STEAM Subject: Climate Science
Lab: The Science of Climate Change
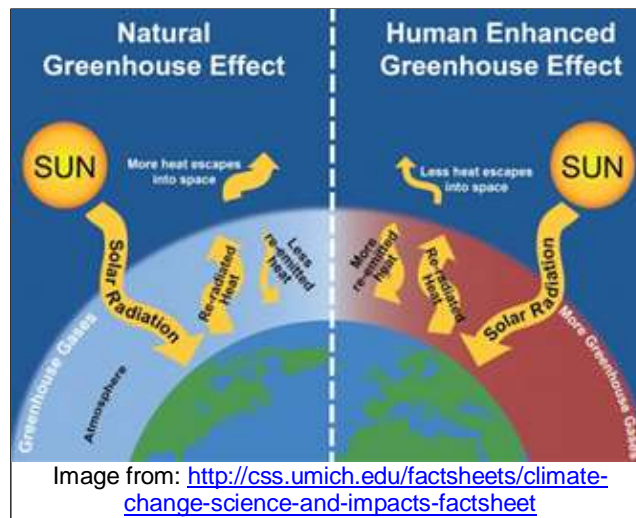
Grades: 2-6

Learning objective:
Students will be able to
- o distinguish the difference between weather and climate
- o define climate change
- o model greenhouse gases
- o identify climate change effects on weather and climate patterns
- o discuss solutions to reduce human impacts on the environment

ENGAGE:
Ask students the following questions:
- How do you think we can protect our environment?
- What is climate change?
- How is our environment impacted by climate change?
- Can we be a part of the solution?
- What is the difference between weather and climate? *Weather is the day to day fluctuation in temperature (hot/cold/rainy). Climate is the long-term average of weather (average temperature/precipitation).*
- Is all pollution visible? Give some examples. *No, there is both visible and invisible pollution.*
    - o *Visible pollution is when trash and marine debris get into our storm drains /waterways and cause our oceans to become polluted. The things we use have a long life, and in some places in the ocean tiny particles of trash accumulate like A LOT of pepper in a bowl of soup.*
    - o *Invisible pollution can be naturally occurring chemicals, but human activities produce more than what is natural. Some examples of gaseous pollution that humans release into the atmosphere such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).*

Image from: http://css.umich.edu/factsheets/climate-change-science-and-impacts-factsheet

EXPLORE:

Heat-trapping Blanket Activity:
In this activity, you will be providing a globe and blanket demonstration to illustrate the heat-trapping blanket climate change metaphor. Tell student that they will represent the Earth during this demonstration, so they are responsible for holding the globe.

Materials needed per student:
- 1 small blanket made of fleece or other thick material
- 1 globe (if you do not have a globe, a map of the Earth will suffice)

Directions:
- Review the difference between weather and climate. Ask students for examples of weather. Use the climate of San Diego as an example of trend versus variation. Watch the following video: https://www.youtube.com/watch?v=e0vj-0imOLw.
- Explain that the greenhouse gases act as a heat-trapping blanket over the Earth. Put the blanket over the globe that your student is holding, as well as their head (if they are comfortable with it). Explain that the more greenhouse gases we add to the atmosphere, the more layers of blankets we add to the Earth.
- Ask student: What happens if you had a few blankets on your head and you had to go stand outside in the sun at noon? (It would get very hot.)
- This demonstration represents what is happening on Earth, the more greenhouse gases we put into the environment, the warmer our climate will get.
    - The climate is changing because of this invisible pollution, overall the days will be warmer. Scientists have found that in southern California, where we live, our climate will get warmer and drier.
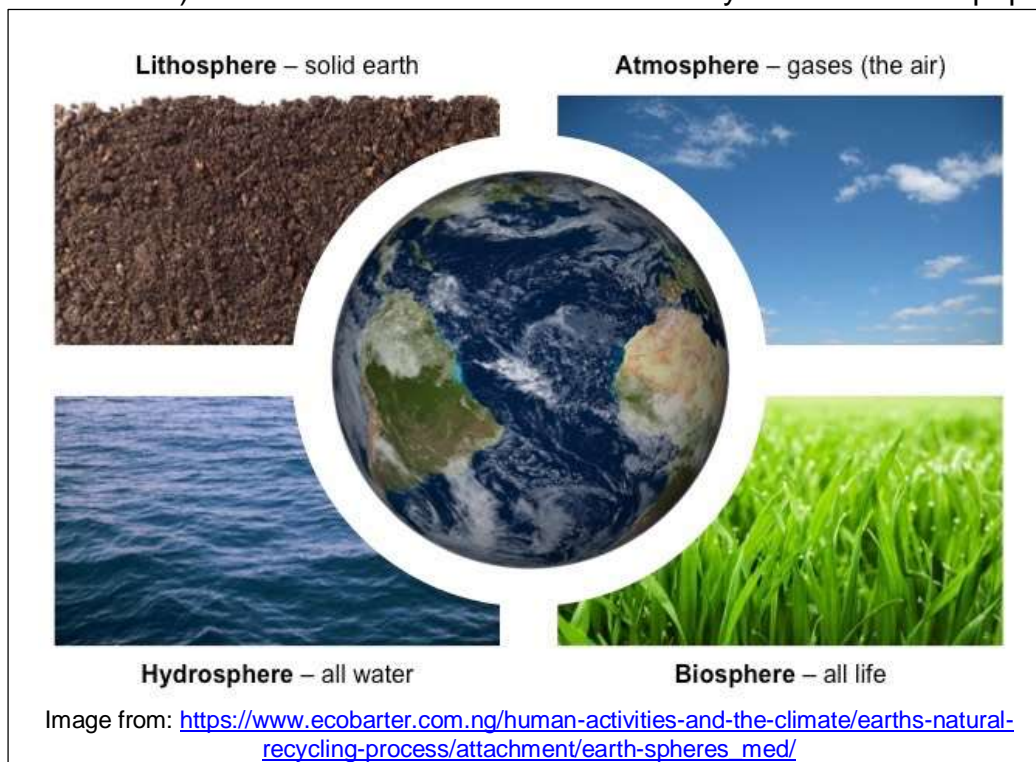
The Carbon Journey Activity:
Follow activity instructions and use pre-assembled carbon cycle die as well as list of items below for the activity. Set up four stations around the room with signs and cups/bowls of colored beads labeled as Lithosphere (black beads), Atmosphere (clear or white beads), Hydrosphere (blue beads), and Biosphere (green beads).
https://aamboceanservice.blob.core.windows.net/oceanservice-prod/education/discoverclimate/noaa_activity10_the_incredible_carbon_journey_111213.pdf

Materials needed per student:
- Pony beads (at least 6 of each color) separated into cups or bowls
    - Blue, green, clear or white, black
- Signs for each station (Lithosphere, Atmosphere, Hydrosphere, Biosphere)
- Pipe cleaners/chenille stems (yarn/string will suffice if a knot is tied at the end to ensure beads do not fall off)
- 5 paper game cubes (cardstock preferred)
    - Found on pages 4-8 on above website. Instructions for assembling cubes found on page 2

- "Incredible Carbon Journey Game Record" worksheet (page 9 on above [website](#))
- Pencil or pen
- Scissors
- Tape
- OPTIONAL: If you do not have beads, you may use colored markers/crayons to represent the beads. Simply have an extra blank piece of paper and place a marker/crayon matching the colors listed above (substituting yellow for clear/white) at each station. Record results as tally marks on blank paper.

Lithosphere – solid earth
Atmosphere – gases (the air)
Hydrosphere – all water
Biosphere – all life

Image from: https://www.ecobarter.com.ng/human-activities-and-the-climate/earths-natural-recycling-process/attachment/earth-spheres_med/

Carbon Journey Discussion:
- What did you notice about Round 1 versus Round 2? *Typically, Round 1 had more repetition-especially with the lithosphere station, carbon was stored underground, Round 2 had more variation with the carbon cycle.*
- Which station did you end up at the most? *Answers will vary.*
- Do you think humans have altered the carbon cycle? *Yes*

EXPLAIN:
- Look at the hottest years on record. https://www.climatecentral.org/gallery/graphics/the-10-hottest-global-years-on-record
- Introduce climate change.
  - There's a group of chemicals called greenhouse gases which includes carbon dioxide (it's what we breathe out and plants use to photosynthesize – these are natural). Greenhouse gases like CO_2 are good for the planet in small amounts because they act like a blanket around the Earth protecting us from solar radiation and keeping the planet

from being too cold. But when we use fossil fuels that come from deep underground to fill up our cars it releases more and more greenhouse gases. Ask student what types of activities release greenhouse gases?

- How does climate change affect the ocean?
  - o The ocean is the heart of our planet. Oceans are the basis of all life: animals, plants, and humans. Ask students what our heart does for our body? Our heart helps blood keep moving throughout our bodies (circulation) and keeps our bodies from getting too hot or cold (regulates body temperature). Similarly, the ocean is like the Earth's heart, it controls the movement of heat and water throughout the Earth, keeping the Earth from getting too hot or cold. This heat-trapping effect is making it hard for the ocean to do its job and keep our Earth healthy.

- **Review STEAM Vocabulary:**
  - o **Carbonate:** Carbonate ions bond with calcium to serve as an important building block of structures such as seashells and coral skeletons.
  - o **Carbon Dioxide (CO_2):** A colorless, odorless greenhouse gas released by burning fossil fuels and in natural processes such as respiration.
  - o **Climate:** Climate is the weather of a place averaged over a long period of time, often 30 years.
  - o **Climate Change:** A long-term change in global or regional climate patterns, especially a change due to an increase in the average atmospheric temperatures.
  - o **Fossil Fuel:** Any combustible organic material formed in the geological past from the remains of buried living organisms. Examples of fossil fuels are oil, coal, or natural gas.
  - o **Greenhouse Gas:** A gas that contributes to the greenhouse effect by absorbing infrared radiation. Examples of common greenhouse gases are carbon dioxide, methane, nitrous oxide, water vapor, and fluorinated gases.
  - o **Weather:** Weather is the state of the atmosphere at a particular location over the short-term. Weather is what you experience when you step outside on any given day.

EVALUATE:

Have students share solutions and brainstorm how we can reduce the effect of climate change on the planet.

When a student answers, ask or explain why that activity lowers greenhouse gas emissions.

Example #3, #4, and #6. Besides making sure our trash doesn't end up on the streets or in the ocean, we should also try to reuse, reduce, and recycle. By taking these actions we reduce the amount of trash that reaches our oceans and the materials that we need to make new things.

Discuss how increased carbon in the atmosphere (heat-trapping greenhouse gases like CO_2 and CH_4) leads to warmer temperatures and climate change impacts such as melting of glaciers and sea level rise.

Check out this list of ideas to reduce the effect of climate change:

https://docs.wixstatic.com/ugd/3687d6_ada68436e6894d8a8338397f8ca9f1a7.pdf

Spanish version:

https://docs.wixstatic.com/ugd/3687d6_7fd654e4bc4e4e309703bb4a704448bb.pdf