**Understandings, Applications and Skills** (This is what you may be assessed on)

**Significant ideas**

* Acid deposition can impact living systems and the built environment.
* The pollution management of acid deposition often involves cross-border issues.

**Big Questions:**

* To what extent have the solutions emerging form this topic been directed at preventing environmental impacts, limiting the extent of the environmental impacts, or restoring systems in which environmental impacts have already occurred?
* How are the issues addressed in this topic of relevance to sustainability or sustainable development?
* In what ways might the solutions explored in this topic alter your predictions for the state of human societies and the biosphere some decades from now?
* To what extent is acidification yesterdays problem? Why has acidification declined in certain regions?
* Examine the relationship between acidification and sustainability
* In what ways is acidification likely to change over the next decades?

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| --- | --- | --- |
|  | **Statement** | **Guidance** |
| 6.4.U1 | The combustion of fossil fuels produces sulfur dioxide and oxides of nitrogen as primary pollutants. These gases may be converted into secondary pollutants of dry deposition (such as ash and dry particles) or wet deposition (such as rain and snow). | The use of chemical symbols, formula or equations is not required |
| 6.4.U2 | The possible effects of acid deposition on soil, water and living organisms include:   * direct effect—for example, acid on aquatic organisms and coniferous forests * indirect toxic effect—for example, increased solubility of metal (such as​ aluminium ions) on fish * indirect nutrient effect—for example, leaching of plant nutrients. |  |
| 6.4.U3 | The impacts of acid deposition may be limited to areas downwind of major industrial regions but these areas may not be in the same country as the source of emissions. | Possible case studies of intergovernmental situations involving acid deposition to  consider include the USA Midwest and Eastern Canada interaction, as well as  the impact of industrial Britain, Germany and Poland on Sweden. |
| 6.4.U4 | Pollution management strategies for acid deposition could include:   * altering human activity—for example, through reducing use, or using alternatives to, fossil fuels; international agreements and national governments may work to reduce pollutant production through lobbying * regulating and monitoring the release of pollutants—for example, through the use of scrubbers or catalytic converters that may remove sulfur dioxide and oxides of nitrogen from coal-burning powerplants and cars. |  |
| 6.4.A1 | Evaluate pollution management strategies for acid deposition. | Reference to Figure 3 Pollution Management] |

6.4.U1 The combustion of fossil fuels produces sulfur dioxide and oxides of nitrogen as primary pollutants. These gases may be converted into secondary pollutants of dry deposition (such as ash and dry particles) or wet deposition (such as rain and snow).

1. What pH are acids?
2. Define acid?
3. Identify the color on a pH indicator identifies an acid.

Watch the video clip on Acid Rain <https://www.youtube.com/watch?v=Nf8cuvl62Vc&feature=emb_logo>

1. State why most rain is acidic?

1. State the differences between wet and dry deposition.
2. Give examples of each of the following:

|  |  |
| --- | --- |
| Term | Example |
| Type of acid deposition |  |
|  |
| Primary pollutants |  |
|  |
| Secondary pollutants |  |
|  |

6.4.U2 The possible effects of acid deposition on soil, water and living organisms include:

* + direct effect—for example, acid on aquatic organisms and coniferous forests
  + indirect toxic effect—for example, increased solubility of metal (such as aluminium ions) on fish
  + indirect nutrient effect—for example, leaching of plant nutrients.

1. Give examples of each of the following:

|  |  |
| --- | --- |
| Term | Example |
| Direct effect |  |
|  |
| Indirect toxic effect |  |
|  |
| Indirect nutrient effect |  |
|  |

6.4.U3 The impacts of acid deposition may be limited to areas downwind of major industrial regions but these areas may not be in the same country as the source of emissions.

Acid deposition can impact living systems and the built environment



1. Reference the image on the right. Evaluate the differences between acid rain in the eastern part of the United States than the west. Justify your reasoning

6.4.U4 Pollution management strategies for acid deposition could include:

* + altering human activity—for example, through reducing use, or using alternatives to, fossil fuels; international agreements and national governments may work to reduce pollutant production through lobbying
  + regulating and monitoring the release of pollutants—for example, through the use of scrubbers or catalytic converters that may remove sulfur dioxide and oxides of nitrogen from coal-burning powerplants and cars.

6.4.A1 Evaluate pollution management strategies for acid deposition.

Thing to consider when evaluating

* Acid deposition travels with wind and water vapor in the atmosphere
* The additional environmental impacts of cleaning up emissions e.g. mining, baking and transporting of limestone
* Monitoring and identify sources may be difficult, as they are often non-point
* Intergovernmental agreements often require proof and appropriate compensation

Altering human activity

Watch the video clip on Cap and Trade https://www.youtube.com/watch?v=pA6FSy6EKrM

Evaluate the effectiveness of Cap and Trade

Regulating and monitoring

Cleanup and Restoration

Watch the video on reducing acid rain <https://www.youtube.com/watch?time_continue=137&v=VILCk2CpUCw&feature=emb_logo>

Evaluate International and regional cooperation in pollution management involving acid deposition. Consider the following

* Canada affected by acid deposition from the USA.
* Sweden and Norway affected by acid deposition from Poland, Germany and UK.
* China

Identify, discuss and evaluate three of the strategies below for managing acid deposition. What are their strengths and limitations? Present your findings to the class in a 3-minute presentation

* Switch to renewable energy sources (reduce fossil fuel use)
* Increase energy efficiency (Better light bulbs and appliances)
* More public transportation (fewer automobiles on the road)
* Use low-sulfur fuels\install scrubbers on smokestacks of coal-fired power plants to remove SO2
* Catalytic converters installed on automobiles to remove SO2 and NOx
* Add lime to acidified lakes and streams
* Add lime to forestry plantations

Examples of Evaluations

(Strategy) Replace car transport with low emission transport such as bicycles, electric vehicles, alternative energy driven transportation. – (Evaluation) Need to encourage bicycle use through sharing stations – requires public investment (low cost) and needs to be within easy reach.

(Strategy) Car pooling – (Evaluation) Reduces cars on road but requires people to change habits and organize time with others.

(Strategy) Improving public transportation networks – (Evaluation) Expensive but very effective. Some resistance may come from political beliefs against a social way of living.

(Strategy) Encouraging home-working to reduce transportation requirements. – (Evaluation) May reduce peoples’ social contact causing depression.

(Strategy) Reduce the sulfur content of fossil fuels – (Evaluation) Can be anthropocentric if government requires the sulphur content to be reduced. This has been the most successful way of reducing acid deposition in the US.

(Strategy) Use catalytic converters on car exhausts. – (Evaluation) Catalysts need replacing frequently.

(Strategy) Restocking of lakes after remediation. – (Evaluation) Needs careful management and unlikely to restore the same ecosystem that existed prior to the pollution event due to the nature of complex systems and alternate stable state theory.

ESS can be like learning a new language. So many words are not commonly used in everyday English. This can be challenging. To help you keep up with ESS Terms, you will need to create your own ESS DICTIONARY. You should add to this over the year and keep it in your notebook or on a page file THAT YOU CAN UPDATE AND ADD TO EASILY. Most of the vocabulary words can be found either on your STUDY GUIDE or at mrgscience.com.

You will be responsible for leaning the words and their meaning. Periodic quizzes will be given on the words. So, make your dictionary creative and you will remember the words more easily.

**KEY TERMS**

Acidification

wet deposition

direct effects

regulate

nutrient effect

lichen

public transport

acid precipitates

dry deposition

toxic effects

catalytic converters

hydrogen ion

indicator species

combustion

sulfur dioxide

primary pollutant

nutrient effect

scrubbers

pH

water cycle

sulfur fuels

​ organisms

secondary pollutant

restore

burnt tree

geological effect

fossil fuels

acid deposition

nitric acid

replace

aluminium ion

toxic effect

lime