



WABS ACCESS STEM PBL Unit/Lesson Plan

UNIT OVERVIEW

Title of PBL Unit: Climate Change

Target Grade Level(s): 9-12

Subject(s): Science and Engineering

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Problem Statement: As atmospheric CO₂ levels and global temperatures increase, urban populations around the world continue to grow. As these cities develop, it will be important to prepare them for increased temperatures, and transform them into carbon-neutral areas. What products, building designs, materials and processes could help the cities of the future prepare for and mitigate climate change?

Unit Overview and Table of Contents:

Unit Opener: Pre-assess: What is climate change? What do you know about climate change? What causes climate change? Hook: Climate Change Glasgow 2021 Recap/Greta Thunberg

Lesson 1 (Science only): Carbon Cycle - How does Carbon move from the atmosphere to living things; role of land and ocean in sequestering carbon, nature of fossil fuels.

Lesson 2: Global Warming and Climate Change - What evidence do we have that carbon dioxide levels are increasing? What is the impact on climate and human life?

Lesson 3 (multiple days): Student Research (small groups): Proposing/designing solutions or mitigations for climate change

Concluding Lesson: Student Group Presentations, Peer Review

Standards:

NGSS HS LS2-5,7 Ecosystems: Interactions, Energy, and Dynamics; HS ESS 3-1,4-6: Earth and Human Activity; ETS 1-1-4 Engineering Design

21st-Century Skills: Critical Thinking, Creativity, Collaboration, Communication, Information Literacy, Media Literacy, Technology Literacy, Flexibility

Locally and/or Personally Relevant for Students: King County

Connections to Career and Educational Pathways: STEM, Agriculture and Natural Resources, Skilled and Technical Sciences, Health Sciences, Human Services, Business and Marketing.

LESSON 1 OVERVIEW

Lesson Number and Title: #1 Carbon Cycle

Problem Statement: How is carbon recycled through the environment through natural means, and what role have humans played in the addition of carbon to the atmosphere?

Lesson Objectives:

Describe the movement of carbon atoms in carbon dioxide from the atmosphere through living things, and the role of the land and ocean as carbon sinks.

Know the nature of fossil fuels and the result of the burning of fossil fuels on atmospheric carbon levels.

Lesson Standards:

HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere

HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

Materials:

Carbon Cycle Explanatory Video (Version 1,2 or similar choice)

Version 1: [Carbon Cycle Video 1](#)

Version 2: [Carbon Cycle Video Version 2](#)

Alternative option: teacher lecture/ppt

Student Activity: Carbon Cycle Game (Version 1,2 or similar choice)

Source Version 1: [Carbon Cycle Game Version 1](#)

Source Version 2: [Carbon Cycle Game Version 2](#)

Lesson 21st-Century Skills: Critical Thinking, Communication, Information Literacy, Flexibility

Lesson-Connections to Career and Educational Pathways: Natural Resources

LESSON PREPARATION

Time Required: 45-70 minutes

Grouping of Students for Instruction: whole class, individual or pairs/small groups

What is the instruction?

Bell Opener: (Connect to prior knowledge): What is the role of CO₂ in living organisms? (Students should be able to describe the process of photosynthesis by producers which utilizes CO₂ from the atmosphere and the production of CO₂ by all living things during cellular respiration. Review if needed.)

Student Instruction: Carbon Cycle Lecture or Inquiry/Lecture

Direct instruction (video, ppt or lecture). Students learn that carbon is not only passed from producers to consumers/decomposers to return to the atmosphere but can be sequestered in the land or ocean (carbon sinks) and formed into fossil fuels.

Alternative or supplemental inquiry activity: Students can explore the Carbon Cycle Gizmo to trace the path of carbon through the ecosystem (or use a diagram such as from the following example source if Gizmo access is not available). Example: [Carbon Cycle Diagram](#)

Student Activity/Activities (one or both time depending):

Option 1: Carbon Cycle game: Students act out the role of a carbon atom and follow it on a journey through the ecosystem. (See materials for 2 version sources, others available online)

Option 2: Poster/Diagram

Students draw a diagram/poster illustrating their carbon atom journey from the game in Part 2.

Alternative: Students illustrate the journey of a carbon atom from (any example source) to (any example destination). Various sources/destinations can be assigned.

Possible Accommodations:

Student note template can be provided for the lecture.

Teacher can model carbon cycle game and/or lead students through an example(s).

Students can work individually or in pairs/groups to complete activities.

Possible Extensions: see above

Possible Assessment:

Exit ticket: Name 3 potential future destinations for a carbon atom in the atmosphere.

References and Resources: included above

LESSON 2 OVERVIEW

Lesson Number and Title: #2 Climate Change

Problem Statement: What evidence do we have that atmospheric carbon dioxide levels have increased? How have increasing concentrations of CO₂ in the atmosphere affected Earth's climate and human life?

Lesson Objectives: Analyze data on CO₂ concentration in the atmosphere over time. Identify sources of CO₂ and other greenhouse gasses. Make a prediction about future CO₂ levels (without any change in human behavior). Investigate current and projected environmental impacts to rising global temperatures.

Lesson Standards: NGSS HS LS2-7 Ecosystems: Interactions, Energy, and Dynamics; HS ESS 3-1,4,5 Earth and Human Activity

Materials:

Lesson Material adapted from the following source: [At the Core of Climate Change](#)

Student investigation reporting template (1 per student)

One class set of 4 Station Cards with instructions (2 Graphs/Maps, 1 Station Instructions card per station) containing environmental impact data for student analysis including: 1/2) Graph/Global map of rising mean global temperature 3/4) Graph/Map of Rising Sea Levels 5/6) Graph/Location images of melting glaciers 7/8) Graphs of increasing severe weather events

Lesson 21st-Century Skills: Critical Thinking, Collaboration, Communication, Information Literacy, Media Literacy, Technology Literacy, Flexibility

Lesson-Locally and/or Personally Relevant for Students: Pacific Northwest

Lesson-Connections to Career and Educational Pathways: STEM, Natural Resources, Skilled and Technical Sciences

LESSON PREPARATION

Time Required: 45-70 minutes

Grouping of Students for Instruction: whole class, and individual, pairs or small groups

What is the instruction?

Bell Opener: What do you know about climate change?

Student Instruction and Activity:

How do we know that CO₂ levels have increased over time? Gathering evidence from ice cores (Video: 20 min and/or alternative ppt: [At the Core of Climate Change](#)) Followed by activity where students will visit four stations to gather information on climate change, and global and local impacts to the environment and human quality of life due to rising global temperatures. Students will turn in a reporting template with a summary of what they concluded by looking at the station evidence.

Whole Class Discussion (time permitting): Students will share what they learned visiting the stations, and/or comment on local or personal impacts of climate change.

(Future Lesson)

Student Research: Proposing solutions: <https://www.drawdown.org/> Students will use site for webquest to explore possible solutions or mitigations to climate change or the effects of climate change.

Possible Accommodations:

Students can visit stations in pairs or groups.

Student reporting template may contain scaffolding or sentence starters.

Possible Extensions: Investigate a local health impact of climate change (heat wave, wildfires).

Possible Assessment:

Exit ticket: Pick 3 solutions you think would have the greatest impact on either reducing, mitigating, or adapting to climate change.

References and Resources: [At the Core of Climate Change](#)

LESSON 3 OVERVIEW

Lesson Number and Title: #3 Proposing or Designing Solutions to Climate Change

Problem Statement: What products, building designs, materials and processes could help the cities of the future prepare for and mitigate climate change?

Lesson Objectives: Investigate solutions/mitigations to climate change and/or means of adapting to rising global temperatures.

Lesson Standards: NGSS HS LS2-7 Ecosystems: Interactions, Energy, and Dynamics; HS ESS 3-1,4,5 Earth and Human Activity

Materials:

(Optional: intro ppt/video on climate change)

Student Research: <https://www.drawdown.org/> Students will use this site as a launching point for a webquest to explore possible solutions or mitigations to climate change or the effects of climate change.

Presentation/Project Instructions and Rubric (see below)

Lesson 21st-Century Skills: Critical Thinking, Collaboration, Communication, Information Literacy, Media Literacy, Technology Literacy, Flexibility

Lesson-Locally and/or Personally Relevant for Students: Pacific Northwest

Lesson-Connections to Career and Educational Pathways: STEM, Natural Resources, Skilled and Technical Sciences, Health Sciences, Human Services, Business and Marketing.

LESSON PREPARATION

Time Required: 45-70 minutes

Grouping of Students for Instruction: whole class, and individual, pairs or small groups

What is the instruction?

Bell Opener: Name one strategy that humans can use to reduce the effects of global warming. (Elicit

what students already know is being done or could be done).

Student Instruction Day 1:

Optional: Teacher will begin with ppt or video review of effects of climate change and/or what is being done to address this issue currently.

Teacher will explain student project guidelines and expectations with a provided rubric (see below).

Teacher will model use of site: <https://www.drawdown.org/> to research solutions to climate change

Student Activity Day 1: Students will form or be assigned pairs/groups (or choose to work individually).

Students will use website provided to investigate climate change solutions. Students will choose one solution/mitigation to focus on (option: students sign up with teacher so that each group has a different topic to investigate). Students will use internet to investigate their chosen topic further.

Student Activity Day 2-?: Student will continue research and or research and design. Students will prepare a presentation, model, or proposal which provides background on their solution and why or how it will be be useful to address a climate change problem.

Student Activity Final Day: Students will present their solution or model to whole class. Option: presentations will be done in a format of student choice (can include ppt, video, model, story/skit...) Presentation will be graded by rubric by teacher and by peer review. Subsequently, feedback will be provided to groups.

Possible Accommodations:

Additional sources can be provided for research. Students could be assigned specific topics.

A ppt template can be provided with scaffolding to guide student presentations.

Students can work individually or in groups; roles can be assigned.

Possible Extensions:

Industry Partner Videos, or guest lectures shown prior to student research which outline or model local solutions in action.

Project research can extend to include a design and build extension (engineering).

Possible Assessment:

Presentation or design grading by rubric (see example below):

References and Resources: <https://www.drawdown.org/>

Sample Presentation Rubric:

Level	Content	Organization	Presentation Style
4	<ul style="list-style-type: none"> · Content is appropriate to the action strategy · Presentation addresses each of the specific bullet points for the chosen action strategy 	<ul style="list-style-type: none"> · Presentation is well-organized and understandable · Presenters are knowledgeable and able to answer questions · Presentation time is 5-10 min 	<ul style="list-style-type: none"> · All members demonstrate equal responsibility · Speakers use clear, audible voice · Visual aids are well prepared, relevant, and not too distracting
3	<ul style="list-style-type: none"> · Content is appropriate to the action strategy and answers some of the specific bullet points for the strategy 	<ul style="list-style-type: none"> · Presentation is organized but presenters could have been more prepared 	<ul style="list-style-type: none"> · Speakers and/or audio/visuals are somewhat difficult to understand <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> · Group members do not participate evenly
2	<ul style="list-style-type: none"> · Content is appropriate to the action strategy but answers none of the specific bullet points for the strategy 	<ul style="list-style-type: none"> · Presentation is disorganized and/or presenters not well prepared 	<ul style="list-style-type: none"> · Speakers and/or audio/visuals are difficult to understand <p style="text-align: center;">OR</p> <ul style="list-style-type: none"> · Not all members of group participate
1	<ul style="list-style-type: none"> · Content that is presented is not relevant to the action strategy 	<ul style="list-style-type: none"> · Presentation is extremely disorganized 	<ul style="list-style-type: none"> · Speakers and/or audio/visuals are not understandable