MIDDLE SCHOOL SCIENCE

Term 1: Climate Change

**Essential Question**

How do humans impact the environment that we live in?

How has environmental change affected humans?

How can we work to mitigate the negative impacts that we’ve already had upon the environment?

**Understandings**

*Students will understand that:*

Climate and weather are not the same. Weather is the local pattern that changes daily while climate is the long term and larger area patterns.

Climate and weather are impacted by human activities and climate change.

There is a finite amount of energy in the biosphere and therefore energy must be conserved.

Food webs and chains represent the transfer of energy between organisms in an ecosystem

The limited amount of energy in an ecosystem controls populations sizes.

Populations cycle based on factors of population density and factors independent of density.

There is a finite amount of matter in the universe and therefore matter must cycle.

Carbon cycling focuses upon photosynthesis, cellular respiration and decomposition. Human activities are altering the process of the carbon cycle.

Nitrogen cycling utilizes a variety of microbes living in the soil to transform unusable nitrogen into usable forms. It is impacted in various biomes by human activities.

Greenhouse gases are produced by human activity at an increasing rate. These gases affect our atmosphere, thereby impacting species.

The increase in greenhouse gases and their impact on the atmosphere negatively affect humans respiration.

Human population has been increasing at high rates for the last few hundred years. This increase impacts our usage of natural resources and the climate.

Our biosphere is made of different biomes, determined by their physical location and their climate. As the climate changes, these biomes are changing system as well as shifting locations.

Human behaviors, such as deforestation and ozone depletion, have altered not only the physical environment but also organisms and their ability to adapt.

**Knowledge:**

*Students will know:*

* definitions of weather and climate as well as how weather and climate differ
* how climate is determined by the rotation of the Earth on its axis
* how seasons are determined by the rotation of the Earth around the sun and on its axis
* how seasons are affected by climate change
* that climate is affected by human activities
* the Law of Conservation of Energy
* definitions of a food web, food chain, autotroph, heterotroph, producer, primary consumer, secondary consumer, tertiary consumer, decomposer
* the 10% rule describes the flow of energy through trophic levels
* because of the Law of COnservation of Energy, the amount of energy available to each trophic level controls population sizes
* the scientific definition of a population
* the characteristics affecting population sizes - birth rate, death rate, immigration, emigration
* factors controlling population size are density dependent or density independent
  + density dependent factors have a more significant impact upon dense populations. these include competition, predation and disease transfer.
  + density independent factors affect populations the same regardless of how many individuals are in the population. Examples include weather related issues (drought, floods)
* the Law of Conservation of Mass/Matter
* OPTIONAL: structure of atoms
* nutrients cycle through the ecosystem because of the Law of Conservation of Mass
* how carbon cycles through the environment, including the role of photosynthesis, cellular respiration, and decomposition in the cycle.
* human actions are changing how carbon cycles through the environment
  + the role of fossil fuels and combustion in adding carbon dioxide back into the environment
  + deforestation removes photosynthetic organisms from the environment, leaving more carbon dioxide in the atmosphere
* OPTIONAL: how nitrogen cycles through the environment, including the role of decomposers
  + human activities, like fertilization, affect how nitrogen cycles and how organisms can grow (eutrophication)
* what a greenhouse gas is, including examples
* the effects of increasing greenhouse gases in the atmosphere
* how greenhouse gases are produced
* why greenhouse gases have been increasing over time
* examples of how greenhouse gases can be mitigated
* the increase of greenhouse gases affect human respiration
* the parts of the respiratory system and their functions
* how greenhouse gases and other pollutants make breathing more difficult for specific populations
* that human population has been growing at a faster rate since the Industrial Revolution
* how the larger human population size has increased the production of greenhouse gases
* what a carbon footprint is and how it is affected by individual choices
* that governmental decisions impact legislation about greenhouse gases
* how the size of the human population impacts natural resource consumption
* climate change impacts people differently depending upon economic status and gender
* the differences between rainforests, deciduous forests, deserts, grasslands and tundra
* where different biomes are found across the globe
* biome locations are shifting due to climate change
* what deforestation is
* how deforestation impacts the biome specifically where occurring
* how deforestation impacts the carbon cycle
* how deforestation impacts climate change
* organisms have to adapt to environmental changes caused by deforestation
* what natural selection is and how it affects survival and reproduction rates
* the difference between oxygen gas and ozone
* the importance of ozone in the atmosphere
* how CFCs break ozone apart
* the effects of ozone depleting substances on the ozone layer
* how thinning of the ozone layer affects organisms and the ecosystem
* thinning of the ozone layer allows increased UV radiation to hit Earth
* the parts of the integumentary system and their purpose for humans
* increased exposure to UV radiation can cause sunburns, and potentially cancer
* ways to protect against increased UV radiation
* how climate change has increased the number of disturbances around the world (wildfires, tsunamis, hurricanes)

**Skills:**

*Students will be able to:*

* explain the difference between climate and weather
* model how the sun’s rays vary across the globe
* appropriately draw a food chain and food web, using arrows to indicate energy flow
* predict the impact of alterations to the food web upon various levels
* calculate the amount of energy theoretically available at various trophic levels using the 10% rule
* explain why energy travels through a food web, applying the Law of Conservation of Energy
* apply the 10% rule to explain why population sizes at higher trophic levels are smaller
* calculate population statistics, including growth rates and density
* graph populations and use the graph to explain what is happening to a population
* predict what happens to population sizes when density dependent and density independent factors occur
* explain why nutrients cycle, applying the Law of Conservation of Mass/Matter
* OPTIONAL: diagram an atom and label its parts
* model the carbon cycle
* predict effects of human activities on the carbon cycle
* identify if an environment is acting as a carbon source or a carbon sink and explain why
* OPTIONAL: diagram and label the nitrogen cycle
* OPTIONAL: explain the role of bacteria in the nitrogen cycle
* OPTIONAL: predict the effects of human activities on the nitrogen cycle
* OPTIONAL: explain how eutrophication happens and what it does to a local ecosystem
* model how the atmosphere acts as a greenhouse
* predict what would happen if the amount of greenhouse gases changes
* explain how human activities affect greenhouse gas production
* justify the usage of greenhouse gas mitigation strategies
* explain how and why greenhouse gas production has changed over time
* identify the parts of the respiratory system
* explain the function of the parts of the respiratory system
* utilize data to explain how greenhouse gases impact the respiratory system
* predict which populations will be more drastically impacted by increased greenhouse gases and justify the prediction
* explain how and why the human population size has changed over time
* relate human population size to greenhouse gas production
* determine their carbon footprint and predict how they could change their footprint
* predict the impact of government regulations on greenhouse gas production
* advocate for changes in government policy affecting climate change
* relate human population size to natural resource consumption
* interpret data to determine how population size, economics and inequalities are connected to climate change
* evaluate programs aimed at eliminating inequalities related to climate change
* graph temperature and precipitation to create a climatograph
* interpret a climatograph, predicting the type of biome represented by the graph
* explain biome locations based on climate and latitude
* predict what would happen to a biome based on climate change
* explain deforestation including its impacts upon the local region, the global carbon cycle and climate change
* predict how actions to mitigate deforestation would affect ecosystems
* explain how organisms have to adapt to new environments caused by human activities
* explain the importance of the ozone layer to humans and ecosystems
* model how CFCs break ozone
* use data in explaining how ozone holes above the antarctic have changed over time
* relate international agreements to CFC production and ozone production
* explain how increased UV radiation exposure is caused by thinning of the ozone layer
* identify parts of the integumentary system and explain their function
* relate thinning of the ozone layer, increased UV radiation, and skin disorders
* justify choices of how to protect the skin against UV radiation

**Curriculum Standards** (applied as a resource) - 2016 Massachusetts STE Frameworks

6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life.

7.MS-ESS3-4. Construct an argument supported by evidence that human activities and technologies can mitigate the impact of increases in human population and per capita consumption of natural resources on the environment.

7.MS-LS1-4. Construct an explanation based on evidence for how characteristic animal behaviors and specialized plant structures increase the probability of successful reproduction of animals and plants.

7.MS-LS2-1. Analyze and interpret data to provide evidence for the effects of periods of abundant and scarce resources on the growth of organisms and the size of populations in an ecosystem.

7.MS-LS2-4. Analyze data to provide evidence that disruptions (natural or human-made) to any physical or biological component of an ecosystem can lead to shifts in all its populations.

7.MS-LS2-3. Develop a model to describe that matter and energy are transferred among living and nonliving parts of an ecosystem and that both matter and energy are conserved through these processes.

8.MS-ESS1-1b. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth’s tilt and differential intensity of sunlight on different areas of Earth across the year.

8.MS-ESS2-5. Interpret basic weather data to identify patterns in air mass interactions and the relationship of those patterns to local weather.

8.MS-ESS3-5. Examine and interpret data to describe the role that human activities have played in causing the rise in global temperatures over the past century.

8.MS-LS1-5. Construct an argument based on evidence for how environmental and genetic factors influence the growth of organisms.

8.MS-LS4-4. Use a model to describe the process of natural selection, in which genetic variations of some traits in a population increase some individuals’ likelihood of surviving and reproducing in a changing environment. Provide evidence that natural selection occurs over many generations.

**Mission Integration**

\* students convince families to implement carbon footprint reduction techniques for at least a short period of time.

\* Students will write letters to state and federal politicians to express their thoughts on climate change.

**Performance Task** or Design Thinking Culminating Assessment

\* Students will write letters to state and federal politicians to express their thoughts on climate change and advocate for their position.

**Other Evidence**

See individual lesson plans & Learning plan below

**Topic Overview**

***Order of topics presented (Calendar)***

Climate vs. weather (including Earth rotation and seasons)

Conservation of energy (including Food webs & Population cycling)

Conservation of matter (including atoms/elements (OPTIONAL), Carbon cycle, Nitrogen cycle (OPTIONAL - time dependent)

Greenhouse gases

Respiratory system

How changes in human pops are affecting greenhouse gases (including Natural resource consumption; Human impacts on resources; inequities of climate change impacts)

Biome lesson

Deforestation (including Behavior changes due to climate change; Natural selection)

Seasonal changes affected by climate change

Disruptions (Including Ozone depletion with Integumentary system; Wildfires)

**Learning Plan**

*Learning Activities - What experiential or inductive learning will help students to explore the big ideas and questions to achieve desired understandings for their expected performances?*

How much hotter is your hometown than when you were born?

Weather vs Climate guided reading

Weather vs Climate using M&Ms

Modeling Sunlight on Earth

The Sun’s Rays

Why we have seasons interactive

Modeling food web with yarn

Energy Pyramid Calculations

Scrambled Food Chain

Antarctic food web game

Food web interactive

Google expedition - food chains

Save the Penguins

Energy transfer using water lab

Oh Deer!

Rachel Carson: Silent Spring reading and discussion

Carbon Cycle game

Carbon Cycle Lab

Data Nugget - Are Forests helping in the fight against climate change?

OPTIONAL: nitrogen cycle game; nitrogen cycle concept mapping; “There’s Something Fishy”; applying the nitrogen cycle to food growth

Analyzing graphs to determine the effects of human activity on Carbon dioxide

HHMI’s Calculating Carbon Footprint

Human Causes of Global Warming Webquest

Article Jigsaw about Greenhouse gas litigations and legislation

Modeling Greenhouse Effect

HHMI - Trends in Atmospheric Carbon Dioxide

Analyzing Greenhouse Gases and Global Temperature Data over Time

Debating the Issues - Greenhouse Gas controversial statements

Creating a Town and Evaluating it for greenhouse gas production

Where do Greenhouse Gases come from? webquest

Balloon model

Google expedition - respiratory system

Measuring lung capacity using balloon

I Breathe WHAT?!

Will the air be clean enough to breathe?

Whirling Swirling Air Pollution

Current AQI Data

Respiratory Distress Lab - HASPI

Food For Thought - activity showing energy consumption and wealth OR Global Resource Bank

Human Population Inequity articles jigsaw

Growth of Human Population & carbon dioxide emissions graphing activity

Quick Trip to 7.5Billion Scavenger Hunt

Education and Human Populations Guided Reading and discussion

Let the Chips Fall activity

Great Graph Match

Virtual Biomes

HHMI - BiomeViewer

HHMI - Exploring Biomes with Gorongosa

Biome Marketing Project

Studying Climatographs

Deforestation & the Climate Cycle

Global Forest Change

EarthTime Simulation of Deforestation

Clinometers and measuring CO2 sequestering

Natural selection simulation

Natural and artificial selection interactive

When a species can’t stand the heat - Data Nugget

Making of the fittest - HHMI

Catch a bunny

Analyzing the Antarctic Ozone Hole - measuring ozone hole sizes

Artic Ozone Hole Guided Reading

Guided Video notes - Ozone Holes

Graphing the area of the Ozone Hole above the antarctic

CFC Audit

GumDrop Ozone Depletion Modeling

Culminating Assessment - Write to Politician

**Resources**

Materials posted to Team Drive - Science Curriculum Planning → 7/8 Middle School → 7-Science → Unit 1 Climate Change

Links to online resources on Google Site in Unit 1 Climate Change folder (<https://sites.google.com/ursulineacademy.net/seventhgradescience/home>)