SeaGlide_TEAM	Climate Change & Solutions	Lesson #9 (60 minutes)

Description:

Since the dawn of the Industrial Revolution, carbon-based fuel sources have been used to power everyday machinery to make life easier. However, a new problem has arisen as well: the buildup of greenhouse gases. Because of this, global temperatures have slowly risen, negatively impacting ecosystems that rely on consistent climate. You will be taking the role of a concerned citizen by analyzing Carbon Emissions. This analysis will help to reduce the Carbon footprint and make a difference in the community. You will also write to your local government representatives to advocate for environmentally-friendly public policies.

Students will be able to:

- Connect a result of Climate Change to increased Carbon Emissions
- Calculate the amount of Carbon released into the atmosphere from energy and service usage
- Devise solutions to reduce Carbon Emissions based on family habits and limitations
- Communicate the impact and importance of environmentally friendly practices to local government representatives

Students will understand:

As contributing members of the planet Earth, it is the duty of students to both plan and take action to protect the global ecosystem. After learning that ocean acidification is the result of climate change by carbon emissions, students discover that the usage of cars and of electricity contributes to climate change. Through this lesson, students will become active members of their community by communicating the importance of climate change and its impacts on the global ecosystem to their local government representative(s). This will allow students to enact real change in their community and plan for a brighter, greener future.

Key Definitions & Concepts: [1]

- **Sustainability**: avoidance of the depletion of natural resources in order to maintain an ecological balance
- **Climate Change**: a change in the statistical distribution of weather patterns when that change lasts for an extended period of time
- **Carbon Emission**: historically defined as the total emissions caused by an individual, an event, an organization, or a product; may also be expressed as Carbon Footprint

Standards: [Copied from: 2]

HS-ESS3-1: Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity

- Students will be calculating and quantitatively analyzing the amount of Carbon Emissions released by each family. They are then using this data to come up with solutions for each

family. Students are using their knowledge of the harmful effects of Carbon Emissions in order to come up with solutions to this real-world problem and make a difference.

HS-ESS3-3: Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

- Through the *That's A Lot of Carbon* activity, students are observing the effects that increased Carbon Emissions have on the atmosphere. Students also learn how increased emission of Carbon Dioxide leads to global warming and climate change. Since organisms are dependent on stabilized global temperatures and since humans rely on these organisms for resources, humans are affected by Carbon Emissions and its impact on Climate Change.

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

- Throughout the lesson, students are discovering how Carbon Emissions are impacting the environment, as well as practices to reduce these emissions. Students have the opportunity to analyze a fictional family's energy and service usage, gaining an understanding of how solutions can be created. Then, they learn about policies currently in place and being pushed to help reduce their community's carbon footprint. Through the evaluation, students are given the opportunity to voice their concerns and solutions to their local government representative.

Background Information

Prior Knowledge:

- Ocean Acidification is the phenomenon where increased Carbon Emissions have led to increased levels of Bicarbonate in the ocean, increasing its acidity.
- When fossil fuels or carbon-based fuels are burned, Carbon Dioxide is released in the form of a gas and is deposited into the atmosphere.

Science Practices: [Copied from: 3]	**Core Ideas: [Copied from: 4]**	**Cross Cutting Concepts: [Copied from: 5]**
● Using Mathematical & Computational Thinking ● Constructing Explanations & Designing Solutions	● Human Impacts on Earth Systems ● Developing Possible Solutions	● Stability & Change ● Influence of Science, Engineering, & Technology on Society & the Natural World ● Science is a Human Endeavor

Possible Preconceptions/Misconceptions:

Students may experience confusion with calculating the amount of Carbon Dioxide released as pounds. Even though this is unconventional, the purpose of it is for students to comprehend the relative amount of CO_2 released. Students have experience working with pounds, so they may easily identify if a family contributes CO_2 in a large or small amount. If pounds were not used, students would be required to work with grams, which would result in absurdly large numbers. Using pounds in the activity avoids this.

	Lesson Plan - 5E(+) Model	

Engage:

The instructor will engage students in a review discussion on Ocean Acidification and its causes. The instructor will then ask students what releases Carbon Dioxide into the atmosphere. Students should have already have heard about climate change and its causes from the media. This question should lead into a discussion that is designed to allow for a more engaging, less rigid way for the students to go over what they know and for the instructor to see what they know. The instructor should expect students to identify the following atmospheric contributions to Carbon Dioxide: fossil fuels (gas, oil, etc.) and carbon-based fuels. This discussion should take no longer than 10 minutes.

Explore:

Part I: Introduction [6]

The instructor will begin by breaking students into group of three and by distributing the *That's A Lot of Carbon* worksheet. The students will be working individually to complete this worksheet with one of the corresponding family worksheets. It is recommended to allow students to choose which family that they want to analyze. However, ensure that each of the provided families are being analyzed by a similar average of students. This will allow for the class discussions to be open and objective.

Part II: *Benchmark Lesson*: That's A Lot of Carbon [6]

Students will read a prompt, examining their chosen family's use of services that rely on CO_2 for energy. Students will then calculate the pounds of CO_2 emitted by these services, totaling the amount of Carbon Emissions for each family and also for each family member. Afterward, the instructor will have one student representing each of the families come to the front of the class to write their Carbon Emissions calculations. The instructor will ask students questions that focus on what the top contributors to Carbon Emissions were per family. These questions should also focus on asking students to compare the top contributors to Carbon Emissions between the families, i.e. how does one family compare to the rest? etc. Through this discussion, students will be analyzing and interpreting the data collected about each family's Carbon Emissions. The goal is for students to discover behaviors in each family and determine how those behaviors contribute to their overall Carbon Emissions. This activity serves to show students that Carbon Emissions cannot only be calculated, but also can be analyzed based on variable criteria. This part of the lesson is designed to be an engaging compare-and-contrast activity that allows for students to begin thinking about how regular behaviors can affect the world surrounding them. This activity should take less than 20 minutes

Part III: *Investigation Lesson*: Carbon Emissions Analysis [6]

Following the discussion, the students should begin working on the analysis questions on the back of the *That's A Lot of Carbon* worksheet. These questions extend the class discussion following the Carbon Emissions activity, prompting students to analyze the specific causes of their family's Carbon Emissions. Students will employ critical thinking and devise solutions as to how their family can reduce their Carbon Emissions. The instructor should allot 5 minutes for the students to work through the analysis questions, then use up to 5 minutes correcting any misunderstandings by reviewing the students' responses as a whole class. This activity should take up to 10 minutes.

Explain:

Throughout the exploration of this lesson, students will engage in discussions and activities that seek to discover their understanding of the topic at-hand as it relates to climate change by carbon emissions. Instructors should informally ask questions to promote thoughtful discussion that is designed to aid in addressing any questions or concerns that some students may have. Students are expected to formalize their answers throughout the entirety of the lesson via the worksheets and the evaluation that concludes the lesson.

Elaborate: [7]

Through the benchmark lesson of the exploration, students are comparing and contrasting Carbon Emission levels between a variety of families. This is a real-world connection because it is designed to have the students apply critical thinking techniques to understanding how regular behaviors affect the world around them by determining the leading causes of increased Carbon Emissions. The benchmark activity also prompts students to discuss and defend ways in which their family can reduce Carbon Emissions. This activity serves as a way for students to begin thinking about how they can influence their own family in being more energy conscious and environmentally friendly.

**********NOTES FOR THE TEACHER**********

Below is an additional activity that would engage students in thinking critically about climate change based on current events. It is not included in the lesson because of timing purposes, but it is recommended to be used as an at-home assignment that is due during the next class meeting. See activity below:

Students will read the article, The World is Not Addressing Climate Change, that discusses the scientific evidence in support of Climate Change by Carbon Emissions. Students are exposed to quantitative and qualitative evidence supporting a scientific theory, as well as current events relating to the lesson topic during class time. This article from Newsela also has the capability to have its Lexicon score adjusted, allowing for differentiation based on a student's reading level and the grade level of the class. This allows all students, regardless of reading level or ability, to learn the same information and contribute to the class activity. After reading thoroughly and having completed the lesson as designed, then the students will be primed to completing the *Climate Change Article* worksheet that guides them through reading comprehension questions related to the article and through analysis questions that draws from the activities in this lesson.

Evaluate:

Students will write letters to their local government representative about Climate Change policies in their communities. Students will use the knowledge they gained in this lesson to explain the dangers and impact that Climate Change by Carbon Emissions has on local and global ecosystems. Students will not only be challenged to use the knowledge they learned, but also explain and verbalize it in the form of a letter. The instructor should allot the remaining class time for this activity. If students are unable to complete the assignment on time, it should be due at the following class.

Throughout the entirety of this lesson, there will be both formal and informal evaluations. The informal evaluations occur throughout the exploration via leading and open-ended questioning, as well as through the open class discussions. The informal evaluations will allow for the teacher to gauge surface-level understanding of the students. By surveying the students during completion of the worksheets and activities, teachers will be able to hear and to address any misconceptions or misunderstandings as necessary. The formal evaluations of this lesson are the *That's A Lot of Carbon* worksheet and the *Write to Your Local Representative* activity.

Enrich:

This lesson can be differentiated to a environmental law class, focusing on the specific policies and laws in place that affect the Carbon Emissions of a community. The instructor may choose to focus on the legal and civil aspects of Climate Change by dedicating more time to the Newsela article and to the *Write to Your Local Representative* activity.

All associated documents are attached below

Reference *Annotated Bibliography* on the very last page of this packet

Name: _____ Family: _____

That's A Lot of Carbon [6]

Introduction:

You have just learned about the effects that Carbon Emissions have on rising Earth temperatures. To help reduce your family's Carbon footprint, you must determine the amount of Carbon your family produces on average per year. Then, devise ways you can reduce the amount of Carbon emissions you produce.

1. **Driving:**
   _____Miles driven per year by the vehicle
   _____Miles per gallon (mpg) for the vehicle (average)
   Divide: miles driven by miles per gallon = gallons used per year
   Multiply: gallons used per year by 22 pounds of CO_2
   Do the above calculations for each car or truck that the family drives.
   Add the pounds of CO_2 for all cars and trucks _____
2. **Flying:**
   _____ total miles of air travel per year for all people
   Multiply: total miles traveled by 0.9 pounds of CO_2 = _____
   Note - Total the miles travelled by each family member. (For example, if four people take a 1000 mile flight, the total is 4000 miles.)
3. **Mass Transit:**
   _____ miles on mass transit per year by all people
   Multiply: mass transit miles by 0.5 pounds CO_2 = _____
4. **Taxis and Limos:**
   _____ miles by taxi/limo per year by all people
   Multiply: taxi and limo miles by 1.5 pounds of CO_2 = _____
5. **Electricity:**
   _____ Kilowatt hours (kWh) per year per household
   Multiply: Kilowatt hours by 1.5 pounds of CO_2 per kWh = _____
6. **Heating Oil:**
   _____ gallons per year per household
   Multiply: gallons of oil by 22 pounds of CO_2 per gallon = _____
7. **Natural Gas:**
   _____ therms per year per household
   Multiply therms of natural gas by 11 pounds of CO_2 = _____
8. **Bottled gas or Propane:**
   _____ gallons per year per household
   Multiply gallons per year by 13 pounds of CO_2 = _____
9. **Total:**
   _____ Total Pounds of CO_2 Produced by Your Family

Analysis:

1. Where does your family produce most of its Carbon Emissions? How about the least?

2. Your family's total Carbon Emissions only accounts for one-third of the average family's Carbon Emissions. Identify where the other two-thirds go towards. (HINT: What other services does your family make use of?)

3. Based on Carbon Emissions, formulate ways that you can reduce your family's Carbon Emissions. Give at least three examples of ways your family can reduce emissions. Defend each of your examples.

Jason and Jane Jetsetter and Family [6]

Who are they?

Jason and Jane are co-CEO's of Nirvana Airlines with corporate headquarters in Houston, TX, which is very hot in the summer months. They work very hard, make many important business trips, and earn high salaries. They enjoy free air travel on Nirvana Airlines for business and pleasure, enabling the whole family to spend their hard-earned vacation time visiting distant places such as Thailand, Costa Rica, and Botswana in the past year. They have two college age children, Jack and Jill, who are often homesick for Mom and Dad, requiring them to drive home every weekend (200 miles round trip from each college). Everyone in the family drives an SUV. "It is much safer to drive SUVs," says Jane confidently, "especially when we drive the treacherous snow-packed roads around our vacation house in Colorado where we ski during winter and spring breaks."

Carbon Emissions Per Year

Miles driven	15,000 miles per vehicle. Each of the four cars gets 15 mpg.
Miles flown	40,000 miles of business travel for each parent. 45,000 miles of vacation travel for each of the four people
Miles traveled by mass transit	0
Miles traveled by taxi or limo	500
Kilowatt hours of electricity (kWh)	40,000 kWh for the Houston home and 8000 kWh for the Vail home
Gallons of heating oil	0 (Both homes have electric furnaces.)
Therms of natural gas	0
Gallons of bottled gas or propane	0

Robert and Rachel Retireano [6]

Who are they?

The Retireanos have been retired for 10 years. They live in a two bedroom apartment in a complex that has photovoltaic panels and solar hot water panels on its roof. They share a hybrid car that is used only when they drive on weekends from their home in Komfort, Kansas, to the prairie wetlands 20 miles away to watch birds, hike, and camp. Rachel enjoys visiting with neighbors on the bus when she shops for groceries at the shopping center, a convenient 5 miles away. Robert, a very fit 70 year-old, rides his bike all over town. He detests shopping, but when he must, he carries purchases home in his bike basket. The Retireanos enjoy the simple life close to home, but twice a year, they fly to San Francisco to see their daughter, her husband, and their four grandchildren.

Carbon Emissions Per Year

Miles driven	2000 miles in a car that gets 60 mpg
Miles flown	Both of the Retireanos take two 4000 miles trips (round trip).
Miles traveled by mass transit	1500
Miles traveled by taxi or limo	100
Kilowatt hours of electricity (kWh)	They produce 100 kWh per month more than they use and get a credit from the power company.
Gallons of heating oil	0
Therms of natural gas	0
Gallons of bottled gas or propane	15 (used for both the BBQ on their apartment balcony and for the stove they take camping on the prairie)

The Frank and Fannie Farmer Family [6]

Who are they?

The Farmer family has lived on their 500-acre Illinois property for four generations. The whole family - two parents and ten children - work together to grow soybean and wheat, tend a herd of dairy cows, raise chickens for egg production, and maintain the farm machinery. Every penny seems to be stretched to the limit with so many children to feed and clothe. The long cold winter months demand costly heating oil for their drafty home, and the cost of fuel for the tractors is always going up. Vacations are unheard of. The parents expect the kids to come right from the bus to the barn to do the chores. In spite of the hardships, they all pride themselves in their self-sufficiency and they enjoy many good times with neighbors and local school sports events in the community.

Carbon Emissions Per Year

Miles driven	Frank drives his truck (which gets 12 mpg) 2000 miles and a tractor (which gets 5 mpg) 10,000 miles. Fannie drives her 1982 Chevrolet (10 mpg) 4000 miles and two of the teenage kids have cars that get 21 mpg. Each drives 8000 miles per year.
Miles flown	0
Miles traveled by mass transit	Are you kidding?
Miles traveled by taxi or limo	0
Kilowatt hours of electricity (kWh)	Each month, the house uses 900 kWh, the barn uses 600 kWh, and the chicken coop uses 400 kWh (chickens need light all night.) That's 22,800 kWh per year.
Gallons of heating oil	800
Therms of natural gas	0
Gallons of bottled gas or propane	0

The Sam and Sally Snow Family [6]

Who are they?

Life in Snowdon, northern Saskatchewan, is lonely for some, but a joy for the Snows. They love living in their four-room log cabin, which is "off the grid," deep in the taiga forest not far from the arctic tundra. The long, dark, winter days are perfect for Sam and Sally, who work at home as writers of children's books. They home school their five-year-old twin sons, Saul and Sean. Thank goodness, the cabin's thick walls offer good insulation. The propane tank in the backyard is so large that when filled in the fall, it gets them through the winter with adequate fuel for the cook stove fuel, a small heater in the kids' bedroom, and the lanterns. They could never get by without the two snowmobiles which they use to drive 20 miles into Snowden once a week for supplies. Their gasoline storage tank is enough to last them a whole year.

Carbon Emissions Per Year

Miles driven	2100 miles traveled by each of the two snowmobiles. Each snowmobile gets 10 mpg
Miles flown	Sam and Sally fly to see their book publisher in Montreal twice per year for a total of 4000 miles
Miles traveled by mass transit	0
Miles traveled by taxi or limo	50 miles for each trip to Montreal, sharing the ride
Kilowatt hours of electricity (kWh)	0
Gallons of heating oil	0 (The Snows heat their home with a wood stove and propane.)
Therms of natural gas	0
Gallons of bottled gas or propane	2000 gallons

Connie and Conrad Conservatoria [6]

Who are they?

The Conservatorias live in a suburb of Washington, DC, close to the office of the organization they co-direct which has a mission to save endangered sea mammals. Connie and Conrad are both scientists who are able to work from home three days a week. When they go to the office, 50 miles away in the city, they take the subway. Connie, as an expert on sea mammals, must fly internationally at least twice a month to give her expert advice. Conrad spends his recreational hours developing alternative fuels from cooking oils and composted vegetables he tests in their furnace, which is otherwise heated with oil during their short, mild winter. They both love to cook using their new gourmet stove with 10 burners heated by natural gas. The Conservatorias are so energy conscious by giving back carbon equal to 2,000 pounds each year to the energy company (i.e. their total carbon usage is 2000 pounds less).

Carbon Emissions Per Year

Miles driven	5000 miles in their compact car that gets 30 mpg
Miles flown	Connie makes 26 trips per year. Each is about 6000 miles round trip.
Miles traveled by mass transit	10,400 mile for each of them per year
Miles traveled by taxi or limo	Connie travels 100 miles by taxi to get to and from the airport for each of her 26 trips.
Kilowatt hours of electricity (kWh)	800 kWh/month or 9600 kWh in a year
Gallons of heating oil	200 gallons plus another 200 gallons from Conrad's experimental fuels
Therms of natural gas	1000 therms
Gallons of bottled gas or propane	0

Ursula Urbanite [6]

Who is she?

Ursula lives in the Big Apple, New York City! She is so happy to be finally living on her own in a 200 square foot studio apartment in Manhattan. Ursula was an art history major in college and now works at a gallery in the City that specializes in ceramic sculptures shaped like enormous amoebas. She walks to work when the weather is nice and takes the subway if it is not, or if she is running late. (If she opens the gallery late, the City's ceramic amoeba aficionados would be outraged). Last year, Ursula rented a car twice with three friends, and they drove to Maine to get away from the city hubbub for a few days. Last year, she flew once to visit her grandmother in Florida. Otherwise, Ursula enjoys the Big Apple, the ceramic amoebas, and her little apartment in the middle of all of it.

Carbon Emissions Per Year

Miles driven	1000 miles for the two road trips to Maine in a compact rental car that got 30 mpg.
Miles flown	2000 miles for the round trip flight to Florida
Miles traveled by mass transit	1000 miles on the subway
Miles traveled by taxi or limo	500 miles
Kilowatt hours of electricity (kWh)	3500 kWh in a year to power the tiny apartment
Gallons of heating oil	0 (Ursula's apartment is heated by electricity.)
Therms of natural gas	0
Gallons of bottled gas or propane	0

Dudley and Dahlia Demo [6]

Who are they?

The Demo's Sante Fe, New Mexico home is constructed of hay and pink adobe. It has very large, south-facing windows to let in sunshine during the winter. Their window shades prevent too much sun from getting in on hot summer days. As vegetarians, the Demo's eat vegetables home-grown in their greenhouse. Their lights, the computer, and a few, small household appliances are powered by a wind generator and photovoltaic cells, which are installed on the roof next to their solar hot water panels. The Demo's do not own a car. They bicycle into town for dinner and a movie once a month, making the most of the $40 check they receive from the energy company. They decided not to have children due to the global population problem. Dahlia does not work. She inherited just enough from her father, a California brussel sprouts grower, to build the house and maintain her happy, simple, lifestyle with Dudley, who handcrafts mandolins for students in the Sante Fe Music Academy for money.

Carbon Emissions Per Year

Miles driven	0
Miles flown	0
Miles traveled by mass transit	0
Miles traveled by taxi or limo	0
Kilowatt hours of electricity (kWh)	They make 2400 kWh more than they use each year.
Gallons of heating oil	0
Therms of natural gas	0
Gallons of bottled gas or propane	0

Name: _____ Date: _____

Climate Change Article

1. Why is the IPCC report important?

2. According to the article, what was the IPCC's approach to the results of its report?

3. Based on the graph shown in Image 2 within the article, what can we conclude about the United States' contribution to carbon dioxide emissions?

4. Using information you learned from the reading, devise at least three solutions to help reduce the amount of carbon emissions produced by the United States. Explain how each solution is beneficial.
   Draw knowledge from the lesson and the article to help guide your explanations.

Name: _____ Date: _____

Write to Your Local Representative

Introduction:

As a concerned member of your community, you are able to write to your local government representatives about issues that concern you. Using the information you've learned about Climate Change and its effects on the environment, explain to your local representative why you want them to take a stance on supporting legislation that wants to reduce the negative impacts that humans have on the environment.

Directions:

Pick one piece of legislation or one topic to write about, and spend a few minutes researching so that you understand the basics. A resource like Columbia Law School's Climate Deregulation Tracker helps – the tracker has a page for each rollback that outlines the changes proposed and why they matter. It also lets you sign up for daily or weekly updates to stay on top of changes.

Then, craft a letter explaining:

- **Who you are:** A sentence explaining you're a constituent interested in science and the environment.
- **The legislation you're writing about:** Outline which issue you'd like to discuss and how it will affect the environment, and call out proposed legislation names specifically.
- **How it affects you:** Hate rollbacks of water protections because you grew up swimming at the local lake every summer? Scared for the safety of your drinking water? Put that in your letter.
- **What you want your representative to do:** Clearly state that you want your representative to oppose deregulation (or vote for a piece of legislation you *do* want).

Name: _____Answer Keys_____ Family: _____

That's A Lot of Carbon [6]

Table of Families & Their Carbon Use

	Jetsetter Family	The Retireanos	Farmer Family	Snow Family	Conservatorias	Ursula Urbanite	The Demos
Driving	88,000	733	73,229	4,620	3,667	733	0
Flying	234,000	14,400	0	3,600	140,400	1,800	0
Mass Transit	0	750	0	0	10,400	500	0
Taxi/Limo	750	150	0	150	3,900	750	0
Electricity	72,000	-1800	34,200	0	14,400	5250	-3,600
Heating Oil	0	0	17,600	0	8,800	0	0
Natural Gas	0	0	0	0	11,000	0	0
Propane	0	195	0	26,000	0	0	0
Total	394,750	14,428	125,029	34,370	192,567	9,033	-3,600
Per Person	98,687.5	7214	10,419	8,592.5	96,283.5	9,033	-1,800

Calculation Steps for the Jetsetter Family:

Driving: $(\frac{15{,}000\ miles}{15\ mpg})(\frac{22\ lbs\ CO2}{1\ gal})(4) = 88,000\ lbs\ CO2$

Flying: $(40,000\ miles)(0.9\ lbs\ CO2)(2)\ +\ (45,000\ miles)(0.9\ lbs\ CO2)(4)\ =\ 234,000\ lbs\ CO2$

Taxi/Limo: $(500\ miles)(1.5\ lbs\ CO2)\ =\ 750\ lbs\ CO2$

Electricity: $(40,000\ kWh)(1.5\ lbs\ CO2)\ +\ (8000\ kWh)(1.5\ lbs\ CO2)\ =\ 72,000\ lbs\ CO2$

Total Summation: $88,000 + 234,000\ +\ 750\ +\ 72,000\ =\ 394,750\ lbs\ CO2$

Per Person Calculation: $394,750\ lbs\ CO2\ /\ 4\ persons\ =\ 98,687.5\ lbs\ CO2\ per\ person$

**********NOTE FOR THE TEACHER**********

Negative numbers represent energy that is being donated to the electric company from renewable resources. An example of this would be the solar panels used by The Demos. A negative number will only appear in the calculations if explicitly stated in the given prompt.

Analysis:

1. Where does your family produce most of its Carbon Emissions? How about the least?

   Answers will vary based on family and student calculations.

2. Your family's total Carbon Emissions only accounts for one-third of the average family's Carbon Emissions. Identify where the other two-thirds go towards. (HINT: What other services does your family make use of?)

   The other two-thirds are from business that provide the family services. These include: grocery stores, schools, etc.

3. Based on Carbon Emissions, formulate ways that you can reduce your family's Carbon Emissions. Give at least three examples of ways your family can reduce emissions. Defend each of your examples.

   Answers will vary based on family and student responses/calculations. Expect students to reduce Carbon Emissions from travelling and home energy costs.

Name: _____ Date: _____

Climate Change Article [7]

1. Why is the IPCC report important?

   It shows how much the world's annual carbon dioxide emissions would need to drop in order to keep global temperatures from rising to dangerous levels.

2. According to the article, what was the IPCC's approach to the results of its report?

   The IPCC took an objective approach and did not state whether it thought it was possible to avoid the 2.7 F rise.

3. Based on the graph shown in Image 2 within the article, what can we conclude about the United States' contribution to carbon dioxide emissions?

   The United States is the world's second largest emitter of carbon dioxide.

4. Using information you learned from the reading, devise at least three solutions to help reduce the amount of carbon emissions produced by the United States. Explain how each solution you chose is beneficial.
   Draw knowledge from the lesson and the article to help guide your explanations.

   Answers are dependent on student response.

   Students are expected to write solutions that may include: limiting of fossil fuel usage, reduction of deforestation, introduction of environmentally-friendly legislation, or use of renewable energy resources like solar panels and/or wind turbines, etc.

   Students' reasoning should follow closely to the following logic: if the solution allows for ANY reduction of carbon emissions, then students should explain how the carbon emissions are being reduced. Some may think to include reduction rates or percentages. Dependant on the solution chosen, the students' rationale may not be as widespread. This is to say that most students would explain the benefits of their chosen solutions in terms of their own family or experiences, instead of thinking on the national level.

Annotated Bibliography

[1] Mason, M. (n.d.). What is Environmental Science? Retrieved from https://www.environmentalscience.org/

This website was used for research and inspiration purposes. This reference aided in the completion of definitions. This reference was neither adapted nor excerpted.

[2] Nsta. (n.d.). Access the Next Generation Science Standards by Topic. Retrieved January 18, 2019, from https://ngss.nsta.org/AccessStandardsByTopic.aspx

This website was used in each lesson in the Water Chemistry & Biology module to select proper national set standards for science subjects that each lesson is centered around.

[3] Nsta. (n.d.). Science and Engineering Practices. Retrieved January 18, 2019, from https://ngss.nsta.org/PracticesFull.aspx

This website used in every lesson in the Water Chemistry & Biology module to find Standards for Science and Engineering Practices that are applicable in each lesson.

[4] Nsta. (n.d.). Disciplinary Core Ideas. Retrieved from https://ngss.nsta.org/DisciplinaryCoreIdeasTop.aspx

This website was used in each lesson in the Water Chemistry & Biology module to select appropriate disciplinary core ideas set forth by the NSTA that are at the center of each lesson.

[5] Nsta. (n.d.). Crosscutting Concepts. Retrieved from https://ngss.nsta.org/CrosscuttingConceptsFull.aspx

This website was used in each lesson in the Water Chemistry & Biology module to selecting appropriate crosscutting concepts set forth by the NSTA that apply to each science lesson.

[6] NESTA, & UCAR. (n.d.). CO2: How Much Do You Spew? Retrieved from https://scied.ucar.edu/activity/co2-how-much-do-you-spew

This website and its associated lesson plan were used for adaptation within the lesson plan. The reference aided in the completion of the lesson activity and analysis questions. Also, the lesson activity was adapted to the 5E Model. The lesson activity was useful in illustrating the impact of fossil fuel burning in everyday life. The TeachEngineering activity for *How Much Do You Spew?* was directly excerpted for this activity; however, analysis questions corresponding to this activity were adapted to better fit the 5E Model.

[7] Washington Post, & Newsela Staff. (2018, October 22). World is not addressing climate change, scientists warn in new report. Retrieved March, 2019, from https://newsela.com/read/climate-change-dire/id/46926/

This reference was used for resource purposes. This news article aided in the completion of the lesson activities. This reference was neither adapted nor excerpted. Newsela is useful in lesson differentiation amongst reading levels of students.