Impacting the Carbon Cycle

Taylor Hyatt, Garden County Schools and
Shauna Roberson, Garden County Schools

Grade Level
9-12

Lesson Length
3 periods x 55 Minutes

Agriculture Careers
Microbiologist, Food Scientist, and Animal Nutritionist

Nebraska Science Standards
SC12.3.1

Next Generation Science Standards
LS1.B

Nebraska Agricultural Science Standards
AFNR.HS.2.2

Learning Environments Alignment


Learner-centered


Knowledge-centered


Assessment-centered


Community-centered

These lessons aim to help students make the connection between scientific, business, economic, environmental, and social issues and a degree in agriculture.

Learning Objectives

By the end of the unit, students should be able to:

- Analyze the cause and effect of their individual carbon footprint.
- Create an individual plan to decrease their own carbon footprint.
- Develop a public service statement for the school website that discusses the need for reduction of carbon footprints not only as an individual but also a community.
- Explain the relationship between CO2 and climate factors.

Materials List

- Computer with internet access
- Carbon Footprint Calculator Investigation
- Drawing paper (8.5 x 11 copier paper one sheet per student)
- Colored pencils
- Carbon Cycle Simulation Investigation
- Carbon Cycle Game Investigation
- Dr. Jin Interview Video
- Carbon Footprint Public Service Announcement Rubric
- Extreme Examples?

Investigation

Students will research the impact of the carbon cycle in their own lives and agriculture in order to make informed decisions on how to reduce their carbon footprint.

Research Question(s)

- How do I personally affect the carbon footprint?
- How does agriculture affect the carbon footprint?
- How does a carbon atom move through the carbon cycle?
- How is the carbon cycle related to global climate change?

Day 1: What is my carbon footprint?

Teachers Does: Teacher will facilitate a discussion about climate change and the carbon cycle .

Discussion Questions:

1) How does climate change impact your life?
2) What is the carbon cycle?

Student Does: Students will think about their own life and share their thoughts through discussion.

1. Teacher will introduce phenomenon by asking students to read the following article about climate change:
   - *Humans will perish in 31 years, warns latest climate change study* by Raj Aditya Chaudhuri
   - https://www.cntraveller.in/story/world-environment-day-humans-will-perish-31-years-warns-latest-climate-change-study/?utm_source=facebook&utm_medium=social&fbclid=IwAR2JSw0dapFG3uebJDR0xV07SvE2-nfTb-7DBD9Zqe-RAqOgaqrm6Eh5D2c
2. Teacher will ask students to share their initial reactions on a white board, in a discussion post in and LMS such as Schoology or have students pair share with a partner.
3. The teacher will use random draw technique, such as tongue depressors, to ask a few random students to share their reactions.
4. Allow students some time to contribute their questions to the question board for this phenomenon.
   - For teacher help use the references:
   - *Playbook for Three Dimensional Science Instruction* by Chad Janowski
     - http://einsteinportal.2bsolutions.net/unit-updates/ngss-playbook/ngss-playbook
   - *Why Do Fishermen Need Forests* by Tom Bielik, Daniel Damelin, and Joseph S. Krajcik
     - https://concord.org/wp-content/uploads/publications/why-do-fishermen-need-forests.pdf
5. The teacher will introduce biogeochemical cycles by asking students to draw a quick model of the water cycle as a review of cycles. Ask students to do a quick gallery walk to view other students' models and discuss the similarities and differences. The teacher will then ask students to make a list

of other cycles that are important to life and the earth. The teacher will prompt student thinking until they have listed the nitrogen cycle, phosphorus, and carbon cycle
   - If needed and time allows Khan Academy's Intro to Biogeochemical Cycles maybe useful
   - https://www.khanacademy.org/science/biology/ecology/biogeochemical-cycles/a/introduction-to-biogeochemical-cycles
6. Teachers will then pass out 8.5 by 11 copier paper for students to create an initial model of the carbon cycle for a rural area. Ask students to include plant and animals of the farms in their model.
7. Teacher will then provide students with the link to the International Student Carbon Footprint Challenge Calculator and then allow them time to complete the calculator and provide assistance when questions arise.
   - Calculator can be used without creating an account
   - https://depts.washington.edu/i2sea/?page=fpcalc
8. Ask students to summarize their carbon footprint calculator results and choose one thing to share that they found surprising and one way that agriculture plays a role in their own carbon footprint.

Reflect (Formative Assessment)

1. White board reactions and discussion about the introduction article.
2. Discuss student generated questions on the question board.
3. List of biogeochemical cycles.
4. Initial drawing of the carbon cycle.
5. Group discussion about the importance of an individual's carbon footprint.
6. Group discussion of factors that impact carbon footprint in agriculture.

Day 2: Modeling the Carbon Cycle

Teacher Does: Teacher will ask students if global carbon dioxide concentration is increasing and if it actually a problem?

Student Does: Students will then respond on a white board, a discussion post in and LMS such as Schoology, or have students pair share with a partner.

1. Students will then look over the data at Global Climate Change and analyze the data. https://climate.nasa.gov/vital-signs/carbon-dioxide/
2. Students will then revise their initial response to the questions posed in step 1.
3. The teacher will use random draw technique, such as tongue depressors, to ask a few random students to share their responses and lead a class discussion.
4. Teacher will then instruct students to complete Pre and Post-Industrial Carbon Cycle Simulation activity and provide guidance, as needed as student complete the activity worksheet. https://sepuplhs.org/high/sgi/teachers/carbon_sim.html This simulation requires Adobe Flash Player if using Chrome as your browser you will need to allow it play. It should run more easily in Firefox or Safari.
5. Complete carbon cycle game https://www.windows2universe.org/earth/climate/carbon_cycle.html See student instruction sheet.

Students will use the evidence from the day's learning activities to discuss whether or not increased carbon dioxide is a problem and if it impacts their daily lives.

Day 3: Creating a Carbon Footprint Public Service Announcement

Introduction

Teacher Does: Teachers will show vaping public service announcement. Then the teacher will ask students to explain the purpose/intent of public service announcements.

Student Does: Students will watch the vaping public service announcement and the participate in discussion.

Learning Activities

1. Students will watch the Virginia Jin Interview and the teacher should discuss what students should look for while watching the interview.
2. Extreme examples of change for reducing carbon footprint - Vegan, composting toilets, off the grid housing, green roofs, unique agriculture methods, mining restoration projects
3. Intro expectation/rubric of individual projects
4. Create a public service announcement that highlights 3 changes that can be made in agriculture to reduce the carbon footprint.

Reflect (Formative Assessment)

Each student will share one change from their public service announcement and the rest of the class will have the opportunity to evaluate the change and provide feedback.

Summative Assessment

Students will complete the Modified ISCFC Footprint Classroom Assignment. The Inquiry to Student Environmental Action project allows the resource documents on their website to modified and used by classroom teachers. Students will be asked to complete pages one and two of this assignment on day one and then asked to complete page three as a summative assignment on day three of this lesson.

Carbon Footprint Public Service Announcement	5	4	3	2	1
Theme & Message The overall mood/message/theme of the piece is clear and concise.					
Creativity Elements in the message are cohesive and direct the audience to intended message in an organized, aesthetic, and attractive manor.					
Social Benefit The public service announcement motivates community change in a meaningful way. A minimum of three ideas that reinforce the need for change in the targeted audience.					
Facts The message is based on accurate and verifiable information. Opinion or bias expressed is based in and supported by fact. Source information has been verified and documented using APA formatting.					
Further Information For Further Information sources are provided in an user friendly manor.					
Revised Carbon Cycle Model Students provide a carbon cycle model that depicts a decrease in carbon footprints related to the facts presented.					
Collaboration Almost always listens to, shares with, and supports the efforts of others in the group. Tries to keep people working together.					
Total Points_____					

Scoring Guide:

5 = The highest score possible; indicates a highly effective use of a component. Exemplary demonstration of effort and achievement throughout the video.
4 = Accomplished use of component(s) is consistently demonstrated throughout the video.
3 = Elements described may be present, but are inconsistently or haphazardly applied.
2 = Effort is demonstrated towards incorporating the component(s) listed and described, but the desired results are not seen in the final product.
1 = Scores of 1 reflect the absence of the described elements

Unit References

Bielik, T., Damelin, D. and Krajcik, J. (2018). *Why Do Fishermen Need Forests*. [online] Concord.org. Available at: https://concord.org/wp-content/uploads/publications/why-do-fishermen-need-forests.pdf [Accessed 20 Jun. 2019].

Chaudhuri, R. (2019). *Humans will perish in 31 years, warns latest climate change study*. [online] Condé Nast Traveller India. Available at: https://www.cntraveller.in/story/world-environment-day-humanswill-perish-31-years-warns-latest-climate-change-study/?utm_source=facebook&utm_medium=social#s-cust0 [Accessed 20 Jun. 2019].

Depts.washington.edu. (2019). *International Student Carbon Footprint Challenge*. [online] Available at: https://depts.washington.edu/i2sea/?page=iscfc [Accessed 25 Jun. 2019].

Janowski, C. (2019). *Playbook for Three Dimensional Science Instruction*. [online] Einsteinportal.2bsolutions.net. Available at: http://einsteinportal.2bsolutions.net/unit-updates/ngss-playbook/ngss-playbook [Accessed 20 Jun. 2019].

Khan Academy. (2019). *Intro to biogeochemical cycles*. [online] Available at: https://www.khanacademy.org/science/biology/ecology/biogeochemical-cycles/a/introduction-to-biogeochemical-cycles [Accessed 20 Jun. 2019]

Class Name Name:_____ Per:___

Investigating the Carbon Cycle Over Time

Select 5 different carbon storage areas in the "pre industrial era" part of the simulation (red/orange star icons) and click on each one to learn about it. Complete the table below as you investigate each area. If you finish early read about the other carbon storage areas. All icons must be clicked to move on to the post industrial era portion of the simulation

What is the name of the area?	How is carbon stored/cycled in this area?	How much carbon is stored/cycled here?

Select 5 different carbon storage areas in the "post industrial era" part of the simulation (red/orange star icons) and click on each one to learn about it. Complete the table below as you investigate each area. If you finish early read about the other carbon storage areas.

What is the name of the area?	How is carbon stored/cycled in this area?	How much carbon is stored/cycled here?

Class Name Name:_____ Per:__

Carbon Cycle Game

1. Use a search engine to look up "Carbon Cycle Game" and go to the website https://www.windows2universe.org/earth/climate/carbon_cycle.html to play the carbon cycle game.
2. The goal of this game is to visit and read about all 6 carbon reservoirs and answer all 6 questions correctly. To receive full credit you must visit all 6 reservoirs and answer all 6 questions correctly. When you have completed the game take a screenshot (or print) of your results and place it in the box below.
3. Answer final review question at the bottom of the page.

After playing the game answer the question below:

Imagine that you are working on a ranch. Based on the research you've completed so far on the carbon cycle, describe 3 different reservoirs a carbon atom would move through.

Name:

Lab Report

Please complete the following report during the design and implementation of your experiment.

Research Problem

- Describe what you are investigating and justify why you are investigating the problem.

Hypothesis

- Formulate one or more hypotheses for your experiment.

Procedures

- Create the steps you will follow for your experiment.

Data Collection

- Describe the data that you will collect during your experiment.
- Provide graphs, tables, charts, and raw data as necessary.

Results

- Explain your results.

Conclusion

- Based on your data:
  - What can you conclude?
  - Were your hypotheses supported?
  - Were their limitations to your experiment?
  - What are new research questions that derived from this study?