

**1** A large percentage of the outer shell of today's smartphone is made with a special type of glass called toughened glass—which, as the name suggests, is tougher than your everyday glass. What makes it strong?

**4** The glass is drawn into sheets, then placed in an ion exchange bath. Ions are formed when an atom loses or gains an electron, giving it a charge. Sodium ions ( $\text{Na}^+$ ) are exchanged with potassium ions ( $\text{K}^+$ ). Potassium ions are bigger.

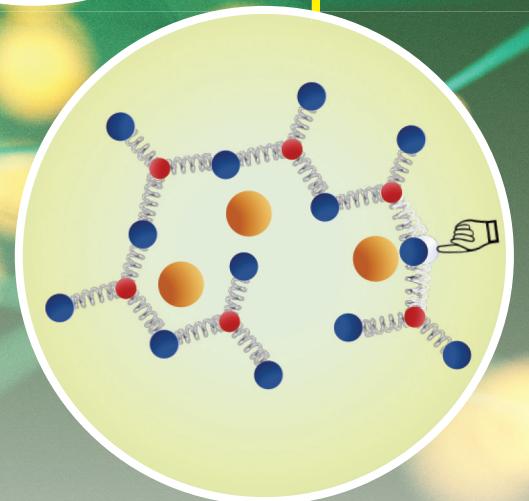
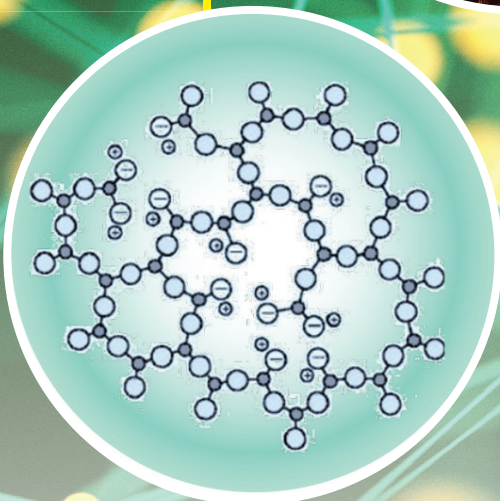
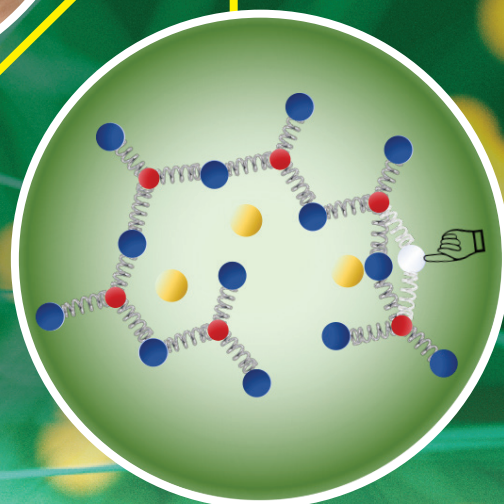
**5** Before the exchange, the atomic bonds have room to compress—they can move and you can push them to break. Now replace some of those ions with bigger ions. The springs are still all the same size!

# TOUGHENED GLASS

**2** As like with many ceramics and glasses, we start with a hot furnace, sand, and other materials such as limestone and sodium carbonate (fun fact: you can also find sodium carbonate in your detergent!).

**3** The resulting glass is an aluminosilicate glass ( $\text{Al}_2\text{SiO}_5$ ) with sodium ions in it. Glasses are interesting because they do not have a periodic (repeating) structure. They form something called networks.

**6** The big ions fill more space and compress those springs more. They are much harder to move and break, and you get a much stronger glass! However, they are also very brittle.



Created by:



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