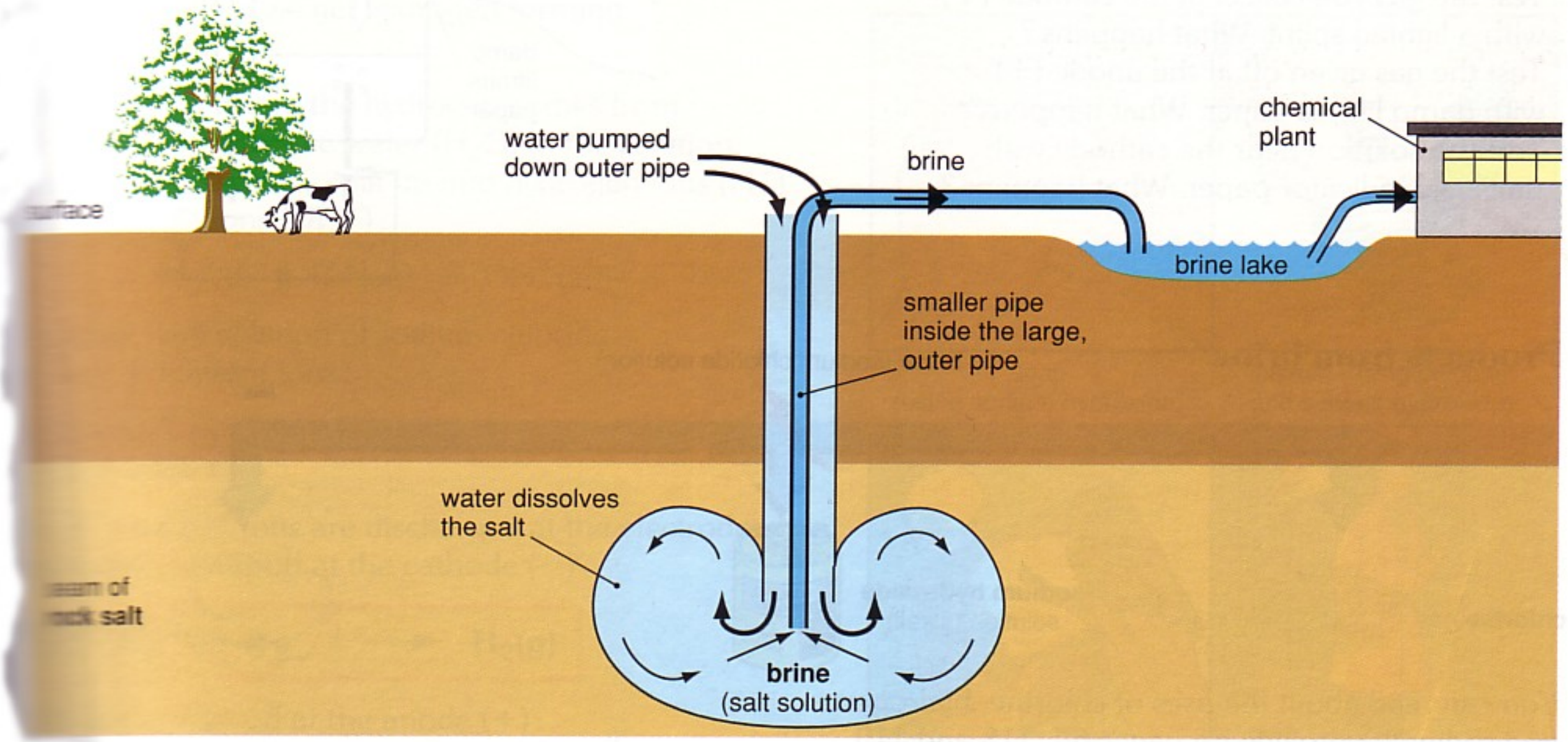
CHEMICALS AND THE EARTH

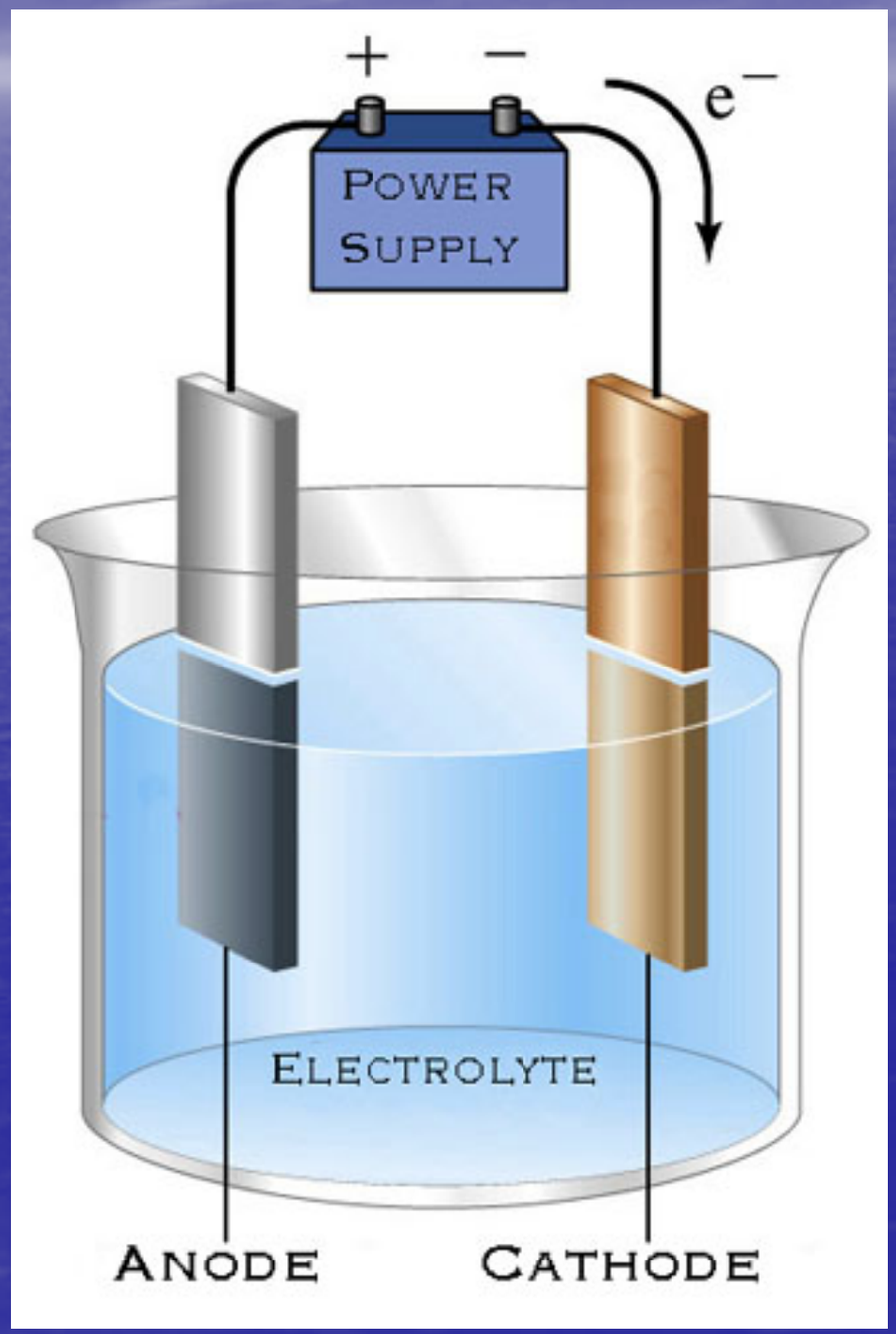
Electrolysis of brine (salty water)

Lesson objectives

- To predict what will happen during the electrolysis of brine
- To see what happens during the electrolysis of brine
- To explain what happens during the electrolysis of brine
- To know some of the uses of the products of the electrolysis of brine


chemical plant
water pumped down outer pipe
brine
brine lake
smaller pipe inside the large, outer pipe
water dissolves the salt
brine
(salt solution)

set up you would need for electrolysis

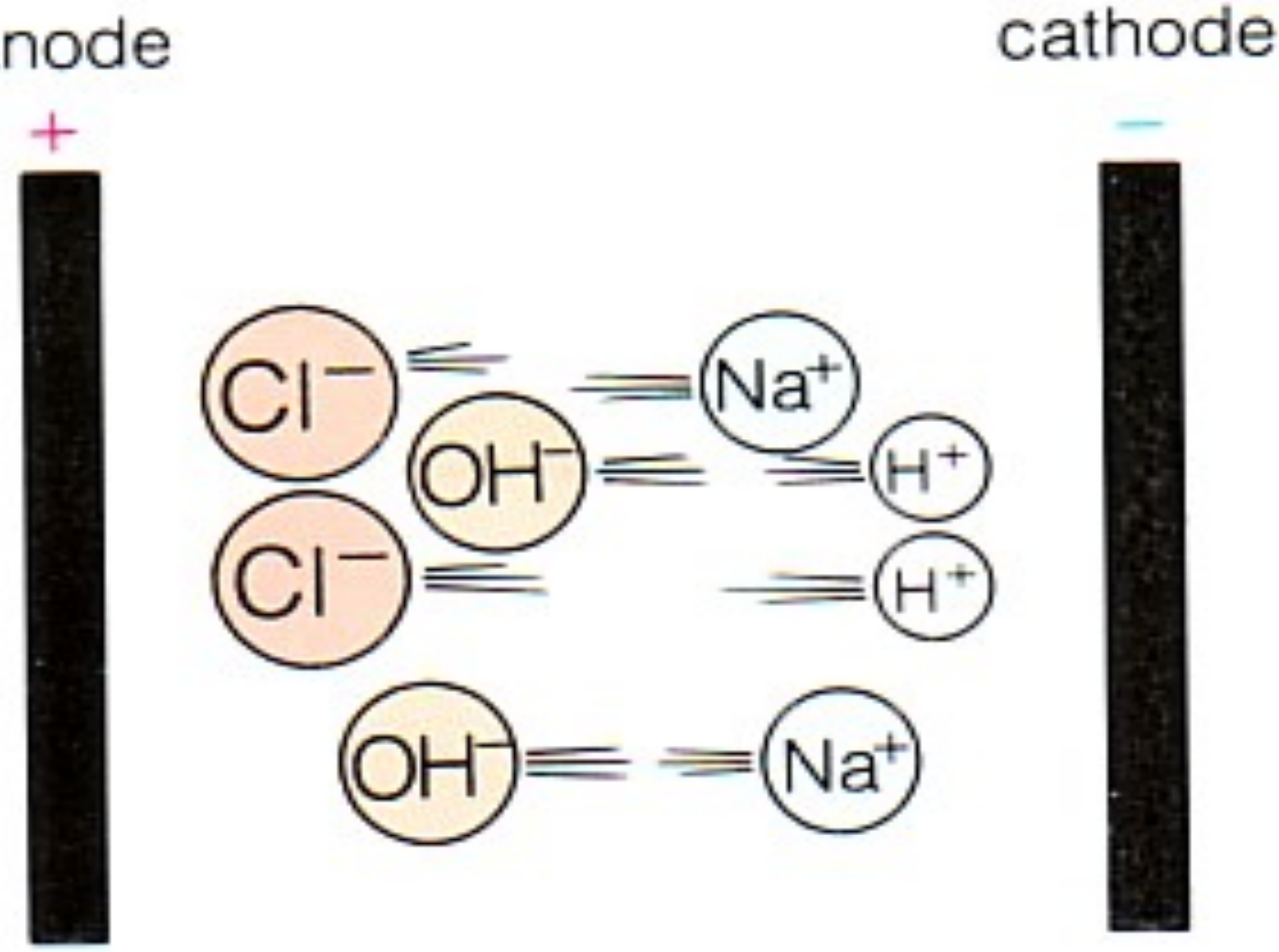


Electrolysis of brine

- When NaCl dissolves in water, it's ions become free to move. So the solution can be electrolysed.
- In water some of the molecules of water will naturally split apart.

Electrolysis of brine

- The NaCl will split into Na^+ ions and Cl^- ions.
- Water splits into H^+ ions and OH^- (hydroxyl) ions.
- So what do we think will happen during electrolysis?
- Remember – Na is VERY reactive, it is much more likely to exist as an ion than hydrogen.


anode
cathode
+
−
Cl⁻
OH⁻
Na⁺
H⁺
Cl⁻
H⁺
OH⁻
Na⁺

Now let’s see what actually happens

Electrolysis of brine

- The H^+ and Cl^- ions are discharged at the electrodes.

Electrolysis of brine

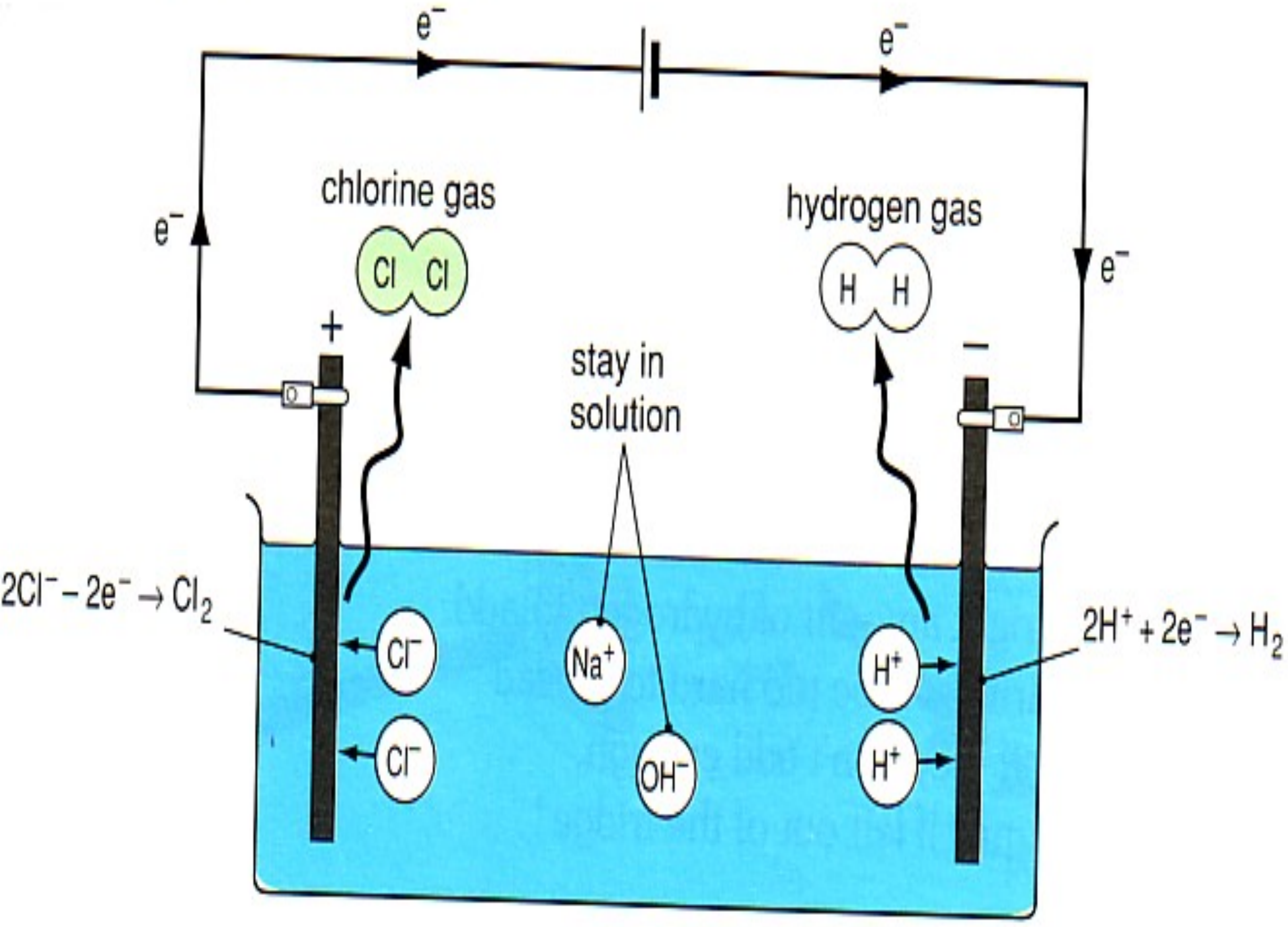
- **Hydrogen** comes off at the cathode (-)
- $2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$
- Hydrogen is …… oxidised or reduced?

Electrolysis of brine

- **Chlorine** comes off at the anode (+)
- $2Cl_{(aq)} - 2e^{-} \longrightarrow Cl_{2(g)}$
- Chlorine is …… oxidised or reduced?

Electrolysis of brine

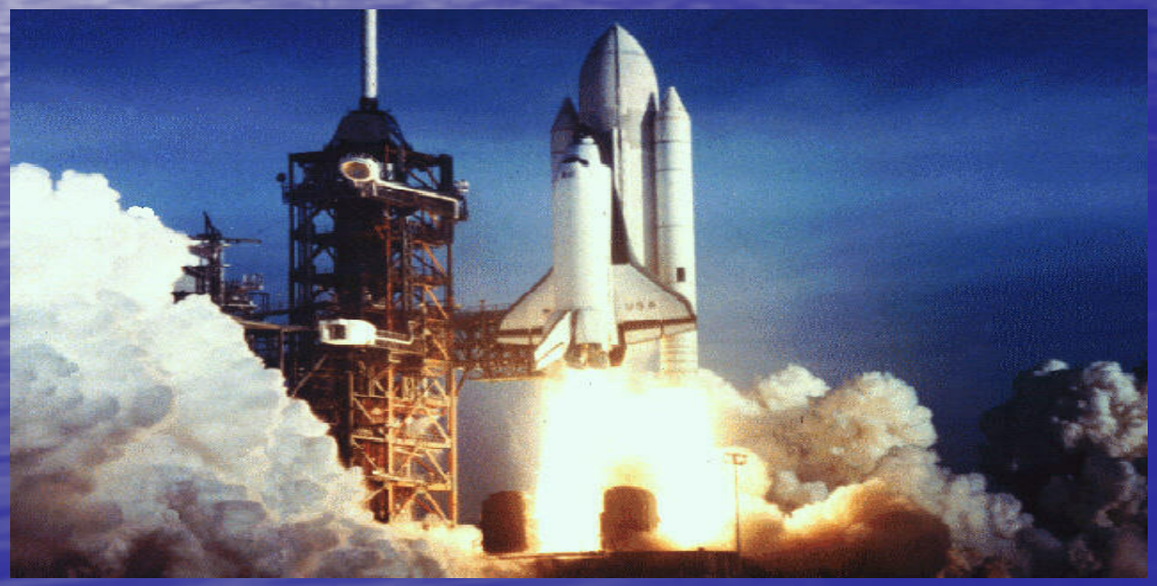
- The Na^+ and OH^- ions stay in solution.
- They join together to form **sodium hydroxide**.
- This is a very important alkali


e⁻
e⁻
e⁻
e⁻
chlorine gas
Cl Cl
hydrogen gas
H H
+
−
stay in solution
2Cl⁻ − 2e⁻ → Cl₂
2H⁺ + 2e⁻ → H₂
Cl⁻
Cl⁻
Na⁺
OH⁻
H⁺
H⁺

Industrial chlorine production from electrolysis of brine

Uses of the products of the electrolysis of brine

Hydrogen



- Used to make margarine (helps to make the oils in the margarine spread on your bread)
- Used as a fuel (already important in space rockets, but may be the fuel of cars after the oil age)

Sodium hydroxide

- Detergents and soap

- Paper

Sodium hydroxide

- Purifying bauxite to extract aluminium

- Rayon and acetate fibres

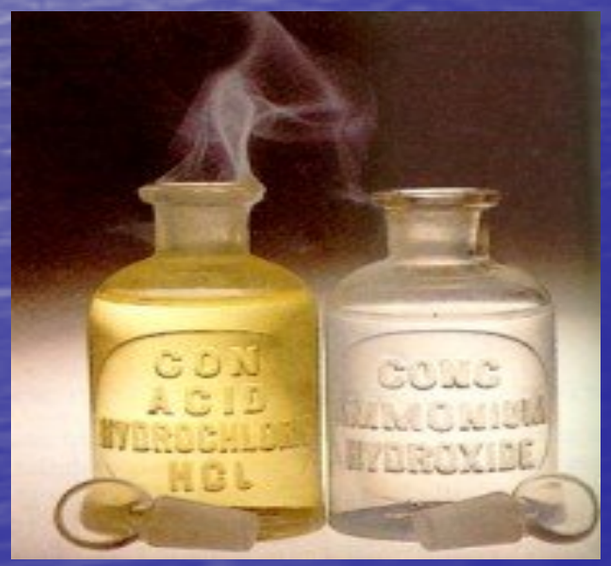
Chlorine

- Bleach

- Killing bacteria in water

Chlorine

- Solvents (used in dry cleaning)



- Hydrochloric acid (HCl)