ACID RAIN

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Acid rain is basically rain that has a higher than normal acid level (low pH).

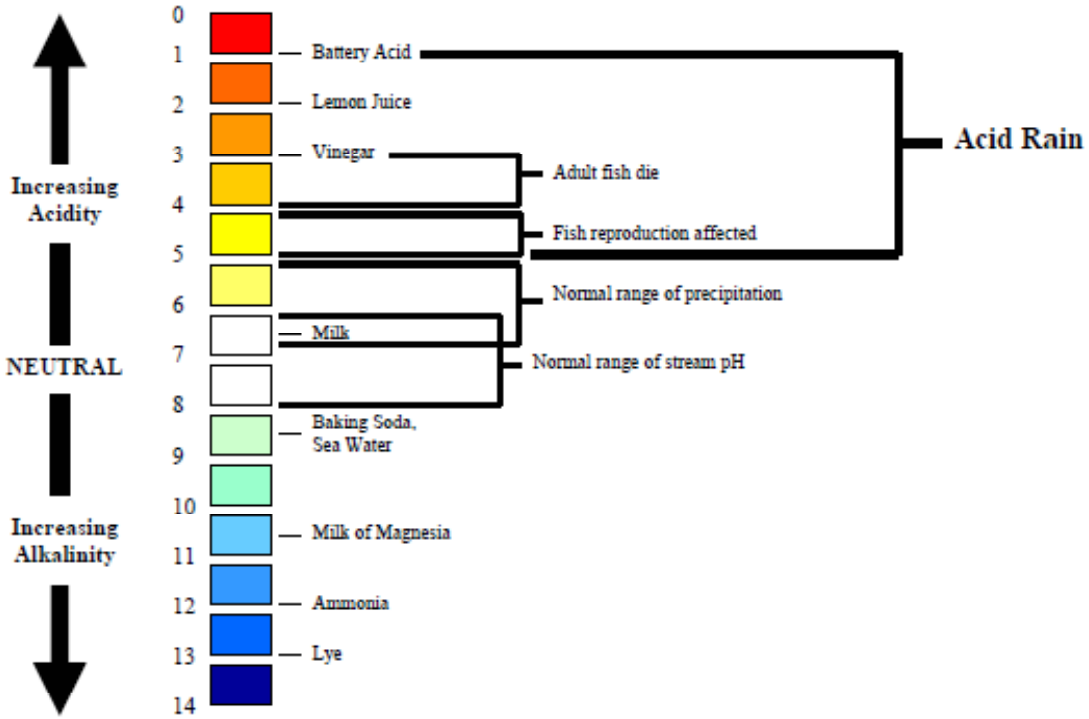


Figure 2. The pH Scale.

ACID RAIN

- Burning coal. Oil and natural gas in power stations makes electricity, giving off sulphur dioxide gas.
- Burning petrol and oil in vehicle engines gives off nitrogen oxides as gases.
- These gases mix with water vapour and rainwater in the atmosphere producing weak solutions of sulphuric and nitric acids – which fall as acid rain.

ACID RAIN: PROBLEMS

- People probably couldn't live without electricity! Therefore coal will continue to be burnt.
- Also, electricity and energy are constantly being *overused*.
- Think of it this way: every time you turn on a light switch or the television set without really needing to, you're indirectly contributing to the acid rain problem.

ACID RAIN: TRANSPORT

- Acid rain can travel long distances.
- Often it doesn't fall where the gas is produced. High chimneys disperse (spread) the gases and winds blow them great distances before they dissolve and fall to Earth as rain.
- E.g. gases produced in England and Western Europe can result in acid rain in Scotland and Scandinavia.

ACID RAIN: WHAT?

- Formed when gases, such as CO_2 and SO_2 react with the water in the atmosphere
- The pH of Rain drops as low as pH of 2, very harmful to our living environment

  - When CO_2 reacts with water, carbonic acid is formed.
    $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$
  - When SO_2 reacts with water, sulfurous acid is formed.
    $SO_2(g) + H_2O(l) \rightarrow H_2SO_3(aq)$
  - When NO_2 reacts with water, nitric acid is formed.
    $2NO_2(g) + H_2O(l) \rightarrow HNO_2(aq) + HNO_3(aq)$

ACID RAIN: EFFECTS

Acid rain is an extremely destructive form of pollution:

Forests, trees, lakes, animals, and plants suffer from acid rain.

Trees

The needles and leaves of the trees turn brown and fall off.

Trees can also suffer from stunted growth; and have damaged bark and leaves, which makes them vulnerable to weather, disease, and insects.

ACID RAIN: TREES

Acid rain can be absorbed by both plants (through soil and/or direct contact) and animals (from things they eat and/or direct contact).

When humans eat these plants or animals, the toxins inside of their meals can affect them.

Brain damage, kidney problems, and Alzheimer's disease has been linked to people eating "toxic" animals/plants.

ACID RAIN: SOIL

- All of this happens partly because of direct contact between trees and acid rain,
- but it also happens when trees absorb from soil that has came into contact with acid rain.
- The soil poisons the tree with toxic substances that the rain has deposited into it.

ACID RAIN: LAKES

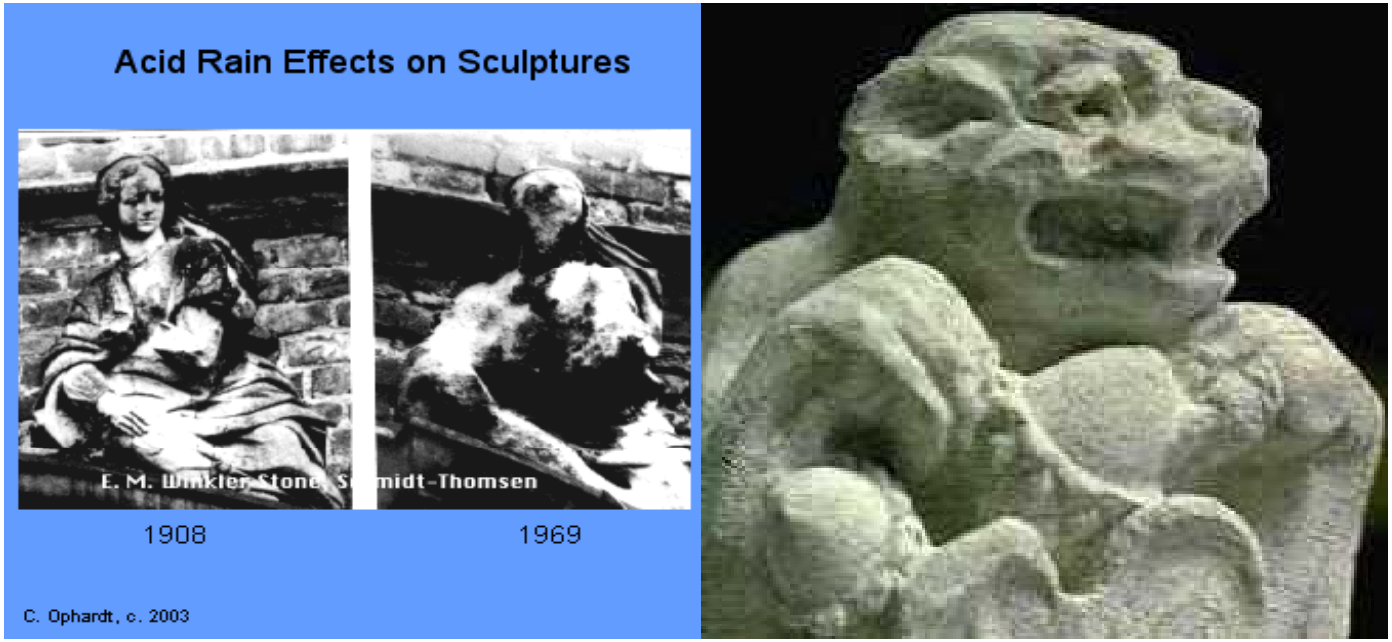
- **Lakes** are also damaged by acid rain. Fish die off, and that removes the main source of food for birds. Acid rain can even kill fish before they are born when the eggs are laid and come into contact with the acid.

- Fish usually die only when the acid level of a lake is high; when the acid level is lower, they can become sick, suffer stunted growth, or lose their ability to reproduce.

- Also, birds can die from eating "toxic" fish and insects.

ACID RAIN: STONES

- Acid rain dissolves the stonework and mortar of buildings (especially those made out of sandstone or limestone).
- It reacts with the minerals in the stone to form a powdery substance that can be washed away by rain.



ACID RAIN: MONUMENTS

- Monuments made of Calcium Carbonate (limestone and marble) will react with acid rain to form Gypsum

- Increases the oxidation rate of metals such as copper and bronze

ACID RAIN: TRANSPORT

Transport

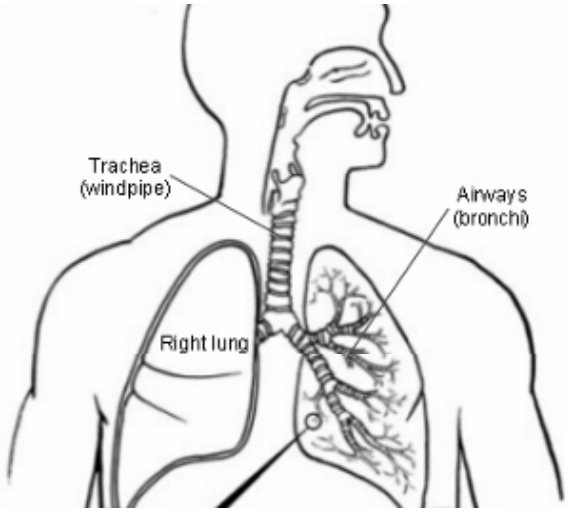
Currently, both the railway industry and the aeroplane industry spend a lot of money to repair the corrosive damage done by acid rain. Also, bridges have collapsed in the past due to acid rain corrosion.

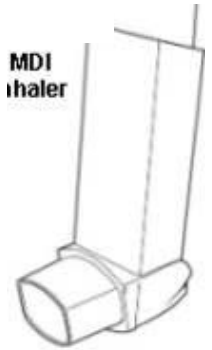
ACID RAIN: HUMANS

Humans can become seriously ill, and can even die from the effects of acid rain (e.g. respiratory problems).

Many can find it difficult to breathe, especially people who have asthma.

Asthma, along with dry coughs, headaches, and throat irritations can be caused by the sulphur dioxides and nitrogen oxides from acid rain.





ACID RAIN: SOLUTIONS

1. Sulphur dioxide can be removed from power stations chimneys but this process is expensive.

2. Reduce the amount of electricity we use

- turn T.V.'s off at the mains, don't leave on standby.
- turn off lights when a room is not in use.

3. Use renewable energy like wind power, solar panels, tidal power, HEP schemes and geothermal energy.

4. Fit catalytic converters to vehicle exhausts which remove the nitrogen oxides.

5. Limit the number of vehicles on the roads and increase public transport.

QUESTIONS

- What is acid rain?
- What are the causes of acid rain?
- What are the environmental and health effects of acid rain?