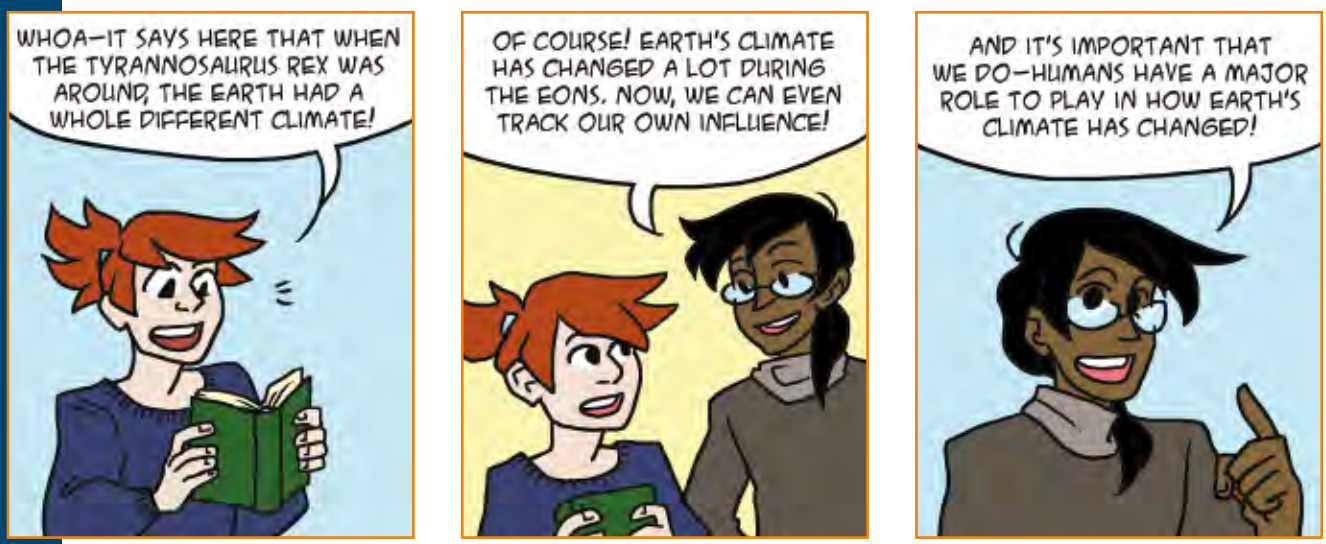
WELCOME TO SPACESHIP EARTH



Imagine our planet as a spaceship orbiting the sun in space. Just as a spaceship carries everything astronauts need to survive and thrive, our Spaceship Earth provides us with all the necessities for life on our planet. Welcome aboard Spaceship Earth!

When you watch a spaceship take off or look at photos of life inside a spacecraft, it's easy to see that the spaceship's passengers have to carry everything they need with them, including enough food, water, and fuel to last the entire flight. There are no grocery stores or gas stations in space! The ship also has to have systems to control both the temperature and the quality of the air, which have to be just right for the astronauts to survive.

ESSENTIAL QUESTION

Why is it important to track data for long periods of time instead of short periods of time?

WORDS TO KNOW

environment: everything in nature, living and nonliving, including plants, animals, soil, rocks, and water.

climate: the average weather conditions of a region during a long period of time. These conditions include temperature, air pressure, humidity, precipitation, winds, sunshine, and cloudiness.

habitable: capable of supporting life.

climate change: a change in global climate patterns. In the twentieth century and beyond, climate change refers to the dramatic warming of the planet caused by increased levels of carbon dioxide in the atmosphere primarily resulting from human activity.

fossil fuels: a source of energy that comes from plants and animals that lived millions of years ago. These include coal, oil, and natural gas.

migration: the movement of a large group of animals, such as birds, due to changes in the environment.

natural resource: a material or substance such as gold, wood, and water that occurs in nature and is valuable to humans.

carbon dioxide (CO_2): a combination of carbon and oxygen that is formed by the burning of fossil fuels, the rotting of plants and animals, and the breathing out of animals or humans.

atmosphere: the mixture of gases surrounding a planet.

By thinking of Earth as a spaceship, you can begin to see how important it is to have fresh water to drink and clean air to breathe. There's absolutely nowhere else we can find these essential things.

Our **environment** and our **climate** keep our home **habitable**. Whether you live in hot, dry New Mexico or cool, rainy Oregon, you depend on the earth's systems to control the climate's delicate balance.

Most of the earth's systems are powered by the sun. The wind and water cycles bring rain that refills our freshwater sources while recycling the earth's fresh air supply.

When large changes occur to the earth's systems, our planet may experience CLIMATE CHANGE. Climate change is the WORLDWIDE shift in the earth's WEATHER PATTERNS in response to burning FOSSIL FUELS.

Have you noticed different weather patterns where you live? Have you heard in the news that storms are stronger and more frequent than they used to be? We experience climate change in many forms, from shorter winters and longer summers to changes in rainfall patterns and animal **migration** routes.

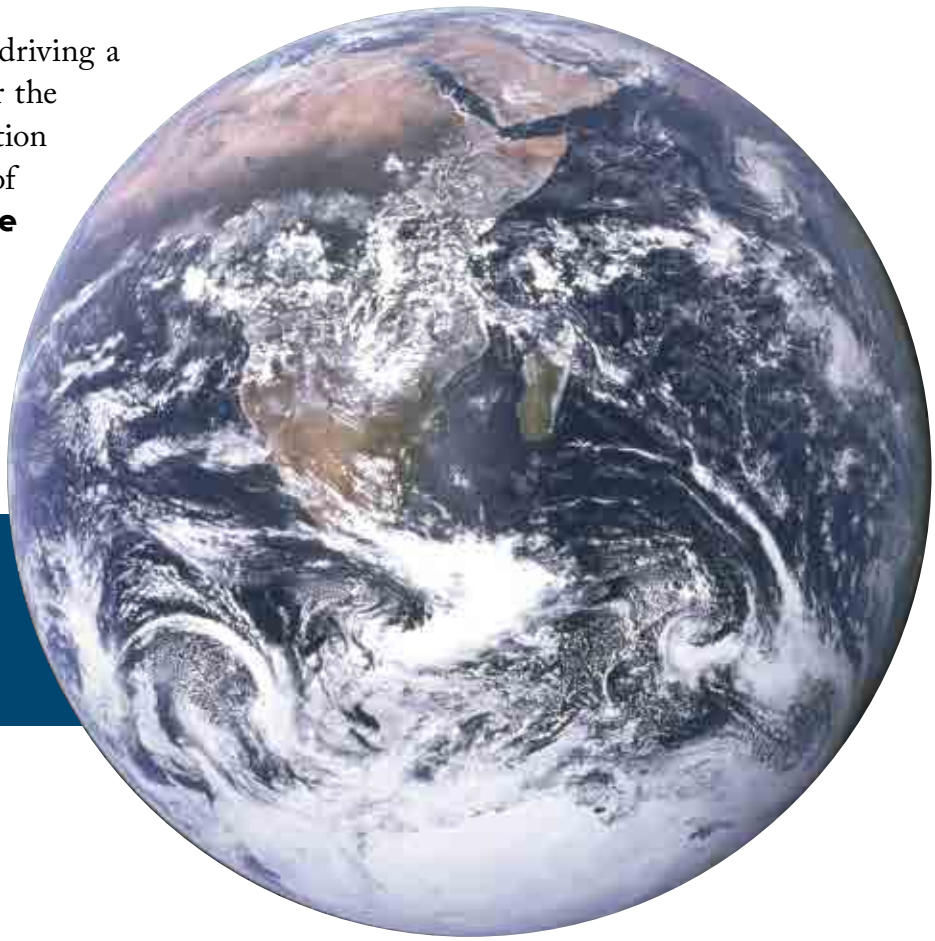
All of the earth's inhabitants have to adapt to the impact of climate change. Many scientists and citizens are working together to find solutions to the problems of our changing planet.

TAKE CARE OF SPACESHIP EARTH

There are almost 8 billion people living on this planet. Each one uses **natural resources** every day. We chop down trees for wood to build houses and burn for warmth. We use water to drink and bathe and wash dishes. We dig up gold and other metals to make jewelry, cars, and cell phones.

We also eat meat, produced from the more than 1.5 billion cows, 2 billion pigs, and 22 billion chickens on Earth! Each pound of meat requires hundreds of pounds of water and food and produces many pounds of waste. That means our meat and dairy consumption impact our planet. In fact, some scientists believe that eating meat is worse for the environment than driving a car.

That's not to say driving a car isn't also bad for the climate! Transportation accounts for much of the **carbon dioxide (CO_2)** that ends up in our **atmosphere**.



The Blue Marble is a famous photograph of the earth taken on December 7, 1972, by the crew of the *Apollo 17* spacecraft.

WORDS TO KNOW

nonrenewable: resources that we can't make more of and that can be used up.

greenhouse gas: a gas such as water vapor, carbon dioxide, or methane that traps heat in the atmosphere and contributes to climate change.

oxygen: a gas in the air that people and animals need to breathe to stay alive and which is the most plentiful element on the earth.

livestock: animals raised for food and other uses.

Many forms of transportation use the burning of fossil fuels as an energy source. When you fill up your car with gas at the gas station, you're pumping a product made from fossil fuels.

Think about your daily life. Do you get driven to school? Do you take a bus to an afterschool program? Do your parents drive to work? Where does the food on your table come from and how does it get to your house? How did your new sneakers get from where they were made to the store you bought them from to your closet?

Most of the transportation around the world uses fossil fuels. You or someone you know might have an electric car that uses a rechargeable battery, but these environmentally friendlier types of transportation are still rare. We have to come up with new types of transportation that use a type of power that does not contribute to climate change.

The production of beef contributes to climate change.

Eunice Foote

Eunice Foote (1819–1888) was the first scientist to make the connection between the amount of carbon dioxide in our atmosphere and climate change. As early as 1856, she submitted her data to the American Association for the Advancement of Science, but because she was a woman, she was not allowed to join the organization or present her findings. A man had to present them for her. Her work laid the foundation for other important scientists, including Charles David Keeling (1928–2005), to measure the carbon dioxide levels in our atmosphere. From Foote's initial work to today, we have been able to track carbon dioxide levels and discover that the amount in our atmosphere is rapidly increasing.

The more people on the planet, the more resources we use. But many of these resources are **nonrenewable** and will eventually run out. That is why it is very important we use our resources wisely. Our individual choices have an impact on the entire world.

In 1862, CARBON DIOXIDE was discovered to be a greenhouse gas, which traps HEAT in our atmosphere and contributes to climate change.

MEASURING CHANGE

One thing that is greatly impacted by human behavior is the atmosphere. Many gases, including nitrogen, **oxygen**, and carbon dioxide (CO_2), make up our atmosphere. The levels of these gases must remain balanced in order for our atmosphere to support life. Changes to our atmosphere can have enormous, life-altering consequences for all life on earth.

CO_2 is a gas that traps heat. Human activities are the primary cause of the majority of the increase in CO_2 levels in our atmosphere. Using fossil fuels in our cars and factories and burning forests to make room for more **livestock** are ways humans release CO_2 into the atmosphere. Our increased levels of CO_2 are contributing to global climate change.

WORDS TO KNOW

data: facts and observations about something.

water vapor: the gas form of water.

species: a group of living things that are closely related and can produce young.

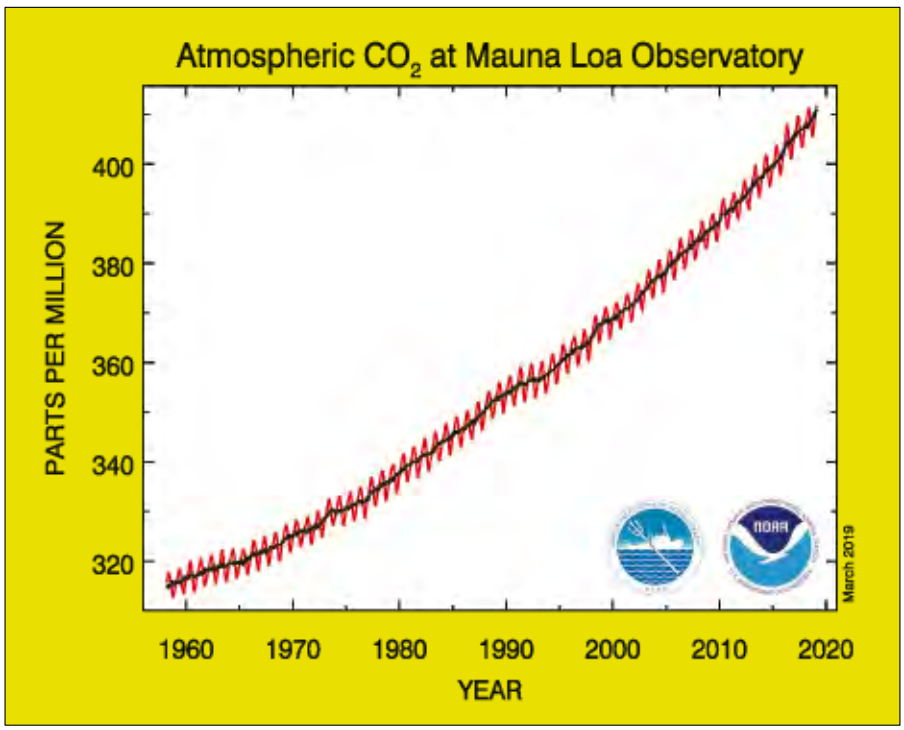
Scientists at the Mauna Loa Observatory in Hawaii have been monitoring CO_2 levels there since 1958. The graph of measurements gathered on CO_2 levels at the Mauna Loa Observatory is known as the Keeling curve.

The Keeling curve is named after American scientist Charles David Keeling, who discovered a way to measure CO_2 in the atmosphere. As you can see from the graph, CO_2 levels rise every year. In fact, we are reaching levels not seen in the last 3,000,000 years.

Scientists study climate change by making observations, gathering **data** through scientific inquiry, and thinking creatively and critically about different theories. What impact do humans have on the environment? What happens when we damage it? How does this affect our climate? Scientists ask these questions, the same ones that we will look at in this book.

Take a look at the graph showing rising CO_2 levels in this video. What could this mean for the future?

Scripps Oceanography Keeling 2019



Credit: Scripps Institution of Oceanography NOAA Earth System Research Laboratory

The Mauna Loa Observatory today

Credit: Christopher Michel (CC BY 2.0)

Why is it important to ask these questions and explore the science behind the answers? Just as a spacecraft needs maintenance and requires that its occupants live a certain way, so does Spaceship Earth. If we want to continue to thrive on this planet, we need to change the way we do things, the way we eat, and the way we live.

For thousands of years, people thought of air as a single substance. They didn't know it was actually a MIXTURE of gases. Air is a mixture of NITROGEN, OXYGEN, ARGON, CARBON DIOXIDE, WATER VAPOR, and more.

We need to find solutions to the problems that are causing the climate of Earth to change in ways that are irreversible. It's important not only so the human **species** will survive, but because millions of other species depend on the health of this planet, too.

In *Climate Change*, we'll take a closer look at the relationships between the atmosphere, the ocean, the land, and Earth's inhabitants to discover how they've changed and why. We'll also be proactive in thinking about the future and what we can do as individuals to help keep the planet healthy.

We need to take care of Earth, just as we'd take care of a spaceship, so that it can take care of us!

Good Science Practices

Every good scientist keeps a science journal!

Scientists use the scientific method to keep their experiments organized. Choose a notebook to use as your science journal. As you read through this book and do the activities, keep track of your observations and record each step in a scientific method worksheet, like the one shown here.

Question: What are we trying to find out? What problem are we trying to solve?

Research: What is already known about the problem?

Hypothesis/Prediction: What do we think the answer will be?

Equipment: What supplies are we using?

Method: What procedure are we following?

Results: What happened? Why?

Each chapter of this book begins with an essential question to help guide your exploration of climate change. Keep the question in your mind as you read the chapter. At the end of each chapter, use your science journal to record your thoughts and answers.

ESSENTIAL QUESTION

Why is it important to track data for long periods of time instead of short periods of time?

INVESTIGATE
WEATHER

How are weather and climate similar to a man walking a dog? **Find out in this video!**

man dog weather climate

How is weather different from climate? Weather can be described as day-to-day conditions. From a bright, sunny day to a snowy day, weather can change quickly. Climate, on the other hand, is long-term weather patterns across many years. Let's explore some of the characteristics of weather.

Think of three characteristics of weather that might influence temperature, such as **humidity**, clouds, and wind. Read or watch the 7-day forecast from a few different sources.

In your science journal, make your own predictions for the next seven days. Be sure to predict for the same hour of each day.

Collect data on the weather for one week at the same time of day for the same location. Use a data table similar to the one below to record your predictions and data.

Date	Prediction	Temperature	Characteristics of weather		

What did you learn about the weather? How did your predictions compare to your data? Were the 7-day forecasts correct? Why do forecasters often get the weather wrong?

WORDS TO KNOW

weather: the temperature, rain, and wind conditions of an area, which change daily.

humidity: the amount of moisture in the air.

Try This!

Have a friend in a different region of the world track weather data at their home. Is their weather more or less predictable than the weather where you are? Do different regions have different variability in their weather?