



Our School's Backyard as a Lab for Studying Climate Change

by Keira Freeman, 2019 CTI Fellow
Carmel Middle School

This curriculum unit is recommended for 6th Grade Science

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Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: My students are all members of our Charlotte community and live on our changing Earth. They are impacted every day by weather and climate in many ways. Students will learn about the climate of different places on Earth and think of ways they can mitigate climate change in their homes and communities. The goal of this unit is to address the importance of stewardship for the earth. Students will listen to different speakers, some not so different from themselves, about the impacts of climate change and the importance of protecting our earth. Students will use scientific modeling to organize ideas, analyze data, and make predictions throughout this unit. Students will gain a larger insight into the constructive and destructive forces on Earth that result in climate changing and affect humans all over the world. Students will be able to collect information, create their own opinions, and share with their classmates and the school how they can be catalysts for change.

I plan to teach this unit during the coming year to 180 students in 6th Grade Science.

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Introduction

School/ Student Demographics

Carmel Middle School consists of about 1250 students of diverse backgrounds. Geographically, the school is located in an affluent suburban setting of Charlotte, NC in the Charlotte-Mecklenburg School District. The demographics at Carmel are 45% White, 32% Hispanic, 18% Black, and 5% Other. At Carmel, we like to consider our school as, "a slice of Charlotte" since we have such a diverse population and have students from all walks of life. 63.5% of students received 4's and 5's according to the NC Essential Standards for Science on the grade 8 Science EOG according to the Charlotte Mecklenburg School Report for the 2017- 2018 school year (1). 34.9% of students across the school are economically disadvantaged. These students, as well as all students, receive assistance from our fantastic PTSA. They provide materials and resources for classroom teachers and students. My school also has church partnerships that provide books, resources, gift cards, and programs like Friday morning tutoring to our students. These students all live in Charlotte and on our changing Earth. They are impacted every day by weather and climate in many ways that this Curriculum Unit will draw attention to.

I have been teaching at Carmel Middle School for three years and this is my first year in my current position. I teach sixth-grade science on a rotating A day B day schedule. I teach the same lesson to six different classes for two days. My students attend my class every other day throughout the school year in ninety-minute blocks. I teach fifteen classes per week. There is an average of thirty students per class. This unit will be taught to all of my sixth graders, around 185 students. I will be teaching the unit for about three weeks. Each class will be taught the lessons every other day for six days each, totaling about twelve classes. I will also share the content with my PLC and hope that every student will be able to participate in my curriculum unit.

I teach about half of Carmel's sixth-grade population. 59.9% of the students entering 6th Grade across the school are proficient, meaning that percentage of students were proficient in reading and math at the end of their 5th-grade year. My team is the English Language Learner team so I will be working with many students who are not native speakers. As science is heterogeneously grouped at Carmel, I have many ELL students grouped with honors and Academically or Intellectually Gifted students. The 6th-grade demographics are similar to the school totals. They consist of 48% White, 30% Hispanic, 17% Black, and 5% Other. Therefore, my classes are a heterogeneous group of students of varying abilities and science backgrounds. I create differentiated activities within the North Carolina State Science Standards to meet the diverse educational needs of my students.

Background

My science curriculum is based on the North Carolina Standard Course of Study with consideration given to the 2009 Science Essential Standards that have been in effect starting during the 2012-2013 school year (2). I paced my instruction based on the 2019-2020 Charlotte-

Mecklenburg School (CMS) district pacing guide for 6th-grade science. Students will be provided with many opportunities for laboratory investigations this year. As a class, we will spend time learning to use appropriate tools and techniques to gather, analyze, and interpret data. My class time is typically divided into direct instruction, guided practice or additional investigation, independent practice or group inquiry activity, explanation of results and time to ask additional questions or share ideas. I engage students by including hands-on activities, labs, and/or investigations during most class periods. We will incorporate academic conversations and effective question stems as a focus in class due to their importance not only throughout Carmel but the district as well. I incorporate the use of a Promethean Board and video clips from Discovery Education, YouTube, and National Geographic regularly. I have access to technology in my classroom and students use their Chromebooks which they also bring home throughout the year for additional research or web activities. I have access to a large school campus with natural areas in different locations for nature journaling outside of the classroom.

Rationale

Through the Climate Change and Mitigation in Our Lives Unit, students will develop a deeper understanding of the human-environment balance. Students will learn about the global effects of greenhouse gasses and climate change and then narrow their understanding of how it may affect their daily lives. They will also reflect on their perspective about the changing earth and think about how the things happening in the world and the things they do every day affects our community our climate and different places on Earth. Students will learn the North Carolina Science standards they are required to learn, but also hopefully make deeper lifelong connections to the Earth and ways to keep it safe.

Before beginning the unit, I will have students complete a KWHLAQ graphic organizer as a pre-assessment and resource throughout the unit. A KWHLAQ Chart asks students K-what they already know, W- what they want to know, H- how do I find out, L- what have I learned, A- what action will I take, and Q- what new questions do I have (3). This will serve as a pre-assessment and a guide and then finally as an informal assessment for students to see if they reached their goals. Students will first state where they are starting from in their knowledge of climate and Earth's different climates affecting things like plant growth and soil formation. They will state what they want to know and how they think they will find their answers. After the unit, they will state what they learned and the actions they can take in their homes and school. Finally asking questions maybe to powers beyond the classroom about how to make positive changes moving forward.

Another critical aspect of this unit will be having the students experience nature journaling. Scientists have shown that being a part of nature helps students to better understand their environment. In "A Sense of Wonder," by Rachel Carson, she discusses the importance when she says "The lasting pleasures of contact with the natural world are not reserved for such scientists but are available to anyone who will place himself under the influence of earth, sea and sky and their amazing life." Like environmental educator David Sobel, I think it is critical for students to learn to love their earth and the environment they live in before asking them to help it (4).

Finally, students will present what they learn to the whole school. They will be advocates for the Earth in our small community. Their final assignment will be to create a poster to be displayed in the school on a specific biome and how that biome will be affected by climate

change. They will include personal details, such as artifacts from their nature journals like drawings or excerpts of their experience and scientific research about how they can inspire and affect change. The students will be able to express themselves creatively through this project and, ideally, inspire many other students and faculty members throughout the school and their communities.

Content Research

Throughout my experience at the University of North Carolina Charlotte and through researching this topic I have learned a tremendous amount about global warming, climate change, and the greenhouse effect. Global warming refers to the modern increasing air temperatures over the surface of the Earth. Throughout the past months, I have learned it is largely due to human activity. Humans are quickly changing the climate of the Earth. The things we have discussed include how we will adapt to these changes, how we can minimize them, and how we can go about doing that. As educators, the one solution we all agree on is our students. We know that spending time to talk to our students about how our climate is changing and how we can be stewards for our planet can impact the future.

One of the first questions we were asked in our seminar was, “Is the Earth warming?” Many Americans and people around the world do not believe the Earth is warming or that climate change is real. They cannot see day to day how their environments are changing or the effects they are having on the planet. Weather refers to the actual state of the atmosphere at a particular time. Contrastingly, climate is a statistical depiction of weather over a period of time. This is important in decision making. Weather allows us to make short term decisions, where climate impacts long term decisions. Based on data and research, we can see that the climate is changing. Data based on global temperature throughout history, Figure 7.1 (5), melting ice, rising ocean temperatures, and rising sea levels, to name a few, we can see the Earth is, in fact, heating up, Figure 7.2 (6). The Intergovernmental Panel on Climate Change (IPCC), an intergovernmental body of the United Nations, whose goal is to “assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation,” called today’s warming “unequivocal” (7). This group summarizes research that has been verified repeatedly to show that our Earth is warming. So how can we fix it?

The three main controls on Earth’s temperature are the concentration of greenhouse gasses, the energy from sunlight reaching our planet, and the albedo, or visible brightness, of our Earth. We can see how much carbon is in the atmosphere, and we know that increased carbon in the atmosphere increases global temperatures. We have added roughly 190 gigatons of carbon to the atmosphere since 1960, Figure 7.3 (8). Carbon is accumulating in the atmosphere and the rate at which this is happening is accelerating. We know that if the energy received by an object exceeds the energy lost, the object’s internal temperature increases. Because of the amount of carbon in our atmosphere, the Earth is less able to “cool off.”

To mitigate the rising temperatures on Earth we need to globally decrease carbon emissions. One way to understand carbon emissions is called “The IPAT Relation,” which is an algebraic equation that suggests environmental impact (I in IPAT) can be equated with carbon emissions. Then population (P) multiplied by affluence (A) and technology (T) quantitatively gives us the carbon emissions (environmental impact) of a population with a certain amount of

wealth and using a specific type of technology. Population is an important factor in the IPAT equation because to support more people we need to be able to provide more resources, such as water, food, and fuel. Providing the basic needs of the growing population will result in the depletion of natural resources and an increase in greenhouse gas emissions that are detrimental to the environment. As the population (P in IPAT) increases, so does the environmental impact (9). The A or affluence of people in the IPAT equation represents the average consumption of each person in the population. As each person consumes more, the total environmental impact (or carbon emissions) increases with it. We use Gross Domestic Product or GDP per capita to see these impacts because it shows that while production increases, consumption does as well. Unfortunately, the ecological impacts of each product are far-reaching and increases in consumption quickly result in large impacts on the environment through direct and indirect sources. Finally, technology shows us how much environmental impact is involved in producing the energy needed in creating, transporting and disposing of the goods, services, and amenities used. Improving the efficiency of technology and/or changing to an energy source that does not emit carbon (e.g. solar versus coal) would help reduce carbon emissions according to IPAT. Though this formula receives criticism for its lack of stress toward social and political factors, it is one way to look at the impact we have on the environment.

So why have we not taken drastic measures to address climate change? Attempts to mitigate climate change will mean changing how humans interact with their environment, and how they produce energy. Some of this change is happening now, but progress is slow. We need to inspire our younger generations to demand even more of those changes. We need to affect policy decisions and reflect on what we are doing to save our planet. In 2001, President George W. Bush said, "The issue of climate change respects no border. Its effects cannot be reined in by an army nor advanced by any ideology. Climate change, with its potential to impact every corner of the world, is an issue that must be addressed by the world" (10). We all rely on the stability of our climate. The ability to access freshwater and produce food are two incredibly important, if not the most important necessities for our survival, that will be affected by climate change. As a teacher, I have to be a guide for my students' explorations of the environment and human-environment balance. We all need to come together to create a better world, and for me, as an educator, that starts with my students.

Because our climate is changing our strategies have come down to mitigating and adapting to climate change. Mitigation refers to minimizing the warming of our planet while adaptation refers to the changes we will all have to make to a warmer world. The more we do today to determine our new standard global climate, the less we will have to do in the future to adapt. Based on the Paris Convention, policymakers and scientists roughly agree that a temperature increase of 1.5 degrees Celsius compared to the average temperature of the pre-Industrial period (around the year 1850) balances "acceptable" impacts of climate change against an achievable goal. In order for this to happen, we have to cut carbon emissions and develop additional technology to remove carbon from the atmosphere or can capture the carbon from the emission source.

There are ways we are working to mitigate our carbon emissions and decrease our environmental impact. Some examples include capping and trading emissions, increasing the energy generated with renewables and nuclear, increasing energy efficiency, changing our methods of transportation, and changing our agriculture and forestry practices. Based on the National Climate Assessment, "At the federal level, a number of measures have been implemented to promote advanced, low-carbon energy technologies and fuels, including energy

efficiency. Broadly considered, these measures include GHG [Greenhouse Gas] regulations; other rules and regulations with climate co-benefits; codes and standards; research, development, and demonstration projects and programs; federal procurement practices; voluntary programs; and various subsidies (such as production and investment tax credits).” In terms of non-fossil fuel related federal measures, namely agriculture and forestry, some mitigation strategies include “agriculture and forestry programs to increase soil and forest carbon sequestration and minimize losses through wildfire or other land-use processes, regulations to phase down hydrofluorocarbons, and standards for reducing methane emissions from fossil fuel extraction and processing” (11).

If we take no action it is very plausible that some physical and ecological impacts will be irreversible for thousands of years which is essentially a permanent timescale given that human civilization is only a few thousand years old. Though there are gaps in our knowledge of climate change, we all will be conforming to its effects for the rest of our lives, directly or indirectly. My goal through this unit is to initiate a conversation with my students about the effects climate change will have in their lives and what they can do to keep the world from warming too much.

Instructional Implementation

Students will learn about ways they can mitigate climate change in their homes and communities. Students can connect their learning to many different subjects. For example in math, students will be interpreting and analyzing graphs and data throughout the unit. In Language Arts, they will be reading and annotating different articles from primary sources from important figures and experts in the field. Students will see the importance of climate change over different points in history, such as the Ice Age, or the Industrial Revolution. Finally, students will also think about the importance of art as a medium for understanding the increasing problems in our climate. Students will create mitigation strategies and present them to classmates. This will allow students to create solutions, as well as obtain ideas from classmates for how they can reduce their carbon footprint.

I will also be involving students in the worldwide conversation happening right now about climate change. Students will listen to speeches from climate activists around the world and from people who are demanding change in their neighborhoods. I hope this exposure to the change happening around them inspires them to also make change.

Many students will listen and understand that change is happening, but still may not be able to imagine how it will look for the places they know and love. Due to this, we will travel outside to investigate our environment as it relates to our curriculum. We will have nature journaling sessions as often as we can, with regards to time and weather. I want students to see for themselves how beautiful our world is and why it is worth protecting.

Also, students will be completing monthly current event assignments. Through these current events, students are free to research and discuss any school appropriate science topic of interest to them. I am excited to see what scientific area each student gravitates toward and how interested they are in the topic. Students will be able to explore topics of interest to them and share those with me and their classmates.

Lessons

Lesson 1: What is climate?

Students will identify the causes of climate change relating to Earth's layers, the oceans, temperature, and rocks and explain why climate change is important to humans and the environment.

Warm-Up (to stay consistent throughout the unit): Students will see an art piece depicting climate. To begin we will familiarly depict climate. Students will see various images of North Carolina including different ecological features such as trees, clouds, and sources of water (12). They will complete a “Brain Dump” activity where they list any word that comes to mind when they see the images.

I will next have students begin to understand the difference between weather and climate-video featuring Neil DeGrasse Tyson "Weather versus Climate" (13). Students will begin their KWHLAQ Charts. They will fill it out throughout the unit starting with the background knowledge they have about climate and climate change. They will begin by filling out what they already know, what they want to know and ideas on how they can acquire more information. Students will follow up with the video Climate Change 101 (14), with Bill Nye, which explains the rise in global temperatures since the industrial revolution. Bill Nye describes the science behind greenhouse gases and the implications of a changing climate on both our natural world and the built environment. He also provides a few suggestions for how we can all be a part of the solution.

We will then watch the video Climate Change: Earth’s Giant Game of Tetris (15) in which students will learn about the carbon cycle, the greenhouse effect, and the environmental impacts of burning fossil fuels in a way that may make more sense to them. Students will complete a set of guided notes during both short videos. I will allow for class discussion after the videos to talk about climate change and decrease potential student anxiety.

Finally, I will allow students to choose from a variety of videos featuring different NASA scientists (16) climate researchers and activists (17) who work in different areas surrounding Earth and Earth’s changing climate and have students reflect on the lives of climate researchers, scientists (18) and activists and what they do. This will help students see real people working for real solutions, some from their community (19) or the same age as them, and see that they can make a difference. Again, after watching these videos we will congregate as a class for discussion and reflection to create conversation and decrease fear in young students.

Lesson 2: Trees are not just for Paper

Students will research different trees native to Charlotte looking at the rings and the environment they grow in. They will create predictions as to how temperature and precipitation influence tree growth.

Warm-Up: Students will read and discuss an excerpt from "Keeping a Nature Journal" by Claire Walker Leslie, Figure 7.4 (20). We will discuss as a class the benefits of going outside and being a part of nature. We will also review how journaling can add to their appreciation and understanding of the environment around them.

Nature Journaling Day: Students will go outside and reflect on the trees, clouds, soil, insects, and whatever else they discover in the area surrounding our school. They can draw

pictures, write descriptions, ask questions, or express themselves in another way to show what the environment means to them. They will use the reading from our warm-up as a guide for their journals. After providing time for them to explore and journal I will ask for volunteers to share their experience and their journal entries. I hope the journaling experiences will allow students to feel the connection to nature and the environment that scientists and many others understand is so important in fostering involvement and stewardship for our communities, our environment, and our Earth.

As a class, students will read how trees can tell us about climate change from NASA Climate Kids (21). We will connect this to the trees we saw while journaling and the different trees across our country. Using tree cookies we have at school, students can see and hold different samples. These samples will show how trees can tell us about precipitation and temperature patterns in different biomes. They will also predict how soil and precipitation in a biome affect the things that can grow there. Students will use tree core samples and collect data on ring samples, precipitation and climate in different biomes by filling out a worksheet called "What are Tree Rings?" from the Chicago Botanic Garden (22). We will end class by discussing how each group's tree rings were similar and different and creating a class Venn Diagram with these similarities and differences. This will show students how precipitation and temperature affect trees and ecosystems in different biomes.

Lesson 3: Climate impacting plant growth

Students will review the climatic factors that influence plant growth in multiple biomes and how they are affected by the environment.

Warm-Up: On Youtube, students will watch 360 Degree Videos of different the different biomes including tundra, taiga, tropical rainforest, temperate forest, desert, grasslands, wetlands, and ocean. Students will then reflect on each biome, discussing environment, temperature, and weather, plant and animal life, and human activity (23).

We will then discuss how climate affects students in their lives, from clothes to food to plant and animal life and think about how that relates to the biome we live in. Students will understand that photosynthesis requires specific temperature and precipitation using the Smithsonian What is Photosynthesis? (24) article and the Photosynthesis! Blinded by the Light Video (25). We will follow up by comparing climate graphs in different areas/ Charlotte in different periods and discussing how this may impact their lives. If there is time, students will communicate with an expert on plant growth, potentially from Dr. Jeff Gillman, lead horticulturist at the UNC Charlotte Botanical Gardens or show students prescreened clips from BBC Planet Earth which have great information about many different world biomes (26).

Lesson 4: Regional impacts of climate change

Students will discover how climate change impacts weather, ecosystems, and human activity in different biomes then interpret information to make regional and global predictions about climate change.

Warm-Up: Students will watch a video about changing human activities. I will start with changes in Charlotte from fifty years ago to now (27), then I will show a global change video (28). They will reflect on the changes they notice and how those changes make them feel.

In groups, students will read about a specific biome (29). They will research their biome in their groups discovering things such as average climate and temperature, precipitation, the plant and animal life there, human activity and more (30). They will discuss and write how climate impacts their biome ecologically and economically focusing on scientific vocabulary and the environment.

We will then have each group will share out using a Jigsaw strategy. Each group will split and join a group with members who learned about a different biome. These students will share out about their biome and learn about the biomes of others. After sharing about every biome, we will discuss how climate change could affect all these different places. We will talk about how our biome may change with global warming and cause our environment to change in the future (31). In the end, each student should be able to describe and understand the regional and global impacts of climate change.

Lesson 5: Ready... set... action

Students will understand climate mitigation and adaptation. They will discuss ways in which they can make a difference in their global community.

Warm-Up: Students will see signs and artwork from different climate marches and movements. They will see the effects of people joining together to protest for the protection of our Earth worldwide. I will include artwork from students their age to relate more easily. I will then show an inspirational video about global climate change and how we are in charge of shaping our future (32).

After, I will explain the impact of carbon and CO₂ in global warming (Dessler, n 5). Students will understand the impact of carbon emissions on the rising temperature of the Earth. I will then explain carbon footprints, and show students my carbon footprint. I will show students different examples of carbon footprints from people in all different parts of the world (33). Finally, I will allow students to see what their/ their family's carbon footprints look like (34).

We will then do an activity on the meaning of climate mitigation and adaptation using video about how children can make a difference (35). Finally, students will create posters on climate change and how to mitigate greenhouse gas emissions and the impact of climate change and how we can prevent destructive changes in specific biomes of students choosing. They will use their notes from the unit to this point, their nature journals, and information from all the influential people they listened to. They will have a rubric for this assignment to include scientific and economic information involving climate, precipitation, human impact, cost to society, and personal impact- including how they can work to mitigate this change.

Lesson 6: Sum it all up

Warm-Up: Photos of inspirational climate change efforts around the world. Students will reflect on how these people are making a difference in the world.

Students will present their posters to their classmates and students will have a gallery walk in the hallways or cafeteria (with administration approval) with observation sheets. Students will perform peer reviews per class for their classmates. We will then have a whole class discussion on climate change and how we can work to mitigate it in our lives and the lives of others. I look forward to discussing how student opinion has changed or been impacted by the unit. We will work to complete our KWHLAQ charts and see what else we may still have

questions about. Posters will then be displayed around the room/school for the rest of the student population to see and potentially be inspired by.

Differentiation

Work will be differentiated in several different ways. Students will receive text engineered articles that will scaffold long articles and allow them to chunk text and better understand what they are reading. Students will also have the resources of their glossaries. Students keep a glossary in the back of their notebooks with important vocabulary and will update them throughout the unit. This will be a reference for difficult texts. During guided notes and activities with written work, I will provide students with a solution station so they do not miss important information. Students also have a choice in what biome they want to research and present to the school.

Assessments

Students will be assessed informally and formally throughout this unit. The largest grade that will come from this unit will be from the poster they create at the end of the unit. This will be assessed by me based on a rubric they will receive in advance. They will also complete peer evaluations which will factor into their final project grade. Informally students will be assessed based on their KWHLAQ charts, class notes, and research worksheets. I will be able to check in on student understanding through these informal assignments.

Appendix 1: Implementing Teaching Standards

6.E.2.3 Explain how the formation of soil is related to the parent rock type and the environment in which it develops.

6.E.2.4 Conclude that the good health of humans requires: monitoring the lithosphere, maintaining soil quality and stewardship.

6.L.2 Understand the flow of energy through ecosystems and the responses of populations to the biotic and abiotic factors in their environment.

Students will be learning about how climate affects our Earth and our backyards. They will understand how they must be stewards for the Earth. Students will also use scientific modeling to organize ideas, analyze data, and make predictions throughout this unit. Students will gain a larger insight into “how interactions of constructive and destructive forces have resulted in changes in the surface of the Earth over time and the effects of the lithosphere on humans” and how they can be catalysts for change.

Appendix 2: List of Materials for Classroom Use

- Chromebooks with internet access
- Art/ Poster Supplies
- Journals/ Notebooks
- Tree Cookies
- Sample Nature Journal Entries

Appendix 3: Resources for Students

Hayhoe, Katharine. "What If Climate Change Is Real? ." YouTube. TEDx Talks, May 5, 2015.
<https://www.youtube.com/watch?v=PtrYNGs9oRM>.

Katharine Hayhoe discusses climate change and how it will affect agriculture, energy, health, infrastructure, natural resources, national security and water availability.

Stevens, Mary Ellis. "Charlotte Climate Strike." *Charlotte Climate Strike*. September 20, 2019.
Local Charlotte girl attending Myers Park High School speaks out on climate change at Charlotte Climate Strike.

Thunberg, Greta. "Greta Thunberg (Young Climate Activist) at the Climate Action Summit 2019 - Official Video." YouTube. United Nations, September 23, 2019.
<https://www.youtube.com/watch?v=u9KxE4Kv9A8>.

Young climate activist Greta Thunberg speaks out about the lack of action leadership has taken against climate change.

"What Can Trees Tell Us About Climate Change?" NASA. Earth Science Communications Team at NASA's Jet Propulsion Laboratory / California Institute of Technology, November 15, 2019. <https://climatekids.nasa.gov/tree-rings/>.

Website students can access information about how tree rings can indicate climate changing.

"What Is Photosynthesis." Smithsonian Science Education Center, March 27, 2018.
<https://ssec.si.edu/stemvisions-blog/what-photosynthesis>.

Website for students with a reading about photosynthesis and a video at the end.

"What's It Like Where You Live?." Missouri Botanical Gardens, 2005. <http://www.mbgnet.net/>.
This will be a good website for students as an extension for learning about the biome they are researching.

Appendix 4: Resources for Teachers

“CO2, Birth & Death Rates by Country, Simulated Real-Time.” Breathingearth, 2006.

<http://www.breathingearth.net/>.

Visual of the world and pinpoints to CO2 emission and births and deaths occurring in real time.

Dessler, Andrew Emory. *Introduction to Modern Climate Change*. Cambridge: Cambridge University Press, 2018.

Informational detailed book about the causes and effects of climate change.

Haskell, David George. *The Forest Unseen a Years Watch in Nature*. New York: Penguin, 2013.

David Haskell goes into detail about an old-growth Tennessee forest and its inhabitants which he visits every day for a year.

Leslie, Clare Walker., and Charles Edmund Roth. *Keeping a Nature Journal: Discover a Whole New Way of Seeing the World around You*. North Adams, MA: Storey Pub., 2003.

Important for class because of the journaling days planned. Helps establish techniques and guides for starting a nature journal and capturing nature.

Martinez, Xiuhtezcatl, and Justin Spizman. *We Rise*. Emmaus, PA: Rodale, 2017.

This book explores many aspects of effective activism and provides step-by-step information on how to start and join solution-oriented movements.

Appendix 5: Notes

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3. “KWHLAQ Chart.” Learn Like A pirate Passion Projects. Accessed September 26, 2019. <https://soesclap.weebly.com/kwhlaq-chart.html>.
4. Sobel, David. *Beyond Ecophobia: Reclaiming the Heart in Nature Education*. Great Barrington: Orion Magazine, 2019.
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6. “Monthly Reanalysis Maps.” Climate Reanalyzer. Climate Change Institute University of Maine, 2019. https://climatereanalyzer.org/reanalysis/monthly_maps/.
7. “Role of the IPCC.” Climate Audit, January 8, 2008. <https://climateaudit.org/2008/01/08/role-of-the-ipcc/>.
8. “A Daily Record of Atmospheric Carbon Dioxide from Scripps Institution of Oceanography at UC San Diego.” The Keeling Curve, June 4, 2019. <https://scripps.ucsd.edu/programs/keelingcurve/>.
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14. “Climate Change 101 with Bill Nye.” Video. Accessed October 25, 2019. <https://video.nationalgeographic.com/video/news/101-videos/151201-climate-change-bill-nye-news>.
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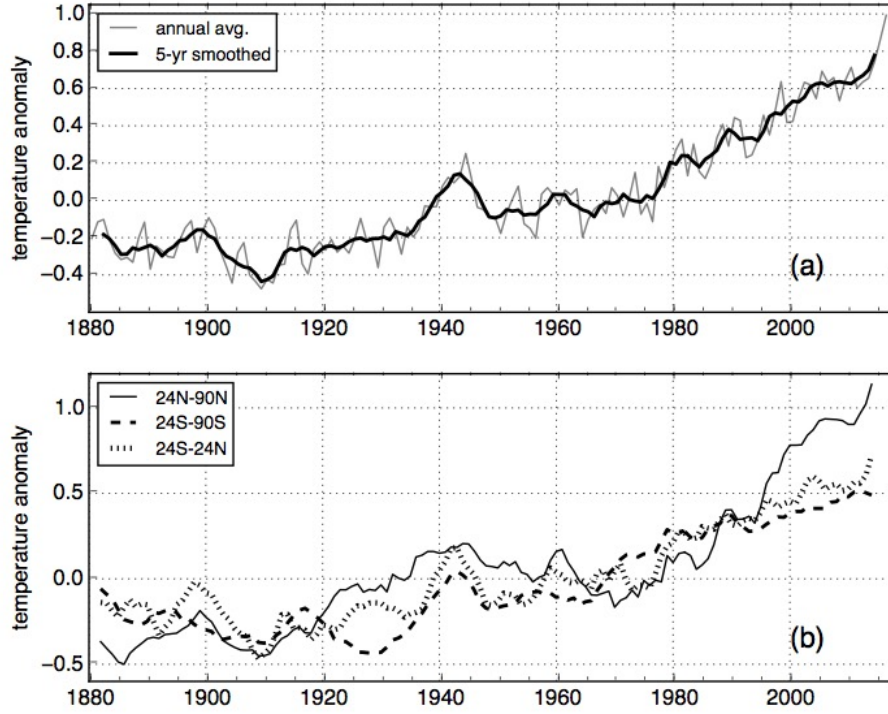
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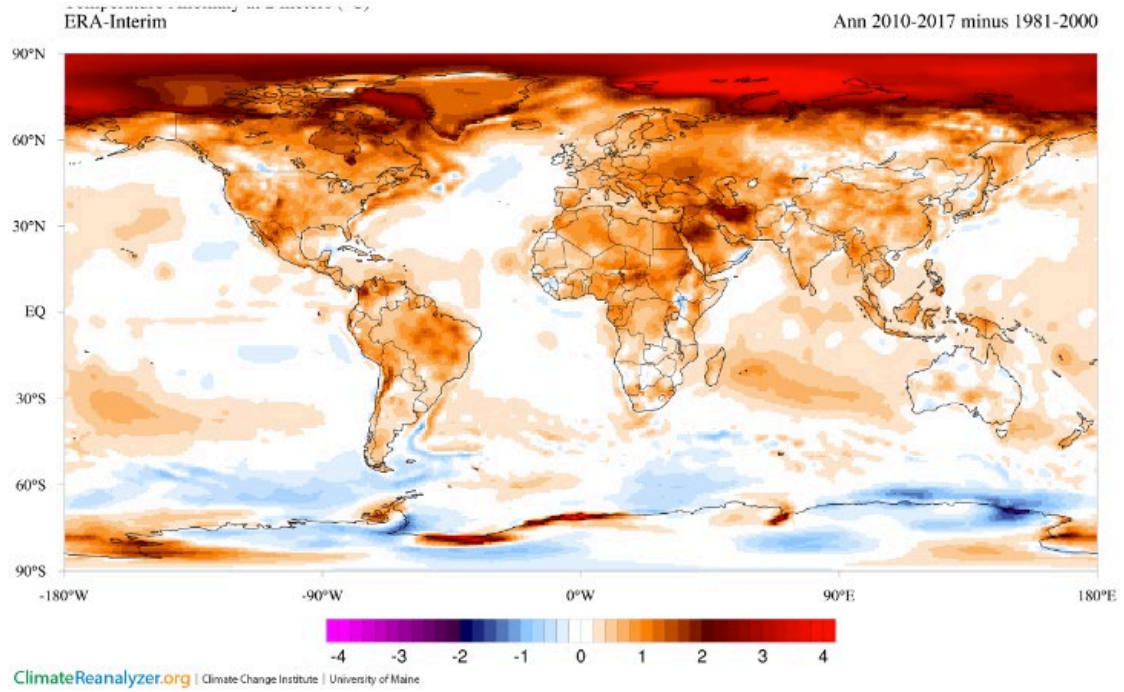
Appendix 7: Data

Figure 7.1



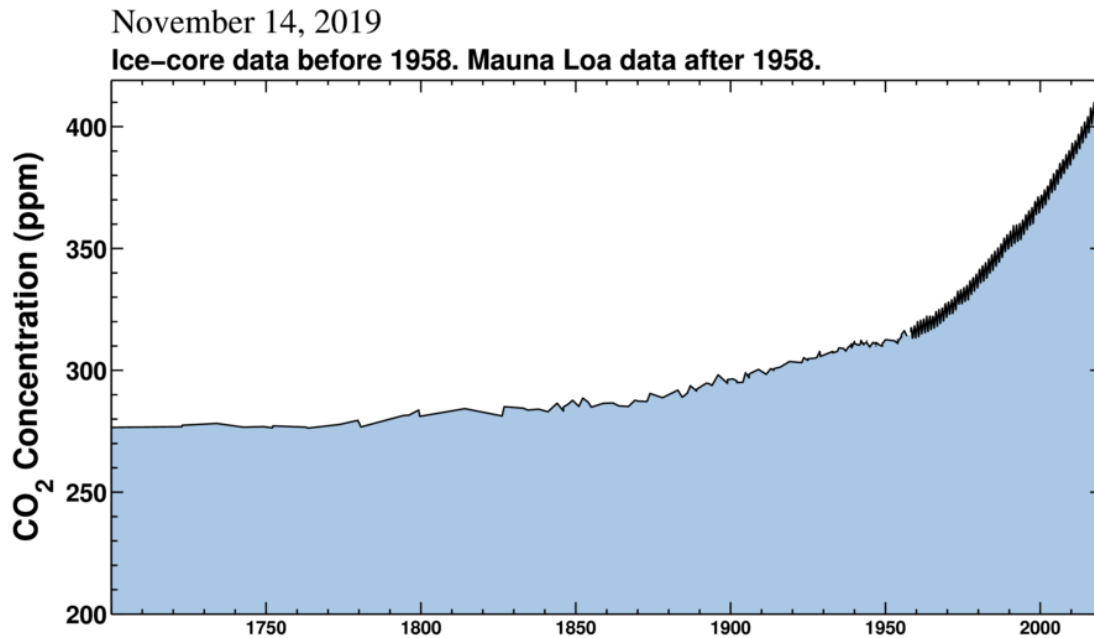
Dessler Figure 2.2

Figure 7.2



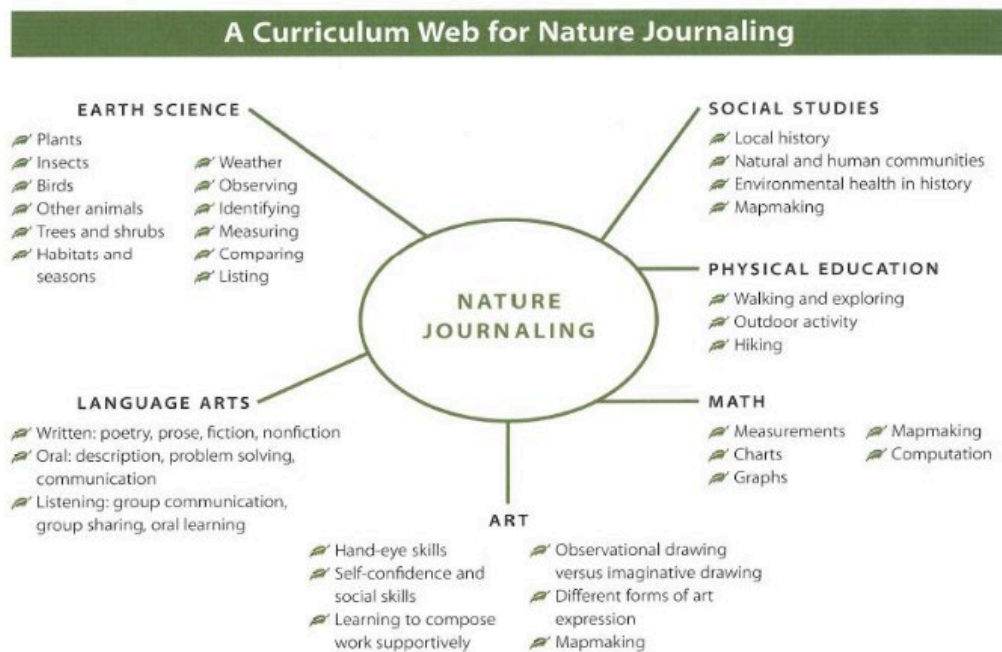
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Figure 7.3



https://scripps.ucsd.edu/programs/keelingcurve/wp-content/plugins/sio-blumoon/graphics/co2_800k_zoom.png

Figure 7.4



From *Keeping a Nature Journal* by Claire Walker Leslie and Charles Roth