



Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2021 Volume IV: The Earth's Greenhouse and Global Warming

Systems For Survival: The Effects of Climate Change in Connecticut

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Introduction

This unit is designed to help 4th grade students foster an understanding of the effects climate change in Connecticut. Students will learn about specific species native to Connecticut, that depend on salt marshes, that are experiencing heavier precipitation and loss of habitat due to the changing climate. The unit focuses on these main questions: How is climate change and the greenhouse effect related? What is happening to the animals on our coastline? Why is there so much flooding occurring in my neighborhood? Students will explore and research species in Connecticut who's survival has been negatively impacted by climate change, specifically the rise in sea level.

Rationale

This unit is adapted to the Next Generation Science Standards (NGSS) assigned to the 4th grade curriculum. I work in the pre-Kindergarten (3 years old) to 8th grade King Robinson Inter-district International Baccalaureate (IB) STEM Magnet School, in the city of New Haven. Being a title 1 school and a having a double magnet theme, my school has shifted their focus to STEM, focusing on the S, which is science. In fourth grade, students' study how energy and fuels are derived from natural resources and affect the environment. Specifically, students will be able to describe the environmental effects on a habit or ecosystem due to climate change, rise of sea level, the greenhouse effect & human activity. Additionally, students will be able to explain how different animals and species have reacted to challenges in their environment and ecosystem.

Elementary aged children grasp new topics easier when topics are relatable. To make this unit engaging for students, they will be studying animals and species here in Connecticut who are facing challenges in their environment. Having this unit focus on species in the student's home state of Connecticut allows them to make a connection to the topic. It also allows students to become more invested in the unit because they most likely have heard of the species and even might have seen them in person before. Additionally, this unit will enlighten students to take action to help their community find solutions to help these species and ways to

protect our coastlines from the rise in sea level occurring at a rapid speed.

There are some local organizations that are working to educate communities in Connecticut about the effects of climate change. For example, the Outer Island Research and Education Program located at the Thimble Islands in Branford, Connecticut is a five acre island that was donated in 1995 for environmental education and scientific research purposes. Outer Island is an ecological preserve and refuge for migrating birds off the coast of Branford, Connecticut. Researchers, scientists and students at Southern Connecticut State University work together to study different species and topics ranging in geology, oceanography, island ecology and intertidal ecology. In addition, Outer Island is partnered with the Stewart B McKinney National Wildlife Refuge that includes islands, salt marshes, grasslands and coastal forests. The Outer Island is extremely important to help migrating birds and threatened species by providing birds a place where they can stop during migrating across the Long Island Sound during the spring and fall. Portions of the island are closed to the public to allow these birds and other wildlife to migrate freely from human disturbance

Something that is extremely intriguing about the Outer Island Research and Educational Program is that a researcher will come meet with students two times in our classroom to give background information about migration and how some species living in our Long Island Sounds are either thriving or dying. This connects greatly with my unit topic because they would be able to learn and ask questions to a researcher who has a passion for this topic. Later, students actually get to board a small ferry and attend another hands on program on the actual Outer Island located in the Thimble Islands. These islands are located less than 20 minutes away from their homes. This is an incredible experience that students can see and interact with species, especially the Saltwater Marsh sparrow.

This experience will be tied into this unit so students can connect within the community to bring more awareness to the species living along the Long Island Sound by going on a field trip. In addition, there is a walkway around the block from the ferry pickup, which is also free, that will allow students to walk along the marshes on a pathway where they can make observations during their nature walk. These hands on experiences will allow students to really connect with this topic by allowing them to observe and make connections to the various species living in Connecticut.

This aligns with my school, King Robinson Inter-District International Baccalaureate STEM Magnet School's mission statement because by the end of the unit, students will be able to "take action and become empowered to be responsible, productive and engaged 21st century global citizens, who are respectful, open minded and reflective with positive attitudes. Students will use their skills to take action that lead to positive contributions to their global environment."

Climate Change & The Green House Effect

Our world is constantly changing, which is impacting the environment's different plants, animal species & humans. One major impact on our environment is climate change. Since the mid 20th century, scientists have been collecting an abundant amount of data about our planet on a global scale, which has indicated that the climate is changing. The cause of the climate change is an amplification of the greenhouse effect. The greenhouse effect is the process by which gases in the Earth's atmosphere trap heat which is radiating from the Earth towards space. The greenhouse effect is extremely important because it allows the Earth to stay

warm & temperatures to be regulated. Since life on Earth depends on the sun for survival, the shortwave radiation from the sun moves through the atmosphere and is absorbed by land and the oceans. Radiation is reemitted from these bodies as long wave radiation, which can be absorbed by greenhouse gases. Some of the gases that are a part of the greenhouse effect are water vapor, nitrous oxide (N₂O), Methane (CH₄) & Carbon Dioxide (CO₂).

The greenhouse effect is extremely important for our atmosphere because it keeps a balanced temperature for the Earth to allow life to grow and survive. The greenhouse effect does not give the same balance to other planets in space due to their atmosphere. For example, the planet Mars has a very thin atmosphere with a very weak greenhouse effect caused by no methane or water vapor to contribute to the effect. This in turn causes Mars to have no signs of life due to the large frozen surfaces. Additionally, problems can occur when an atmosphere has too much of a greenhouse effect. For instance, the planet Venus' atmosphere contains almost all carbon dioxide. Having too much of a greenhouse effect in an atmosphere can cause excruciating temperatures that are too hot to allow life to occur. It's important to understand that the Earth's atmosphere is extremely unique because of the balance of temperatures allowing life on Earth to exist and thrive.

Connecticut is located in the eastern coast of North America, it's geographical location allows the state to experience cold, snowy winters and warm, humid summers. Typically temperatures average 26°F in January and 72°F in July. Since the beginning of the 20th century, temperatures have increased about three degrees Fahrenheit. More recently, above average temperatures at night, exceeding 70°F, have been recorded in the last five years. While Connecticut's temperature increasing about three degrees may not sound like a large change, it does impact our weather in a large way. For instance our winters now consist of more rain than snow. Furthermore, climate change is resulting in our summers becoming dryer and more humid with higher heat indexes. In turn, these temperatures are leading to climate change in our area with an increased number of species and coastal communities and habitats being threatened.

The Effects of Climate Change

Due to global climate change there has been both visible and invisible effects that our environment has faced. Whether it's glaciers that have broken off into the oceans, temperature changes in different areas or plant and animal species in threat, things are happening rapidly to affect our environment. The Intergovernmental Panel on Climate Change (IPCC) has predicted that the effects of climate change will vary over time. The IPCC has also predicted that the global average temperature will increase 1.8 to 5.4 degrees Fahrenheit over the next few decades. In addition, more frequent wildfires, longer drought periods, increased drought periods, increase of tropical storm intensity and sea level rise are some other potential threats that different regions of the United States may be faced with in the future.

What is Happening to our Snow Days? Why Is It Raining Again.

According to the National Oceanic and Atmospheric Administration (NOAA), extreme weather patterns in Connecticut is causing heavier storms occurring more frequently, with heavier amounts of water provided by each storm. As a result, storms in Connecticut are formed quicker, with greater strength, powered by more heat and moisture. Furthermore, greater changes in extreme weather are seen in the winter and early spring. With warmer winters occurring, it is not cold enough for snow to form changing the predicted weather that was once experienced in Connecticut. This is because warmer air has the capability to absorb and hold more water vapor than cooler air. As climate change continues, there will continue to be more extreme precipitation occurring in the United States. As temperatures increase, so does the ability to hold more water vapor. So, with our warmer winters comes more rainfall instead of snow. The more moisture in the air, the heavier the rainfall will become to replace the heavy snowy winters we in Connecticut have once experienced.

Climate Change & Sea Level Rise. What is happening to Connecticut's coastlines?

When waters warm they expand, which can lead to sea-level rise. The heavier than normal rainfall has had an influence on coastal flooding. This is because the rain is falling at a quicker than normal rate for the soil to be absorbed. So, storm water that isn't being absorbed is turning into runoff water and flooding yards, roads or other surfaces. Sea level is measured every 6 minutes using equipment like satellites, floating buoys off the coast and tidal gauges. The sea level specifically in Connecticut has risen 5 inches since 1964 and will continue yearly.

Although there are various reasons why sea level is changing here in Connecticut. There are loss of glacial ice, a slowing Gulf Stream, and sinking land. Have you ever seen the Empire State Building located in Midtown Manhattan in New York City? It is a 102 story sky scraper that is the 4th tallest building in New York city and the 6th tallest building in the United States. Now imagine the weight of 800,000 of those buildings. That is over 2.1 billion pounds of ice falling into the ocean. That would be approximately how much glacial ice is melting into our oceans each year. You may be thinking how is ice glaciers in Antarctica impacting the United States, or even more specifically the state of Connecticut? The ice sheets that are melting and collapsing into the ocean are impacting the ocean volume at a much faster rate than normal. The glaciers are putting so much water into the ocean that they are rising the height of the ocean. Imagine a bathtub filling up with water and getting closer and closer to the top. Ice melt is causing approximately two-thirds the amount of sea level rise in the world.

You may be thinking what is causing the glaciers to be breaking off into ice sheets at a quicker rate. The answer is actually very simple. Oceanographers have found that the ocean is getting gradually warmer. The ocean's temperature has risen 1.2 degrees Fahrenheit since the 1950s. Since the ocean is getting warmer gradually, it is cause ice to melt and oceans to expand. A 1.2 degree increase may not seem like a large number to cause any significance in the ocean; however, it has caused over six inches of sea level rise. This is significant when you remember the total volume of the ocean. Thermal expansion has increased causing sea

levels to rise 75% faster over the last ten years as compared to previous years. Although all oceans around the world are different temperatures, it becomes difficult to pin point the exact location where thermal expansion is happening. However, oceanographers do know that deeper water expands more than shallow water as it gets warmer. This is because there is more pressure with deeper water allowing the waters to have a greater capacity to expand and cause sea level rise. To put the amount of sea rise occurring from thermal expansion in perspective imagine the volume of an Olympic size swimming pool filled with water. Then take that Olympic size pool and multiple it by 142 million. That is the amount of sea level rise occurring in the world's ocean which is then impacting our coastlines.

The Gulf Stream is another factor that is leading to regional sea level rise on the east coast. The Gulf Stream impacts the East Coast of the United States and has less of an influence on other places in the nation. The Gulf Stream circulates water around the East Coast. This is a continuous cycle that transports the warm salt water from the south to the north where it cools down. However, there is a big problem. The cycle is slowing down, causing the Gulf Stream to take less water from the East Coast, leaving more water to pile up. Since the water is supposed to be getting pulled from the shore to enter this continuous cycle, the lack of speed occurring in the Gulf Stream is now resulting in a change in sea level along the east coast. You may be thinking what is causing the Gulf Stream to slow down? The answer is there is too much fresh water entering the cycle which is interrupting the balance of the saltwater and freshwater mixture. The increased amount of freshwater is coming from the glaciers that are breaking off and melting into the ocean near Greenland. Since freshwater does not sink as fast as salt water, climate change is ultimately slowing down the Gulf Stream. Our coast lines are impacted because now high tide is seem being increased causing changes in sea level. This eventually is pushing the beaches, marshes and developed neighborhoods back and increases flood zones. In turn, these changes are causing extreme flooding when it rains causing millions of dollars to repair damaged areas.

One of the last major cause of changes in sea level is due to the sinking of land in various locations. In different areas it is actually the leading cause of the change in sea level. The ground is still reacting to the weight of the glaciers that covered the globe 20,000 years ago. In 2002, NASA launched the Gravity Recovery and Climate Experiment (GRACE) twin satellites, which take precise measurements of the contribution that ice sheets loss of mass contributes to changes in gravity, which is adding to sea level rise. Post glacial rebound is impacting the East Coast because of the rise of land masses that have been damaged after massive melt-off at the end of the last ice age 6,000 years ago.

So how can we relate what is happening to our home here in Connecticut? Since ocean levels on the East Coast are rising between two to six millimeters each year as a result of climate change Connecticut residents are and will continued to be impacted. About 61% of Connecticut's population is prone to flooding. In connection, Connecticut residents can loose more than 24,000 acres of land due to sea level rise. That amounts to approximately 18,182 football field of loss land taken over by sea level rise. Without action, coastal neighborhoods, rail lines, route I-95 & Tweed Airport, located in New Haven will experience more tidal flooding and damage. This will result in millions of dollars of yearly repair. In addition, the population of birds in Connecticut will decrease from 53,000 to 5,000 within the next 25 years. There will also be other plant and animal species that will be impacted as well.

Connecticut's Salt Water Marshes & the Impacts on Habitats, Species & Environments

According to the state of Connecticut Department of Energy and Environmental Protection, there are about 84 species of mammals, 335 species of birds, 49 species of reptiles and amphibians, 196 species of fish and an estimated 20,000 species of invertebrate that call be found in the state of Connecticut. However, due to the increasing rate of climate change and rise of sea level, these species & their habitats are at great risk of being threaten and even endangered if solutions are not put into place soon. With the rising sea level impacting the salt water marshes, there are a number of species at highest risk due to climate change.

Some of the specific animals that this unit will focus on are the “winners and losers” of Connecticut including the Saltmarsh Sparrow and the Marbled Salamander. In addition, this unit will also look into other East Coast species and products that have also change dramatically in the past few years. This includes lobsters in New England and the product maple syrup. Within the unit, students will also have the opportunity to research other species who may be thriving or dying in various areas like Connecticut, the East Coast or other areas of the United States of America.

To understand why species are endangered, students need to understand different types of ecosystems. Up until this point in their education, students can most likely identify a few different types of ecosystems. For instance, they may recognize a rainforest, desert, ocean, forest and a savannah. However, students probably never heard of a marshland or have even realized how close the marshland ecosystem is to their homes. By having students study ecosystems and what animals belong in each ecosystem it will allow them to understand how it is affecting a species. For instance, to better understand why the saltmarsh sparrow is dangerously close to extinction, students will need to identify where these birds make their nests and why nests need to be built at the highest part of the estuary away from the ocean and more inland.

The Connecticut Department of Energy and Environmental Protection (DEEP), which is dedicated to conserving, improving and protecting Connecticut's air, water and other natural resources and the environment, have taken many steps to preserve and protect the state's plant and animal populations to avoid extinction. In 1989, The Connecticut Endangered Species Act was passed with the goal to conserve, protect, restore and enhance any threatened or endangered species and their habitat. Every 5 years, species are reviewed and can have their status changed. The three categories where species at risk can identify as are species of special concern, threatened species and endangered species.

Below are a few species we will focus on in this unit.

1. *Saltmarsh Sharp-Tailed Sparrow*: The Saltmarsh Sharp-tailed Sparrow spends most of its time hidden in the tall grass along the salt water marshes in Connecticut where they collect and eat insects. They build their nests above the typical high tide level on the highest part of the marsh platform, inland from where the marsh turns into ocean. They build a cup-shaped nest when brown- flecked eggs will appear. The endangered Salt Sharp-tailed Sparrows of Connecticut are most often referenced and related to the Polar Bear of the Artic. This is because they are at extreme risk due to the ongoing sea level rise due to climate change in Connecticut. Since these sparrows only build nests in saltmarshes, the increasing risk of flooding in the area are causing the number of surviving saltwater sharp-tailed sparrows to decrease. According to the Connecticut Audubon Society, the population of species has declined 90% each year, which is a rapid rate for any species. It is projected that the species may be

extinct within the next forty years.

2. *Piping Plover*: The Piping Plovers are small birds about six to seven inches, weighing between 1.5 to 2.5 ounces. They have white bellies and a creamy, brown, sand color above. They also have a single black neck band and a black bar on their white forehead. Their feathers are mostly dark brown. The piping plover can be found from Nova Scotia to North Carolina. In Connecticut, this bird arrives along the coastal beaches to nest in late March. Their shallow nests are made in in the sand where they lay eggs. Both climate change, especially sea level rise, and humans have invaded their nesting habitat causing them to be put on Connecticut's Endangered Species Act Protection in 1992. The rise in sea level are drowning out the nests. In addition, since these tiny chicks cannot fly until they are about 28 days old, they need a safe environment that is regulated for them to safely walk and run. Every spring, the Department of Energy and Environmental Protection (DEEP) allocates areas of shorebird nesting habitats along the coastline by using stakes and twine fencing and signs to protect the bird species. In addition, on some beaches, DEEP installs welded wire fencing to create enclosures around piping plover nests to protect them from being washed away from the waters, destroyed by predators or stepped on by humans. In 1984, there were only 30 piping plover nests reported in Connecticut. With the help of the DEEP actions to protect and monitor nesting sites, the number of piping plovers nests are increasing. In 2019, 57 nests hatched 98 piping plover chicks.
3. *Marbled Salamander*: Unlike other species who are being threatened by climate change, the marbled salamander (*Ambystoma opacum*) is thriving and multiplying. Marbled salamanders are found commonly in deciduous woodlands where water or moist areas are found close by. Although they prefer dry, sandy-soiled habitats, they also thrive in wet, swampy soils. Due to the rising temperatures and climate in Connecticut, salamanders are reproducing at a rapid rate, they are now responsible for altering pond biodiversity. Since they lay their eggs in ponds in the fall and hatch during the harsh winter months. The ones that survive are able to grow before the warming spring allowing them to be the perfect predator for the ponds. Since marbled salamanders eat everything, like worms, slugs, snails, spiders, crickets, beetles, ants and other invertebrates and breed before other pond species, they are referred to as the wolves of the water. This is especially true now that winter months are not experiencing the same freezing temperatures keeping ponds frozen like they have in the past. When the ponds are froze over, predators like the marbled salamander were able to be kept in check to not overpopulate an area. Now, with less harsh winters, there are more ponds the marbled salamanders are able to survive and reproduce in. This is hurtful to ecosystems because now the predator is taking over the ecosystem and making it unbalanced. For example, Mark Urban, an associate professor of ecology and evolutionary biology at the University of Connecticut, found that when he looked under a pond that had a sheet of ice on top he noticed that the water was extremely green with lots of overgrown algae. He could tell immediately that the ecosystem was disturbed and the cause was from the marbled salamander. Since the over population of marbled salamanders has been an ongoing investigation, it was clear that the salamanders were in the pond and ate the animals that graze on the algae. This disruption of the ecosystem is eye-opening because with the over stimulation of one species is inhibiting an entire ecosystem from thriving and surviving. Mark Urban mentioned that when he first started studying marbled salamanders in Connecticut only about one third of the ponds had them. When he returned back to the same area a few years later he found that this predator was in almost every pond and stated that it was one of the biggest changes he had ever witnessed. As climate change continues, the salamanders are able to enter more ponds and habitats and bring unbalance to them.
4. *New England Lobsters*: Lobsters used to thrive in New England, especially in the 1990s. Since then, the lobster population has drastically decreased especially in Connecticut and Rhode Island. The loss of

supply is impacting economic sales, especially in restaurant and supermarkets. It is also negatively impacting tourism in the summertime. This significant change is a result from climate change and warmer waters, which is changing the habitats where animals are living and relocating. In 1997, twenty two million pounds of adult lobsters were reported in Cape Code, Massachusetts and Rhode Island. This was the greatest number of lobster reported in the New England area. Robert Bradfield, a former Rhode Island fisherman, reported that in the 1990s, his lobster traps were catching up to 2,000 ponds of lobster a day. Nearly ten years later, he had to quit catching lobster and change his career because he was catching less than one hundred pounds per day. As time moved on and temperatures increased from climate change, the number of lobsters reported in this areas started to dramatically decrease. For instance, sixteen years later, in 2013, the number of lobster reported dropped to 3.3 million from 22 million in 1997. The average temperature of the water was recorded by a power plant in the Long Island Sound, and no averages 68 degrees Fahrenheit. Lobster thrive in cooler temperatures between 61 and 64 degrees Fahrenheit. These lobsters have migrated to northern New England, in the Gulf of Maine, where the water flows from Canada, Maine, New Hampshire and the northern shore of Massachusetts. Fisherman have reported they have record high number and have seen the lobster population nearly double to two hundred and fifty million. As water temperatures rise, lobsters will be migrating towards the poles where the water is cooler. This is very concerning because as William Adler, a Massachusetts lobsterman and member of the commission's lobster management board stated, "We can't control the water temperature." To sum it up, the lobsters are now thriving in Northern New England, but it is not certain how long this will continue and what the future will hold for New England.

5. *Maple Syrup*: In 2015, the northeast region of the United States, was thriving with the production of maple syrup reaching one hundred twenty five million dollars in sales. However, in recent years, the Acer Climate and Socio-Ecological Research Network, better known as ACERnet, have found that tapping season is very reliant on weather conditions and temperatures. Climate change is impacting maple trees and syrup production due to warming temperatures and changes in precipitation. Furthermore, the impacts are affecting tree health and growth, shortening tapping seasons and a decreasing sap quality and quantity. This in turn, results in lower rates of syrup production in the United States. Paleoecologists, who study the vegetation of the past by looking at pollen deposited in lakes, have seen that tree species has changed as climate changed over the past thousands of years. The USDA Forest Service maintains a "Climate Change Atlas" that shows the habitat of 134 tree species in the eastern United States is predicted to change due to climate change. Unlike animals, individual trees cannot migrate to a new area to get the nutrients it needs to thrive and survive. These maps show a decline in sugar maple in most of it U.S range by 2100. This means that the trees will most likely still be in the areas come 2100, however, the habitat will not be suitable for the production of maple sap for syrup. In addition, tree health is extremely important for the production of sugar maple sap. Two effects of climate change that could affect sugar maple health are warmer winters and more frequent frost in the springtime. The warmer winter temperatures cause the budding of trees to happen earlier. Having a bud break two to three weeks earlier than normal can cause leaf- dieback from the frequent frost occurring in the spring. This in turn impacts the growth of mature trees since the weather is causing a shorter growing season. Since temperatures are increasing at a faster rate, tapping season is getting earlier and earlier every year. As climate change continues, tapping season is projected to begin fifteen to thirty days early by 2100. ACERnet is working to understand and improve these affects by teaming up with universities, specifically the University of Massachusetts Amherst, University of Virginia, Dartmouth College, and Montana State University and stake holders like, State Maple Syrup Association, North American Maple Syrup Council, International Maple Syrup Institute and Land Managers. Their goal is to help the maple industry to adapt and thrive in the future with these

new conditions. They also plan on improving the tapping industry with resources, improving tapping conditions, and making decisions on how to best maintain and grow syrup production with the effects of climate change occurring.

What Are The Solutions to Help Climate Change in Connecticut?

Solutions to help eliminate Climate Change are not simple. Since Connecticut's sea levels are rising and land is sinking at a faster rate, solutions become complicated. In addition, there are many infrastructures and coastal properties that are also at risk and need help. With the help of community individuals, local, state and federal officials can work together to better protect the effects of climate change in different areas. For instance, to protect coastal communities, plans need to be made to protect homes, communities, wildlife and wildlife habitats from flooding. In addition, after areas are impacted from flooding or natural disasters, it is important to rebuild strong so the same problems do not continue to occur or abandon them altogether. Forward thinking is also key to help with the impacts of climate change. For instance forward thinking building codes, evaluating coastal developments, are all ideas to help with the ongoing changes in Connecticut.

In addition, it is extremely important for changes to occur quickly in order to make change to our environment. Building seawalls to decrease flooding from tides and storms will also prevent extreme damage in certain areas. However, costs are extremely high to maintain seawalls. As sea level is rising, finding a solution to drain water is also important. Building storm pumps and upgrading sewage systems are some examples to help with the drainage of water. Another solution to help with sea level rise and the areas and wildlife habitats being affected is using the beach as barriers by building sand dunes.

Another solution for eliminating the effects of climate change is building a low carbon future for Connecticut. According to the governor's Council on Climate Change from December 18, 2018, carbon dioxide represents the greatest warming potential due to its atmospheric abundance. Governor Malloy issued Executive Order No. 46 creating the governor's Council on Climate Change, which includes, examining policies and regulations designed to reduce greenhouse gas emissions, establishing goals to achieve 8% reduction from these gas emission by a set goal of 2050. This including recommending policies and legislative actions to reach the 2050 goal, and monitor greenhouse emission levels yearly to determine whether or not the state is in line to meet its targeted goal.

To help establish a plan to meet the 2050 goals to decarbonize Connecticut's economy the Council on Climate Change are focusing on three topics. These topics are a zero carbon electricity generation, clean transportation and a clean, efficient and resilient building plan. If effective, this will help Connecticut achieve a zero carbon future, which will help with the effects of Climate Change in our area. To establish a cleaner and greener way to effective power emission free electricity by creating more wind and solar infrastructures, which can be costly at first, will show significant changes in the long run.

Teaching Strategies

Lesson 1: Discuss what living things need in order to survive by creating a list. Then watch the video <https://www.generationgenius.com/videolessons/structure-and-function-video-for-kids/> (You can search for the video with the title Structure of Living Things on the Internet). If you sign up for an account or free trial you will be able to watch the entire video on Structures of Living Things. There are plenty of other videos and or books you can find that introduce this topic. At this point, students should have a clear understanding of the words internal structure, external structure and how structures and function help living things do different things like grow, survive, reproduce and behave.

Lesson 2: What is Climate Change? Although living things need ecosystem structure and function to survive and thrive, there are challenges living things are facing. This video, <https://www.youtube.com/watch?v=WkvPdUtYhX8> (You can search for the video with the title Climate Change For Kids- A Fun Engaging Introduction to Climate Change on the Internet), will discuss the causes of climate change like the greenhouse effect, fossil fuel burning, farming, and deforestation. Students can hold discussions as to what they notice in their community changing because of climate change.

Lesson 3: Students will play a game called The Climate Time Machine using their electronic device by going to <https://climatekids.nasa.gov/time-machine/> (You can search for the website with the title NASA Climate Change For Kids on the Internet). This would be great to do with a partner so the students can discuss what they notice happening in the game and reflect on how it connects to them and other living things. Some questions to consider are: How much Arctic sea ice has melted just since satellites started observing around 30 years ago? What parts of the world will be under water as sea level rises, inch by inch, foot by foot? How much has the greenhouse gas carbon dioxide increased in the air just in the last few years? How much has temperature risen around the world in just a little over 100 years?

Lesson 4: Read the book, *Polar Bear, Why Is Your World Melting*, by Robert Wells to build background knowledge on the greenhouse effect. Students will learn more about the greenhouse effect by measuring temperature. Global warming is the key component of climate change. It is caused in part by the greenhouse effect. As a class or in small groups one might have students place two thermometers side by side in a sunny spot inside or outside of the classroom. Put one of the thermometers inside a jar covering the top with plastic wrap. Leave the other thermometer outside the jar, but right next to it. Have students hypothesize what will happen and why. Have students record temperatures every 10 minutes on a recording sheet. Overall, the goal of this lesson is to understand how solar energy (light) goes inside the vase and is changed into thermal energy (heat). This heat cannot escape the vase. It's trapped, and the air inside of the vase gets warmer and warmer as more light (solar energy) enters the vase. This is very similar to the greenhouse effect. The second thermometer is exposed to *air*. Even though it doesn't seem like much is happening in the air, a lot of factors are at work that allow the warmer air to mix with the cooler air in a constant interactive dance.

Lesson 5: Students will investigate the effects of melting ice and its contact with water. Climate change is causing warmer temperatures, which is causing glaciers to melt faster than they can accrue new ice. These warmer temperatures also mean that some places are getting more rainfall than snow. Students can connect the fewer amount of snow days and snowfall they have seen these last few years. Since there is less snow falling, glaciers melt and have more contact with water. This in turn causes the ice to melt quicker. Ice melts more quickly in water than air because water is denser – has a greater concentration of molecules – than air. When ice is in water, more molecules bump against it and transfer more heat energy.

Instructions:

1. Place an equal number of ice cubes in each container. You can use either regular ice cubes or ice cubes made with colored water. (Coloring makes no difference to melting. It simply makes it easier to see the ice as it melts)
2. Add a small amount of water to one of the containers.
3. Set the timer or stopwatch. Visit the containers every few minutes to see what is happening.

Students can check out this videos while they are waiting <https://www.youtube.com/watch?v=hC3VTgIPoGU> (You can search for the video with the title Chasing Ice- Captures largest glacier calving ever filmed)

Lesson 6: Sea level rise and Connecticut. Students will learn how the saltmarsh sparrow is being impacted from sea level rise. This is a great time to call the Outer Island Research and Education Program (use this link to fill out <http://outerisland.org/index.php?id=contact-us&lang=eg> You can search for the application with the title Outer Island Contact Us on the Internet). If you are unable to go visit the Outer Island, this link is a great virtual option that will explain how the saltmarsh sparrows are being affected by sea level rise and how they are helping the species from extinction. <https://fb.watch/6vyqd9rkNw/> (You can search for the video with the title Live From the Marsh with saltmarsh Sparrow on the Internet)

Lesson 7: Students will research other animals and species in Connecticut or New England that are also being affected by sea level rise and climate change. You can scaffold this by giving students the species to research or having various informational poster around the room and having students note the similarities and differences among the species. By the end of this lesson, students should have a clear understanding that different species are being affected and if there is no change, then these species will become extremely threaten or extinct during their lifetime.

Lesson 8: Taking Action. Students will create a campaign to inform the community how they can help some of the endangered species here in Connecticut. Students can choose a way they want to promote change by creating a poster, website, PowerPoint, flyer, etc.. that will grab the attention of the community and demand change. Take it a step further by getting the school, family and even the news involved in this movement.

Reading List for Students

This list of supplemental texts are suggestions and can be read in any order. These text listed below will help build knowledge about climate change and help them identify ways they could help make a change in the world. The goal is for students to realize the negative effects climate change is having in this world and make connections to the way they are also effected.

“Greta’s Story: The Schoolgirl Who Went On Strike to Save the Planet” by Valentina Camerini .

This information text shares a true story about a young eco-activist whose persistence sparked a global movement.

“What is Climate Change?” by Gail Herman

This informational text discusses what climate change means and how it's affecting our planet.

"It's Your World: get Informed, Get Inspired & Get Going!" by Chelsea Clinton

This informational text tackles some of the biggest challenges our world is facing today. Using data, charts and stories, this text informs kids on various subjects. Use this text to focus on the issues of Climate Change and Endangered Species.

"Basher Science: Climate Change" by Simon Basher

This informational text will discuss the carbon cycle and the greenhouse effect.

"What Every Child Should Know About Climate Change" by Baby Professor

This informational text discusses how climate change effects everyone, regardless of age, gender, nationality. It is a worldwide problem that kids should know and ways to minimize the effects.

"Mission: Save the Planet: Thinks YOU Can Do To Help Fight Global Warming" by Sally Ride and Tam O'Shaughnessy

This is a how to book is a guide to help kids impact their community and world. From simple measures like turning off the water while you brush your teeth, to bigger challenges like making some noise in the larger community, this simple guide helps lay a conceptual foundation for kids to become responsible energy consumers in the years to come.

Materials:

The materials in this unit are important for students to have a hands on experience while learning about climate change, sea level rise, animals who are threatened or near extinction. These materials will help build knowledge and a better understanding of the various issues in the unit.

1. Video links:

Lesson 1- <https://www.generationgenius.com/videolessons/structure-and-function-video-for-kids/> (You can search for the video with the title Structure of Living Things on the Internet).

Lesson 2- <https://www.youtube.com/watch?v=WkvPdUtYhX8> (You can search for the video with the title Climate Change For Kids- A Fun Engaging Introduction to Climate Change on the Internet)

Lesson 5- <https://www.youtube.com/watch?v=hC3VTgIPoGU> (You can search for the video with the title Chasing Ice- Captures largest glacier calving ever filmed)

Lesson 6- <https://fb.watch/6vyqd9rkNw/>(You can search for the video with the title Live From the Marsh with saltmarsh Sparrow on the Internet)

2. Game Link Game:

<https://climatekids.nasa.gov/time-machine/> (You can search for the website with the title NASA Climate Change For Kids on the Internet). (Lesson 3)

3. Book:

Read the book, *Polar Bear, Why Is Your World Melting*, by Robert

4. Experiment Materials:

Lesson 4 materials: 2 thermometers, 1 jar, plastic wrap, recording sheets

Lesson 5 material: Two identical plastic containers or one divided containers, Ice cubes,

Water (room temperature), Food coloring (optional), Timer or stopwatch,

recording sheet

Lesson 6 use this link to fill out for field trip

<http://outerisland.org/index.php?id=contact-us&lang=eg> (You can search for the application with the title Outer Island Contact Us on the Internet).

5. Electronic devices (Chromebook or iPad). This will be needed so students can conduct research and also to create their campaign at the end of the unit.

Teacher Bibliography

“Endangered, Threatened, and Special Concern Species in Connecticut.” *CT.gov*, 18 Dec. 2020, portal.ct.gov/DEEP/Endangered-Species/Endangered-Species.

This resource will clarify the Connecticut Endangered Species Act (passed in 1989) is and how it recognizes the importance of the state’s plant and animal populations and the importance to protect them. This resource also identifies the differences between endangered species, threatened species and species of special concern.

Furfaro, Hannah, and August 23. “The Saltmarsh Sparrow Is Creeping Dangerously Close to Extinction.” *Audubon*, 22 Sept. 2016,

www.audubon.org/news/the-saltmarsh-sparrow-creeping-dangerously-close-extinction#:~:text=The%20Saltmarsh%20Sparrow%20Is%20Creeping%20Dangerously%20Close%20to%20Extinction&text=It's%20first%20light%2C%20and%20the,coast%20is%20silky%20and%20pale.&text=Chris%20Elphick%2C%20a%20conservation%20biologist,he%20stops%20in%20his%20tracks.

This resource will dive deeper in to explaining all about the saltmarsh sparrow and why it is so close to extinction. It will also explain a saltmarsh sparrow’s habitat and how the rising waters are wiping away their nests filled with eggs or with chicks that are unable to fly.

Governor's Council on Climate Change (Conn.). *Building a Low Carbon Future for Connecticut: Recommendations from the* . Connecticut Department of Energy and Environmental Protection, 2018, <https://portal.ct.gov/-/media/Malloy-Archive/Press-Room/20181218-Governors-Council-on-Climate-Change-Final-Report.pdf>

This is a governor's council report on climate change that discusses how carbon dioxide is the greenhouse gas that represents the greatest warming potential due to its atmospheric abundance and long atmospheric lifetime. This report poses some solutions to decrease greenhouse gas emission.

Hancock, Elaina. "Rapid Change – A Tale of Two Species." *UConn Today*, 29 Aug. 2018, today.uconn.edu/2018/08/rapid-change-tale-two-species/.

This resource explains how the environmental changes are effecting two types of species. The article focuses on the saltmarsh sparrow and the marbled salamander, *Ambystoma opacum*. These two species are linked by the same variable, a rise in global temperature.

Means, Tiffany. "Why Is It Raining so Hard? Global Warming Is Delivering Heavier Downpours " *Yale Climate Connections*." *Yale Climate Connections*, 25 May 2021, yaleclimateconnections.org/2021/04/global-warming-is-delivering-heavier-downpours/.

This report expresses how the United States is experience a rise in precipitation. It explains why the United States in particular is experiencing more rainfall and how the average temperature has increase 1.8 degrees Fahrenheit as a result of the release of heat trapping greenhouse gases into the atmosphere.

O'Donnell, James. 2019, pp. 1–14, *Sea Level Rise in Connecticut, Final Report February 2019*. <https://circa.uconn.edu/wp-content/uploads/sites/1618/2019/10/Sea-Level-Rise-Connecticut-Final-Report-Feb-2019.pdf>

This resource is a very detailed report about a plan of action for sea level rise in Connecticut. There are various charts with data that compare the increase in sea level starting in the late 1930s and making predictions through the year 2100.

Quincy, Susan, et al. 2020, pp. 1–25, *Connecticut: Our Changing Climate*. <https://portal.ct.gov/-/media/DEEP/education/kellogg/CT-Changing-Climate-Booklet.pdf>

This climate report booklet has lots of information about effects of climate change in Connecticut provided by the Connecticut Department of Energy and Environmental Protection. This is a great resource because it breaks down each piece of climate change, the greenhouse effect, sea level rise, wildlife at risk, extreme weather, and provides solutions to how Connecticut is responding to these challenges.

Rasmussen, Carol. "Glacial Rebound: The Not So Solid Earth." Edited by Rob Garner, NASA, NASA, 25 Aug. 2015, <https://www.nasa.gov/feature/goddard/glacial-rebound-the-not-so-solid-earth>

This informative resource discusses glacial rebound in a very detailed text that explains how satellites from NASA is tracking how sea level rise is occurring two to three times quicker than average. It also explains how glacial rebound is effecting the East Coast.

Runkle, J., K. Kunkel, S. Champion, D. Easterling, B. Stewart, R. Frankson, and W. Sweet, 2017: Connecticut State Climate Summary. *NOAA Technical Report NESDIS 149-CT*, 4 pp.

<https://statesummaries.ncics.org/chapter/ct/>

This report explains how temperatures in Connecticut have increased since the beginning of the 20th century. There are various charts that have been tracking temperatures and global sea level projected with prediction through the 21 century. It goes into detail about the increase in rainfall and the decrease in snowfall with rationale for those changes.

SeaLevelRise.org. "Sea Level Rise Causes." *Sea Level Rise*, 1st Street Foundation, 2017, sealevelrise.org/causes/.

This resource explains the four main causes of sea level rise that include ice melt, thermal expansion, the slowing of the Gulf Stream and land sinkage, This article goes into a lot of detail about each cause with lots of examples.

SeaLevelRise.org. "Connecticut's Sea Level is Rising." *Sea Level Rise*, 1st Street Foundation, 2017, <https://sealevelrise.org/states/connecticut/#:~:text=And%20it's%20Costing%20Over%20%242,than%20it%20was%20in%201964.&text=This%20increase%20is%20mostly%20due,and%20it's%20causing%20major%20issues.>

This resource explains how it is costing over two billion dollars to provide solutions in fixing sea level rise in Connecticut. It provides information about the causes and complications of sea level rise in coastal communities and wetland habitats. It goes into detail about how the solutions are not simple, but important in order to preserve ecosystems and communities.

Shay, Jim. "CT Audubon: 6 Species at High Risk from Climate Change." *Connecticut Post*, Connecticut Post, 5 Dec. 2015, www.ctpost.com/news/article/CT-Audubon-6-species-at-high-risk-from-climate-6669737.php.

This short reports names the top six species at high risk due to climate change. These species are the saltmarsh sparrow, the black-capped chickadee, moose, piping plover, roseate tern and Atlantic salmon. Each species is provided a detailed explanation as to how they are being individually effected differently from climate change.

"Survival by Degrees: 389 Bird Species on the Brink." *Audubon Connecticut*, 18 Oct. 2019, nm.audubon.org/news/survival-degrees389birdspeciesbrink#:~:text=Survival%20by%20Degrees%3A%20389%20Bird%20Species%20on%20the%20Brink%2C%20a,number%20one%20threat%20to%20birds.&text=The%20good%20news%20is%20that,at%20risk%20from%20climate%20change

This report detailed how 37% of Connecticut's birds are vulnerable to climate change across the seasons. This rapid change of climate can lead to various bird populations to decline and even become extinct if the species is unable to adapt. It explains how greenhouse gas emission is a huge part of this challenge. The report goes on to suggesting a call of action on how change needs to occur in order for protect bird's ecosystems by ultimately reducing greenhouse gas emissions 45% by 2030.

Whittle, Patrick. "As Lobster Population Shifts North, Connecticut Industry Struggles." *Courant.com*, Hartford Courant, 12 Dec. 2018, www.courant.com/news/connecticut/hc-ap-lobsters-moving-north-0819-20150818-story.html.

This report by the State of Connecticut Department of Environmental Protections describes how habitats and
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wildlife will be impacted by sea level rise. In particular it explains how the coastal wetlands are experiencing an imbalance between fresh water and salt water in estuarine systems due to sea level rise. It goes on to explain that wildlife will need to either adapt to the climate change or migrate to a new habitat in order to survive. This report focuses on bird, mammals and invertebrate that have been effected. The Department also details ways in which they are helping, for instance, habitat management, land protection and conservation in various areas in Connecticut.

Appendix on Implementing District Standards

This unit is designed to incorporate the Common Core State Standards and 21st century skills which will prepare our students for their future.

SCIENCE

LS1.A: Structure and Function Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Students will discuss and note the structures of living things and identify the importance of these structures functions to survive and thrive. This CCSS will be implements in the beginning of the unit to ensure that all students know what a living thing needs in order to survive and the functions that help them grow, behave, reproduce and survive. Students will be able to make personal connections by identify different structures of their own body and also different animals. Students can expand this standard by reading about different living species and comparing their similarities and differences.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind or vegetation.

Students will be able to make several observations during hands on experiments and field trips to identify the effect weathering, like heavy rainstorms, have on an area due to climate change. Students will be able to learn about the effects of sea level rise and connect it to where they live here in Connecticut.

LITERACY

CCSS.ELA-LITERACY.RI.4.7

Students will be able to Interpret information presented visually, orally, or quantitatively by making observations and take part in small group and whole group discussions by using the videos, animations, websites, readings to explain the effects climate change. Students will be able to interpret this information to gain knowledge to share their thoughts and ideas.

CCSS.ELA-LITERACY.RI.4.1

Students will be able to refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text. Students will be able to do this multiple times throughout the unit and have extra opportunities when engaging in the student supplementary resources.

CCSS.ELA-LITERACY.W.4.2

Students will be able to write informative/explanatory texts to examine a topic and convey ideas and information clearly. Students will have the opportunity to create a campaign piece to spread awareness in their community. Students will have the opportunity to research species that are effected by climate change and rise in sea level. They will also come up with solutions they and the community can do to help.

SPEAKING AND LISTENING

CCSS.ELA-LITERACY.SL.4.1

Students will engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 4 topics and texts*, building on others' ideas and expressing their own clearly. This will be implemented in every lesson so students have the opportunity to share their thoughts and ideas with different classmates to learn from one another.

CCSS.ELA-LITERACY.SL.4.1.C

Students will pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others. Setting up a question spot or a “parking lot” poster where students can write their questions on sticky notes and post on a poster is a great way to collect data on what the students are having trouble understanding. This will make it easier for the teacher to provide additional lessons or resources to students to clarify any questions they might have.

CCSS.ELA-LITERACY.SL.4.4

Students will be able to report on how climate change is affecting Connecticut and use appropriate facts and relevant, descriptive details to support their research. When presenting their final project, students will speak clearly at an understandable pace.

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