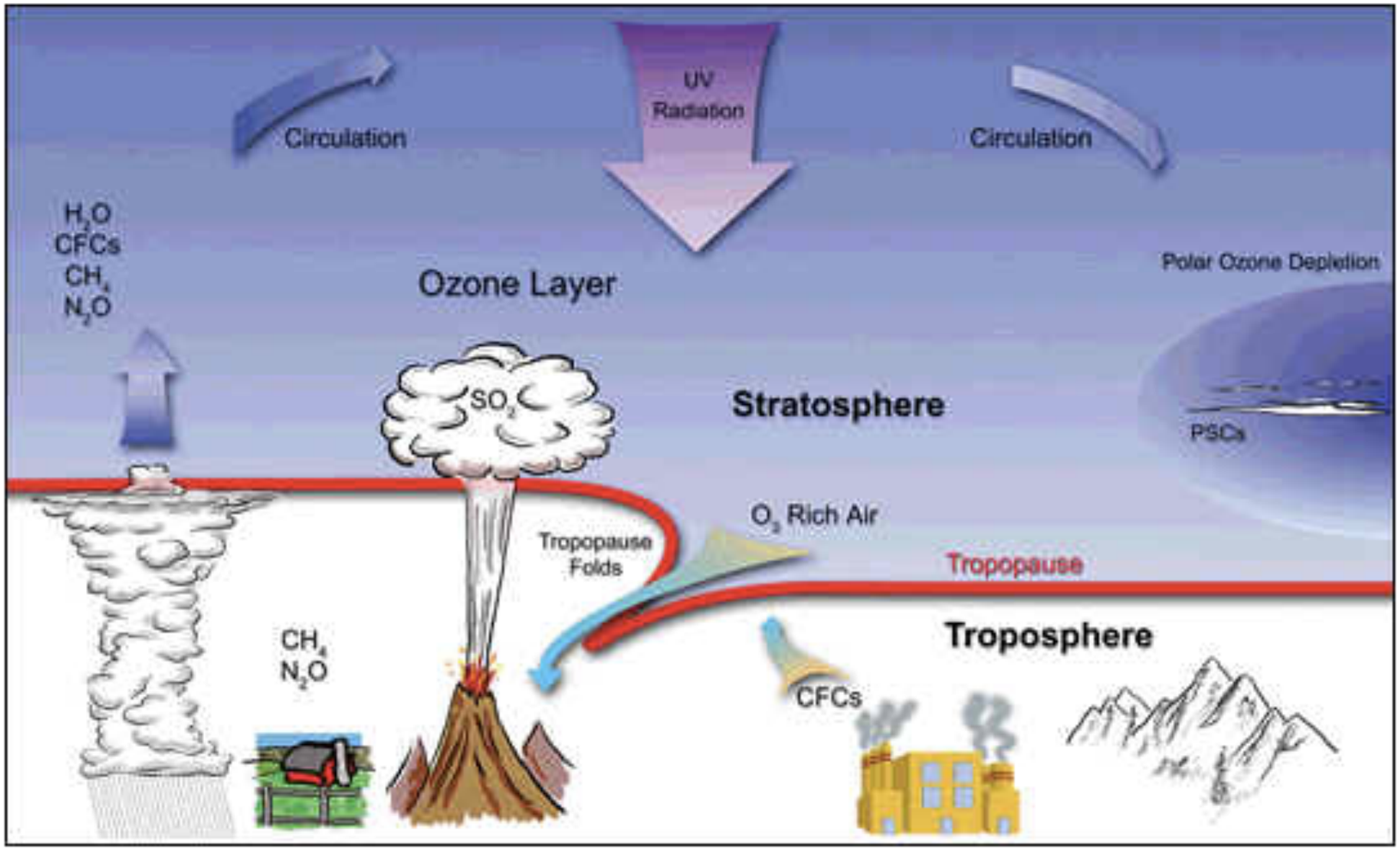
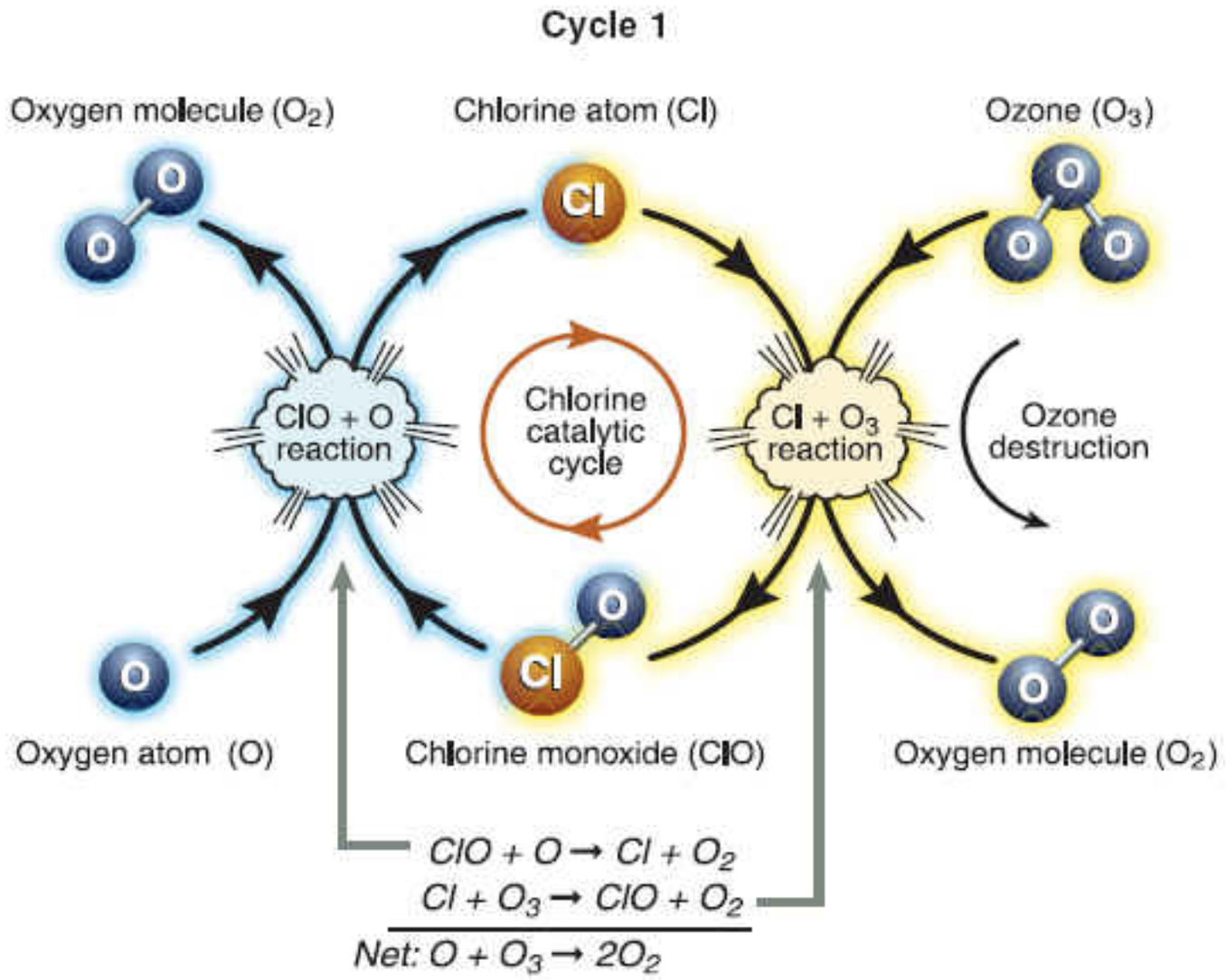
Chemical Reactions

Only in a lab?

Ozone Destruction

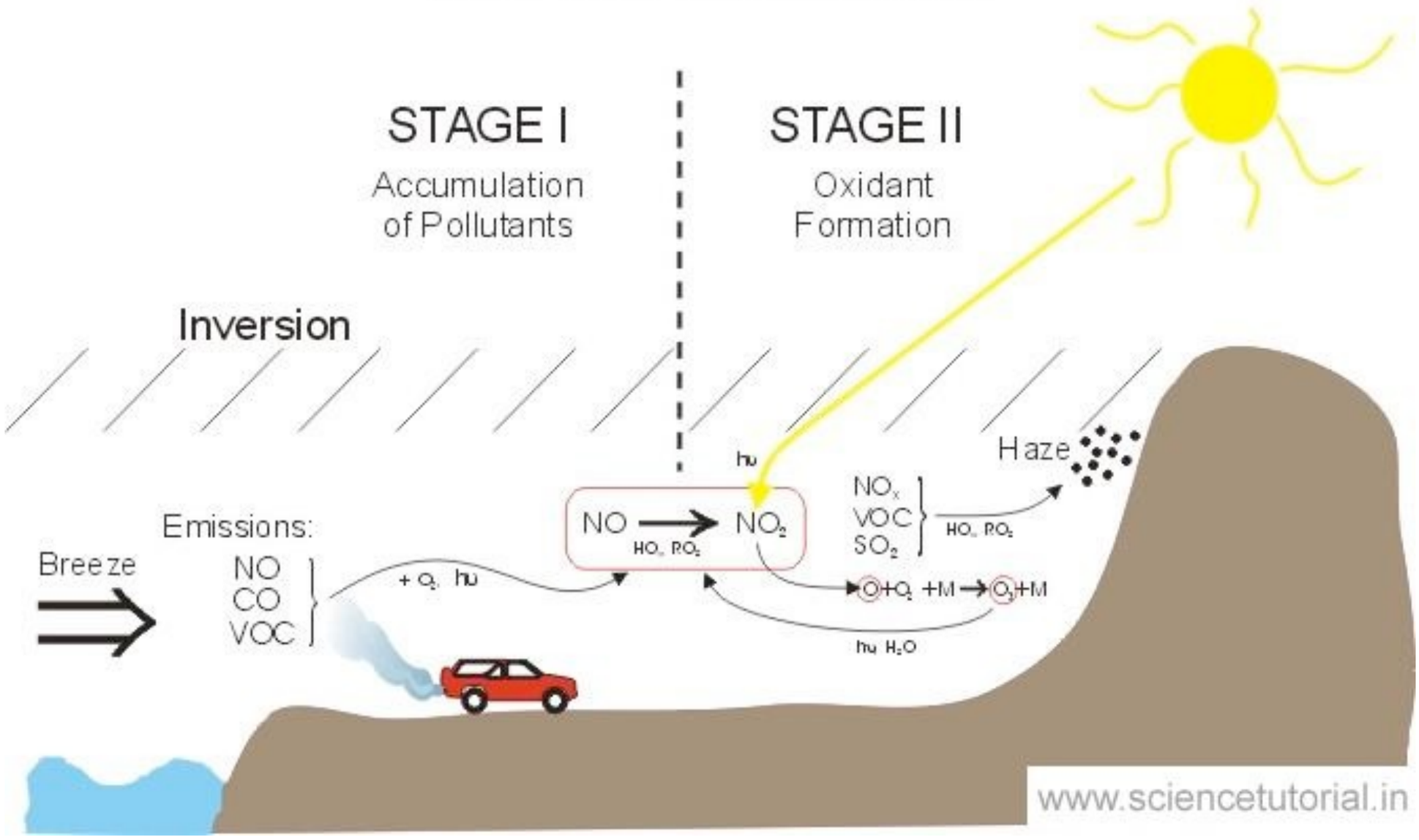


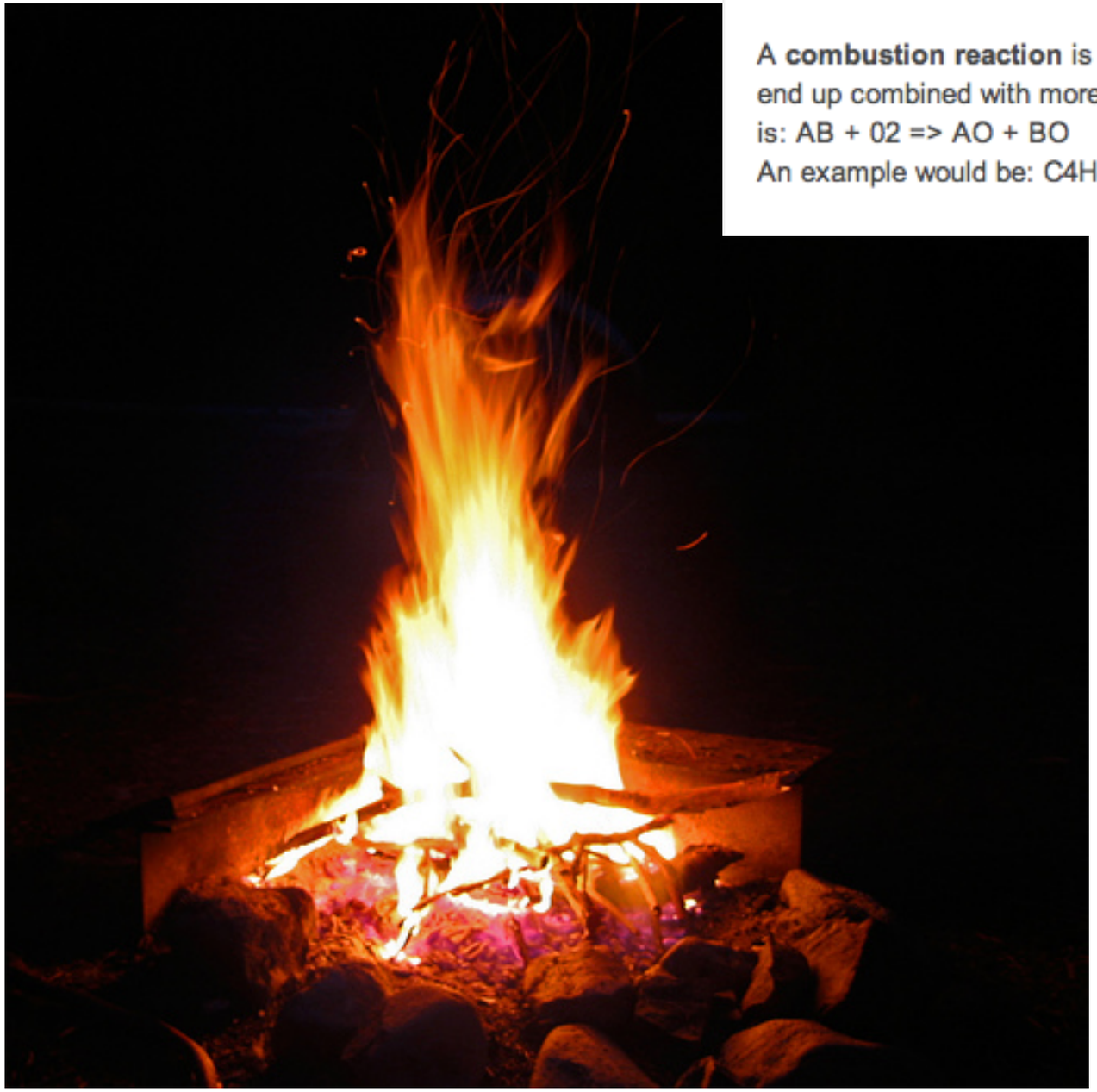
NASA Earth Observatory (Illustration courtesy Barbara Summey, SSAI)



The destruction of ozone in Cycle 1 involves two separate chemical reactions. The net or overall reaction is that of atomic oxygen with ozone, forming two oxygen molecules. The cycle can be considered to begin with either ClO or Cl. When starting with ClO, the first reaction is ClO with O to form Cl. Cl then reacts with (and thereby destroys) ozone and reforms ClO. The cycle then begins again with another reaction of ClO with O. Because Cl or ClO is reformed each time an ozone molecule is destroyed, chlorine is considered a catalyst for ozone destruction. Atomic oxygen (O) is formed when ultraviolet sunlight reacts with ozone and oxygen molecules. Cycle 1 is most important in the stratosphere at tropical and middle latitudes, where ultraviolet sunlight is most intense.

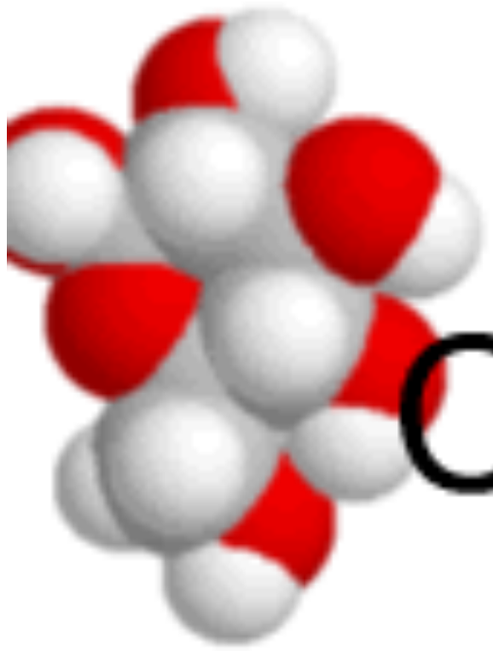
PHOTOCHEMICAL SMOG





A **combustion reaction** is where burning in the air is involved. The oxygen atoms usually end up combined with more than one type of atom as products. The formula for combustion is: AB + 02 => AO + BO
An example would be: C4H8 + 6O2 -> 4CO2 + 4H20

Respiration



$C_6H_{12}O_6 + O_2$

$CO_2 + H_2O$

+ Energy

Glucose and oxygen=energy+carbon dioxide+water

Making Water...

Different "types" of chemical reactions

Synthesis:

$$A + B \rightarrow AB$$
$$E_1 + E_2 \rightarrow C$$

Decomposition:

$$AB \rightarrow A + B$$
$$C \rightarrow E_1 + E_2$$

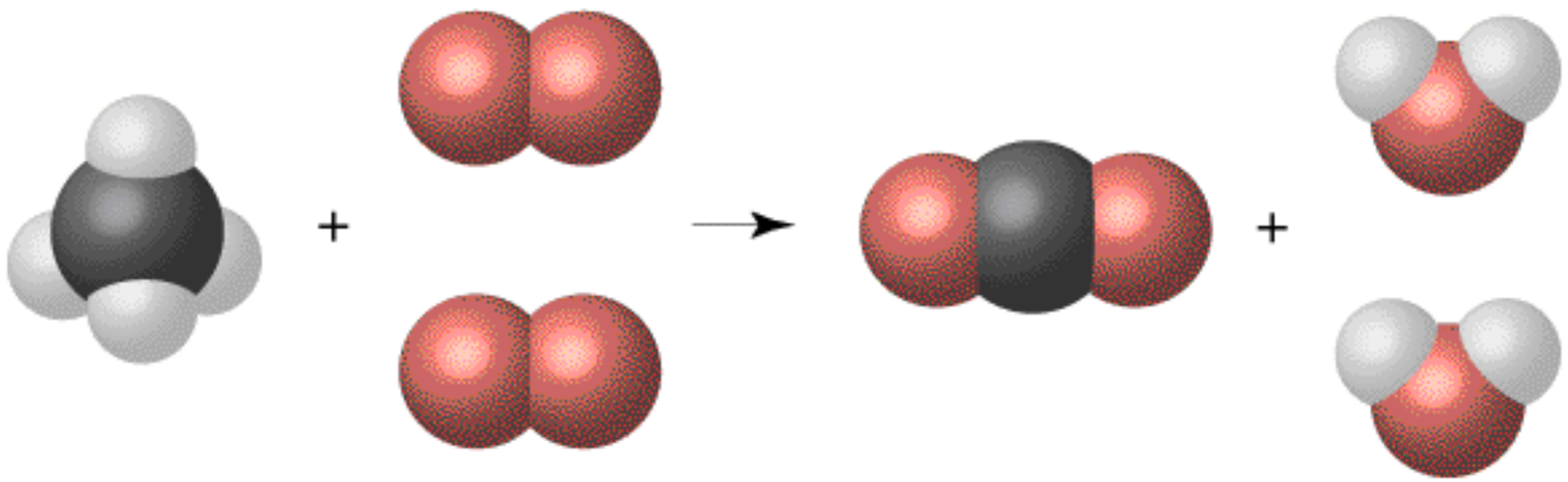
Single Replacement:

$$AB + C \rightarrow AC + B$$
$$C_1 + E \rightarrow C_2 + E$$

Double Replacement:

$$AB + CD \rightarrow AC + BD$$

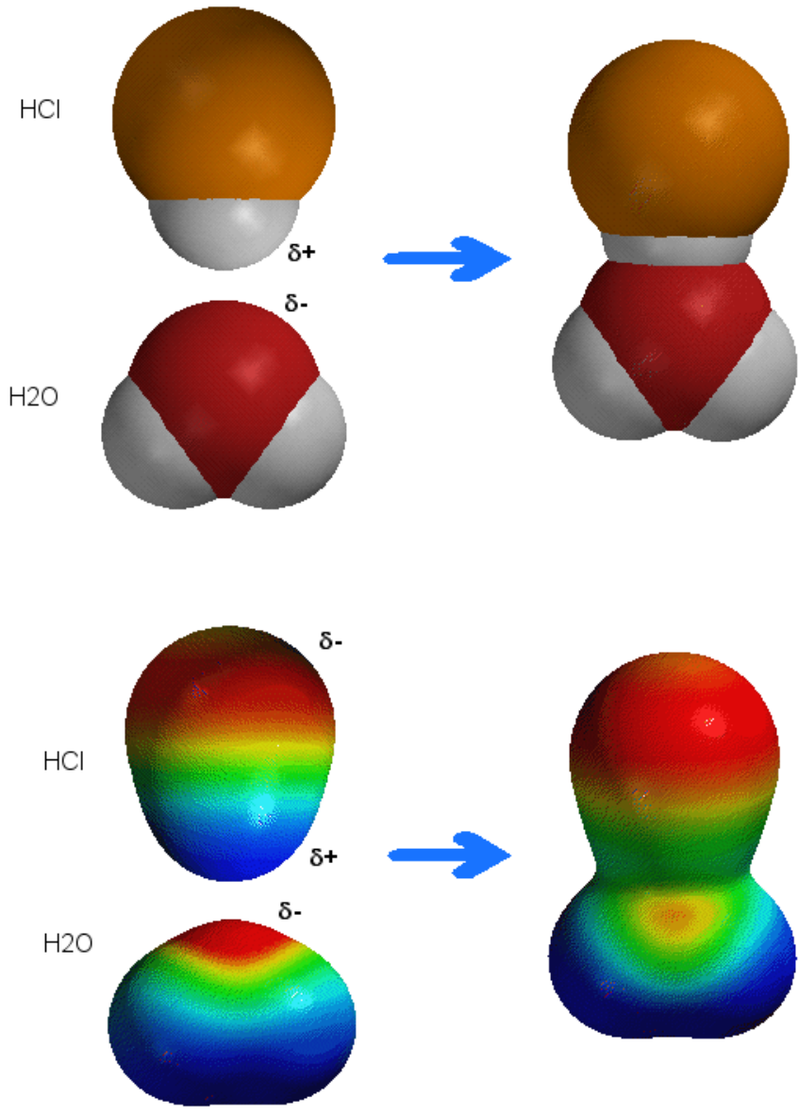
Always Balanced



One methane molecule + Two oxygen molecules → One carbon dioxide molecule + Two water molecules

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

$\begin{pmatrix} 1\ C \\ 4\ H \end{pmatrix}$ (4 O) $\begin{pmatrix} 1\ C \\ 2\ O \end{pmatrix}$ $\begin{pmatrix} 2\ O \\ 4\ H \end{pmatrix}$



$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

H_2O and HCl approach

$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

H_2O and HCl attract each other

$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

Begining bond making/breaking

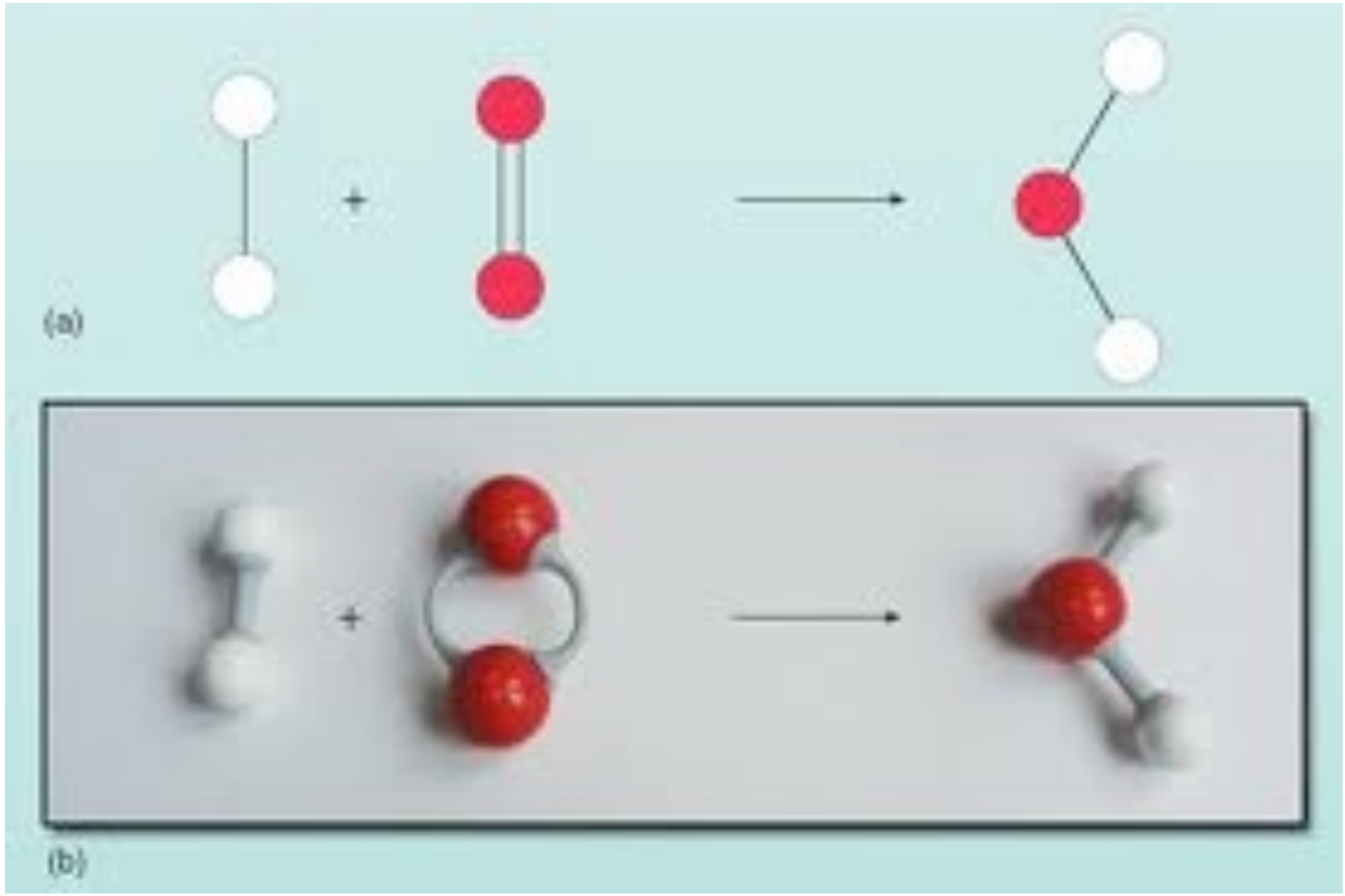
$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

Bonds to H made and broken

$HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

Separation of H_3O^+ and Cl^-

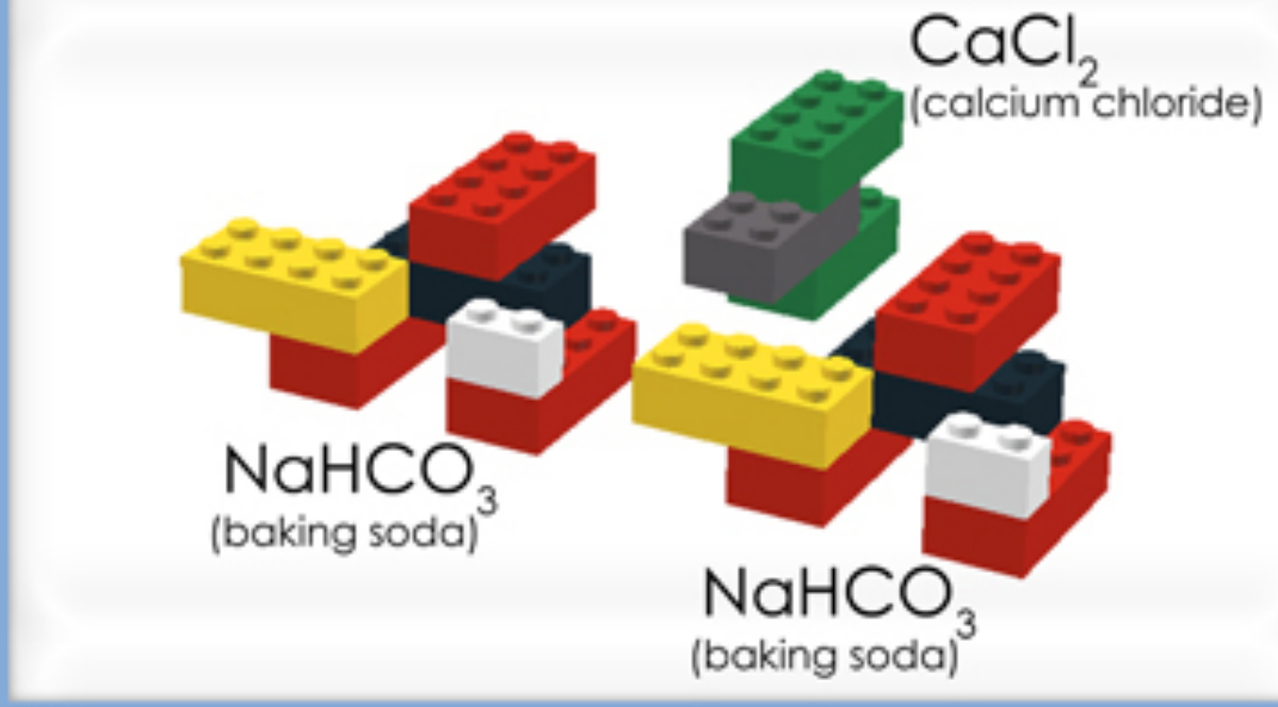
What could this be representing?



To balance this equation, you would need an extra H_2

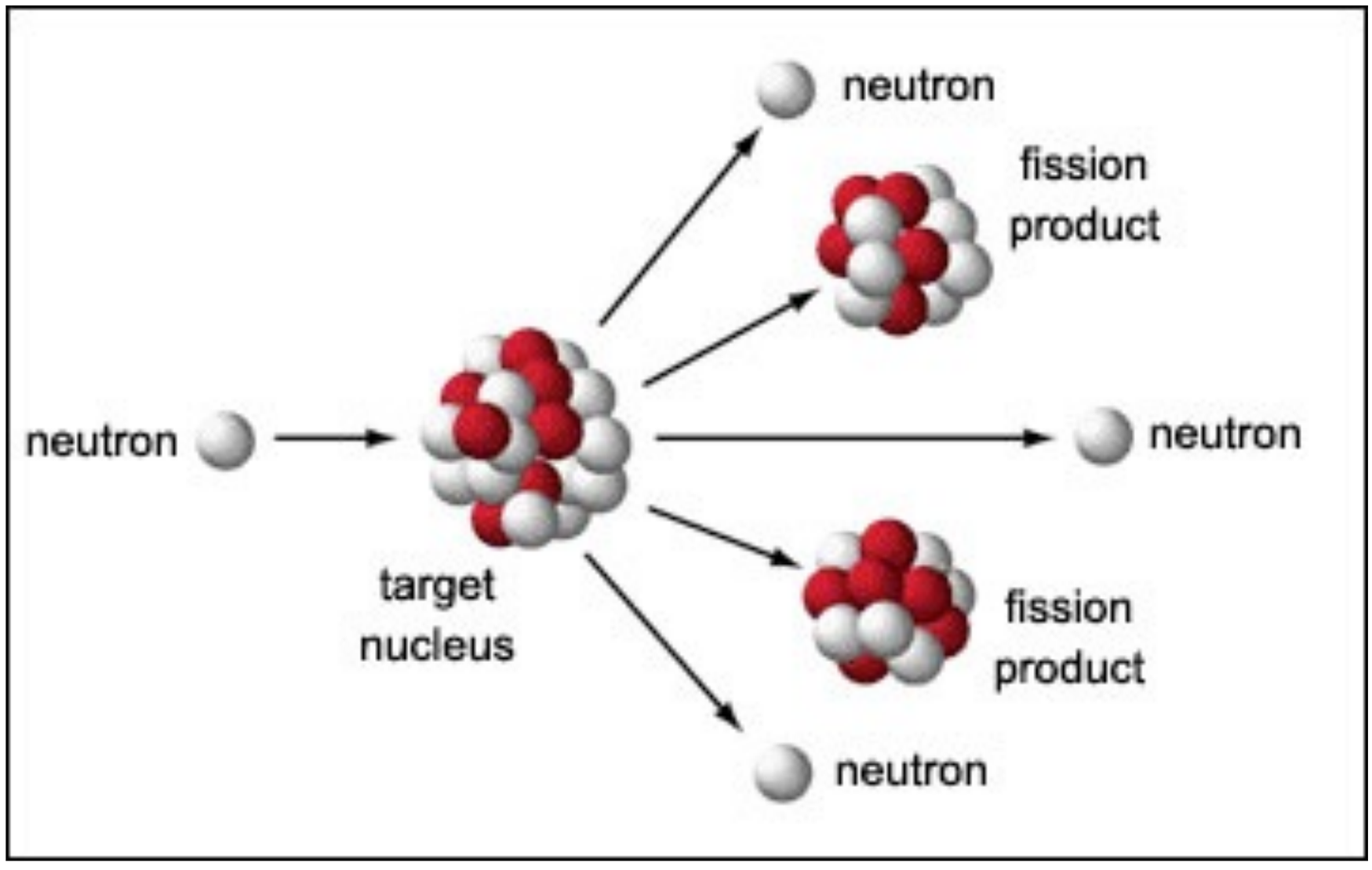
Chemical Reactants

(What we put in the bag)



How to build $NaHCO_3$ (baking soda):

vs. nuclear reactions...



A nuclear reaction involves the splitting of nuclei, usually producing something unstable and releasing neutrons. After a nuclear reaction, a process of emitting radiation (alpha beta and gamma) occurs for it to gain stability.

A chemical reaction is where atoms bond with each other to gain stability (sharing of electrons) and does not affect the nucleus of the chemicals involved.

More chemical reactions

experiment 1.5

Aim

To observe some chemical reactions and write their balanced chemical equations.

Part A Swapping ions

Materials

- lead nitrate solution $Pb(NO_3)_2$
- potassium iodide solution KI
- 3 test-tubes

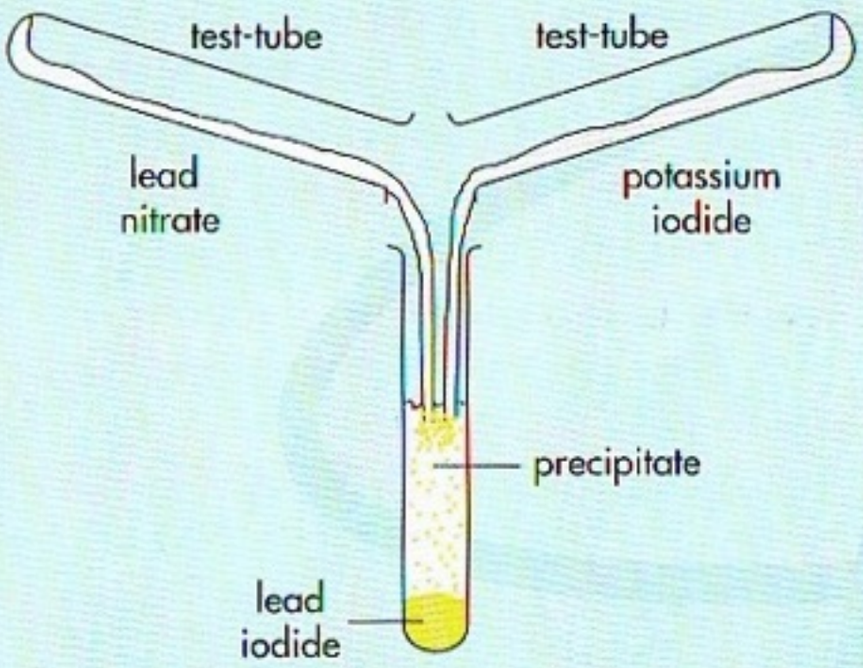


FIGURE 1.13 A precipitate is formed in this reaction.

Safety

Lead compounds are poisonous. Handle them with care, and wash your hands thoroughly after using them.

Method

1 Pour about 2 cm depth of lead nitrate into one test-tube and about 2 cm depth of potassium iodide into the other.
2 Pour the contents of the test-tubes into a third test-tube.
3 Allow the mixture to settle.
4 Record your observations.

Discussion

In this reaction, the ions of the two substances swap over and one of the new substances is a solid. This solid also contains lead ions.

1 Write a word equation for this reaction showing how the ions swap.
2 What product remains dissolved in the clear solution? How could you obtain a solid product from this solution?
3 Write a balanced chemical equation for this reaction.

FIGURE 1.18 The reaction between potassium iodide and lead nitrate is a spectacular example of a double replacement reaction.

Double replacement reactions

Sometimes when two compounds react they totally swap ions. Two new compounds are formed. Instead of one element or group of elements being replaced, two lots are replaced. This is called a **double replacement reaction.**

You observed this type of reaction in Experiment 1.5, part A, the reaction between potassium iodide and lead nitrate. It is called 'swapping ions' because it is a double replacement reaction:

potassium iodide + lead nitrate → potassium nitrate + lead iodide

$$2KI(aq) + Pb(NO_3)_2(aq) \rightarrow 2KNO_3(aq) + PbI_2(s)$$

In this experiment, an insoluble salt (PbI_2) was formed and appeared as a solid that settled out of solution. The insoluble lead iodide is known as a **precipitate.** Reactions that have precipitates as their products are known as precipitation reactions.