Unit 9: Air Pollution

Content Area: **Science**
Course(s):
Time Period: **Marking Period 4**
Length: **2 weeks**
Status: **Published**

Summary

In this unit students will explore the major types of air pollution. The unit will address the sources of each pollutant and how the pollutants affect the environment. Major topics in this unit include acid deposition, ozone depletion, climate change and photochemical smog. Particular attention will be paid to air pollution problems in urban areas and methods for mitigating the problems caused by it.

Revised July 2021

CS.9-12.8.2.12.EC.1	Analyze controversial technological issues and determine the degree to which individuals, businesses, and governments have an ethical role in decisions that are made.
CS.9-12.8.2.12.EC.2	Assess the positive and negative impacts of emerging technologies on developing countries and evaluate how individuals, non-profit organizations, and governments have responded.
CS.9-12.8.2.12.EC.3	Synthesize data, analyze trends, and draw conclusions regarding the effect of a technology on the individual, culture, society, and environment and share this information with the appropriate audience.
CS.9-12.8.2.12.ETW.4	Research historical tensions between environmental and economic considerations as driven by human needs and wants in the development of a technological product and present the competing viewpoints.
LA.SL.11-12.1.A	Come to discussions prepared, having read and researched material under study; explicitly draw on that preparation by referring to evidence from texts and other research on the topic or issue to stimulate a thoughtful, well reasoned exchange of ideas.
LA.SL.11-12.1.B	Collaborate with peers to promote civil, democratic discussions and decision-making, set clear goals and assessments (e.g., student developed rubrics), and establish individual roles as needed.
LA.SL.11-12.1.C	Propel conversations by posing and responding to questions that probe reasoning and evidence; ensure a hearing for a full range of positions on a topic or issue; clarify, verify, or challenge ideas and conclusions; and promote divergent and creative perspectives.
MA.S-IC.B.3	Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.
MA.S-ID.A.1	Represent data with plots on the real number line (dot plots, histograms, and box plots).
SCI.HS-ESS3-4	Evaluate or refine a technological solution that reduces impacts of human activities on climate change and other natural systems.
SCI.HS-ESS3-6	Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity (i.e., climate change).
SCI.HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and climate change have influenced human activity.
SCI.HS-ESS3-5	Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated

	future impacts to Earth systems.
TECH.9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources (e.g., NJSLSA.W8, Social Studies Practice: Gathering and Evaluating Sources.
TECH.9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience (e.g., S-ID.B.6b, HS-LS2-4).
TECH.9.4.12.IML.5	Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).
TECH.9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).
TECH.9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change (e.g., NJSLSA.W1, 7.1.AL.PRSNT.4).
	When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.
	Gradual atmospheric changes were due to plants and other organisms that captured carbon dioxide and released oxygen.
	Changes in the atmosphere due to human activity have increased carbon dioxide concentrations and thus affect climate.
	Examples of Earth systems to be considered are the hydrosphere, atmosphere, cryosphere, geosphere, and/or biosphere. An example of the far-reaching impacts from a human activity is how an increase in atmospheric carbon dioxide results in an increase in photosynthetic biomass on land and an increase in ocean acidification, with resulting impacts on sea organism health and marine populations.
	Current models predict that, although future regional climate changes will be complex and varied, average global temperatures will continue to rise. The outcomes predicted by global climate models strongly depend on the amounts of human-generated greenhouse gases added to the atmosphere each year and by the ways in which these gases are absorbed by the ocean and biosphere.
	Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.
	Examples of data on the impacts of human activities could include the quantities and types of pollutants released, changes to biomass and species diversity, or areal changes in land surface use (such as for urban development, agriculture and livestock, or surface mining). Examples for limiting future impacts could range from local efforts (such as reducing, reusing, and recycling resources) to large-scale geoengineering design solutions (such as altering global temperatures by making large changes to the atmosphere or ocean).
	Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).
	Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.
	Emphasis is on using data to provide evidence for how specific biotic and abiotic differences in ecosystems (such as ranges of seasonal temperature, long-term climate change, acidity, light, geographic barriers, or evolution of other organisms) contribute to a

change in gene frequency over time, leading to adaptation of populations.

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Emphasis is on quantitative analysis and comparison of the relationships among interdependent factors including boundaries, resources, climate, and competition. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered from simulations or historical data sets.

Examples of key natural resources include access to fresh water (such as rivers, lakes, and groundwater), regions of fertile soils such as river deltas, and high concentrations of minerals and fossil fuels. Examples of natural hazards can be from interior processes (such as volcanic eruptions and earthquakes), surface processes (such as tsunamis, mass wasting and soil erosion), and severe weather (such as hurricanes, floods, and droughts). Examples of the results of changes in climate that can affect populations or drive mass migrations include changes to sea level, regional patterns of temperature and precipitation, and the types of crops and livestock that can be raised.

Examples should include climate feedbacks, such as how an increase in greenhouse gases causes a rise in global temperatures that melts glacial ice, which reduces the amount of sunlight reflected from Earth's surface, increasing surface temperatures and further reducing the amount of ice. Examples could also be taken from other system interactions, such as how the loss of ground vegetation causes an increase in water runoff and soil erosion; how dammed rivers increase groundwater recharge, decrease sediment transport, and increase coastal erosion; or how the loss of wetlands causes a decrease in local humidity that further reduces the wetland extent.

Design or refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Humans depend on the living world for the resources and other benefits provided by biodiversity. But human activity is also having adverse impacts on biodiversity through overpopulation, overexploitation, habitat destruction, pollution, introduction of invasive species, and climate change. Thus, sustaining biodiversity so that ecosystem functioning and productivity are maintained is essential to supporting and enhancing life on Earth. Sustaining biodiversity also aids humanity by preserving landscapes of recreational or inspirational value.

Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation.

Essential Questions and Enduring Understandings

Essential Questions:

How has technology changed the relationship between human beings and the atmosphere?

In what ways is the atmosphere important for biodiversity and human survival?

How are land based and aquatic ecosystems impacted by air pollution issues created by humans?

What impact will air pollution problems have on our long term ability to feed a growing human population?

Enduring Understandings:

All air pollution issues are the result of human activity, especially the large scale combustion of fossil fuels.

Air pollution issues will impact global biodiversity, human health, planetary systems and our ability to provide food and water to people around the world.

Objectives

Students will know that air pollutants are categorized into 7 major classes due to their compositions and effects, and know the source and effect of each pollutant.

Students will know the phenomenon of ozone depletion along with its causes, environmental impacts and effects on humans.

Students will know that urban areas are susceptible to air pollution issues.

Students will know the processes that form acid rain, as well as the environmental impact of this phenomenon.

Students will know the process of photochemical smog formation, its impacts, and why cities like LA and Mexico City are the most impacted by it.

Students will be skilled at identifying the secondary impacts on the environment and humans of acid rain, ozone depletion and smog.

Students will be skilled at describing methods for reducing the impact of these pollutants on the environment and human health.

Learning Plan

Complete homework assignments consisting of 3-5 textbook questions, web based assignments or using outside resources

Guided PPT and class discussion: What is Air Pollution? Primary vs Secondary Pollutants and 7 major categories.

Independent reading and notes: Air Pollutant categories, sources and impacts

Video and independent reading assignment: Photochemical smog - LA and Mexico City

Case Study worksheet: Los Angeles and Air Quality Problems

Guided PPT and discussion: Ozone Depletion

Independent research: Impacts of Ozone loss and Global Distillation Effect

Reading and Worksheet: Acid deposition - causes and major impacts on ecosystems and agriculture

Guided PPT: Urban Air Pollution problems and strategies for mitigation

Video: An Inconvenient Truth with class discussion

Indoor Air Pollution - sources and health impacts

Assessment

Formative Assessments:

- Worksheets
- Do Nows
- Exit Tickets
- Class Discussions

Quizzes:

- Acid Rain and Ozone Depletion
- Urban Air pollution and Photochemical Smog

Bench Marks:

SGO, Midterm and Final Exam

Alternative:

- Guided PPT and class discussion: WHat is Air Pollution? Primary vs Secondary Pollutants and 7 major categories.
- Independent reading and notes: Air Pollutant categories, sources and impacts
- Video and independent reading assignment: Photochemical smog - LA and Mexico City
- Case Study worksheet: Los Angeles and Air Quality Problems
- Guided PPT and discussion: Ozone Depletion
- Independent research: Impacts of Ozone loss and Global Distillation Effect
- Reading and Worksheet: Acid deposition - causes and major impacts on ecosystems and agriculture

- Guided PPT: Urban Air Pollution problems and strategies for mitigation

Summative:

Unit Tests:

- Air Pollution: Major Categories, Ozone Depletion, Acid Rain, Smog and Urban Air Quality Issues

Materials

Raven & Berg Evnironment Textbooks (ISBN: 978-1-119-39341-2)

Guided note packets (teacher developed)

Technology (student & teacher laptops, SmartBoard)

PowerPoints

Workshets/notes

Youtube/Netflix

Air Quality Test Kit

Globe and World Map

Suggested Strategies for Modification

https://docs.google.com/spreadsheets/d/1P8BzKodtBsbWi4rQ0tunGWhZkCOg52IvbNO7yy-TFJI/edit?usp=sharing