IB ESS YEAR 2 - Unit 3 Atmospheric Systems and Societies

Teacher(s)	IB ESS PLC	**Subject Group and Course**	Group 4 - ESS		
Course Part and Topic	Topic 6 Atmospheric Systems and Societies	**SL or HL / Year 1 or 2**	SL Year 2	**Dates**	5 weeks
Unit Description and Texts		**DP Assessment(s) for Unit**			
• Oxford Textbook Topic 6 • Topic 6.1 Intro to the Atmosphere • Topic 6.2 Stratospheric Ozone • Topic 6.3 Photochemical Smog • Topic 6.4 Acid Deposition		• Formative/Summative assessment quizzes and activities/reports to check for understanding - Based in IB exam questions and format			

INQUIRY: establishing the purpose of the unit

Transfer Goals

List here one to three big, overarching, long-term goals for this unit. Transfer goals are the major goals that ask students to "transfer" or apply their knowledge, skills, and concepts at the end of the unit under new/different circumstances, and on their own without scaffolding from the teacher.

Statement of Inquiry
The atmosphere is a dynamic system that is essential to life on Earth.

Phenomenon: Changing atmosphere affects how much water trees need.

CCC: Patterns/Energy and Matter/Stability and Change/ Cause and Effect/ Systems and System Models

Core Ideas: Atmosphere/Atmospheric Compositions/ozone/UV radiation/Human activities contributing to ozone depletion/pollution management/photochemical smog/acid deposition

Review Significant Ideas

- The atmosphere is a dynamic system that is essential to life on Earth.
- The behaviour, structure and composition of the atmosphere influence variations in all ecosystems.
- Stratospheric ozone is a key component of the atmospheric system because it protects living systems from the negative effects of ultraviolet radiation from the Sun.
- Human activities have disturbed the dynamic equilibrium of stratospheric ozone formation.
- Pollution management strategies are being employed to conserve stratospheric ozone.
- The combustion of fossil fuels produces primary pollutants that may generate secondary pollutants and lead to photochemical smog, the levels of which can vary by topography, population density and climate.
- Photochemical smog has significant impacts on societies and living systems.
- Photochemical smog can be reduced by decreasing human reliance on fossil fuels.
- Acid deposition can impact living systems and the built environment.
- The pollution management of acid deposition often involves cross-border issues.

ACTION: teaching and learning through inquiry

Content / Skills / Concepts - Essential Understandings	**Learning Process** *Check the boxes for any pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.*
<u>Students will know the following content: Understandings and Knowledge</u> <u>6.1 Intro to the Atmosphere</u> ● The atmosphere is a dynamic system (with inputs, outputs, flows and storages) that has undergone changes throughout geological time. ● The atmosphere is predominantly a mixture of nitrogen and oxygen, with smaller amounts of carbon dioxide, argon, water vapour and other trace gases. ● Human activities impact atmospheric composition through altering inputs and outputs of the system. Changes in the concentrations of atmospheric gases—such as ozone, carbon dioxide, and water vapour—have significant effects on ecosystems. ● Most reactions connected to living systems occur in the inner layers of the atmosphere, which are the troposphere (0–10 km above sea level) and the	Learning experiences and strategies/planning for self-supporting learning: ☒ Lecture □ Socratic seminar ☒ Small group/pair work ● Atmospheric Composition Webquest ● Global Warming and the Greenhouse Effect Reexamined

stratosphere (10–50 km above sea level). ● Most clouds form in the troposphere and play an important role in the albedo effect of the planet. ● The greenhouse effect of the atmosphere is a natural and necessary phenomenon maintaining suitable temperatures for living systems. <u>6.2 Stratospheric Ozone</u> ● Some ultraviolet radiation from the Sun is absorbed by stratospheric ozone causing the ozone molecule to break apart. Under normal conditions the ozone molecule will reform. This ozone destruction and reformation is an example of a dynamic equilibrium. ● Ozone depleting substances (including halogenated organic gases such as chlorofluorocarbons—CFCs) are used in aerosols, gas-blown plastics, pesticides, flame retardants and refrigerants. Halogen atoms (such as chlorine) from these pollutants increase destruction of ozone in a repetitive cycle, allowing more ultraviolet radiation to reach the Earth. ● Ultraviolet radiation reaching the surface of the Earth damages human living tissues, increasing the incidence of cataracts, mutation during cell division, skin cancer and other subsequent effects on health. ● The effects of increased ultraviolet radiation on biological productivity include damage to photosynthetic organisms, especially phytoplankton, which form the basis of aquatic food webs. ● Pollution management may be achieved by reducing the manufacture and release of ozone-depleting substances. Methods for this reduction include: ○ developing alternatives to gas-blown plastics, halogenated pesticides, propellants and aerosols ○ developing non-propellant alternatives. ● UNEP has had a key role in providing information, and creating and evaluating international agreements, for the protection of stratospheric ozone. ● An illegal market for ozone-depleting substances persists and requires consistent monitoring. ● The *Montreal Protocol on Substances that Deplete the Ozone Layer* (1987)and subsequent updates is an international agreement for the reduction of use of ozone-depleting substances signed under the direction of UNEP. National governments complying with the agreement made national laws and regulations to decrease the consumption and production of halogenated organic gases such as	☒ PowerPoint lecture/notes: ● Flipped Notes and Videos in Schoology ☒ Individual presentations ● Human Impact Essay ☒ Group presentations ● Case Studies - Ozone, Photochemical Smog, and Acid Deposition ● Pollution Management Strategies Evaluations ☒ Student lecture/leading □Interdisciplinary learning Details: *Students will learn through a combination of presentations, team/small group work, activities surrounding threats to and conservation of biodiversity.* Other(s): Use of social media - Instagram/Twitter for increased awareness - creation of a children's book, game, etc to inform the younger generation of issues surrounding biodiversity **Formative assessment(s):** Quizzes In class activities Case studies Research assignments **Guidance:**

chlorofluorocarbons (CFCs). 6.3 Photochemical Smog ● Primary pollutants from the combustion of fossil fuels include carbon monoxide, carbon dioxide, black carbon or soot, unburned hydrocarbons, oxides of nitrogen, and oxides of sulfur. ● In the presence of sunlight, secondary pollutants are formed when primary pollutants undergo a variety of reactions with other chemicals already present in the atmosphere. ● Tropospheric ozone is an example of a secondary pollutant, formed when oxygen molecules react with oxygen atoms that are released from nitrogen dioxide in the presence of sunlight. ● Tropospheric ozone is highly reactive and damages plants (crops and forests), irritates eyes, creates respiratory illnesses and damages fabrics and rubber materials. Smog is a complex mixture of primary and secondary pollutants, of which tropospheric ozone is the main pollutant. ● The frequency and severity of smog in an area depends on local topography, climate, population density, and fossil fuel use. ● Thermal inversions occur due to a lack of air movement when a layer of dense, cool air is trapped beneath a layer of less dense, warm air. This causes concentrations of air pollutants to build up near the ground instead of being dissipated by “normal” air movements. ● Deforestation and burning may also contribute to smog. ● Economic losses caused by urban air pollution can be significant. ● Pollution management strategies include: ○ altering human activity to consume less fossil fuels—example activities include the purchase of energy-efficient technologies, the use of public or shared transit, and walking or cycling ○ regulating and reducing pollutants at the point of emission through government regulation or taxation ○ using catalytic converters to clean the exhaust of primary pollutants from car exhaust ○ regulating fuel quality by governments ○ adopting clean-up measures such as reforestation, regreening, and conservation of areas to sequester carbon dioxide. 6.4 Acid Deposition	**Students should recognize the atmosphere as a dynamic system. The composition of the atmosphere has changed throughout geological history. Living organisms (biotic components) have transformed the atmospheric composition of the Earth and vice versa throughout history.** **The use of chemical symbols or chemical formulae for atmospheric gases, ozone destruction, photochemical smog, and acid deposition is not required.** **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.**

- 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 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 aluminum ions) on fish
    - indirect nutrient effect—for example, leaching of plant nutrients.
- 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.
- 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 power plants and cars.
- Clean-up and restoration measures may include spreading ground limestone in acidified lakes or recolonization of damaged systems—but the scope of these measures is limited.

<u>Students will develop the following Applications & Skills:</u>

- **Discuss** the role of the albedo effect from clouds in regulating global average temperature.
- **Outline** the role of the greenhouse effect in regulating temperature on Earth.
- **Evaluate** the role of national and international organizations in reducing the emissions of ozone-depleting substances.
- **Evaluate** pollution management strategies for reducing photochemical smog.
- **Evaluate** pollution management strategies for acid deposition.

International Mindedness:

Impact to the atmosphere from pollutants can be localized, as evidenced by the destruction of the ozone layer over the poles of the Earth.

Pollutants released to the atmosphere are carried by currents in the atmosphere and may create damage in a location other than where they are produced.

The depletion of ozone has global implications to ocean productivity and oxygen production.

National economic approaches may have an impact on international environmental discussions.

The global rise of urbanization and industrialization has led to an increase in urban air pollution.

The polluting country and the polluted country are often not the same: acid deposition affects regions far from its source. Therefore, solving this issue requires international cooperation.

Summative assessments:
Group project
Summative assessment over each subtopic and over Topic 7 all

Differentiation:

☒ Affirm identity - build self-esteem

☒ Value prior knowledge

☒ Scaffold learning

☒ Extend learning

Details:

- *SWD/504 – Accommodations Provided*
- *ELL – Reading & Vocabulary Support*
- *Intervention Support*
- *Extensions – Enrichment Tasks and Project*

Approaches to Learning (ATL)

Check the boxes for any explicit approaches to learning connections made during the unit. For more information on ATL, please see the guide.

☒ Thinking

☒ Social

☒ Communication

☒Self-management

☒ Research

Details: This topic provides students with a vast amount of information that can be studied in many ways. The ATLs used for this subtopic will vary

depending on the individual students and groups approach to showing their understanding of the material

SEP: Asking Questions and Defining Problems/Engage in Argument from Evidence

Language and Learning *Check the boxes for any explicit language and learning connections made during the unit. For more information on the IB's approach to language and learning, please see the guide.*	**TOK Connections** *Check the boxes for any explicit TOK connections made during the unit*	**CAS Connections** *Check the boxes for any explicit CAS connections. If you check any of the boxes, provide a brief note in the "details" section explaining how students engaged in CAS for this unit.*
☒ Activating background knowledge ☒ Scaffolding for new learning ☒ Acquisition of new learning through practice □ Demonstrating proficiency Details: *Students will acquire new vocabulary dealing with climate change and the impacts humans have on climate* *Connections:* *ESS:Energy and equilibria (1.3); humans and pollution (1.5); resource use in society (8.2); communities and ecosystems (2.2); investigating ecosystems (2.5); systems and models (1.2); introduction to water systems (4.1); introduction to soil systems (5.1); biomes, zonation and succession (2.4);climate change—causes and impacts (7.2)*	☒ Personal and shared knowledge ☒ Ways of knowing ☒ Areas of knowledge ☒ The knowledge framework Details: The atmosphere is a dynamic system—how should we react when we have evidence that does not fit with an existing theory? The Montreal Protocol was an international agreement created by the UN— can one group or organization decide what is best for the rest of the world? Environmental problems are often emotive—under what circumstances should we maintain a detached relationship with the subject matter under investigation? To what extent does the recognition of the ethical responsibility of knowledge influence the further production or acquisition of knowledge?	☒ Creativity ☒ Activity ☒ Service Details: *Continue recycling and composting initiatives* *Encourage carpooling or taking alternate transportation to reduce carbon footprint*

Resources *List and attach (if applicable) any resources used in this unit*
• Oxford Environmental Systems and Societies ISBN 978-0-19-833256-5 • Biozone Environmental Science Student Workbook ISBN 978-1-927173-55-8 • Hodder Education Environmental Systems and Societies Study and Revision Guide ISBN 978-1-471-89973-7 • IB ESS Schoology Group

REFLECTION: considering the planning, process, and impact of the inquiry

What worked well *List the portions of the unit (content, assessment, planning) that were successful*	**What didn't work well** *List the portions of the unit (content, assessment, planning) that were not as successful as hoped*	**Notes / Changes / Suggestions** *List any notes, suggestions, or considerations for the future teaching of this unit*