

Two degrees Fahrenheit. That's roughly how much Earth's average temperature has risen since the 1880s. It may not sound like much, but the change is having effects all over the globe: Ice is melting at the North and South poles. Ocean levels are rising. In some places, rainfall is getting heavier; in others, droughts are becoming more severe.

This increase in Earth's average temperature over a long period of time is called global warming. The increase along with all its side effects are known as climate change. Scientists have linked climate change to human activities.

Some people remain unconvinced that humans are causing the warming or that it's even happening. In a 2016 Pew Research Center survey, 20 percent of Americans said there's no solid proof of global warming. But the vast majority of climate scientists—97 percent, according to studies by the Center for Climate Change Communication at George Mason University in Virginia—agree that the problem is real and urgent. If dramatic steps aren't taken, they say, life on Earth could become very challenging.

"It's difficult to make people understand how urgent this is when you look outside and the weather seems pretty normal," says James Hansen, a climate scientist at Columbia University in New York City.

Here's what you need to know about the causes and effects of climate change and what can be done about it.

1. What are greenhouse gases, and how do they cause climate change?

Greenhouse gases are invisible gases in the air that act like the glass **panes** of a greenhouse, trapping some of the sun's heat close to Earth. Some of them, such as carbon dioxide, occur naturally in our atmosphere. But when we burn **fossil fuels** (such as coal and oil) to power homes, cars, and factories, we release even more greenhouse gases.

The so-called greenhouse effect is a good thing—to some extent. Without it, our planet would be a frozen wasteland. The problem, climate scientists say, is that we're producing too much of these greenhouse gases. Since the Industrial Revolution, the amount of carbon dioxide in the atmosphere has increased by more than 40 percent. That means more heat is being trapped and, as a result, Earth's average temperature has been rising.

2. Do we know that human activity is responsible?

Experts have examined the natural factors known to affect Earth's temperature and concluded that these factors are not changing nearly enough to cause the current warming. Carbon dioxide levels *did* rise and fall naturally long ago, but those changes occurred gradually over thousands of years. Now, through the burning of fossil fuels, humans are releasing carbon dioxide into the air much faster than nature has ever done, scientists say. That explains the rapid warming better than anything else, most climate scientists have concluded.

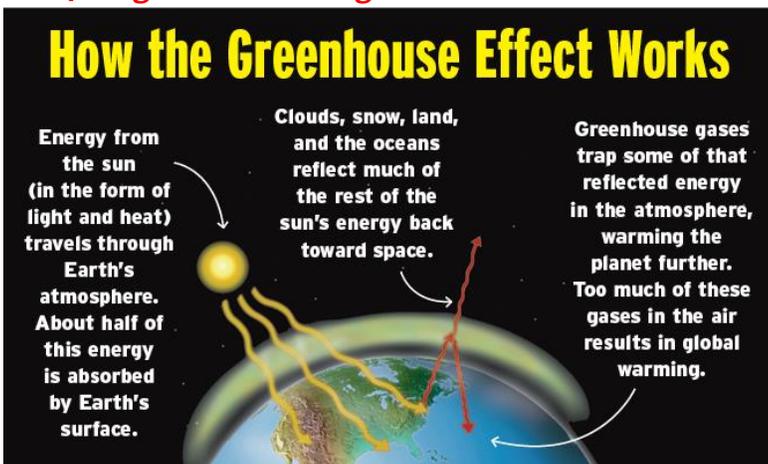
3. If Earth is getting warmer, why is it still so cold in some places?

To understand how cold weather occurs in a warming world, it helps to know the difference between climate and weather. *Weather* is what’s going on outside in a certain place on any given day. It can change quickly and be hard to predict. *Climate* describes what weather conditions are usually like in a place over a **prolonged** period of time—and it changes slowly. Scientists say that Earth’s climate has been getting hotter for decades (see “*Tracking the Warming Trend*,” below).

“Two weeks of really cold temperatures don’t **negate** decades of warming,” says Jake Crouch of the National Oceanic and Atmospheric Administration (NOAA).

In Canada, for example, winters are still bitterly cold—but not as consistently cold as they used to be. The warming trend means that the ice in the country’s outdoor skating rinks is melting earlier in the season. Researchers estimate that the number of outdoor ice-skating days will drop by 34 percent in Toronto and 19 percent in Calgary by 2090.

4. Is global warming to blame for all the recent wild weather?



Scientists have published strong evidence that the warming trend is making heat waves more frequent and intense. Coastal flooding is also increasing as the oceans rise. As for hurricanes and other storms, while global warming doesn’t necessarily cause them, it likely makes them worse. For example, during Hurricane Harvey last August, up to 40 percent more rain poured down than would have

if the exact same hurricane had happened decades earlier, experts say.

Climate change, says Kathleen Hayhoe, a climate scientist at Texas Tech University, “takes the natural risks that we’ve always faced and **exacerbates** them.”

5. Why are the seas rising—and how fast?

Sea water levels are rising for two main reasons, scientists say. The oceans are getting warmer—and water expands as it heats up, causing sea levels to rise. Plus, melting glaciers and ice sheets are adding more water to the oceans.

The seas are now rising at an average rate of about 1 foot per century. If that were to continue, the increase would probably be manageable, some experts say. But some scientists fear sea levels could begin to rise much more quickly. Ultimately, seas could rise 20 feet or more above their current level. That’s enough to flood many of the world’s biggest coastal cities, such as New York, Miami, and Shanghai. But just how

long it would take to happen is unclear. Our best bet, experts say, is to try to slow the process of sea level rise by cutting emissions.

6. Where will the effects of global warming be felt first?

People around the world are already feeling the effects. In Cape Town, South Africa, for example, years of warmer weather—coupled with less rainfall—have led to three straight years of drought. The city of 4 million people now faces a water shortage so extreme that its water supply could run out in 2019.

In other places, *too much* water is the problem. Because of sea level rise, the Marshall Islands in the Pacific Ocean flood frequently and could be unfit for human habitation within decades, scientists say.

If greenhouse gas levels continue to rise unchecked, the impacts could be much more severe.

Over the next 25 or 30 years, scientists say, the climate is likely to continue to warm, causing more extreme weather, including stronger hurricanes, more prolonged droughts, and more wildfires. In the long term, climate effects could become so severe that they lead to political unrest in some places and mass extinctions of plants and animals.

7. Can the warming be stopped?

Most climate scientists say it's too late for the warming to be stopped altogether, but it can be slowed to a potentially manageable pace—if humans drastically reduce greenhouse gas **emissions**. Some countries, such as Sweden, have already seen their emissions fall after investing in renewable energy. Other countries have set emissions limits for power plants. But experts say we need to do much more to avoid the worst effects of climate change.

Nearly all 196 countries have signed a 2016 climate pact known as the Paris agreement, pledging to voluntarily limit future greenhouse gas emissions. The goal is to keep Earth's temperature from rising more than 3.6 degrees Fahrenheit this century. That would “hold warming to something we actually can largely adapt to without fundamental changes and impacts on our civilization,” says Hayhoe, the climate scientist.

8. Is the U.S. dropping out of the Paris agreement?

Last year, President Trump said that the U.S.—the second-largest greenhouse gas emitter after China—would withdraw from the Paris agreement. Trump said the pact imposes unfair environmental standards on American businesses and could hurt the economy, including the loss of 2.7 million jobs by 2025.

“The bottom line is that the Paris accord is very unfair, at the highest levels, to the United States,” Trump said.

However, under the rules of the deal, the soonest any country can drop out is November 4, 2020. In the meantime, the Trump administration is reversing policies—such as increased vehicle fuel efficiency standards and limits on pollution at power plants—designed to reduce U.S. emissions and meet the goals of the Paris agreement. Trump says these requirements were unfairly burdensome to car and energy companies.

But at the same time, a growing number of U.S. cities, businesses, and universities have pledged to reduce greenhouse gas emissions on their own in order to help meet the Paris objectives.

9. Can we get energy without producing so many greenhouse gases?

Yes, and those alternative energy sources may end up being cheaper than burning fossil fuels, some scientists say. Wind turbines, solar panels, hydroelectric dams, and nuclear power plants produce among the fewest emissions. But converting to such power sources would be more expensive now, and it would be disruptive while we make the transition. Ultimately, however, the shift to renewable energy sources could pay for itself by reducing climate change and health problems associated with air pollution, although that isn't certain.

10. What can I personally do about climate change?

A lot, actually. You can cut your own emissions by opting to walk, bike, or use public transportation instead of driving. If you need to drive, pick a small, fuel-efficient car.

If enough people change their behavior, it could make a difference, says Maria Zuber, who directs the climate action plan at the Massachusetts Institute of Technology.

“I think young people have an extremely important role to play here,” she says. “So many of them really want to leave this world in a better place than the world they came into. Realizing how motivated and dedicated these kids are gives me hope.”

Shrinking Arctic Ice

The Arctic is warming more than twice as fast as the rest of the world, and its sea ice is disappearing. Some scientists predict Arctic sea ice will be completely gone during summer months within the next generation.



Jim McMahon

MELTING ICE: Arctic Ocean. Polar bears survive by hunting seals from atop sea ice. As the ice melts, it becomes tougher for the bears to find food.



DIRECTIONS:

- 1) **Number** each paragraph in the left hand margin.
- 2) As you read the article **highlight** in **YELLOW** important information (description of people or places, facts, or other evidence).
- 3) As you read the article, **circle** in **GREEN** key terms, dates, events, names, places, and words that signal relationship (“this led to…” or “as a result of…”). ***If the phrase is longer than 3-4 words it should be highlighted not circled.***
- 4) As you read the article, **box** in **ORANGE** words with which you are unfamiliar. In the margins, **define** these words. Remember, this is an exercise in building your vocabulary. So, if you can use context clues to figure out what the word means, but can’t define it on its own, you need to box and define that word. **Words that have been bolded for you must be defined!**
- 5) **Summarize** EACH article:
 - a. In 1-2 sentences only, summarize the **main idea** being communicated by the article.

- 6) **Analyze:** On a separate sheet of paper, please answer the following questions.
 - a. What effects do scientists say the increase in Earth’s average temperature is already having on the planet?
 - b. Why do you think climate change is a controversial topic in the U.S.?
 - c. If the Earth is getting warmer, why is it still so cold in some places?
 - d. Based on the article, what are some things you can do to help reduce greenhouse gas emissions?