Ecology: Acid Deposition and Forest Ecosystems

Lesson 19
Text Book Reference: Section 3.11, pages 116 - 119

Video: Acid Rain

The earth's atmosphere is about 900 km thick but living things are confined to a thin layer extending to only 3.2 km above the surface. It is in this layer that most pollutants gather.

The main source of air pollution is the burning of fossil fuels in houses, factories electric generating stations, and refineries, and vehicle engines.

When burned they produce soot, smoke, a mixture of gases including sulphur dioxide, SO_2, oxides of nitrogen, $NO_{x,}$ carbon monoxide, CO, and various other hydrocarbons, C_xHy.

These pollutants rise on warm air currents.

Some remain airborne for a long time and are carried hundreds of kilometers by the wind, some enter clouds and fall back to earth as rain (known as **wet deposition or acid rain**), and some fall back to earth as **dry deposition**.

Dry Deposition

Sulphur dioxide
This gas damages the waxy coating which protects leaves and prevents chlorophyll formation.
It forms an acid vapour in the lungs, which aggravates diseases such as bronchitis.
It corrodes stonework causing it to crumble away.
Oxides of nitrogen
These come mainly from vehicle exhaust fumes.
They corrode metal and stone, and can have harmful effects on people with lung disease.
Hydrocarbons
These come from vehicle exhaust fumes and coal burning.
Some like benzophrene (also present in cigarette smoke), can also cause cancer.

Acid Deposition, or Acid Rain

Acid rain is caused by the dissolving of sulphur dioxide, SO_2, and nitrogen oxides, $NO_{x,}$ in water vapour in the clouds and resulting in the formation of sulphuric acid, $H_2SO_{4(aq)}$, and nitric acid, $HNO_{3(aq)}$. Eventually these fall back to earth as acid rain.

Definition: Acid Precipitation:
It is a form of acid deposition in which acids are dissolved in rain, fog, dew, or snow.

Acid deposition has a pH < 5.6

Damage to plants
Acid rain and dry depositions are blamed for the death of trees and crop damage.
Leaves turn yellow and fall off, and roots are damaged so they can not absorb minerals. This weakens plants so they are more likely to be killed by drought, severe winters and attacks from insects and fungi.

Damage to soils
Acids cause essential minerals in soil to be washed away by rain, and release poisonous chemicals like aluminium and mercury, which are normally insoluble and harmless.
Kills bacteria important to the nutrient cycle.
Promotes the growth of mosses.

Damage to water life
At around pH of 6 shrimps and minnows disappear (these are food for larger fish). At pH 5.6 the external skeletons of crayfish and their eggs soften so they are killed by fungi. Acids also wash aluminium and mercury from soils into the water where they poison fish and other water life.

Damage to man-made structures
dissolves marble structures
damages buildings
corrodes metals
dulls car finishes

Damage to health
causes respiratory problems such as asthma, bronchitis
irritates eyes and skin.

Preventing acid rain
1. Coal and oil can be treated to remove some of their sulphur.
2. Chimneys can be fitted with smoke cleaning equipment.
3. Furnaces can be designed to produce less pollution and become more efficient.
4. Car exhausts can be fitted with devices to remove pollutants.

Homework
1. Work sheet: Acid Rain
2. Read: section 3.11 Acid Deposition and Forest Ecosystems, pages 116 - 119
3. Work sheet: Acid Deposition and Forest Ecosystems