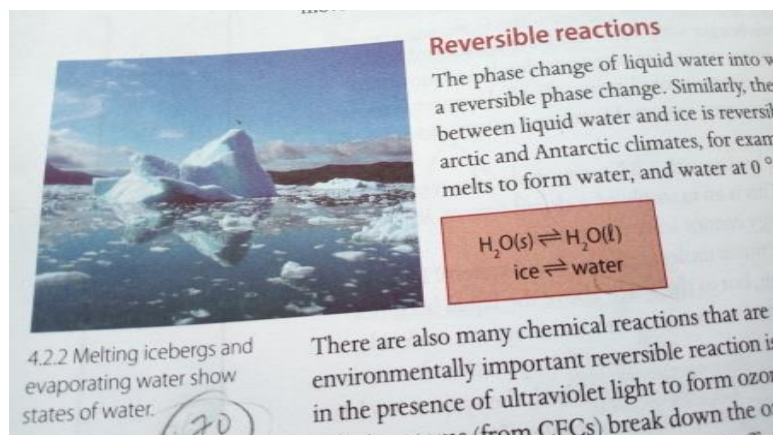


## Supplementary Material

Examples of Chemical Representations in the Physical Sciences textbooks.



**Reversible reactions**  
The phase change of liquid water into ice is a reversible phase change. Similarly, the phase change between liquid water and ice is reversible. In arctic and Antarctic climates, for example, ice melts to form water, and water at 0 °C freezes to form ice.

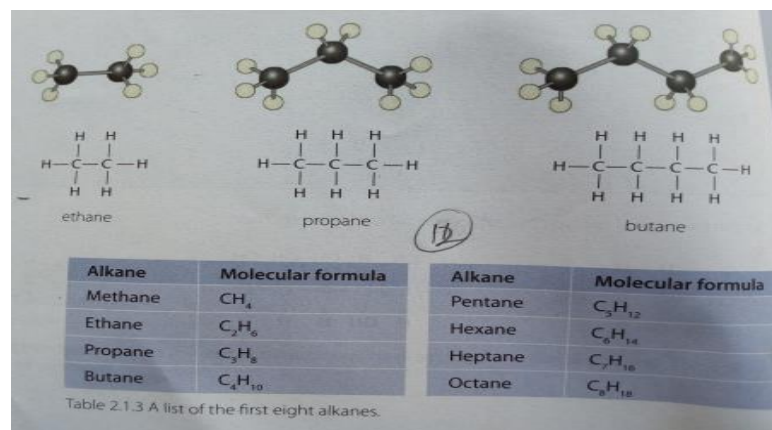
$$\text{H}_2\text{O}(s) \rightleftharpoons \text{H}_2\text{O}(l)$$

ice  $\rightleftharpoons$  water

4.2.2 Melting icebergs and evaporating water show different states of water.

There are also many chemical reactions that are environmentally important reversible reactions. For example, in the presence of ultraviolet light to form ozone, chlorine atoms (from CFCs) break down the ozone.

a

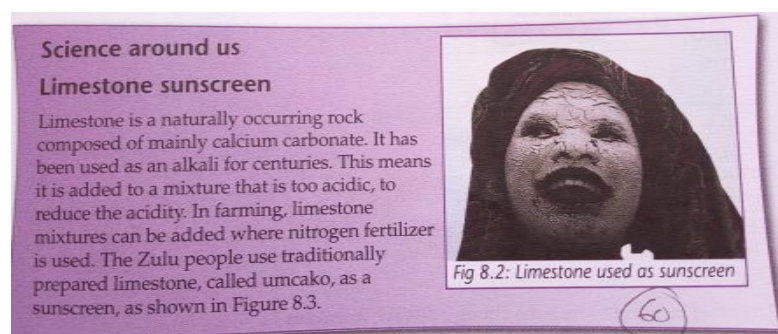


ethane                      propane                      butane

Alkane	Molecular formula	Alkane	Molecular formula
Methane	CH <sub>4</sub>	Pentane	C <sub>5</sub> H <sub>12</sub>
Ethane	C <sub>2</sub> H <sub>6</sub>	Hexane	C <sub>6</sub> H <sub>14</sub>
Propane	C <sub>3</sub> H <sub>8</sub>	Heptane	C <sub>7</sub> H <sub>16</sub>
Butane	C <sub>4</sub> H <sub>10</sub>	Octane	C <sub>8</sub> H <sub>18</sub>

Table 2.1.3 A list of the first eight alkanes.

b



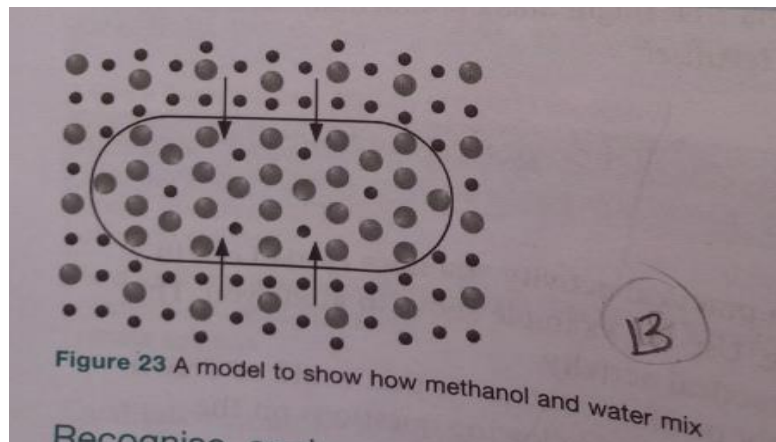
**Science around us**  
**Limestone sunscreen**

Limestone is a naturally occurring rock composed of mainly calcium carbonate. It has been used as an alkali for centuries. This means it is added to a mixture that is too acidic, to reduce the acidity. In farming, limestone mixtures can be added where nitrogen fertilizer is used. The Zulu people use traditionally prepared limestone, called umcako, as a sunscreen, as shown in Figure 8.3.

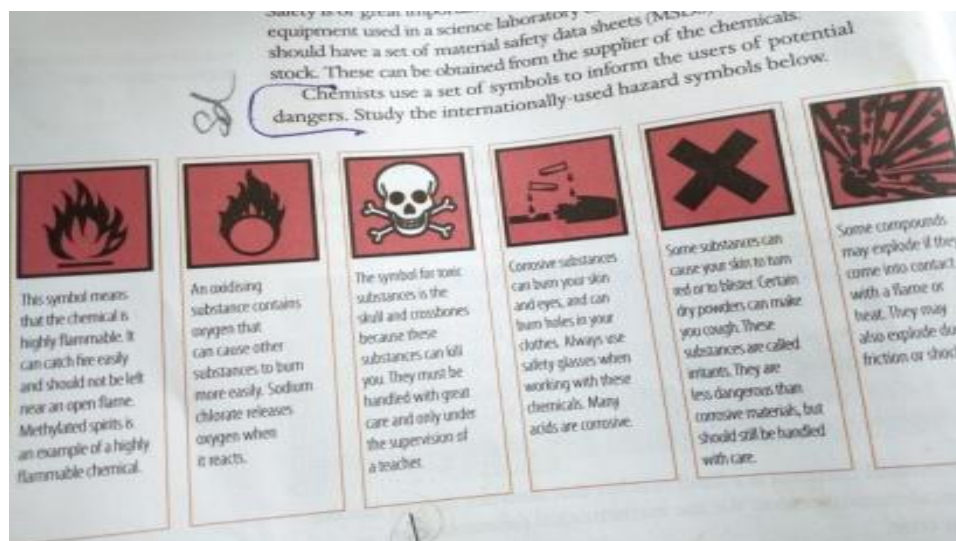
Fig 8.2: Limestone used as sunscreen

c

## Supplementary Material



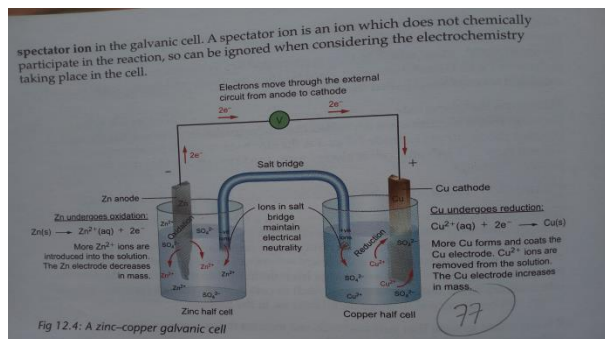
d



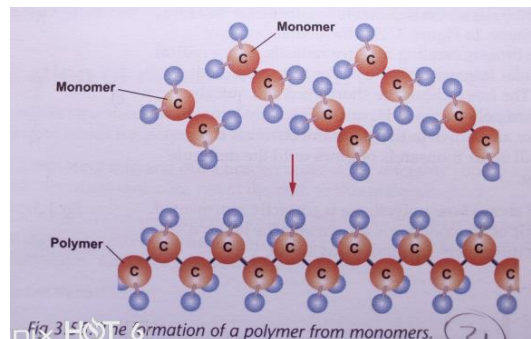
e

**Figure A.** An Example of a multiple representation of the three states of water, which consists of two separate representations, a macro and a symbolic one (a); a hybrid representation with sub-micro and symbolic characteristics (b); an example of a photograph showing a macroscopic representation (c); a submicroscopic representation showing the mixture of methanol and water (d); and a symbolic representations showing the signs of internationally used hazard symbols (e).

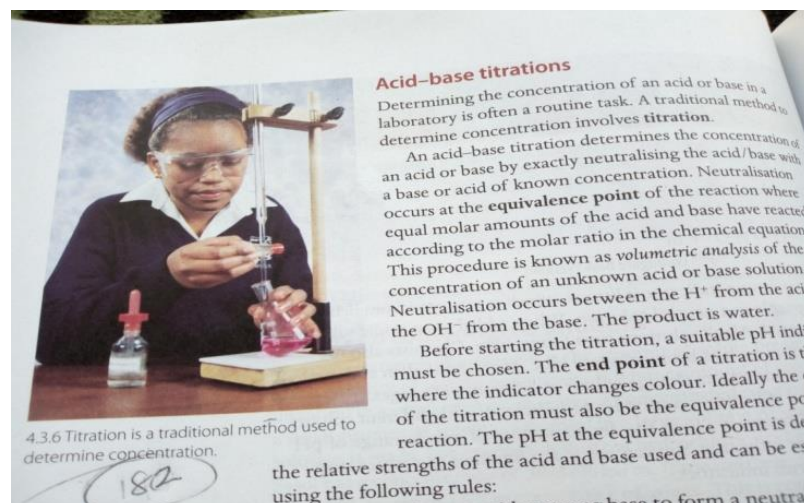
## Supplementary Material



a



b

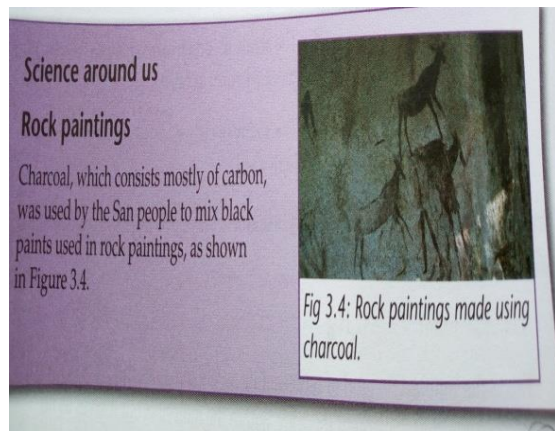


c

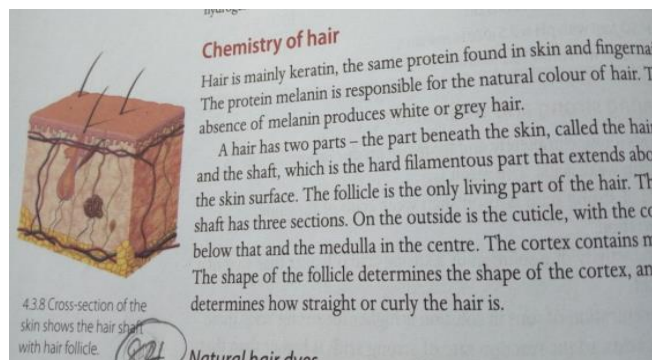
**Figure B.** Example of an explicit representation which the meaning of each surface feature is clearly mentioned (a), an implicit representation which the meaning of only some surface features is mentioned clearly (b), and an ambiguous representation in which there is no indication suggesting the meaning of any surface feature (c).



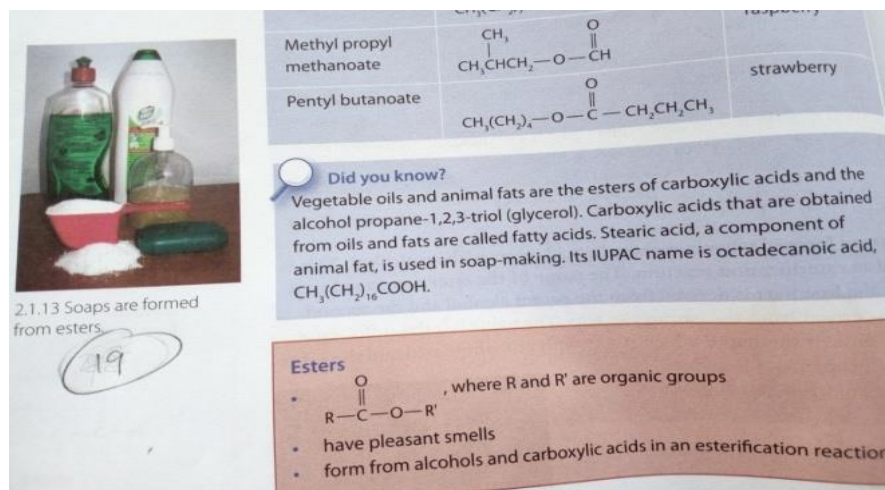
## Supplementary Material



a



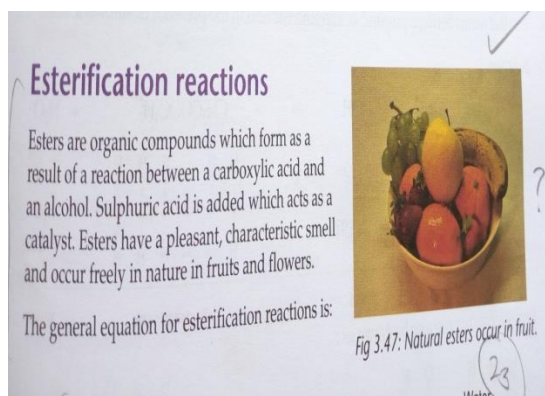
b



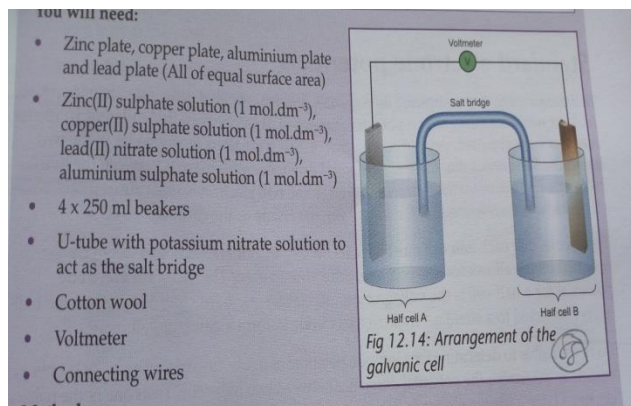
c

**Figure C.** Example of a completely related and linked (a), a completely related and unlinked (b), and a partially related and unlinked representation (c).

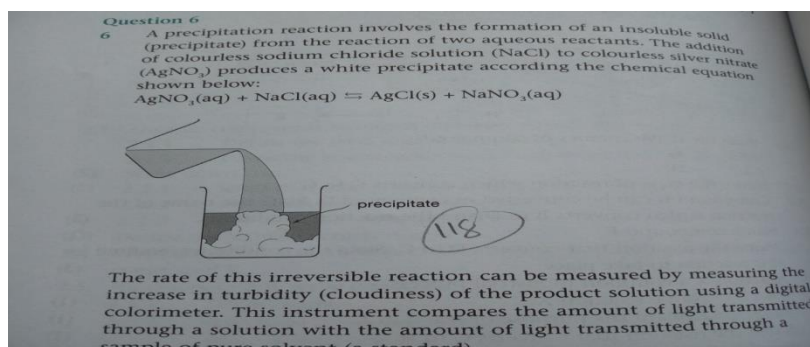
## Supplementary Material



a



b



c

**Figure D.** Example of an existence of appropriate caption (a), a problematic caption (b), and a drawing with no captions (c).