

Name: _____

Date: _____

Class: _____

IB ESS

6.4 Acid Deposition

Significant ideas:

Acid deposition can impact living systems and the built environment.

The pollution management of acid deposition often involves cross-border issues.



What is Acid Deposition?

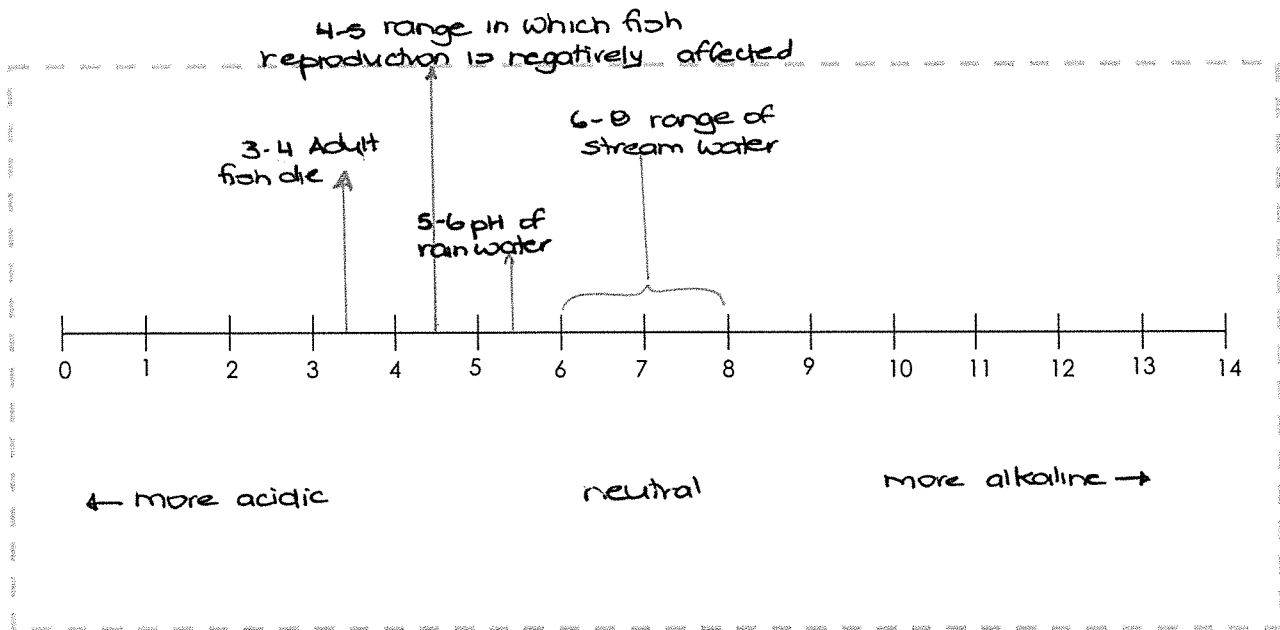
It's more common to talk about "acid rain" than acid deposition, but "rain" is only one way in which the acid may be deposited. Make sure you are using appropriate vocabulary and don't mix up the phrases.

1. a) Complete the pH scale below with the labels:

Neutral, more acidic, more alkaline

b) On the scale, label the following:

- the range in which fish reproduction is negatively affected
- the range in which adult fish die
- The "normal" pH of rainwater
- The "normal" range of pH of stream water



2. Outline the **natural** release of **primary pollutants** that can result in acid deposition.

released by volcanic eruptions and nitrogen oxides
by lightning

3. Outline how human activities result in the release of **primary pollutants** that can result in acid deposition.

combustion of fossil fuels produce sulfur dioxide and oxides
of nitrogen



4. List three secondary pollutants of both dry and wet acid deposition.

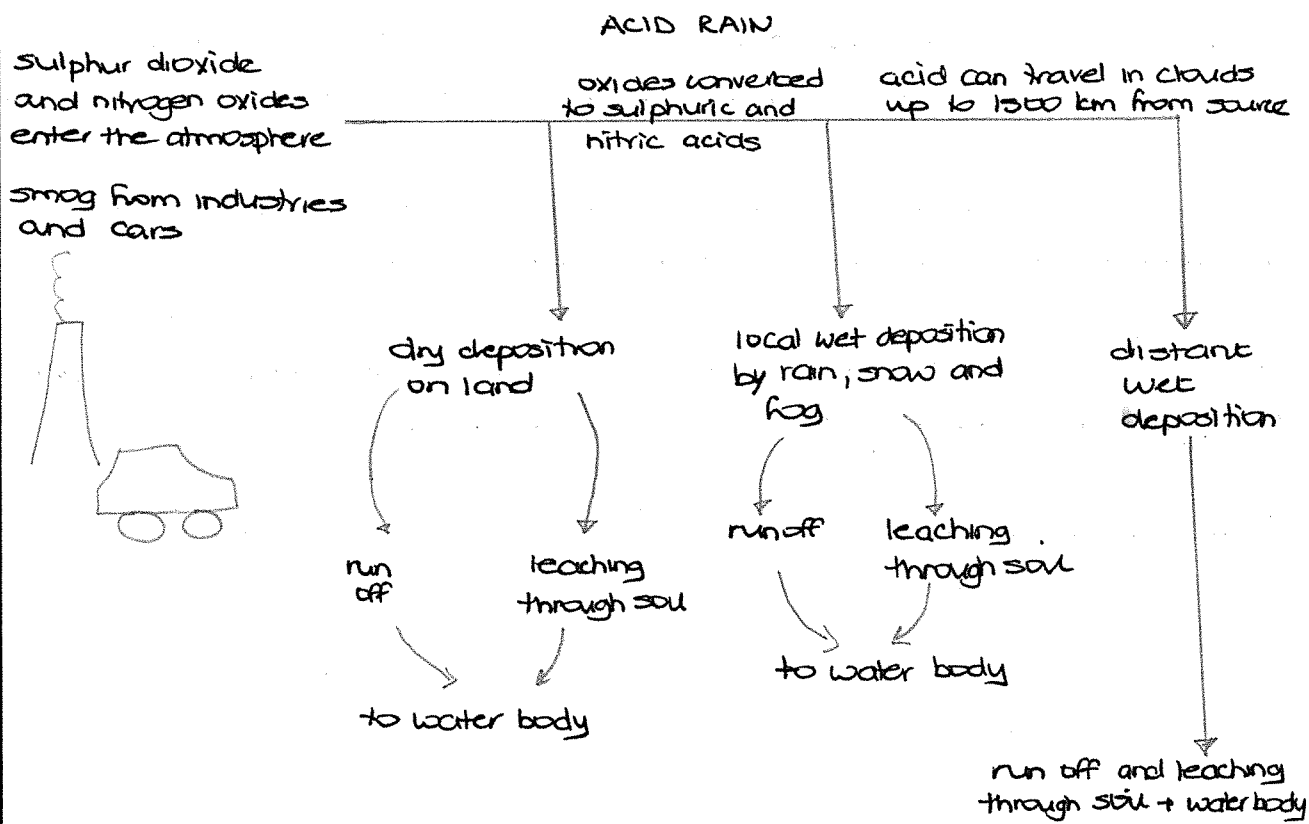
- _____ sulphuric acid (H_2SO_4)
- _____ nitric acid (HNO_3)
- _____ carbonic acid

5. Distinguish between "wet deposition" and "dry deposition".

- _____ wet - the acid comes down in the form of rain (or snow)
- _____ dry - the acid comes down as ash or dry particles

6. Draw a diagram summarizing acid deposition.

In your diagram you should include the release of named primary pollutants, their conversion into named secondary pollutants, and their methods of deposition.



Impacts of Acid Deposition

1. With the help of examples and with reference to acid deposition, distinguish between the terms "direct effect" and "indirect effect".

Direct effect - weakening tree growth in coniferous forests, acid rain falling on lakes and ponds, decreasing the pH and affecting organisms

Indirect effects - toxic effects, increased solubility of metal (Al) ions which is toxic to fish and plant roots and leaching of nutrients.

2. Explain the effects acid deposition on coniferous forest. Use the subheadings to guide your answer.

Leaf and bud yellowing:

This is due to loss of chlorophyll and damage in the form of lesions and thinning of waxy cuticles

Reduced growth:

These and other changes reduce growth as nutrients are leached out and washed away and pathogens and insects can gain entry.

Nutrient leaching:

soil particles are not able to hold on to nutrients such as calcium, magnesium and potassium which are then leached out.

Symbiotic root microbes:

These are killed which greatly reduces the availability of nutrients.

Acid rain also inhibits nitrogen-fixing bacteria

Toxic ions:

Toxic aluminium ions are released into the soil which then damages root hairs.



3. Complete the sentences to outline the effect of acid deposition on aquatic organisms

An increase in soil acidity (a decrease in pH), results in leaching of aluminium (and other toxic metals) as it dissolves more easily in acidic conditions. When aluminium is present in water, it changes the amount of salt and water that a fish can take in. Fish take in oxygen for respiration from water so a change in water intake influences salt intake. The changes in levels of salt, water and oxygen in the body can result in the death of fish (and other aquatic organisms). If Aluminium is present in high concentrations, it can cause direct suffocation of the fish as it causes the build of a solid material on their gills.

4. Outline the effect of acid rain on buildings.

Limestone building and statues (many with archaeological and historical value) react with acid and dissolve

5. Explain how acid deposition can cause lung diseases.

Dry deposition in the form of small particles of sulphates and nitrates can enter the lungs. These can cause asthma and bronchitis

6. With reference to peat bogs, outline a **positive** effect of acid deposition.

Peat bogs with acid rain produce 40% less methane (a powerful GHG). Methane producing bacteria die and are replaced by sulphur consuming bacteria

7. With reference to named countries/regions, explain why acid deposition is considered a **regional** problem, as opposed to a global one.

Before the pollutants can spread over long distances, they return to the surface as wet or dry deposition. The acids seldom travel further than a few thousand kilometers. Scandinavian forests and lakes were mainly affected by acid rain originating in Britain as they were downwind of the British industrial areas.



Pollution Management Strategies for Acid Deposition

1. Complete the table to list some suggestions for pollution management strategies to tackle acid deposition.

Once you have your chosen list of strategies, **evaluate** each of them. Give one "for" and one "against" comment for each if possible

Strategy	Action	Evaluation
Altering human activities causing the pollution	Replace fossil fuels by using alternatives such as ethanol to run cars and renewable energy sources for electricity	Also reduces CO ₂ emissions Fossil fuel reliant economy Power demands increasing
	Use low sulphur fuels, remove sulphur before burning or burn mixed with limestone.	Adds expense Does not reduce CO ₂
Regulate and reduce at point of emission	Clean-up technologies at end of pipe locations eg. scrubbing in chimneys to remove SO ₂	Expensive - cost passed to consumer
	Catalytic converters to convert nitrous oxides back to nitrogen gas.	Catalyser, although initially expensive, are most effective if well maintained
Clean-up and restore	Liming acidified lakes and forests	Costly and needs to be repeated although effective
	Recolonize damaged area	Impacts biodiversity
	International agreements	These are difficult to establish and monitor.

