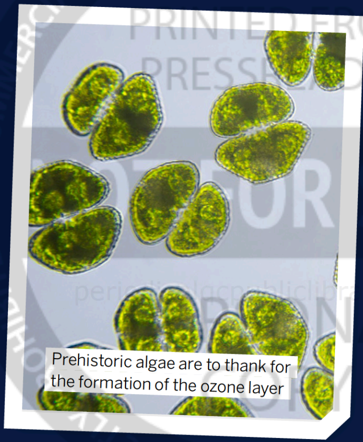
- Ozone layer

ENVIRONMENT

WHERE DID THE OZONE LAYER COME FROM?

The invisible layer in the atmosphere that protects us from deadly radiation formed billions of years ago



Prehistoric algae are to thank for the formation of the ozone layer

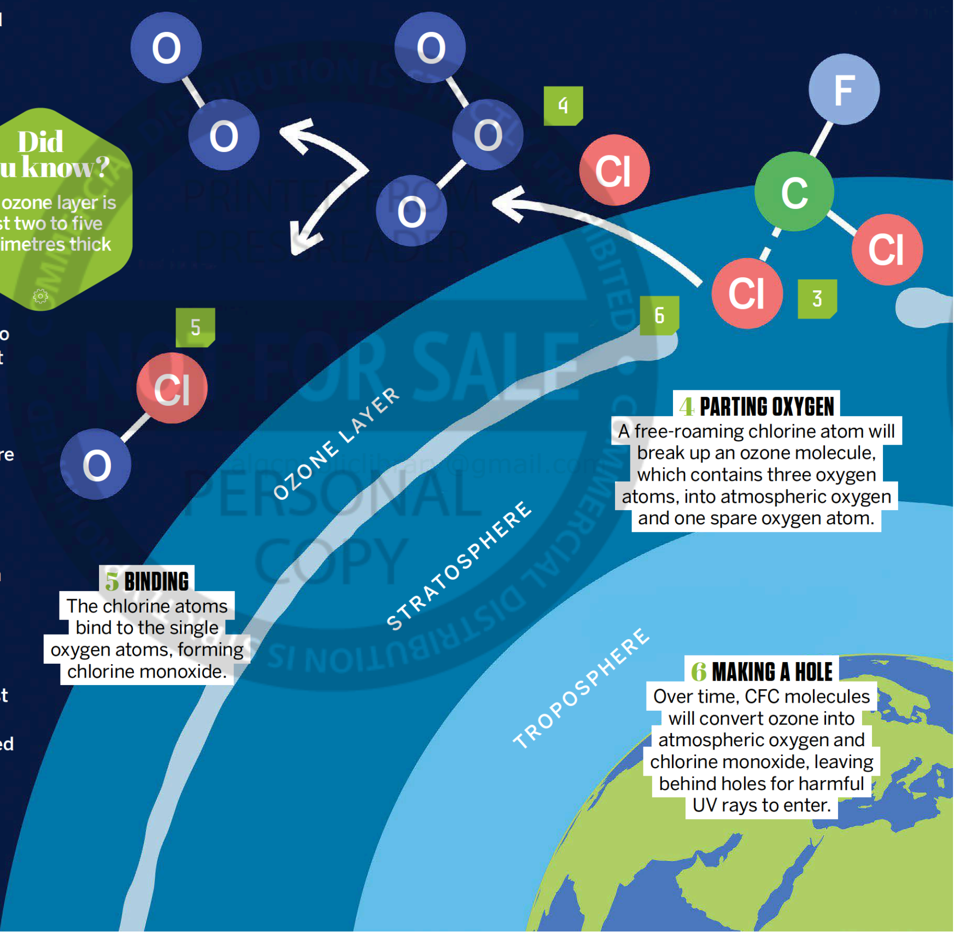
WORDS SCOTT DUTFIELD

Between 10 and 25 miles above our heads in the stratosphere, there is a layer of oxygen dedicated to blocking dangerous forms of solar radiation, called the ozone layer. Along with visible light, the Sun also emits rays of radiation in the form of ultraviolet (UV) light. Within UV are three different wavelengths of light, commonly referred to as UVA, UVB and UVC, each of which has different levels of energy. UVA is the least energetic light, while UVB sits in the middle and UVC is the most energetic. On their journey from the Sun and into Earth's atmosphere, the high energy of the UVC rays is absorbed by the oxygen molecules that form the ozone layer. The lower energy wavelengths of UVA and UVB, however, can pass through ozone and reach Earth's surface. Around 95 per cent of the UV that reaches Earth's surface is UVA, and the remaining five per cent is UVB.

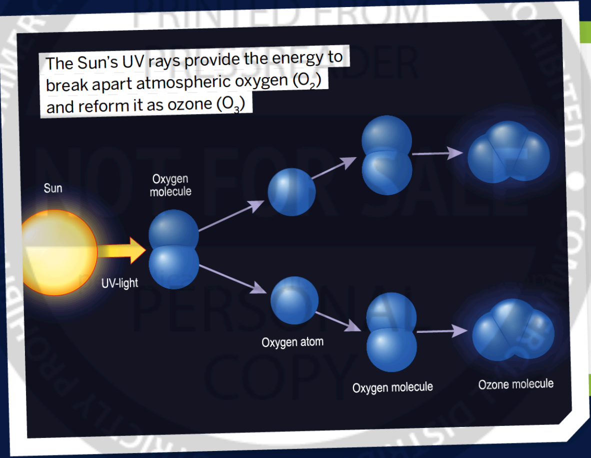
Before Earth was protected by the ozone layer, life was limited to the oceans in water deep enough to shield it from the Sun's harmful UV rays. It's thanks to tiny multicellular organisms called algae that life was able to leave the water and venture onto land. For billions of years, algae have been dumping oxygen into the atmosphere through the process of photosynthesis, where sunlight is used to convert carbon dioxide into food, as well as producing oxygen as a waste product. By around 600 million years ago, during the Precambrian era, the concentration of oxygen was around just ten per cent of modern-day levels, and a layer of ozone – made up of three oxygen molecules – had formed in the stratosphere. Around 150 million years later, thanks to the UV protection of the ozone layer, the world's first terrestrial plants emerged, pumped even more oxygen into the atmosphere and started life's journey on land.

Without the ozone layer to absorb the majority of UV radiation, our planet would be exposed to high-energy rays, wreaking havoc on all life on Earth. Unprotected exposure to UVA and UVB, for example when someone doesn't use sun cream, results in sunburned skin, but can also cause mutations in skin cell DNA, leading to the formation of cancer. When a pair of scientists from the University of California revealed in 1974 that commonly used chemicals called chlorofluorocarbons were destroying the ozone layer, the world began to phase them out. Chlorofluorocarbons (CFCs) were widely used in refrigerators and as propellants in aerosol cans. When released into the atmosphere, CFCs can break apart the oxygen molecules that make up the ozone layer, leading to the formation of colossal holes in this layer of the atmosphere and subsequently paving the way for harmful UV rays to reach Earth's surface.

Did you know?
The ozone layer is just two to five millimetres thick



DID YOU KNOW? The ozone layer was discovered in 1913 by French scientists Charles Fabry and Henri Buisson



FORGING THE SHIELD

The ozone layer's relationship with UV radiation is twofold. On one hand, the atmospheric shield works to block the harmful rays, but on the other, it needs UV to build or repair itself. As wavelengths of solar radiation interact with atmospheric oxygen, which holds two molecules of oxygen, it breaks them apart. The two lonely atoms quickly find a molecule of atmospheric oxygen and bind with, forming three bonded oxygen atoms. Several natural processes, such as sunspots, stratospheric winds and even volcanic eruptions, deplete the ozone layer, maintaining a cycle of formation and depletion. However, when the balance is interrupted, such as with the release of CFCs, more ozone is lost than the Sun's UV rays can build, and holes are formed.

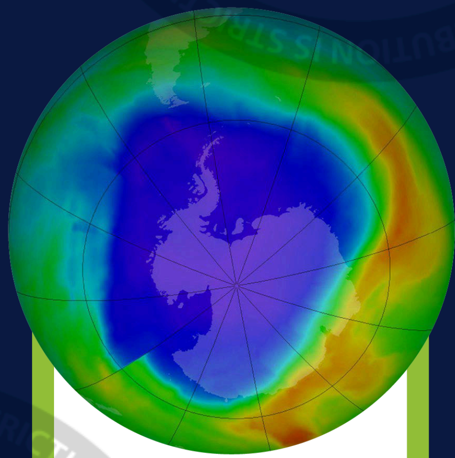
BREAKING DOWN OZONE

How CFCs tear giant holes in the atmosphere

1 UV LIGHT
UVA isn't blocked by the ozone layer, but the majority of UVB and UVC are absorbed.

2 MEETING UV
When CFCs are released into the atmosphere and reach the ozone layer, they interact with the UV light emitted from the Sun.

3 ATOM BREAKAGE
When the molecules of CFCs interact with UV light, it causes atoms of chlorine to separate from the CFCs.



The ozone hole (blue) over Antarctica in 2013

REPAIRING HOLES IN THE OZONE

Since the introduction of the 1989 Montreal Protocol, an international agreement to rid the world of ozone-depleting chemicals such as CFCs, giant holes over the polar regions are set to close as soon as 2045. An assessment by the United Nations has found that the ozone hole over the Arctic could heal in the next 11 years, and the layer above Antarctica will close by 2066. By simply eliminating the use of ozone-depleting chemicals, the natural process of ozone formation has gradually been able to reverse the thinning of the ozone layer and patch up holes. At present, the ozone hole over the Antarctic has a maximum area of around 10 million square miles. Its largest size was reached in 2000, when the hole peaked at around 11 million square miles.