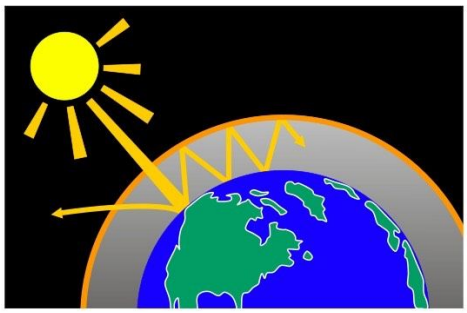
Greenhouse Gas Tag!

Eco-Schools Topic:
Greenhouse Effect/ Climate Change
Standards:
3.10 Earth Resources
3.11 Energy from the Sun
Guiding Question:
What do greenhouse gases do? How is our planet warming?



Key Questions, Attitudes, and Behaviors to teach:

- What traps the sun's heat? (K)
- I feel like I can make a difference to protect our planet. (A)

Lesson Objectives:
Students will...

- Learn why Earth, unlike other planets, is warm enough to be livable
- Learn how humans are contributing to Earth's warming
- Be able to give examples of greenhouse gases and explain where they come from.
- Identify ways they can reduce their CO2 impact
- Be active

Grade Level:
Grades 3-8
Materials:

- Paper and writing utensils
- Whiteboard/markers

OPTIONAL:

- Sun and Earth Representations
- Pinnies/hats that students can flip over or backwards once they become GHGs
- Greenhouse gas picture (on last page)

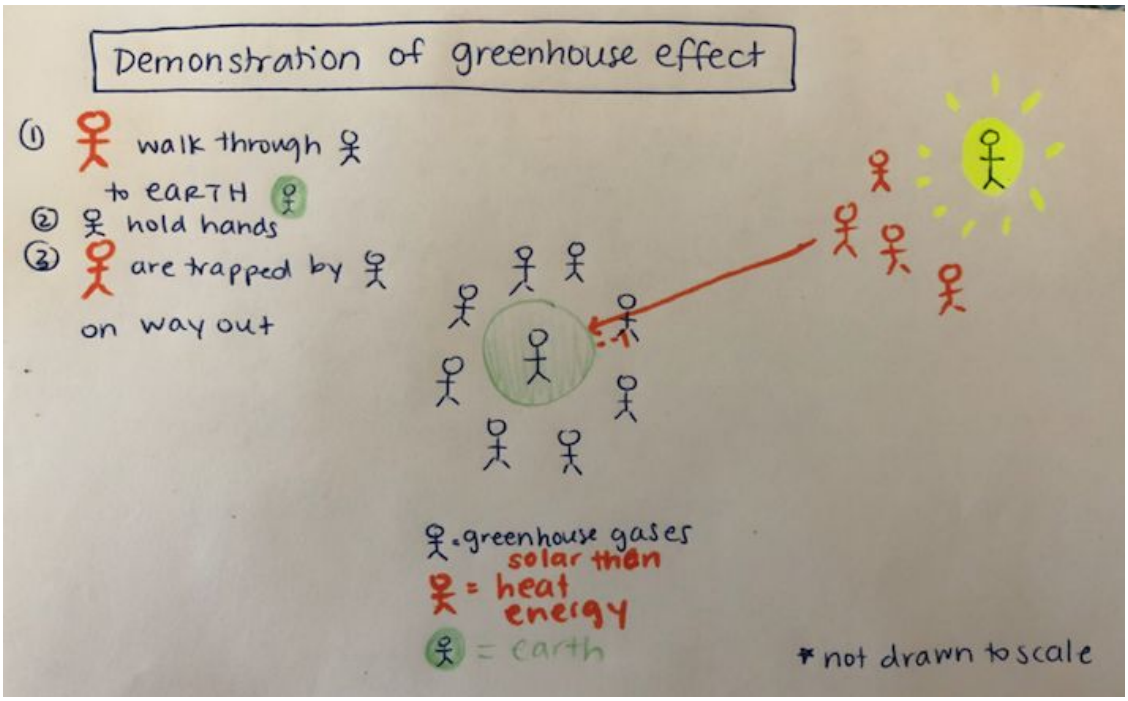
Prep:

- Review the Greenhouse Effect and Greenhouse Gases: https://climatekids.nasa.gov/greenhouse-effect/
- Watch video: https://www.youtube.com/watch?v=VYMjSule0Bw
- Intro: Have enough paper and pencils for each student. Have a whiteboard, whiteboard marker ready and double-sided jerseys to flip once students become GHGs (if you would like).
- Game: Have an open field with 2 defined goal areas across from one another. One goal will represent the sun and the other goal will represent the earth. You can identify these 2 areas with signs and visuals if you like.

Engaging Intro

- Pose questions to the students to see what they already know
    - *Who knows what global warming is?*
    - *What causes global warming?*
    - *Why does it work?*
- Have students draw what they believe to be the greenhouse effect (relationship between the energy from the sun to earth and back).
- You can have a few students share out what they think the greenhouse effect is
- Optional: Watch EPA Greenhouse Effect video or draw out a basic diagrams with labels
    - To watch the video, you can either show it on a projector if it's available or have volunteers bring laptops to show the video to small groups of kids

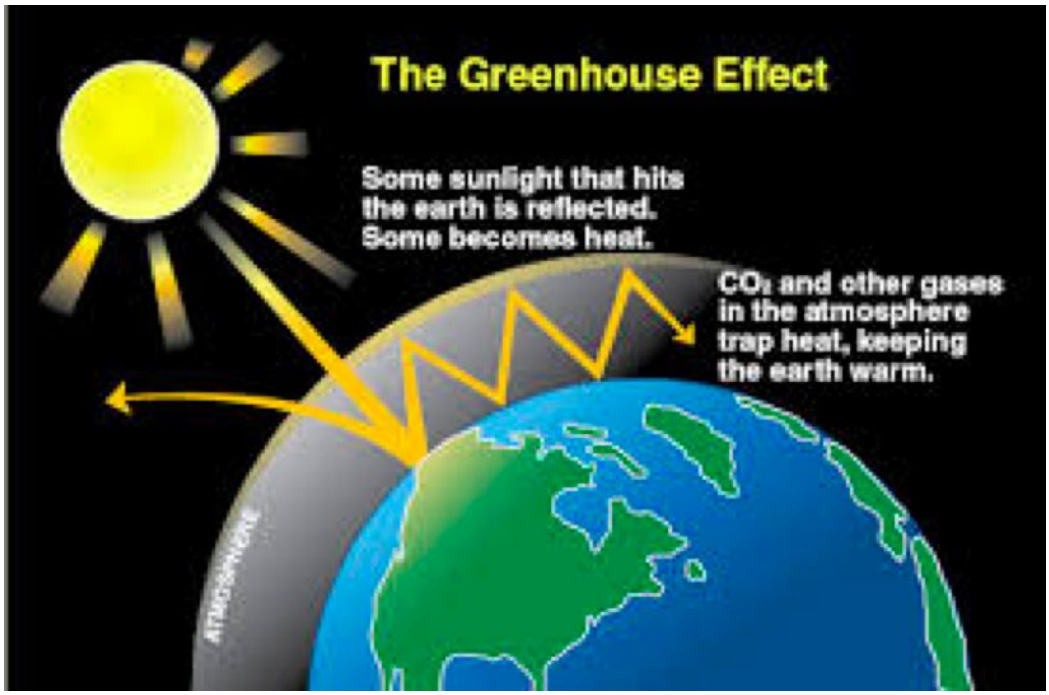
- **DEMONSTRATION:** Illustrate the greenhouse effect and explain how it works by having the students act out the greenhouse effect



    - Split the big group into two smaller groups (when there are large groups of kids)
    - Have one ESLI volunteer act as a narrator, continually explaining what is happening and reminding students of what they should do
    - In each smaller group, designate two students to be the "Earth" and the "Sun"
    - Have the rest of the students stand in a circle around the "Earth" with their arms by their sides to represent the "Greenhouse gases" in the atmosphere. The "Sun" should stand about 7 ft away from the "Greenhouse Gases"

- ESLI volunteers (or older students if there aren't enough ESLI volunteers) should stand next to the "Sun" to represent "Sunlight"
- When the charade begins, "Sunlight" should walk through the "Greenhouse Gases" and reach the "Earth," representing incoming solar radiation.
- Once the "Sunlight" reaches the "Earth," the energy then leaves the "Earth" and becomes "Heat". The "Heat" should try to leave the Earth and go back into space towards the "Sun." At the same time, the "Greenhouse gas" students should join hands, trapping the "Heat" close to the "Earth."
    - Holding hands represents the Greenhouse Effect, that Sunlight can come in to the atmosphere but not all the heat can leave.
- Repeat the charade as many times as necessary until students understand what is happening.
- Take time to answer any questions about the Greenhouse Effect

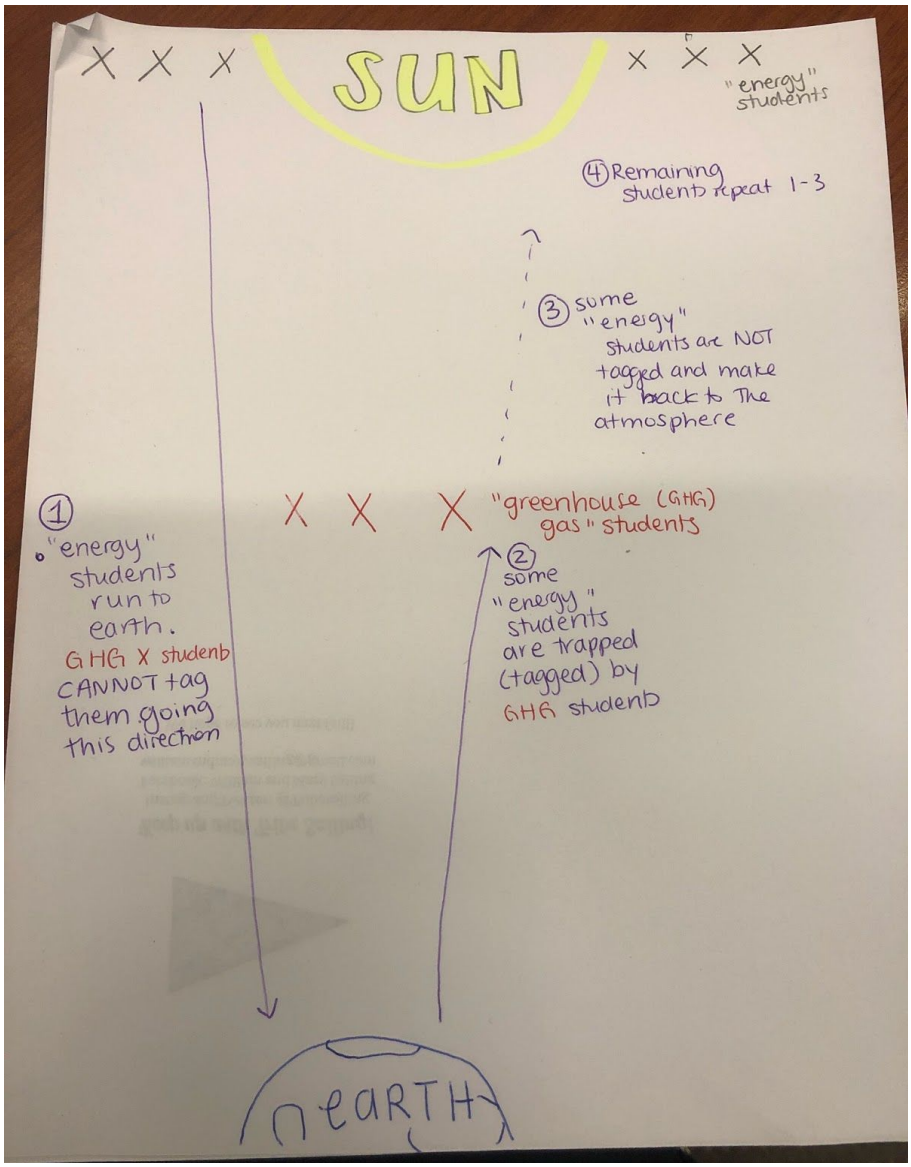
- **EXPLANATION:**



- *"What is a greenhouse gas?*
    - Greenhouse gases are molecules that trap energy radiated off earth's surface
    - Types of GHGs:
        - Carbon Dioxide--CO_2 (most common GHG)
        - Methane--CH_4
        - Nitrous Oxide--N_2O
        - (see link for specifics)

        - ***We need some greenhouse gases in our atmosphere, otherwise our planet would be too cold for life to survive***
        - However, we are putting too many gases into the atmosphere!
    - *Where do GHGs come from?*
        - Transportation: Cars, trucks, planes, trains, boats
        - Industry: Factories, businesses
        - Electricity: Coal Power Plants, Natural Gas Power Plants
        - Agriculture: Raising livestock, harvesting crops, processing food
        - (see link for specifics)
    - *What is the greenhouse effect?*
        - When Earth's atmosphere (GHGs) traps energy from solar radiation to heat the Earth (about 70% of solar energy is absorbed, and 30% is reflected)
        - Make it relatable to students
            - Describe the earth as a car. On a hot day, some solar energy reflects off the car and some solar energy heats up the air inside the locked car.
            - GHGs in the atmosphere act as a blanket for the earth. Blankets keep you warm by trapping your body heat close to you; the atmosphere keeps the earth warm by trapping solar energy against the earth.
            - Advanced students who ask--
                - Why is energy trapped going out but not coming in to the Earth?
                    - Energy changes from solar radiation to heat radiating off the earth's surface
                    - UV radiation coming in has much smaller wavelengths than the IR energy that travels out, and is therefore more easily trapped. (More: https://www.climatechangecu.com/science-behind-climate-change/the-greenhouse-effect-uv-and-ir-radiation)
    - *Where does the term "greenhouse effect" come from?*
        - A ***greenhouse*** used for gardening traps heat to help plants grow indoors in colder climates like the greenhouse effect where gases are trapped heating the earth.
- Have kids practice explaining concepts back to you to confirm that they understand the greenhouse effect
- Today we will play the greenhouse gas and solar energy form of tag!

Exploratory Activity (15 min): Basic Greenhouse Effect Game
(Spin-off of Sharks and Minnows, in collaboration with Swarthmore University)



1. Designate one side of the field as “SUN” and the other side as “EARTH”
2. Split the class into two groups: 3/4 of the students will represent energy and the other 1/4 represent greenhouse gases (GHG).
3. Energy students start at the “sun” and GHG students start in the middle of the field.
4. When the instructor says “go,” energy students run to the Earth side; the GHG students cannot tag them.

Eco-Schools Leadership Initiative

With a little bit of knowledge, we can ESLI make a difference

5. Once “energy” students have reached the earth, they transform from solar energy to heat energy radiating off the surface of the Earth.
6. When the instructor says “go,” energy students run to the Sun side, avoiding the GHG students who want to tag them.
7. The “energy” students tagged by the GHGs join the GHG students and tag the remaining energy students in the next round.
    a. With every round, there will be more GHGs present to capture more energy.
8. After the first round, pause the game and explain to the students what they just modeled, clarifying any questions.
    a. When “energy students” are tagged and join the GHG students, this doesn’t mean that solar energy becomes GHGs. The purpose of the game is to illustrate how an increase in GHGs results in more solar energy being trapped, and that every round, like every year, we are pumping more GHGs into the atmosphere causing more energy to be trapped, and the earth to be warmer.
9. The game continues for five rounds or until there are 2 or less energy students remaining.

Extension: Change up the number of people who start out representing greenhouse gases. What happened when there were more greenhouse gases?

10. More GHGs= More energy trapped, leads to global warming

Diagram of Greenhouse Gas Tag setup

Meaningful Discussion (10-15 min)

- Make bullet point list of things that we could do to reduce carbon impact. Include examples from past ESLI lessons (See below).
- *Food:*
    - *Eat locally*
    - *Use less packaging*
    - *Plant seeds*
- *Transportation:*
    - *Choosing to bike or walk instead of taking a car*
    - *Carpooling or riding the bus*
- *Recycling:*
    - *Reducing our consumption of items*
    - *Reusing things (ex. cereal box folders, upcycled musical instruments)*
- *Water:*
    - *Conserve water as much as possible*
        - *Turn off tap when you brush your teeth, etc*
    - *Protect watersheds*
    - *Pick up litter*
- *Energy:*
    - *Turning off the lights*
    - *Using appliances that don’t need as much energy to work*
    - *Unplugging appliances*
    - *Renewable energy (solar)*
- *Ecology/Biodiversity:*

- *Planting trees*
- *Create habitat in your backyard for native plants/animals- carbon cycle*

- Make this list into the student's pledge to help the planet. Have the kids sign their name to remind them what they have learned over the year.

Links and Resources

- EPA Video Link: https://www.youtube.com/watch?v=VYMjSule0Bw
- NASA Climate Change Facts: https://climate.nasa.gov/
- Climate Change for Kids: https://climatekids.nasa.gov/greenhouse-effect/