercury glass	silver	silver nitrate
vaseline glass	yellow to green	uranium
cranberry, ruby	pink or red	colloidal gold chloride, tin chloride

The Lycurgus Cup (Roman empire, 4th century CE) contains metallic nanoparticles: 66% silver, 31% gold, 3% copper

reflects green

transmits red



CorningWare: glass devitrified with TiO_2 seed crystals

Corning™ PC-220 Pyroceram™ Hot Plate Stirrer, 480°C, Glass Ceramic

pyroceram availability

https://www.amazon.com/Corningware-Pyroceram-Cornflower-Ceramic-Cookware/dp/

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About this item

- Stovetop Pyroceram Blue Cornflower 4-pc Casserole Set includes: 2L Casserole with Glass Lid & 3L Casserole Dish with Glass Lid, Bakeware is made of the original Pyroceram white based material
- Electric & gas stovetop safe, Dishwasher & microwave safe, Oven safe (preheated oven) & broiler safe
- Non-porous surface does not absorb food odors, flavors or stains
- 10 Year Limited Warranty on Pyroceram bakeware
- 2 Year Limited Warranty Pyrex glass lid

Customer ratings by feature

Easy to clean 4.8

Value for money 4.2

Fiberglass


R13
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OWENS CORNING
PINK
NEXT GEN
FIBERGLAS
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FACED
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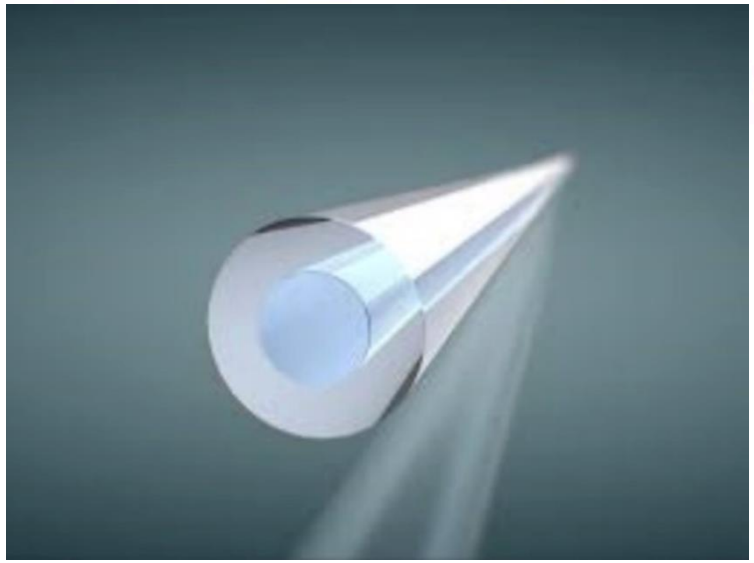
Enamel

“Porcelain" Enamel

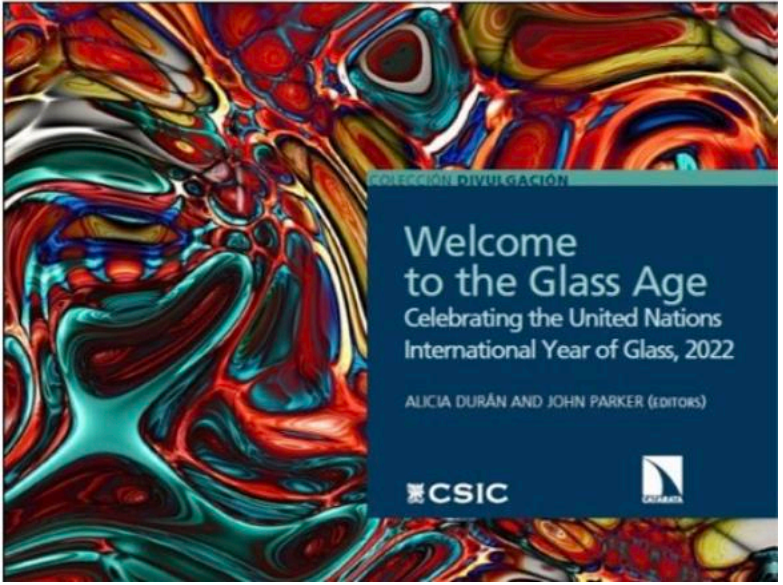
2022: the UN International Year Of Glass

Glass has played a major role in advancing civilization and mankind throughout recorded history be it in the arts, architecture, transportation, medicine, communication, and other branches of science.



The use of glass in architecture dates to Roman times, containers have an even earlier history in Egypt and Mesopotamia (now Syria and Iraq) and glass beads were widespread throughout the Middle East, India and China, being traded internationally trade from the Bronze Age. The development of modern science has been based on glass artefacts from the large scale (astronomy) to the small scale (biology); from simple lamps to the lenses for lighthouses; in communications and electronics ranging from the first valves to optical fibres.

Now in a world constrained by a variety of environmental pressures, glass is one of the most recyclable materials; it has a variety of roles in reducing greenhouse gas emissions such as energy saving coatings, double/triple glazing and solar cells, it is made from widely available materials and is contributing to major improvements in our health.



In the future glass fiber products are expected to displace steel, aluminum, wood, PVC, and other traditional materials. According to the Trend Forecast and Opportunity Analysis of Global Glass Fiber Composite Market Report, the overall global glass fiber composite consumption will grow at 8.5% p.a. In the next 5 years five key fields —auto firmware, building decoration, safety protection, aerospace and liquid filtration— will take up 80% of glass fiber composites.

The glass fiber market has many other sectors based on novel glasses (chemical resistance, elastic moduli) and different fiber formats. A vital market is wind turbine blades, a low carbon source of almost 20% of the world's electrical energy; another is insulation.

All modern means of communications and data / information technologies are enabled by hair-thin strands of glass that can carry light over hundreds of kilometers before needing (optical) signal amplification.

Table of Contents

Chemistry References	Images	Applications of materials	links for *Garbology*
Design inSite	Scale of Things	How Products Are Made	Edward Humes' website
WebElements Periodic Table	Periodic Table table	pencil factory	Parts of a Landfill
Periodic Videos	Bragg's Law demonstration	single stream recycling center	Puente Hills Landfill
Chemical & Engineering News	closest packing	space shuttle NASA: Thermal Protection System	EPA solid waste landfills
C&EN Periodic Table special issue	Crystals@Otterbein	dentistry properties of materials	UW Superior microplastics researcher
Introduction to X-Ray Diffraction	snowflakes	food ***What's That Stuff?*** chocolate ... marshmallows	Winnebago County Solid Waste Dept
Green Chemistry	"Chemistry in Art" exhibit	M&M packing [campus computers]	ChicoBag
Green Engineering		Cradle to Cradle Products Innovation Institute	Tri-County Recycling
MRSEC Education Group			TerraCycle
			Ridwell
			Senseable City Lab at MIT
			The Art of Recology
			Washed Ashore

WASHED ASHORE

ART TO SAVE THE SEA

green bay botanical garden

more from the Green Bay exhibit