

# Glass use in 21<sup>st</sup> Century



How many do you have at home?

## Glass is not always simple!

❑ (a) Soda Lime Glass normal glass

❑ (b) Toughened/Tempered Glass: Glass doors and panels; swimming pool glass fence, general domestic glassware, bottles and glass jars

❑ (c) Annealed Glass: Table-tops, cabinet doors, domestic sliding windows,.

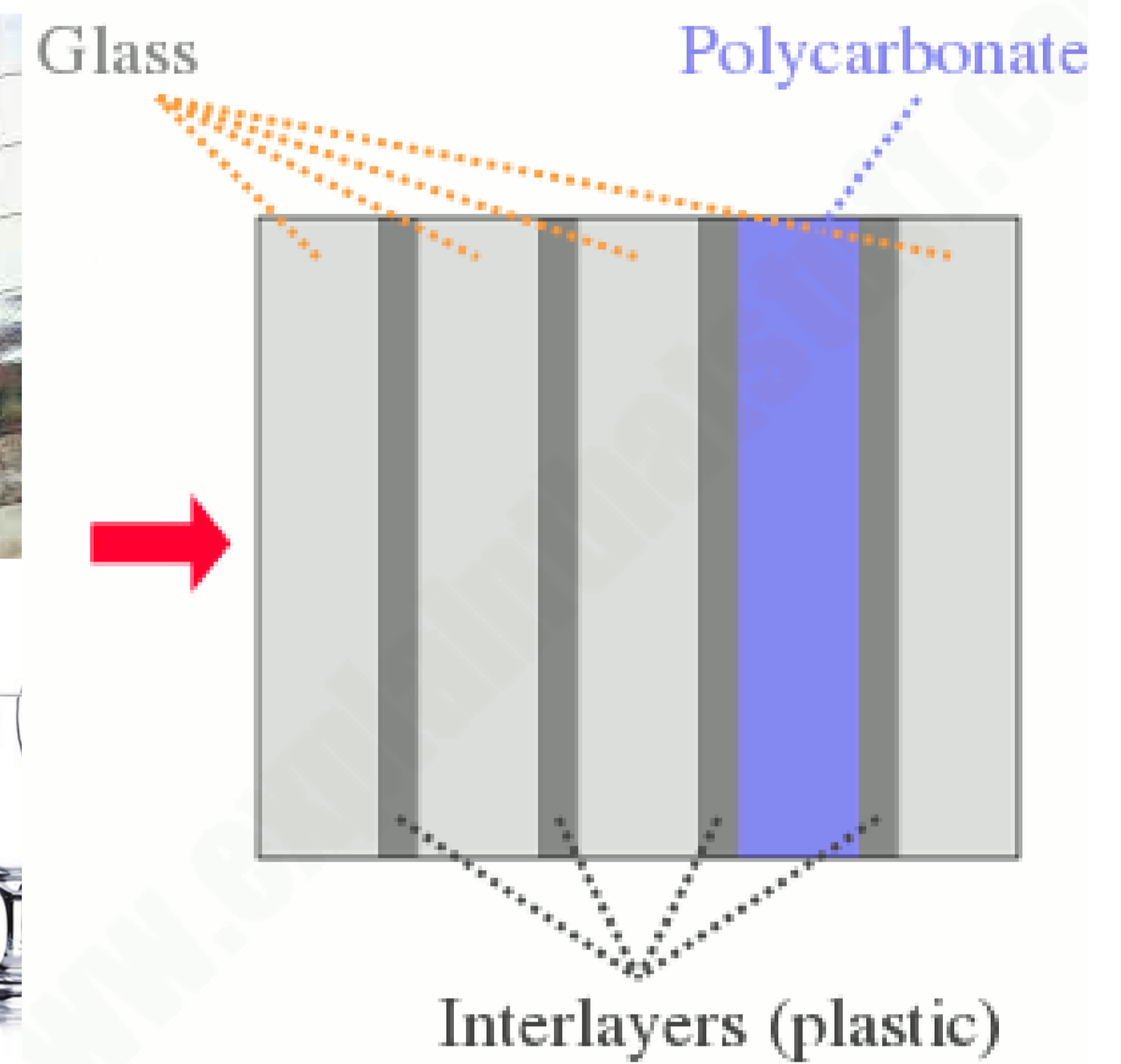
❑ (d) Laminated Glass (Poly vinyl butadiene PVB interlayer): car windscreens, structural glass, skyscraper glazing;

❑ (e) Low E (or Emissivity) Glass: Energy Efficient Glass (transparent metal sputter heat /cold coating): High rise building / architectural extra large windows

❑ (f) Bullet Proof Glass (multi-laminated PVB glass + Polycarbonate insert): Special protection / Train driver windshields (withstand 20kg dead weight impact at 120 to 300 km/h)

❑ (g) Wired Glass (wire mesh inset glass casting): fire safety glass.

❑ (h) Mirror Glass (silver/copper coated sealed backing).



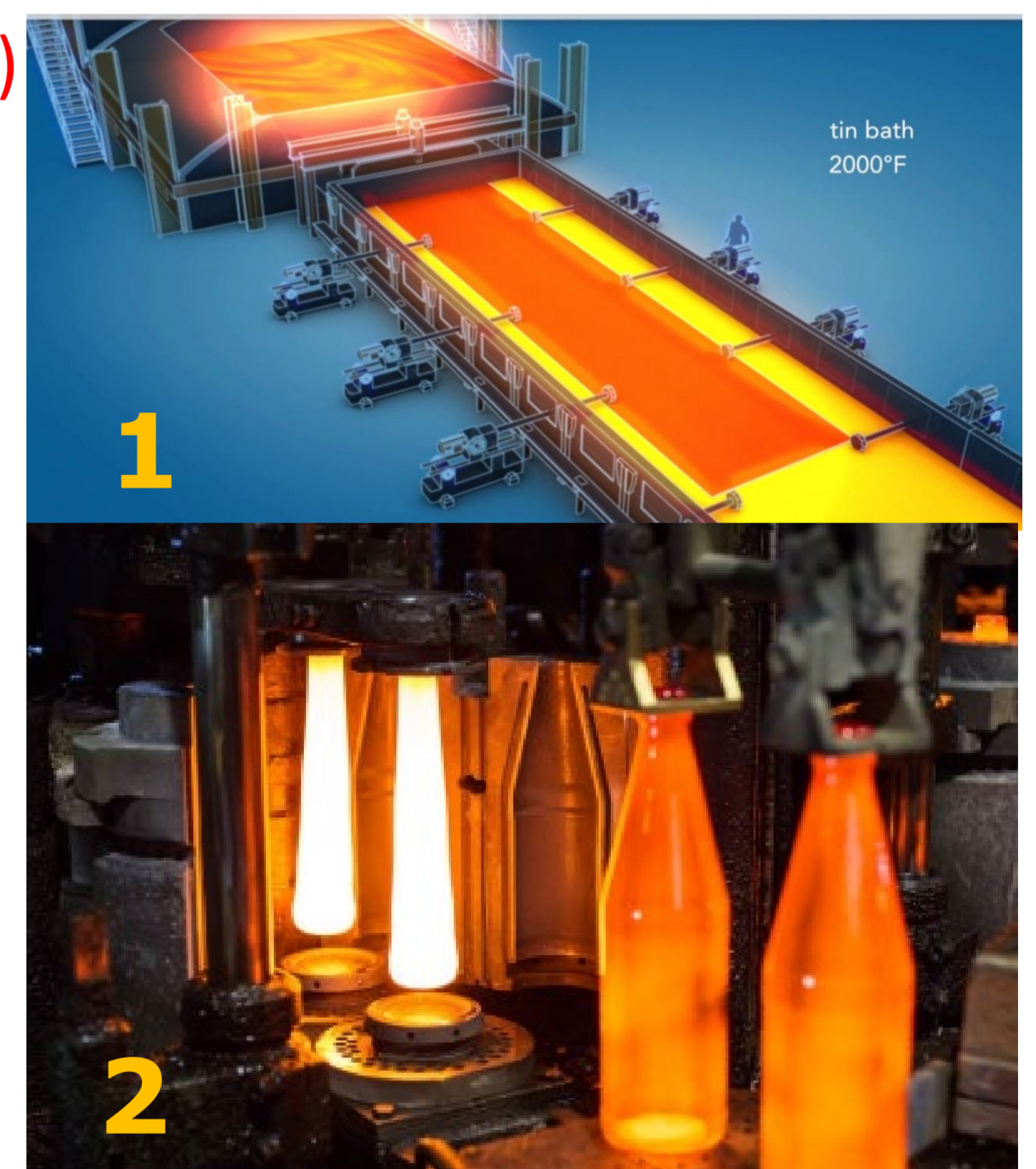
Quiz: 1) Match the different glass types to the glasses listed above. How many of these glass types can you find at home?

Which glass types can be recycled back into new glass? ❑ (a), ❑ (b), ❑ (c), ❑ (d), ❑ (d), ❑ (f), ❑ (f), ❑ (g), ❑ (h)

Are there other uses for glass that cannot be recycled back into making new glass?

## Producing glass product:

For centuries, flat glass was produced by blowing a large bubble of molten glass at the end of a metal tube and beating the heated result flat. The blown cylinder process continued to be developed until the mid 19th century; hence many early Australian homes have ripples in window glass. Modern Glass Making In the early 20th century, techniques were developed to draw molten glass into sheets and mechanically polish them on both sides. This process met the demand for modern building and automotive glass, but was replaced in 1959 when Pilkington Brothers introduced the Float Glass process (i.e. item 1 to right) using a molten tin bath, which now accounts for ninety percent of the world's flat glass (invented by Sir Alastair Pilkington in 1952). Glass blow/casting is used for domestic bottles and glassware (i.e. item 2 to the right).



## THE CHEMISTRY OF COLOURED GLASS

Glass is coloured in 3 main ways. It can have transition or rare earth metal ions added; it can be due to colloidal particles formed in the glass; or it can be due to particles which are coloured themselves. This graphic shows some of the typical chemical elements that are used to colour glass.

### SODA-LIME GLASS

COMPOSITION  
SiO<sub>2</sub> 70-74%  
SILICON DIOXIDE  
CaO 10-14%  
CALCIUM OXIDE  
Na<sub>2</sub>O 13-16%  
SODIUM OXIDE

Soda-lime glass is the most common glass type, making up an estimated 90% of all manufactured glass. Its uses include containers, windows, bottles, and drinking glasses. The above percentages are a general composition only; other compounds are also present in smaller amounts.



These are typical colours, and can be affected by the type of glass as well as the concentration of the colourant. Combination with other elements and compounds can also have an effect on the final colouration of the glass.

## Oxides for colour!

Mixed originally with the silicon dioxide clean sand:

- Iron added as Iron Oxide II (Fe<sub>2</sub>O<sub>3</sub>) => **Deep green;**
- Iron Oxide II (Fe<sub>2</sub>O<sub>3</sub>) and elemental sulphur (S) => **deep green-brown glass**
- Chromium Oxide (CrO<sub>2</sub>) => **drab army green**
- Mixtures of Chromium Oxide (CrO<sub>2</sub>), Arsenic (As) and Tin Oxide (SnO<sub>2</sub>) => **emerald-green glass**

Added to molten glass:

- > Copper Oxide (CuO & Cu<sub>2</sub>O) or Cobalt Oxide microparticles added to molten glass => **blue glass**
- > Nickel (Ni) micro-particles added to molten glass => **dark chocolate brown glass**
- > Gold (Au) microparticles added to molten glass => **rose red coloured glass**
- > Adding copper-tin alloy microparticles to molten glass => **ruby red glass**
- > Manganese Oxide (Mn<sub>3</sub>O<sub>4</sub>) microparticles added to molten glass => **purple glass**
- > (Uranium) Oxide Diuranate (e.g. Na<sub>2</sub>U<sub>2</sub>O<sub>7</sub>·6H<sub>2</sub>O) added to molten glass => **pale green glass**
- > Oxides of neodymium (NdO<sub>2</sub>) and cerium (CeO<sub>2</sub>) => **violet glass**
- > Oxides of Erbium (Er<sub>2</sub>O<sub>3</sub>) => **pink coloured glass**
- > Mixing Elemental Selenium microparticles, Cadmium Sulphide (CdS), arsenic trioxide (As<sub>2</sub>O<sub>3</sub>) => **various deep shades of red**
- > Cadmium Sulphide (CdS) => **yellow glass**

