HOW TO SAVE THE PLANET

Over the last year, hundreds of thousands of children have missed school to join climate strikes. What is climate change and what can you do about it?

Waving hand-painted placards, young people in more than 1,600 cities around the world have gathered outside parliaments and local government buildings to protest. They say our planet is in the grip of a climate emergency and the lack of action to tackle it is putting Earth's future at risk. This is the face of the #FridaysforFuture movement, the protest started last summer by Swedish teenager Greta Thunberg. She stopped going to school on Fridays and instead sat outside the Swedish parliament, holding a sign that said "School strike for the climate".

Thunberg says that grown-ups have failed you. She asks why the adults in charge aren't taking action. There is no longer any doubt that the climate is changing – the science facts are there. Climate change is the long-term shift in weather patterns, including rising average temperatures around the world, caused mostly by human activities such as farming, cutting down forests and burning fossil fuels (coal, oil and gas). People, however, continue to argue about how the climate will change in the future and the extent to which humans are to blame.

Turning this situation around means making big changes to the way we live. The climate strikers want us to think differently. They argue that people have little choice now, and if these changes are inconvenient, they are nothing compared to the risks of overheating our planet. Knowledge is the key weapon in the fight against climate change – we can't really change anything if we don't understand it properly. Here, then, is all the essential information that you need to know. Are you ready to dive in?

GETTING HOTTER

The average global temperature at the Earth's surface increased by 0.85°C between 1880 and 2012.

Polar regions are warming twice as fast as other parts of the world.

Is the world warming?

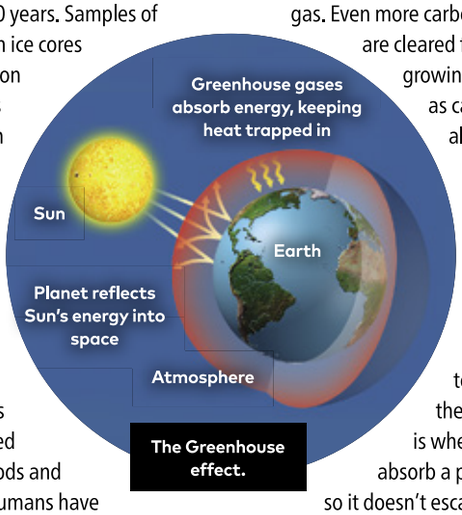
Yes. The evidence that the planet is getting warmer isn't just the findings of one or two studies, it comes from data collected by thousands of scientists around the world. Data from the United Nations Intergovernmental Panel on Climate Change (IPCC) – an organisation that advises governments on climate change – shows that each of the last three decades has been warmer than any other decade since 1850. The Central England Temperature records are the longest-running in the world, and they show that the average temperature today is around 1˚C warmer than it was between 1850 and 1900.

Scientists can look back even further than 1850, to find out what Earth's climate was like before humans began keeping records. By drilling deep into glaciers and ice sheets they collect frozen "fossils" of Earth's atmosphere that date back hundreds of thousands of years. Scientists measure the gases and particles in this ancient air to work out how warm it was. The results show that Earth's temperature and weather have changed many times all by themselves. Looking back over very long periods reveals our planet's normal patterns and natural cycles. It also tells us that although Earth's climate has warmed before, it has never done it as quickly as now.

Are humans to blame?

There's no doubt that by burning fossil fuels, humans have put a lot of extra carbon dioxide, methane and nitrous oxide into the atmosphere. Scientists have observed that the mix of gases in Earth's atmosphere has changed over the last 200 years. Samples of ancient air bubbles trapped in ice cores reveal that there is more carbon dioxide, methane and nitrous oxide now than at any time in the last 800,000 years.

These three common gases in Earth's atmosphere are all released by human activities. During a period called the Industrial Revolution, which started in the late 18th century, humans began to use coal- and oil-fired machines to manufacture goods and transport them. Since then, humans have been burning vast amounts of fossil fuels to power transport, industry and heating. Current levels of carbon dioxide are around 40% higher than they were before the Industrial Revolution.



The Greenhouse effect.

Fossil fuels are formed from the remains of animals and plants that were once alive. Because living things (like you) are mostly built out of substances made with the chemical element carbon, burning them releases it in the form of carbon dioxide gas. Even more carbon is released when forests are cleared for farming, to feed a rapidly growing global population. As well as carbon dioxide, farming is also a source of methane and nitrous oxide gases.

How can we be sure?

The answer to whether rising levels of these gases are causing temperatures to rise is something called the greenhouse effect. This is when certain gases in the air absorb a portion of the Sun's energy so it doesn't escape back into space. Carbon dioxide, methane and nitrous oxide all make the atmosphere act like a giant duvet, trapping heat inside. On Earth, the greenhouse effect has kept the planet cosy enough for living things to survive, but

SLIPPERY SLOPE

1 August 2019 saw the largest loss of ice in a single day from the Greenland ice sheet: 12.5 billion tonnes of ice melted into the sea.

This image from June 2019 shows a team of dogs wading through water on top of melting sea ice in Greenland.

Climate change – no laughing matter for clownfish.

PLANETARY PARPS

Cows and other grass-munching farm animals are responsible for 14.5% of all greenhouse gas emissions.

it's clear that increasing greenhouse gases creates a more powerful greenhouse effect. For example, Venus has far more carbon dioxide in its atmosphere than Earth. The temperature on its surface is 460˚C – hot enough to melt some metals. Scientists now believe strongly that the extra greenhouse gases humans have been pumping into the atmosphere are the most likely cause of global warming.

Wild weather

A 1˚C temperature rise doesn't sound too bad, but remember – it's just an average across the whole globe. Polar regions are warming twice as fast as other parts of the world, and the Arctic sea ice that forms during winter has decreased every year since 1979. Glaciers – as well as the huge ice sheets covering Greenland and Antarctica – are shrinking, and between 1901 and 2010, the average global sea level has risen by 19 centimetres.

A small rise in temperature has also had a massive impact on local weather conditions. For the UK, these changes mean wetter weather and more risk of flooding near the coast. In other areas of the world, climate change is making extreme weather events, such as droughts, heatwaves, storms and wildfires, more likely to happen – and worse when they do.

The Bramble Cay melomys.

Effects on the environment

These changes are disrupting the delicate balance of life on every continent, endangering entire communities of living things. Many animals are moving in response to changing climate. Mosquitoes that carry malaria, for example, are spreading as the world warms. Species that can't respond so well, however, are now under threat. Earlier this year, the Bramble Cay melomys – a type of small rat that lived in Australia – became the first confirmed mammal extinction due to climate change. The United Nations (a group of 193 countries that works to tackle issues affecting the whole world) predicts that a million more species are at risk.

Life in the oceans

The oceans soak up most of the extra heat. This helps to regulate the planet's climate, but it also affects sea life. Warmer water damages the sea anemones that provide a safe hiding place for clownfish. In a process called bleaching, the corals shed the tiny micro-organisms that provide them with food and make them coloured. When anemones bleach, clownfish become stressed out and stop laying eggs. Sea turtles are under pressure, too. Rising seas are flooding the beaches where they lay their eggs. Hotter sand also affects the sex of turtles hatching from eggs. A study carried

Meet a scientist

DR HEATHER GRAVEN

SENIOR LECTURER, IMPERIAL COLLEGE LONDON

Dr Heather Graven studies Earth's atmosphere and how it is affected by greenhouse gases.

Why did you choose climate physics?

I was always interested in the atmosphere – it's invisible but connects us all. I love the thrill of changing my own and other people's perceptions of the world.

What's the most exciting recent development in your field of study?

The HIPPO project (hippo.ucar.edu) used an aeroplane that flew from the north pole to the coast of Antarctica, taking measurements of the atmosphere from near the surface to over six miles high. This has given us a whole new view on the atmosphere.

What advice would you give to young people?

Young people interested in science should make sure to nurture their interests, scientific and otherwise, both inside and outside of school. The most important thing is to maintain your curiosity about the world.

out in Australia in 2018 found that 99% of new green sea turtle hatchlings were female.

Is it too late?

No one knows for certain what will happen. Even if people stopped burning fossil fuels and cutting down forests now, the greenhouse gases already in the atmosphere would continue to warm Earth for decades. However, we're not stopping – far from it. The last 40 years of human activity have produced about half of all the greenhouse gases since records began.


Get on your bike.

Climate scientists use computers to play out different scenarios using the vast amount of data from past and present. Their predictions show that continuing these greenhouse gas emissions unchecked will cause further warming and irreversible changes to the planet. However, Greta Thunberg insists that it's not too late. "Yes, we are failing, but there is still time to turn everything around," she says.

What is being done?

In 2015, the leaders of 195 countries, including the UK, signed up to the Paris Climate Agreement, an action plan to tackle the causes of climate change. It aims to stop the global temperature from rising more than 2˚C above the levels that existed before the Industrial Revolution – and to try and limit it to 1.5˚C. On 23 August 2019, world leaders will attend a climate conference to report on their progress.

In May this year, the UK Parliament declared an environment and climate emergency. Although this does not have the power to force the Government to do anything, it has been called a huge step in the right direction. The UK Government is planning to cut emissions to "net zero" by 2050, meaning that any carbon dioxide released will have to be captured again, for example by planting trees.

How can you make a difference?

Reducing the greenhouse gases that we release is the top priority. This will involve 7.7 billion people in almost 200 countries changing nearly every aspect of their lives – from transport and energy to fashion and food. Small changes by individuals do count, though. You can start by walking or cycling short distances rather than driving, or setting your heating to a lower temperature. These simple changes will also reduce your local air pollution and save your family money.

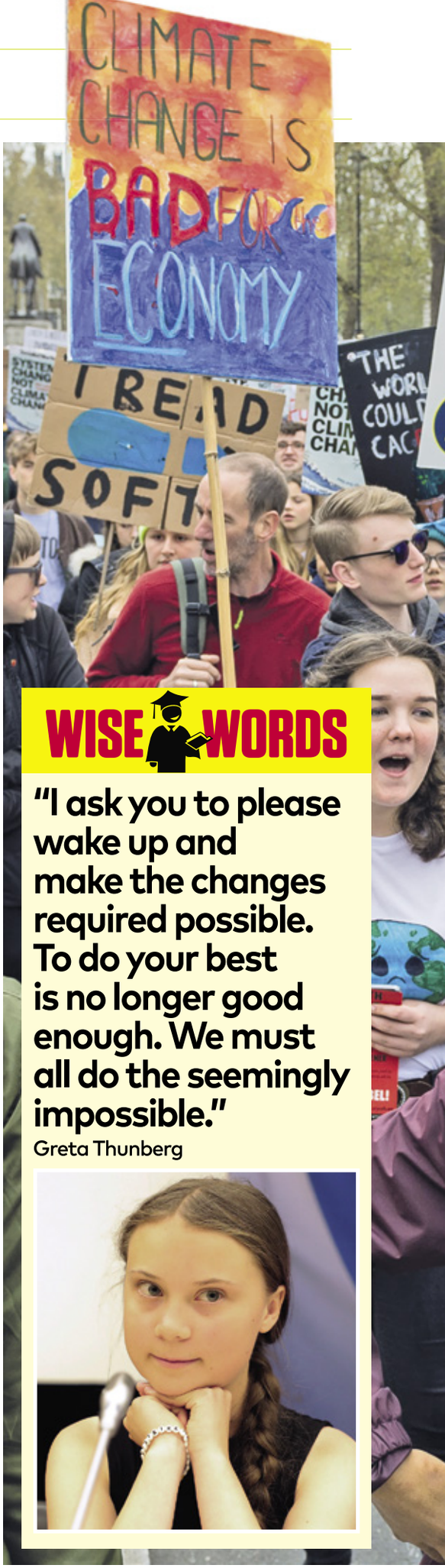
Change your behaviour

Everything we buy, watch, eat and wear takes energy to make, and because 80% of the world's energy comes from fossil fuels, that creates more greenhouse gases. The simplest solution is to buy less stuff. Food is a great place to start: find out where it came from and how it was produced. Many foods that go off quickly are flown in by aeroplane – a huge source of greenhouse gases.

Spread the word

You might not be able to make laws to tackle climate change, but you're never too young to influence the people who do. Spreading your knowledge of climate change and inspiring others to take action is a great way to make a difference. Start small: find out how much your family and friends know about the issue, using the quiz opposite. Ask your school what they are doing to tackle climate change. You could even follow in Greta Thunberg's footsteps and create your own campaign. Above all, don't be daunted. Remember – we can still fix this.


Fresh to your plate – via an aeroplane.



WISE WORDS

"I ask you to please wake up and make the changes required possible. To do your best is no longer good enough. We must all do the seemingly impossible."

Greta Thunberg