

CLIMATE KEEPERS

Teacher's Guide

Grades 4-6



Four Climate
and Clean
Energy Lessons

Engaging
Student
Activities



Dear Teacher,

PGE Project Zero is pleased to introduce *Climate Keepers: Agents of Project Zero*, a new environmental education comic for students in grades 4-8. PGE Project Zero is our commitment to engaging students in learning about climate science and clean energy. Through this comic and associated lessons, your students will learn about climate change and participate in thoughtful discussions.

Climate Keepers: Agents of Project Zero (available in English and Spanish) is designed to help young people explore ways they can make positive change to fight the climate crisis. The comic provides a springboard to implementing a range of student-friendly classroom activities to help you meet your science and language arts curriculum objectives. The Teacher's Guide provides four lessons aligned to language arts and science standards, engaging reading and activity sheets (available in English and Spanish), and online resources for extended student learning.

[PGE Project Zero](#) aids youth in learning about climate change science and exploring clean energy, and empowers them to make a positive impact on the planet. After you complete the activities, we look forward to hearing your feedback.

Sincerely,

Portland General Electric





OVERVIEW

TARGET AUDIENCE

The program is designed for students in grades 4-6.

OBJECTIVES

- Increase awareness of climate change causes, issues, and related vocabulary
- Explore ways to be Climate Keepers by taking climate-friendly actions as part of everyday living
- Offer online learning resources to extend student learning

COMPONENTS

- *Climate Keepers: Agent of Project Zero*, a full-color comic (available in English and Spanish)
- Teacher's Guide featuring:
 - Four lessons with instructional guidelines
 - Reading and activity sheets (available in English and Spanish)
 - Online resources for extended student learning
- [Climate Keepers](#) website

THE LESSONS ARE:

Lesson 1: Meet the Climate Keepers

Lesson 2: What is climate change?

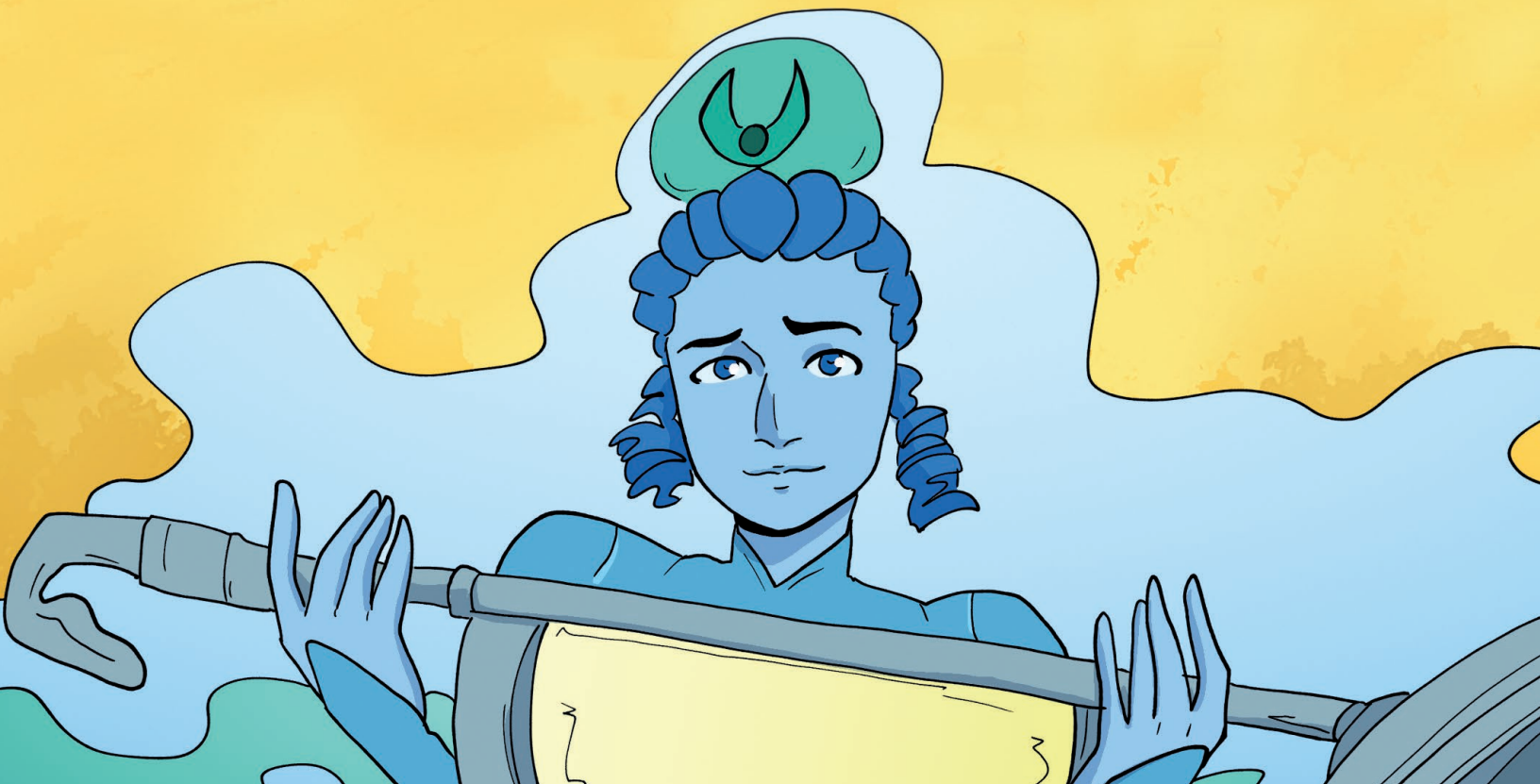
Lesson 3: Experimenting with greenhouse and carbon dioxide

Lesson 4: Your carbon footprint

EACH LESSON'S ACTIVITY INCLUDES:

- Explanation of lesson
- Time needed to lead the lesson
- Objectives for students
- Step-by-step teacher instructions
- Alignment to Common Core Standards for Science and English Language Arts and Literacy where applicable
- Reading and activity sheets (available in English and Spanish)

Email PGE your questions about Climate Keepers.





Lesson 1: Meet the Climate Keepers



Introduction: This lesson will introduce *Climate Keepers: Agents of Project Zero* as a springboard to learning about climate change.



Time: One class period (45-60 minutes)



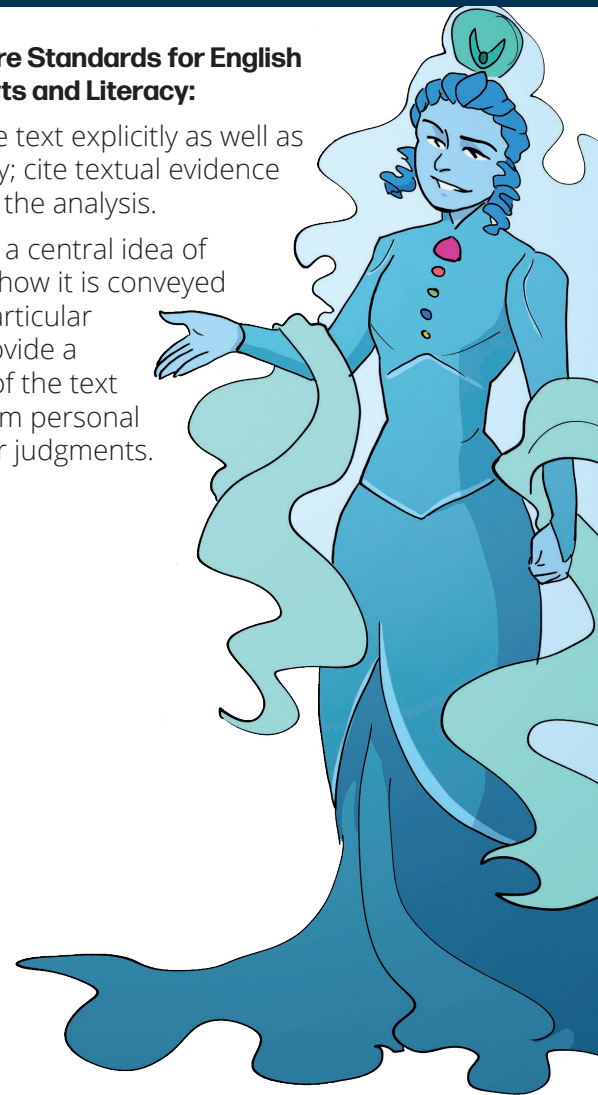
Objectives for Students:

- Read and discuss the comic *Climate Keepers: Agents of Project Zero*, with a focus on the plot
- Define *climate change* and discuss causes, as identified in *Climate Keepers*
- Develop a list of vocabulary related to climate change



Common Core Standards for English Language Arts and Literacy:

- Analyze the text explicitly as well as inferentially; cite textual evidence to support the analysis.
- Determine a central idea of a text and how it is conveyed through particular details; provide a summary of the text distinct from personal opinions or judgments.



EXTEND STUDENT LEARNING

NASA Climate Kids

<https://climatekids.nasa.gov/menu/weather-and-climate/>

The Greenhouse Effect and Our Planet

<https://education.nationalgeographic.org/resource/greenhouse-effect-our-planet>

The Climate Reality Project

<https://www.climateRealityproject.org/blog/just-kids-what-climate-change-and-what-can-i-do>



MATERIALS

- *Climate Keepers: Agents of Project Zero* comic for each student (available in English and Spanish)
- Reading Sheet: "Who's Who in *Climate Keepers*?" (available in English and Spanish)
- Activity Sheet: "Think About It" (available in English and Spanish)



ACTIVITY DIRECTIONS

1. Hand out *Climate Keepers: Agents of Project Zero*, an entertaining comic with an important message about climate change. Have students read it aloud to each other, or read in small groups of three to four.
2. Review the comic. Distribute the reading sheet "Who's Who in *Climate Keepers*?" to students to help guide their understanding.
3. Discuss the comic after distributing the activity sheet "Think About It." Then, ask the students:
 - What is climate change? (*Climate change* refers to long-term shifts in temperatures and weather patterns, mainly caused by human activities, especially the burning of fossil fuels.)
4. Have students collect a short list of unfamiliar climate change vocabulary in their notebooks. Examples might include *fossil fuels*, *greenhouse gases*, and *carbon*.
5. Share next steps for research and activities. Use the story as a springboard for the lessons that follow. Let students know they will be researching, conducting experiments, and developing an understanding of how they can impact climate change in a positive way.

Lesson 1: Reading Sheet

Who's Who in *Climate Keepers*?

CAST OF CHARACTERS

Gaia	Intergalactic alien who leads the Climate Keepers; <i>Gaia</i> is the Greek personification of Earth
Ipsium	Gaseous human-like being, personification of carbon pollution; <i>Ipsium</i> is Latin for "yourself"
Ignatius	Band member and Climate Keeper
Van	Band member and Climate Keeper; he is deaf and uses American Sign Language
Ailani	Climate Keeper
Rowan	Climate Keeper
Mira	Inventor and Climate Keeper
Nebulae	Assistants to Gaia

STORY

The story begins with an introduction to Gaia, protector of all Earth. Metro Marina is a city setting. Ipsium, a grey cloud, is looking for a place to acquire carbon. This cloud moves around the city area but doesn't settle anywhere. The citizens of Metro Marina have worked hard to minimize their carbon footprint.

Gaia realizes that the villain Ipsium is back. Ipsium settles at the outskirts of the city, where there is factory smoke and a trucking yard. After Ipsium gathers strength by absorbing carbon, it decides to wreak havoc on the urban environment by encompassing the area in a smoke-like fog.

At first, Ignatius and Van, Climate Keepers and members of a band playing in Metro Marina, think the fog machine has been left on. But then, they discover this is not true. The trapped heat soon disturbs people too.

Ailani and Rowan, two more of the Climate Keepers, receive an emergency message from Gaia to come to Headquarters. Gaia explains the problem and shows them the solution. Another Climate Keeper, Mira, explains why Ipsium has returned and introduces a device she and her father created—a vacuum powered by geo rings. The vacuum removes the carbon in the black clouds and turns them into harmless Nebula. The Climate Keepers power up their rings. They fight a fierce battle with Ipsium in the fueling yard, spilling some oil. Rowan creates a bag of oil absorbent granules to soak up the oil. Finally, they win the battle.

Afterward, the owner of the trucking yard speaks with Ailani and Mira about the best ways to make the space more green and eco-friendly.



Guardianes del Clima

Grados 4-6

Lección 1: Hoja de Lectura

¿Quién es quién en Guardianes del Clima?

ELENCO DE PERSONAJES

Gaia	Extraterrestre intergaláctico que lidera a los Guardianes del Clima; Gaia es la personificación griega de la Tierra.
Ipsum	Ser humanoide gaseoso, personificación de la contaminación por carbono; <i>Ipsum</i> es la palabra latina para "tú mismo"
Ignatius	Miembro de la banda y Guardián del Clima
Van	Miembro de la banda y Guardián del Clima; es sordo y usa el lenguaje de señas americano
Ailani	Guardián del Clima
Rowan	Guardián del Clima
Mira	Inventora y Cuardiana del Clima
Nebulae	Asistentes de Gaia

HISTORIA

La historia comienza con una introducción a Gaia, protectora de toda la Tierra. Metro Marina es un entorno ciudadano. Ipsum, una nube gris, está buscando un lugar para adquirir carbono. Esta nube se mueve por el área de la ciudad pero no se asienta en ninguna parte. Los ciudadanos de Metro Marina han trabajado arduamente para minimizar su huella de carbono.

Gaia se percata de que el villano Ipsum ha vuelto. Ipsum se instala en las afueras de la ciudad, donde hay humo de fábrica y un patio de camiones. Después de que Ipsum se fortalece al absorber carbono, decide causar estragos en el entorno urbano al abarcar el área con una niebla similar al humo.

Al principio, Ignatius y Van, Guardianes del Clima y miembros de una banda que toca en Metro Marina, creen que la máquina de humo se ha quedado encendida, pero después descubren que esto no es cierto. El calor atrapado pronto molesta también a las personas.

Ailani y Rowan, otros dos Guardianes del Clima, reciben un mensaje de emergencia de Gaia para que vayan a la sede. Gaia les explica el problema y les muestra la solución. Otra Guardiiana del Clima, Mira, explica por qué Ipsum ha regresado y presenta un dispositivo que ella y su padre crearon: una aspiradora alimentada por geoanillos. El vacío elimina el carbono de las nubes negras y las convierte en Nebula inofensiva. Los Guardianes del Clima encienden sus anillos. Luchan en una feroz batalla con Ipsum en el patio de combustible, y derraman un poco de aceite. Rowan crea una bolsa de gránulos absorbentes de aceite para absorber el aceite. Finalmente, ganan la batalla.

Posteriormente, el propietario del patio de camiones habla con Ailani y Mira sobre las mejores maneras de hacer que el espacio sea más verde y ecológico.





Lesson 1: Activity Sheet

Think About It

Questions	Page
Why do you think Ipsum refuses to settle in this area of Metro Marina?	1
What makes Ipsum stronger? What is he looking for? Where can he find it?	2
Where is Ipsum going to have fun?	3
What three strategies defeated Ipsum last time?	7
What plan do the Climate Keepers have now to defeat Ipsum?	8
What environmental disaster takes place during the battle with Ipsum?	11
How do the Climate Keepers solve this problem? What three changes did the owner of the trucking yard make to keep Ipsum away?	12

Guardianes del Clima

Grados 4-6

Lección 1: Hoja de Actividades

Piénsalo

Preguntas	Página
¿Por qué crees que Ipsum se niega a instalarse en esta área de Metro Marina?	1
¿Qué hace a Ipsum más fuerte? ¿Qué está buscando? ¿Dónde puede encontrarlo?	2
¿Dónde se va a divertir Ipsum?	3
¿Qué tres estrategias derrotaron a Ipsum la última vez?	7
¿Qué plan tienen ahora los Guardianes del Clima para derrotar a Ipsum?	8
¿Qué desastre ambiental tiene lugar durante la batalla con Ipsum?	11
¿Cómo resuelven los Guardianes del Clima este problema? ¿Cuáles fueron los tres cambios que hizo el dueño del patio de camiones para mantener alejado a Ipsum?	12



Lesson 2: What Is Climate Change?



Introduction: This lesson will help students define climate change vocabulary and begin an investigation of climate change.



Time: One class period (45-60 minutes)



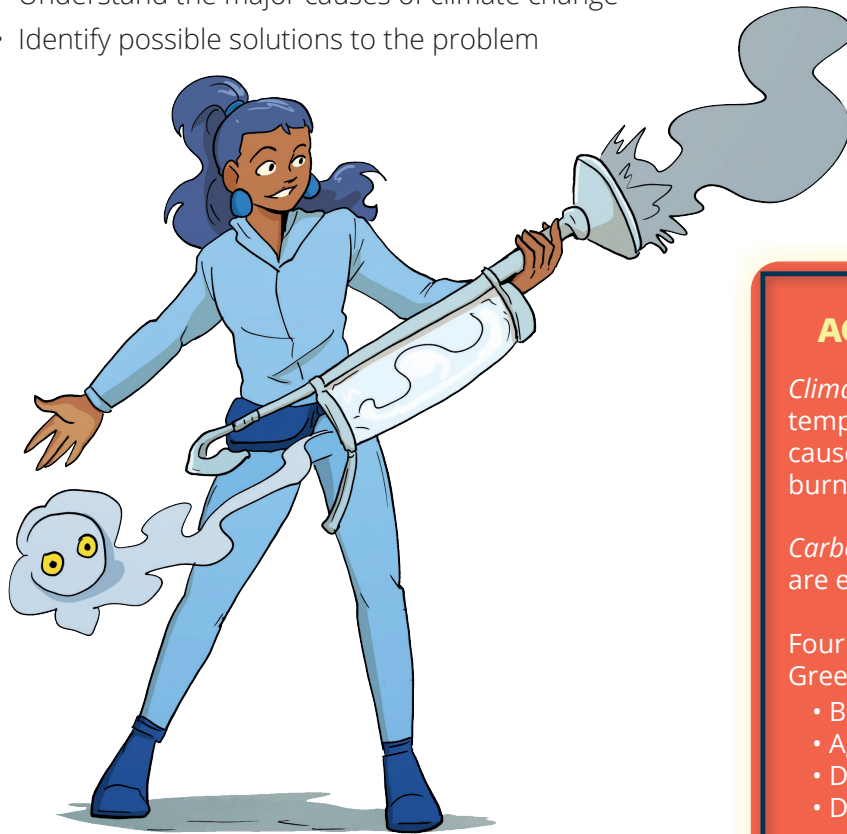
Objectives for Students:

- Develop a better understanding of climate change and its impact on the world
- Understand the major causes of climate change
- Identify possible solutions to the problem



Common Core Standards for Science:

- Obtain and combine information about ways individual communities use science ideas to protect Earth's resources and environment.
- Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.



ACTIVITY SHEET ANSWER KEY

Climate change refers to long-term shifts in temperatures and weather patterns, mainly caused by human activities, especially the burning of fossil fuels.

Carbon dioxide, nitrous oxide, and methane are examples of greenhouse gases.

Four Human Activities That Increase Greenhouse Gas Emissions:

- Burning fossil fuel
- Agriculture
- Deforestation
- Decomposition of waste in landfill



MATERIALS

- Activity Sheet: "Climate Change: Explore the Causes" (available in English and Spanish)



ACTIVITY DIRECTIONS

1. Ask a student to define *climate change*, as a review. Record the definition on a whiteboard, blackboard, or large easel sheet. Then ask the class the causes of climate change and record them.
2. Have students watch the YouTube video ["What Is Climate Change? Explore the Causes of Climate Change"](#).
3. Discuss the video, briefly reviewing and updating the information on the whiteboard from the class discussion if needed.
4. Place students in small groups of three to five. Have them watch the video again, using the activity sheet "Climate Change: Explore the Causes" to help them collect the information they need. At the end of the activity sheet, students should list ways they can help reduce carbon and other greenhouse gases in the environment.
5. Ask each group to share one of its solutions with the rest of the class. Have the entire class choose a single call to action.



Lesson 2: Activity Sheet

Climate Change: Explore the Causes

What is climate change?

Complete the sentence:

_____, _____, _____,
and _____
are examples of greenhouse gases.

Four Human Activities That Increase
Greenhouse Gas Emissions

1. _____
2. _____
3. _____
4. _____

Record some statistics that
surprise or shock you:

List some ways we could stop or reduce climate change:

1. _____
2. _____
3. _____

Lección 2: Hoja de Actividades

Cambio climático: explora las causas

¿Qué es el cambio climático?

Completa la oración:

_____, _____,
y _____ son ejemplos
de gases de efecto invernadero.

Cuatro actividades del ser humano que
aumentan las emisiones de gases de efecto
invernadero

1. _____
2. _____
3. _____
4. _____

Registra algunas estadísticas que
te sorprendan o conmocionen:

Lista algunas maneras en que podríamos detener o reducir el cambio climático:

1. _____
2. _____
3. _____



Lesson 3: Experimenting with Greenhouses and Carbon Dioxide



Introduction: This hands-on lesson will investigate the greenhouse effect and the power of carbon dioxide. It includes two outdoor experiments: one class demonstration and one group activity. (Teachers will prep before class by gathering materials in bags for each student group.)



Time: One class period (45-60 minutes)



Objectives for Students:

- Simulate Earth's atmosphere and the greenhouse effect
- Demonstrate the role of carbon dioxide gas



Common Core Standards for Science:

- Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
- Reason abstractly and quantitatively.



MATERIALS

- Activity Sheet: "Recording Results" (available in English and Spanish)
- Class Demonstration: "What Is the Greenhouse Effect?"
 - A clear glass jar
 - Clear plastic wrap
 - 2 thermometers
 - A stopwatch or personal phone
- Group Activity: "What Happens When Carbon Dioxide Increases?"
 - 2 sealable plastic sandwich bags
 - Vinegar
 - Baking soda
 - A tablespoon
 - 2 tissues
 - A stopwatch or personal phone



ACTIVITY DIRECTIONS

1. Have students watch the YouTube video "[What Is the Greenhouse Effect?](#)" Review with the class how the greenhouse effect is a natural process that makes life on Earth possible. Identify the three important greenhouse gases: carbon dioxide, methane, and water vapor.
2. Distribute and discuss the activity sheet "Recording Results" for the class demonstration and the group activity.
3. Organize the class into groups of three or four students. Take your student groups outdoors with their bags of materials.
4. Introduce the class demonstration. Students will record the temperatures displayed on two thermometers (one inside the plastic-sealed glass jar, the other next to the jar) over a 20-minute period. Have them predict what will happen and record it on their activity sheet:
 - Will the temperatures vary? Which thermometer may have a higher temperature? Why?
5. Introduce the group activity, which will demonstrate the effect of an increase in carbon dioxide in a greenhouse. (Students will be recording thermometer readings as part of the class demonstration at the same time.) Explain to students that the reaction between baking soda and vinegar produces carbon dioxide gas. Ask students to predict what will happen and record it on their activity sheet.
6. Have each student group:
 - Fill the first plastic bag with 2 tablespoons of vinegar. Then fill the second plastic bag with 12 tablespoons of vinegar.
 - Take the two tissues and fill each with 2 tablespoons of baking soda, folding each side to create a pocket.
 - Drop a baking soda pocket into the first bag and seal it quickly. Use the stopwatch to measure and then record how long it takes for the bag to pop.
 - Do the same with the second plastic bag.
 - Record the results on their activity sheet.
7. Meet as a whole class to share results.
 - What conclusions can be drawn from the recorded temperatures on the thermometers? Are there any other versions of greenhouses in daily life? (*In a vehicle parked in the sun, sunlight and heat become trapped inside.*)
 - Why did the bags of vinegar and baking soda pop? And what amount of vinegar created the quickest and largest reaction? (*Once the baking soda and vinegar mix, carbon dioxide gas starts to fill the bag until it runs out of room, causing the bag to pop.*)
 - What else did they learn from doing their own experiments about climate change?



Lesson 3: Activity Sheet

Recording Results

Class Demonstration: What Is the Greenhouse Effect?

Record what you predict will happen: _____

Comparing Temperatures

Time	In the Glass Jar	Outside the Glass Jar
0 minutes		
after 10 minutes		
after 20 minutes		

Explain what happened: _____

Group Activity: What Happens When Carbon Dioxide Increases?

Record what you predict will happen: _____

Comparing Carbon Monoxide Bags

	Vinegar	Baking Soda	Time to Pop
Bag #1	2 tablespoons	2 tablespoons	
Bag #2	12 tablespoons	2 tablespoons	

Explain what happened: _____

Lección 3: Hoja de Actividades

Registro de resultados

Demostración en clase: ¿Qué es el efecto invernadero?

Anota lo que predices que sucederá: _____

Comparación de temperaturas

Tiempo	En el frasco de vidrio	Fuera del frasco de vidrio
0 minutos		
después de 10 minutos		
después de 20 minutos		

Explica lo que pasó: _____

Actividad de grupo: ¿Qué sucede cuando aumenta el dióxido de carbono?

Anota lo que predices que sucederá: _____

Comparación de bolsas de monóxido de carbono

	Vinagre	Bicarbonato de sodio	Tiempo para estallar
Bolsa #1	2 cucharadas	2 cucharadas	
Bolsa #2	12 cucharadas	2 cucharadas	

Explica lo que pasó: _____



Lesson 4: Your Carbon Footprint



Introduction: Students will understand the meaning of *carbon footprint*. (And whether they are helping or hurting *Ipsum!*) They will brainstorm ways to reduce their own carbon footprint. They will also expand their thinking by considering ways to reduce their school's carbon footprint.



Time: One class period (45-60 minutes)



Objectives for Students:

- Understand the meaning of a carbon footprint
- Discover how their activities and choices influence their carbon footprint and how they can lower it



Common Core Standards for Science:

- Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.



MATERIALS

- Activity Sheet: "What Is Your Carbon Footprint?" (available in English and Spanish)



ACTIVITY DIRECTIONS

1. Have students watch the YouTube video "[The Carbon Footprint](#)" for a simple explanation.
2. Review with students the meaning of *carbon footprint*. (A *carbon footprint* is the total amount of greenhouse gases, including carbon dioxide and methane, that is generated by other actions.) The average carbon footprint for a person in the United States is 16 tons per year, one of the highest rates in the world. The average global carbon footprint is closer to 4 tons per year.
3. Hand out the activity sheet "What Is Your Carbon Footprint?" to each student. Give them about 10 minutes to calculate their own personal carbon footprint.
4. Engage the whole class to discuss their carbon footprints by having them answer the questions:
 - How surprised are they by their footprints?
 - How might they reduce their footprints individually?
 - Are there any ways they could help reduce their school's carbon footprint?
5. Give your students the challenge of being Climate Keepers. Have them create a plan to put some of their ideas into action. Have the entire class choose the best three to five calls to action.





Lesson 4: Activity Sheet

What Is Your Carbon Footprint?

Circle the answers to the questions below. Choose one answer unless otherwise stated.

1. How do you get to school?
 - a. Walk (0)
 - b. Bike (0)
 - c. Car (1,115)
 - d. Bus (131)
 - e. Carpool (459)
2. Do you eat mostly ...
 - a. Fast food (4,818)
 - b. Home-cooked food (629)
3. Do you eat mostly ...
 - a. Vegetables and fruits (153)
 - b. Meat (644)
 - c. Bread (364)
4. Do you turn off the lights when you leave a room?
 - a. Yes (133)
 - b. No (268)
5. Do you unplug appliances and chargers when not in use?
 - a. Yes (9)
 - b. No (18)
6. How do you dry your clothes?
 - a. Hang to dry (0)
 - b. Dryer (750)
 - c. Both (375)
7. Do you turn off the water when brushing your teeth?
 - a. Yes (34)
 - b. No (274)
8. If you have a TV, do you turn it off when you're not watching it?
 - a. Yes (47)
 - b. No (140)
9. If you have a video game system, do you turn it off when you're not using it?
 - a. Yes (29)
 - b. No (90)
10. Do you recycle? (Select all that apply for this question only)
 - a. Magazines (-15)
 - b. Newspapers (-90)
 - c. Glass (-7)
 - d. Plastic (-19)
 - e. Aluminum and steel cans (-86)

Now, add up all the numbers in parentheses for your answers and put the total here:

This is your "carbon footprint" in the number of pounds of carbon dioxide per year. The lower the number, the fewer greenhouse gasses are emitted into the atmosphere, which helps slow climate change.

List some changes you might make in your life to reduce your carbon footprint:

I could turn off _____.

I could get to school by _____.

I could eat more _____.

I could recycle _____.

Lección 4: Hoja de Actividades

¿Cuál es tu huella de carbono?

Encierra en un círculo las respuestas a las preguntas que aparecen a continuación. Elige una respuesta a menos que se indique otra cosa.

- ¿Cómo llegas a la escuela?
 - Caminando (0)
 - En bicicleta (0)
 - En automóvil (1,115)
 - En autobús (131)
 - En automóvil compartido (459)
- Principalmente comes:
 - Comida rápida (4818)
 - Comida casera (629)
- Principalmente comes:
 - Verduras y frutas (153)
 - Carne (644)
 - Pan (364)
- ¿Apagas las luces cuando sales de una habitación?
 - Sí (133)
 - No (268)
- ¿Desenchufas los aparatos y cargadores cuando no los usas?
 - Sí (9)
 - No (18)
- ¿Cómo secas la ropa?
 - La cuelgo para que se seque (0)
 - Secadora (750)
 - Ambos (375)
- ¿Cierras el grifo cuando te lavas los dientes?
 - Sí (34)
 - No (274)
- Si tienes una televisión, ¿la apagas cuando no la estás viendo?
 - Sí (47)
 - No (140)
- Si tienes un sistema de videojuegos, ¿lo apagas cuando no lo estás usando?
 - Sí (29)
 - No (90)
- ¿Reciclas? (Selecciona todo lo que corresponda sólo para esta pregunta)
 - Revistas (-15)
 - Periódicos (-90)
 - Vidrio (-7)
 - Plástico (-19)
 - Latas de aluminio y hojalata (-86)

Ahora, suma todos los números entre paréntesis para tus respuestas y pon el total aquí:

Esta es tu "huella de carbono" en el número de libras de dióxido de carbono por año. Cuanto menor sea el número, menos gases de efecto invernadero se emiten a la atmósfera, lo que ayuda a lentificar el cambio climático.

Lista algunos cambios que podrías hacer en tu vida para reducir tu huella de carbono:

Podría apagar _____.

Podría ir a la escuela en _____.

Podría comer más _____.

Podría reciclar _____.