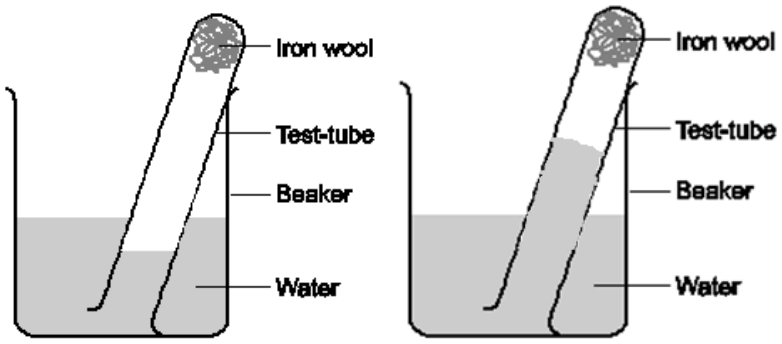
Chemistry Topic 1 – The Earth's Sea and Atmosphere

- **THE EARLY ATMOSPHERE**
- **The young earth:**
- Evolution of life on Earth has caused the Earth's atmosphere to change
- →When looking for clues into the composition of the Earth's early atmosphere, scientists study planets and moons (whose atmosphere has not changed for millions of years)
- In particular, scientists study volcanoes because they release lots of gases
- Conflicting evidence:
    - The atmospheres of Mars and Venus are mainly carbon dioxide
    - The atmosphere of Titan, one of Saturn's moons, is 98% nitrogen
- Space probes have shown that Titan has an icy interior rather than a rocky one (like Earth, Mars and Venus)
- →this makes it more likely that the Earth's early atmosphere resembled that of Mars or Venus (i.e that it contained lots of carbon dioxide)
- **Oxygen:**
- It's known what there was little or no oxygen in the Earth's early atmosphere
- Evidence:
    - Volcanoes don't release oxygen
    - Iron compounds found in the Earth's oldest rocks could only form in the absence of oxygen
- →the Earth's early atmosphere is generally considered to have lots of carbon dioxide and little oxygen
- It also contained water vapour and other gases (e.g methane and ammonia)
- **A CHANGING ATMOSPHERE**
- **The Oceans:**
- As the Earth became older, it cooled, and the water vapour in the atmosphere condensed into liquid water, forming the oceans→…:
    - 1. Carbon dioxide dissolves in the oceans
    - 2. Some marine organisms (e.g coral) use carbon dioxide to make shells of calcium carbonate (over time these formed sedimentary rocks)
- These mechanisms reduced the amount of carbon dioxide in the atmosphere
- **Photosynthesis:**
- Around 1 billion years ago some organisms developed the ability to photosynthesise
- Photosynthesis involves taking in carbon dioxide and releasing oxygen into the atmosphere
- Over time, more and more photosynthesising organisms evolved (e.g plants)→:
    - Further reducing levels of carbon dioxide in the atmosphere
    - Further increasing levels of oxygen in the atmosphere
- **THE ATMOSPHERE TODAY**
- **The composition of the atmosphere:**
- Nitrogen: 78%...oxygen: 21%...argon: 0.9%…carbon dioxide: 0.04%… (+ water vapour – variable from day to day so not included)
- There are also traces of other gases in the atmosphere e.g nitrogen oxides, carbon monoxide, methane and sulphur dioxide
- The amounts of these gases in the atmosphere can vary…

- E.g they can be changed by natural causes:
    - Volcanoes release carbon dioxide and sulphur dioxide
    - Lightning can produce nitrogen oxides
- E.g they can be changed by human activities:
    - Deforestation: less trees→less photosynthesis→more carbon dioxide in the atmosphere
    - Burning fossil fuels increases the amounts of carbon dioxide, carbon monoxide and sulphur dioxide in the atmosphere (harmful!)
    - Engines and furnaces release nitrogen oxides
    - Cattle and rice fields release large quantities of methane
- **Formation of nitrogen:**
- Theory 1: volcanoes released nitrogen when the Earth was young (i.e the early Earth's atmosphere already contained lots of nitrogen…→resembled Titan's atmosphere. *As discussed above, this theory is less likely*)
- Theory 2: nitrogen was added to the atmosphere gradually due to the reactions of nitrogen-containing compounds released from volcanoes
- **Experiment to test % of oxygen in the air:**

BEFORE **AFTER**



- The air in the test tube at the start represents the total volume of air (mainly nitrogen and oxygen)
- After some time, the iron reacts with the oxygen in the test tube to form iron oxide
- This means the oxygen in the test tube gets used up→the volume of air in the test tube decreases (only nitrogen left basically)→the water will rise up the test tube to fill the space
- The difference between the initial volume of air in the test tube and the volume of air once the iron has fully reacted represents the volume of oxygen initially present
- To calculate it in %...
    - % oxygen = ((start volume – end volume)/start volume) x 100