An aerial photograph of a vast, flat landscape, likely a coastal plain or a large field, under a dramatic sky. The sun is low on the horizon, creating a bright orange and yellow glow that transitions into a deep blue. Scattered white clouds are visible in the distance, and the foreground shows a textured, dark surface, possibly water or a wet field, reflecting the light.

Climate Change

Part 1: The Atmosphere

What is the Atmosphere?

The atmosphere is a layer of gases that surrounds the Earth.

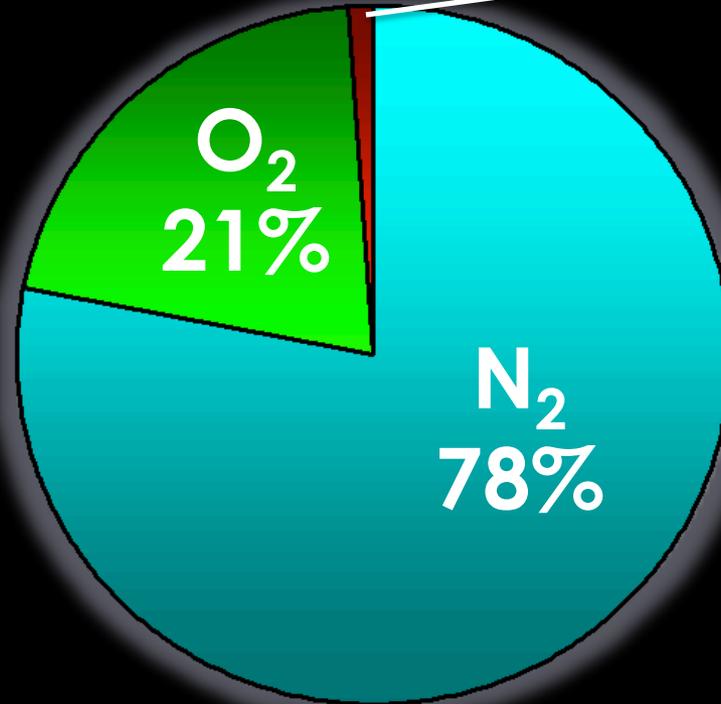
ATMOSPHERE

“gases” “around”

“gases around the Earth”

Composition

Today's atmosphere is composed of different several gases.



Greenhouse
Gases 1%



A Changing Atmosphere

The atmosphere has changed dramatically since the Earth was created 5 b.a. ago.

The atmosphere of early Earth was deadly to any form of life.

Let's look closely at those changes...

Early Earth

Earth was formed 4.5 billion years ago.

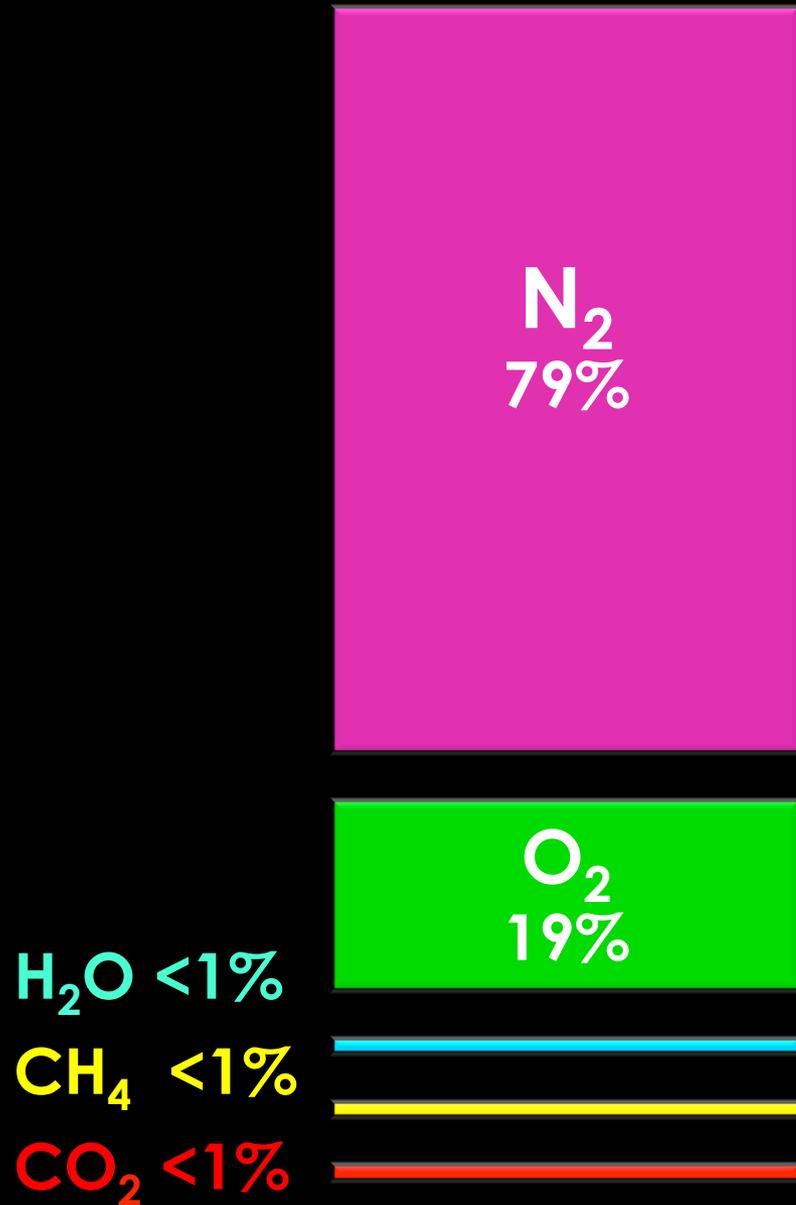
It had no atmosphere at first.

It stayed molten for millions of years.

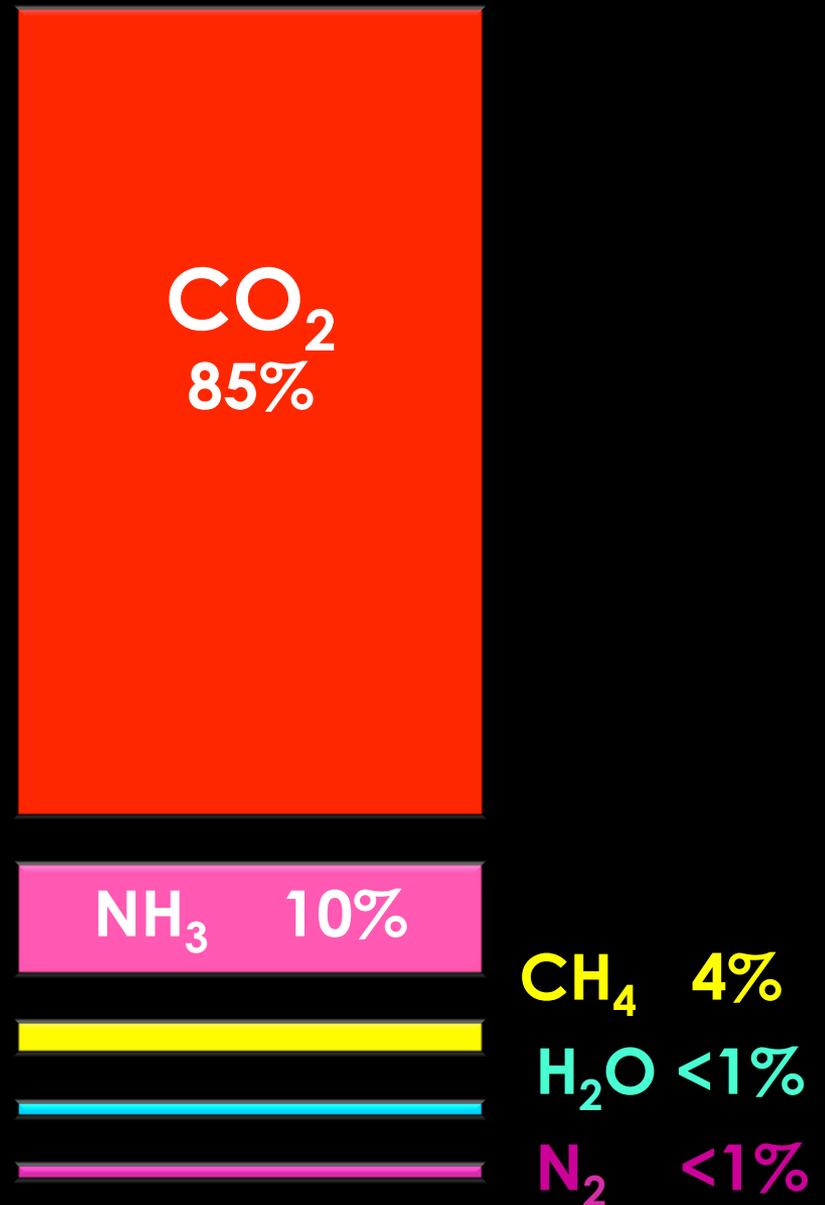
It was covered in active volcanoes.

The volcanic eruptions helped form an early atmosphere.

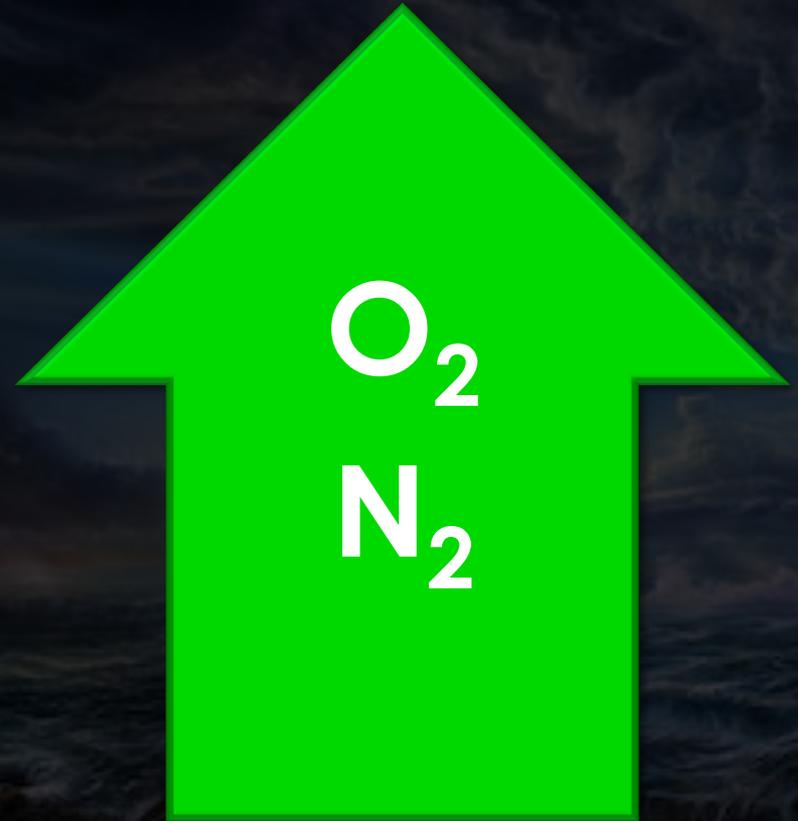
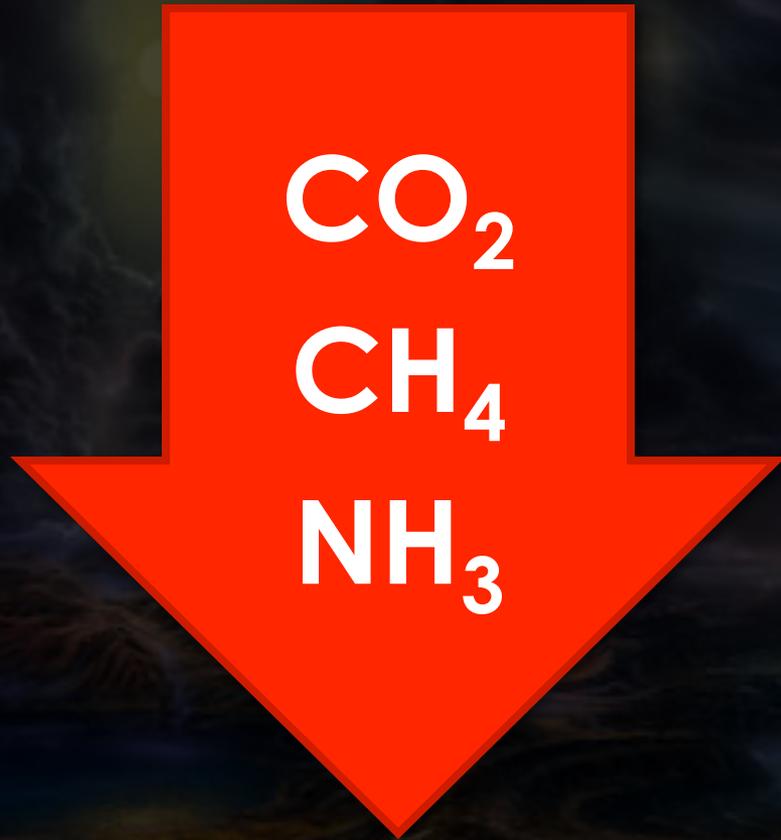
Current Atmosphere



Early Atmosphere



The Big Changes



What caused these changes to occur?

Change #1

One billion years after Earth formed, it started to finally cool down.

Water vapor in the air condensed to liquid.

The rainfall created early oceans and lakes.

CO₂ in the atmosphere dissolved in the water.

CO₂ levels fell quickly.

Change #2

Life on Earth evolved!

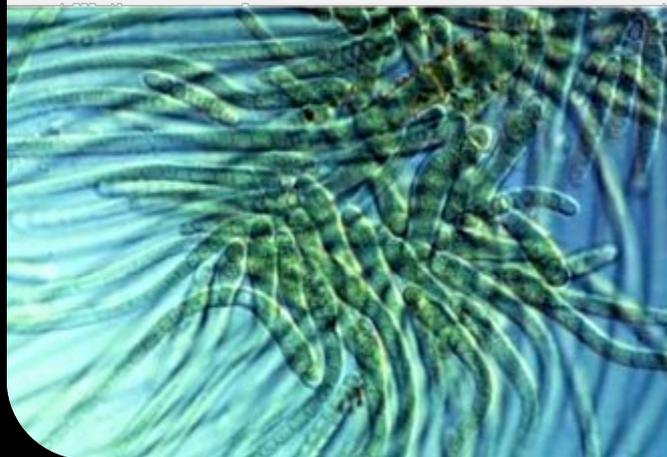
The first life forms on Earth were microbes called cyanobacteria.

The cyanobacteria used photosynthesis, taking CO_2 out of the air and releasing O_2 .

CO_2 levels
continue to fall.

O_2 levels
begin to rise.

Cyanobacteria



Change #3

Cyanobacteria evolve into plants.

Plants continue to release O_2 .

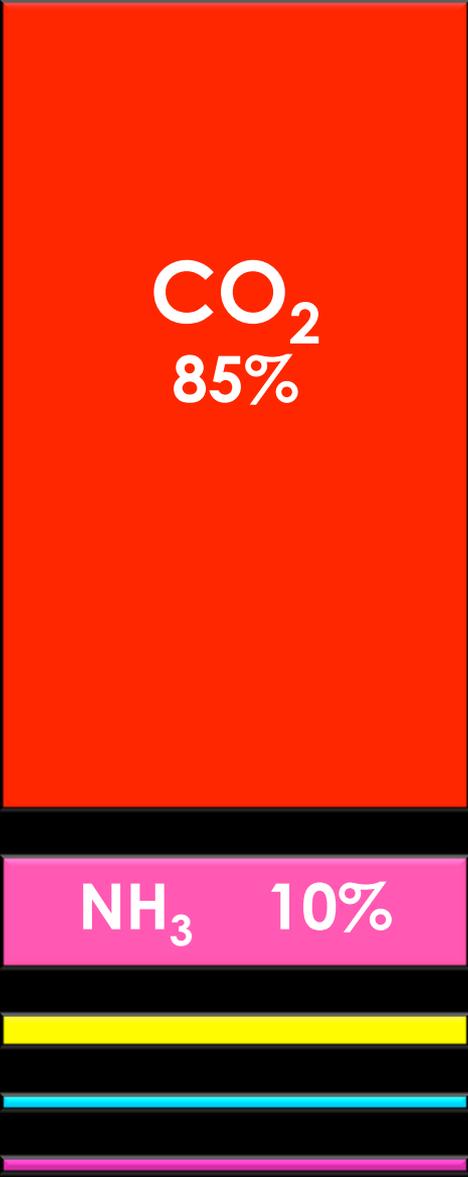
O_2 is a highly reactive gas.

It reacted reacted with CH_4 and NH_4 in the air to form N_2 as a byproduct.

CH_4 and NH_4
levels fall.

O_2 levels
still rising.

Early Atmosphere

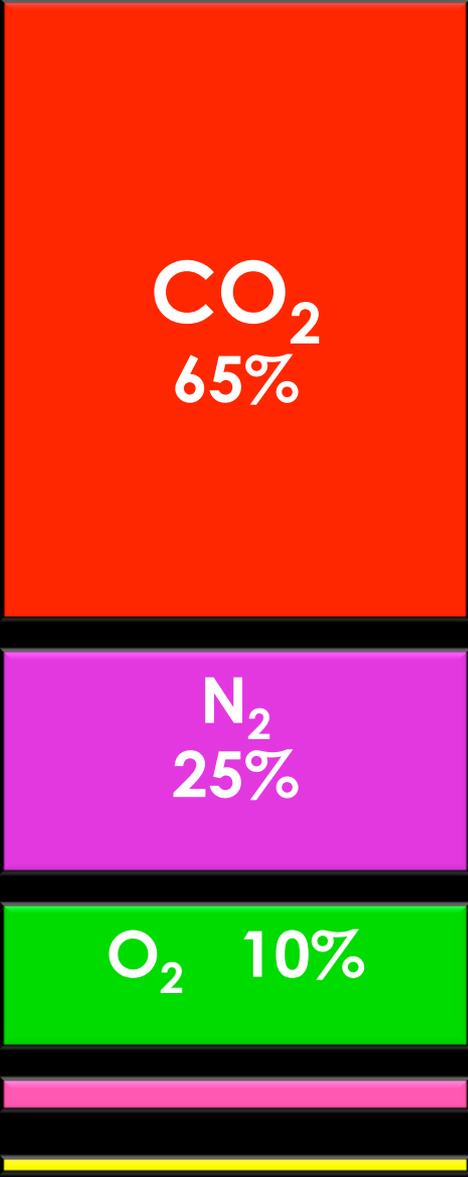


CH₄ 4%

H₂O <1%

N₂ <1%

Earth at "Half-time"



CO₂ 65%

N₂ 25%

O₂ 10%

NH₃ <1%

CH₄ <1%

Earth at “Half Time”



Earth at “Half Time”



Further changes continued after half time...

Change #4

Plants continue to evolve and multiply.

Plants continue to release lots of O₂.

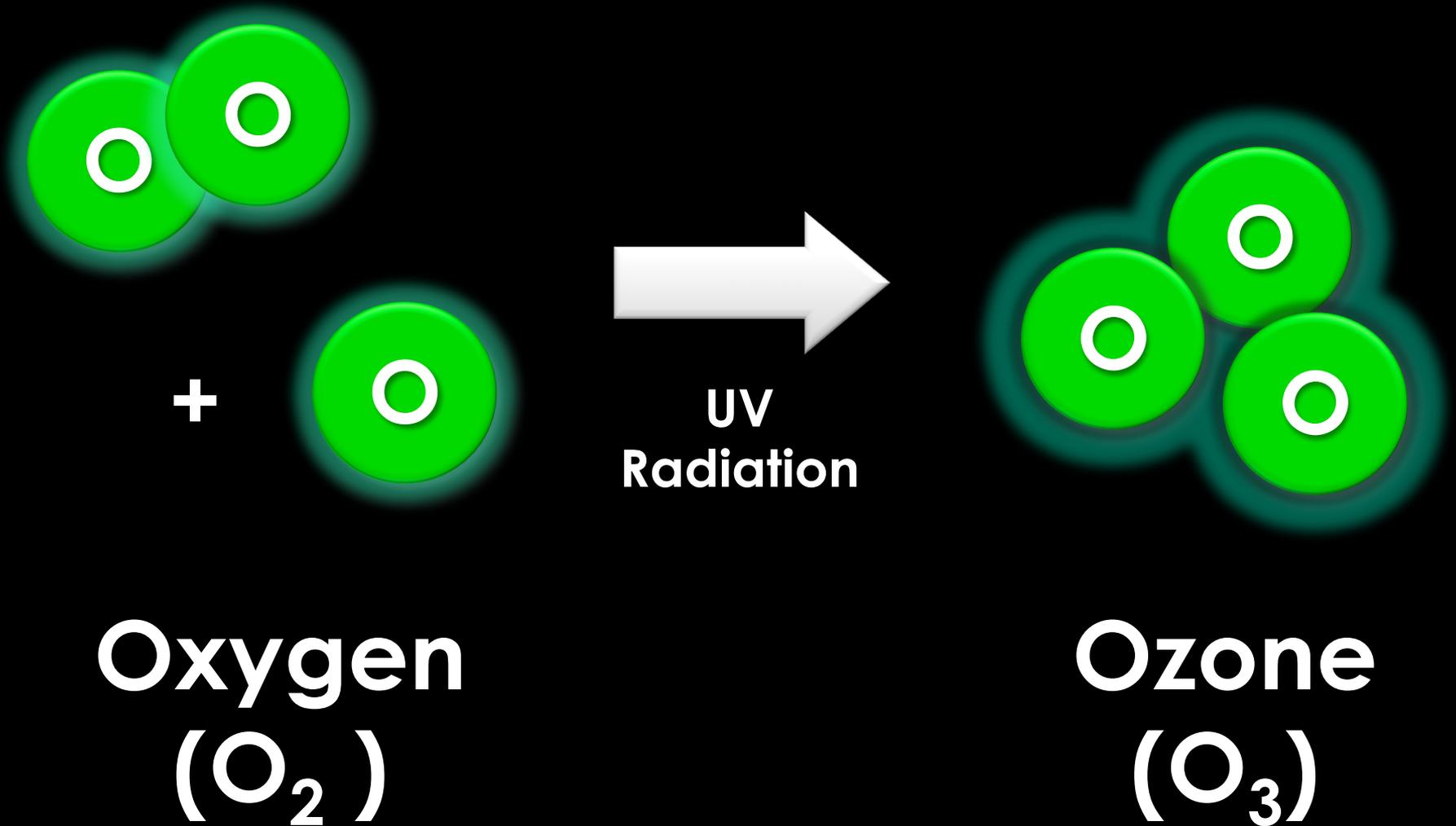
Excess O₂ in the atmosphere forms ozone (O₃).

The ozone layer blocks harmful UV radiation, causing plants to thrive even further.

CO₂ levels plummet.

O₂ levels rise even further.

Ozone Formation



Change #5

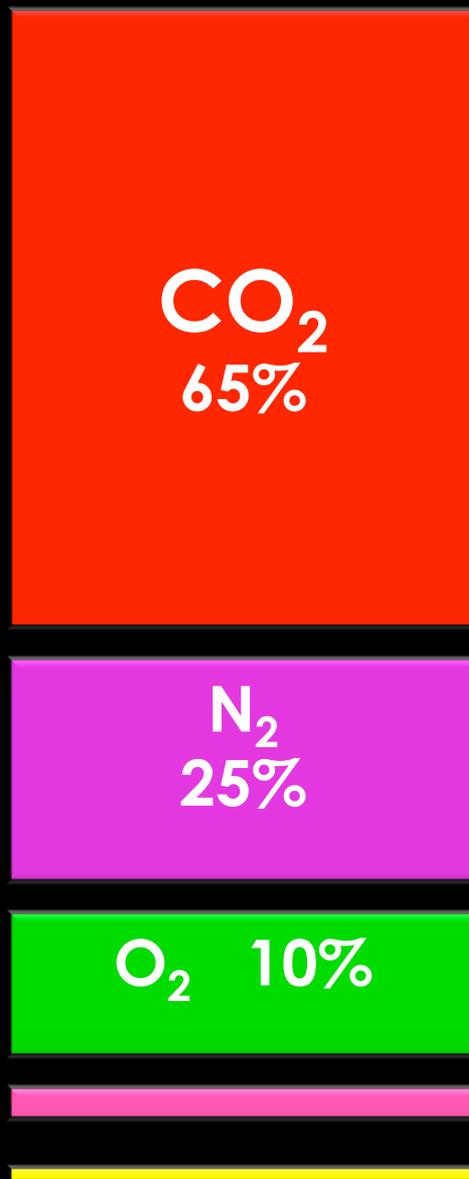
Denitrifying bacteria evolve.

These microbes break down dead organisms.

The decomposition process releases N_2 as a waste product.

N_2 levels rise rapidly.

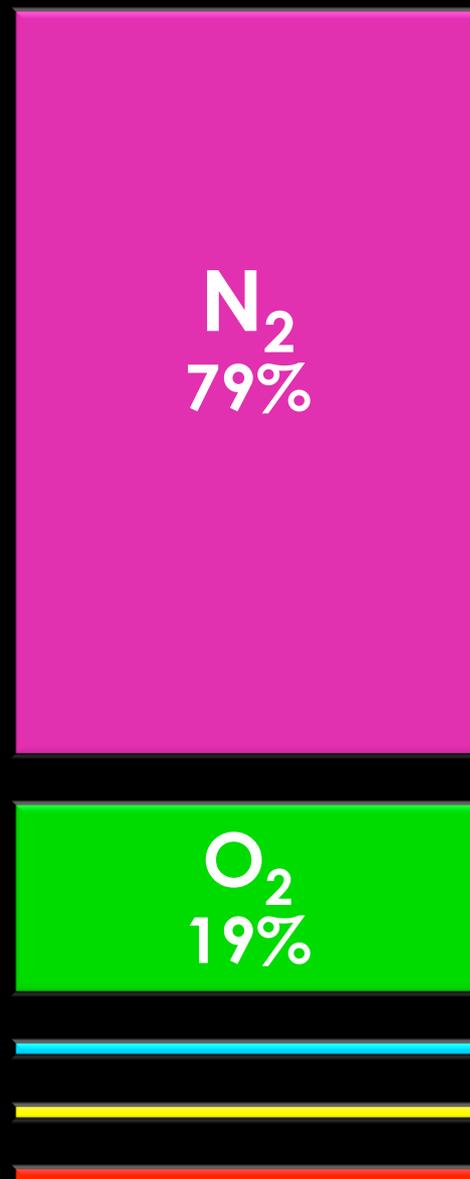
Early at "Half-time"



NH₃ <1%

CH₄ <1%

Current Atmosphere



H₂O <1%

CH₄ <1%

CO₂ <1%

The Future?

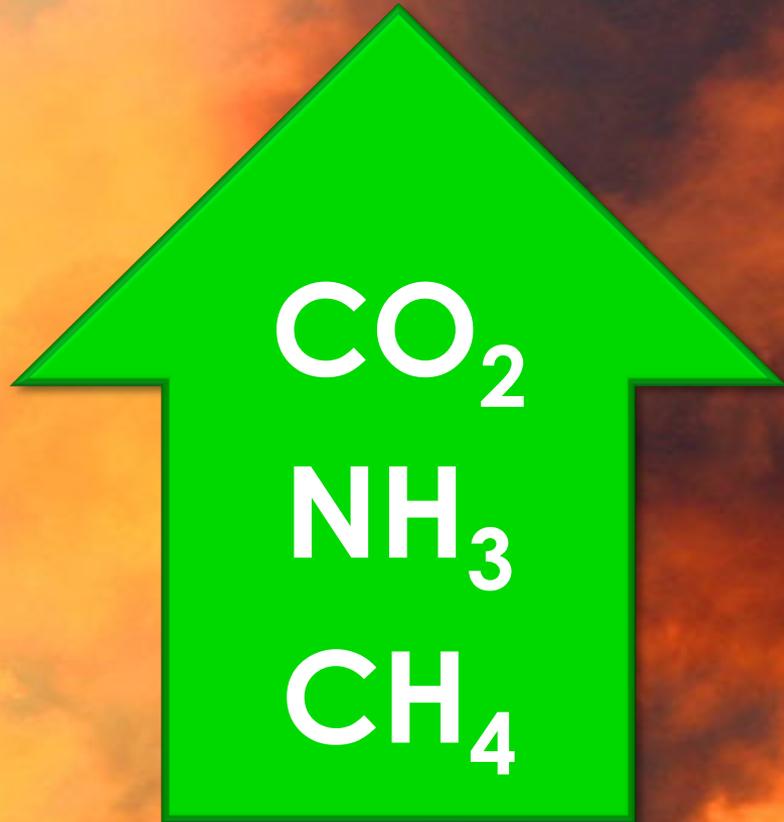
The atmosphere is changing even now.

CO₂ levels are rising again, and rapidly.

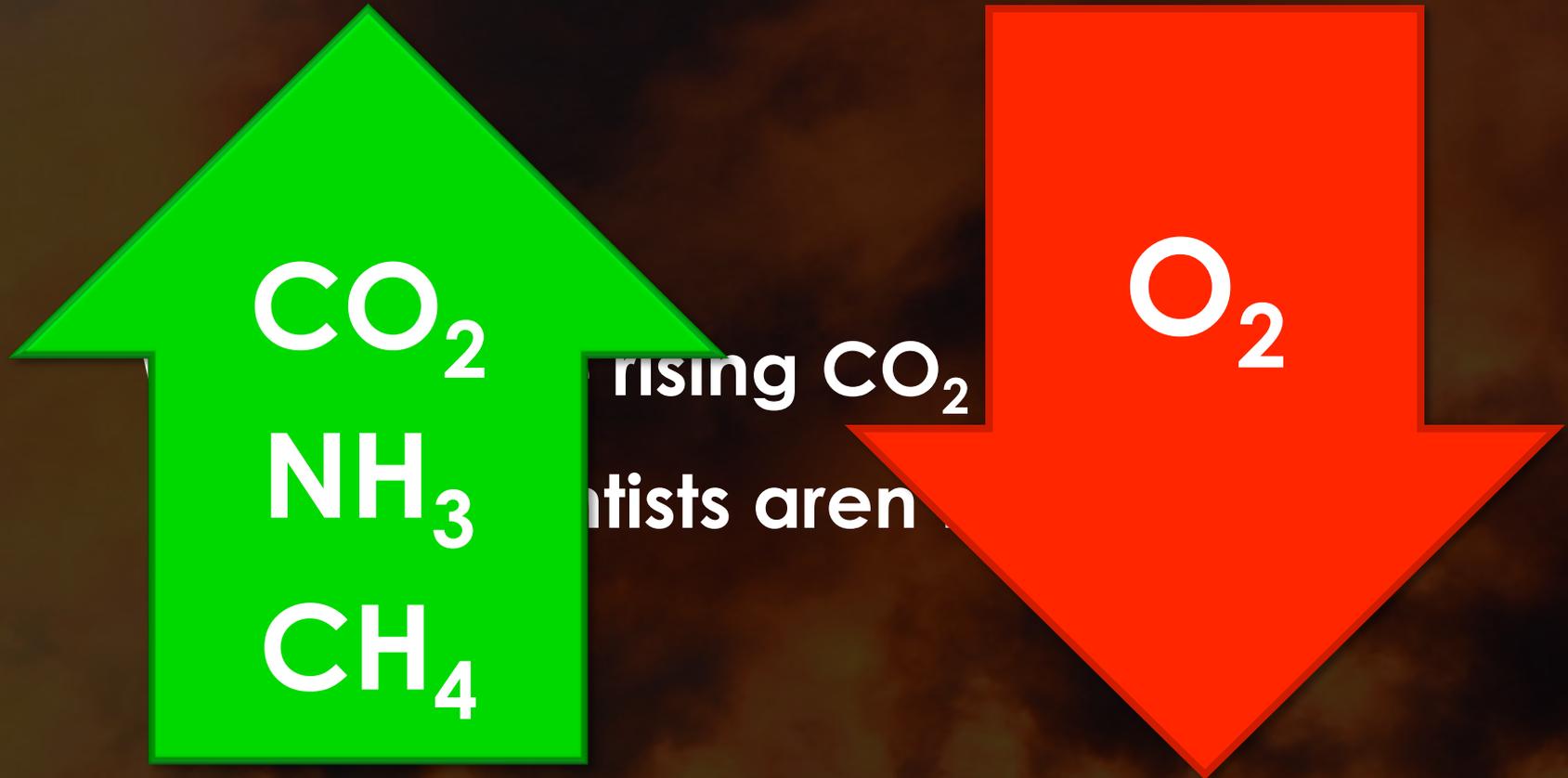
The increase in CO₂ is due to human activity such as burning fossil fuels and deforestation.

The rising CO₂ levels are contributing to the phenomenon called global warming.

The Future

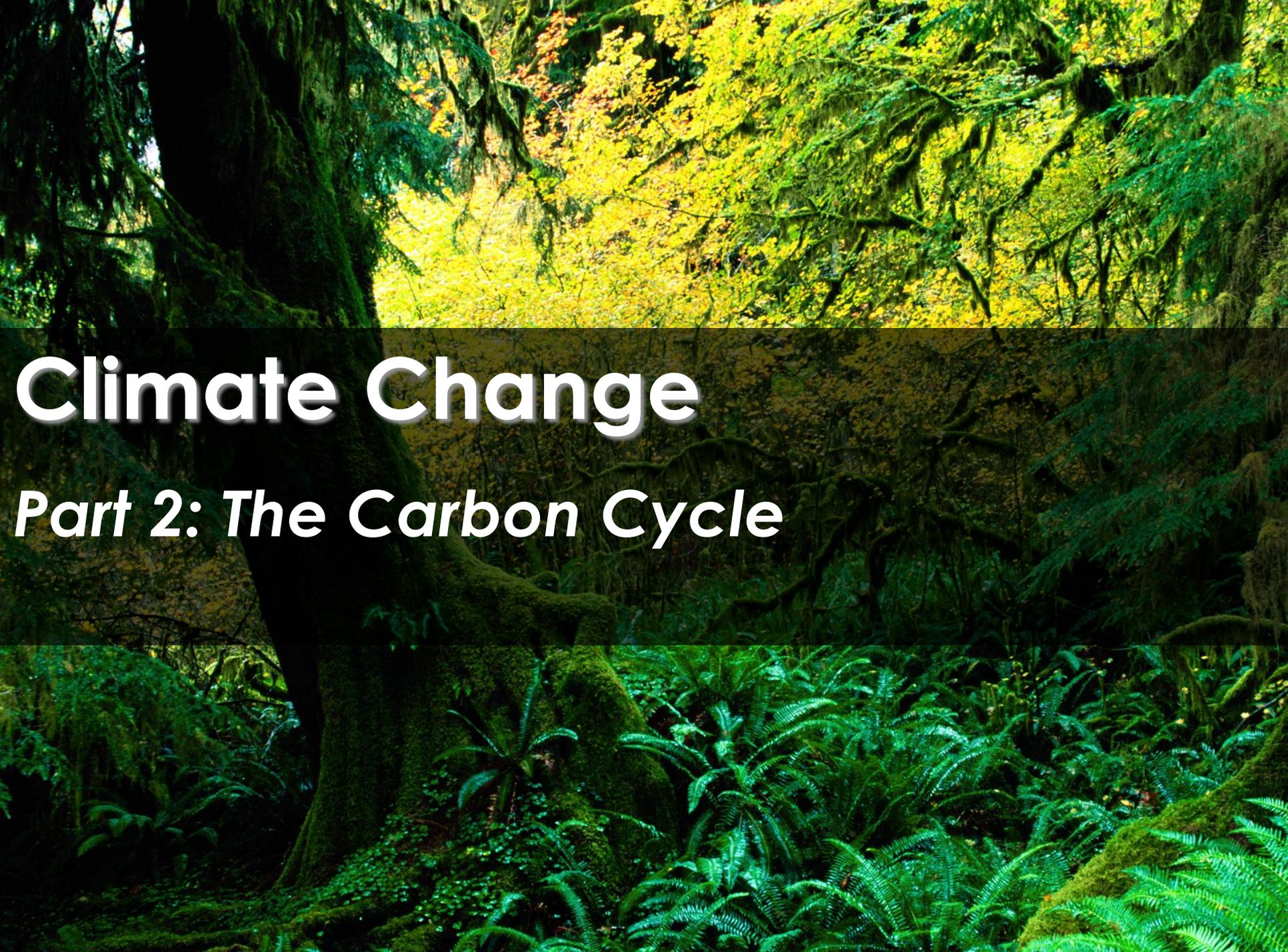


The Future



An aerial photograph of a coastline at sunset. The sky is a gradient of blue and orange, with the sun low on the horizon. The water is dark blue, and the land is a mix of green and brown. A dark, semi-transparent horizontal band is overlaid across the middle of the image, containing the text "Any Questions?".

Any Questions?



Climate Change

Part 2: The Carbon Cycle

Introduction

Carbon is the building block of all life on Earth.

Carbon is found in all living things, such as trees, fish, cells and DNA.

Carbon is also found in many non-living things, from rocks, soil, and atmosphere.

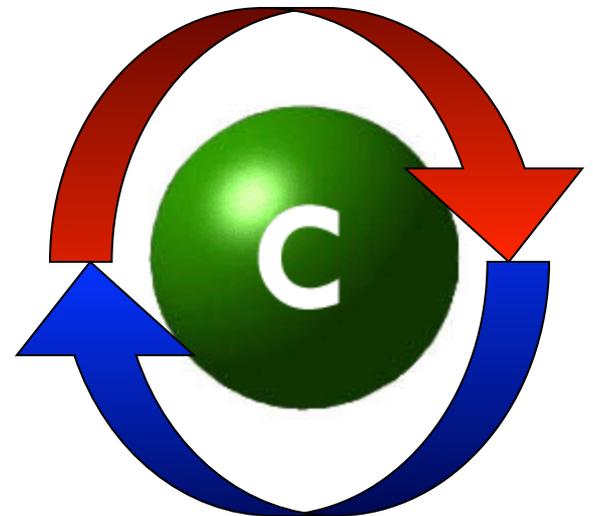
However, carbon is NOT the most common element on Earth. It is only the fourth!

Carbon Cycle

Carbon moves around in the carbon cycle.

The carbon cycle is a process where carbon atoms circulate on Earth.

The Earth's carbon is constantly changing from one form to another in an ongoing, natural process.



Carbon Sinks

Carbon can be either stored or released.

Carbon **SINKS** take out more carbon from the atmosphere than they put in.

e.g. plants performing photosynthesis.

Photosynthesis

Sugars / Starches

Oceans & Lakes

Forming Fossil Fuels

Carbon Sources

Carbon can be either stored or released.

Carbon **SOURCES** put in more carbon to the atmosphere than they take out.

e.g. animals performing respiration

Respiration

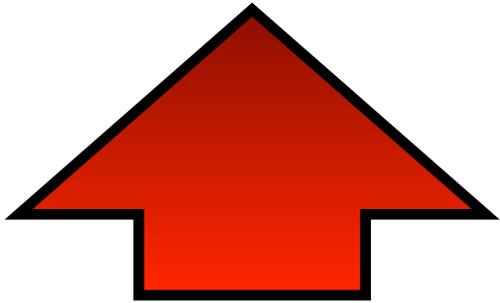
Decomposition

Deforestation

Burning Fossil Fuels

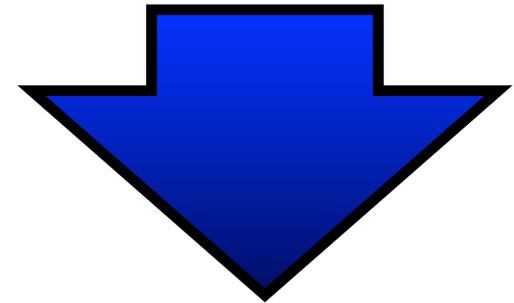
Biological Components

Carbon in the atmosphere



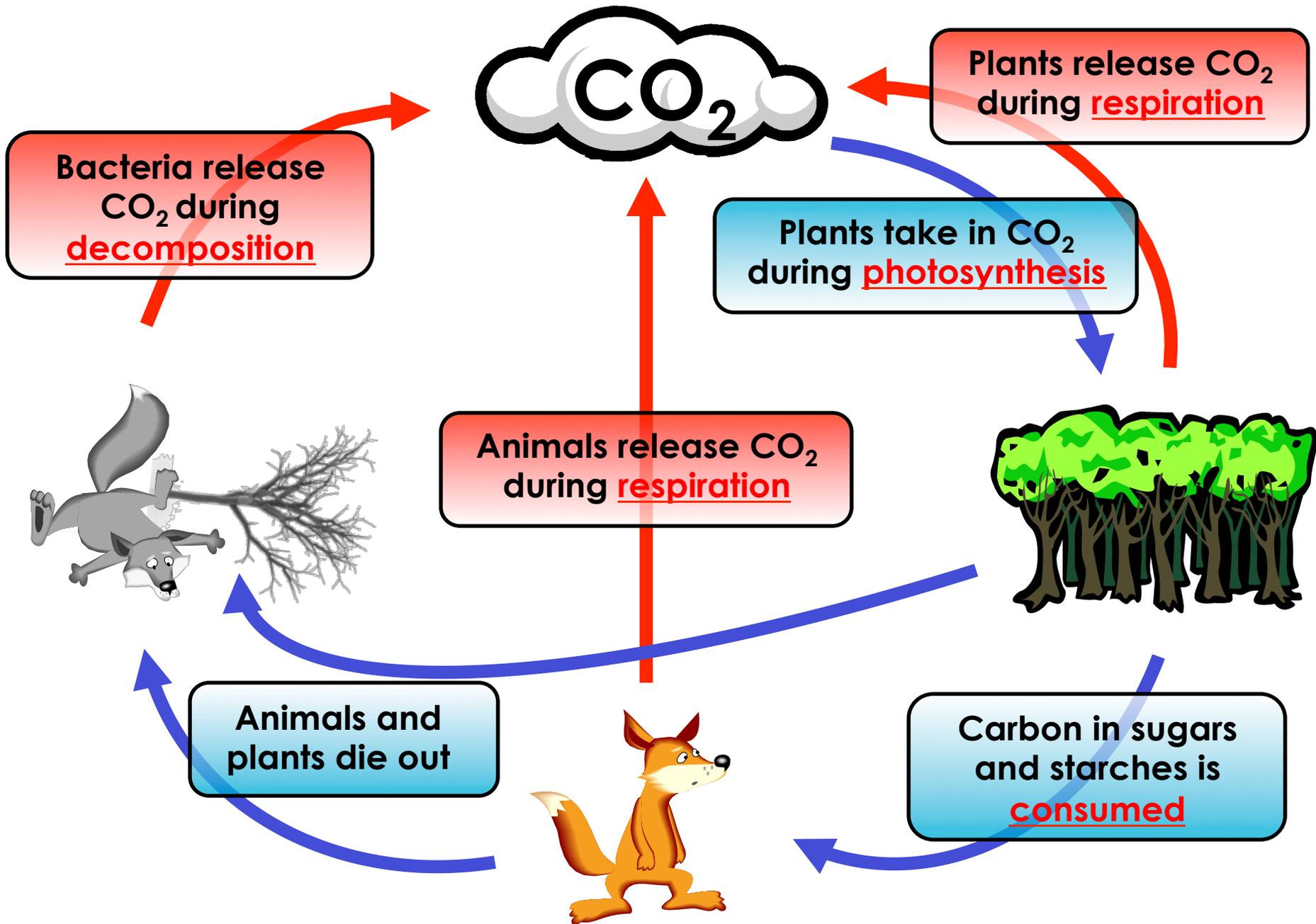
Respiration

Decomposition



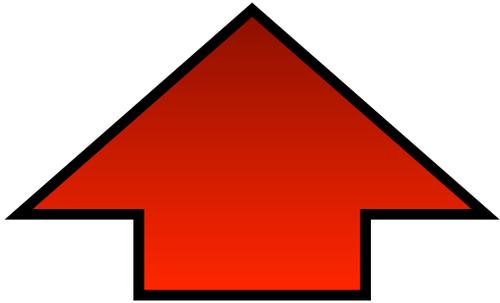
Photosynthesis

Stored in starches



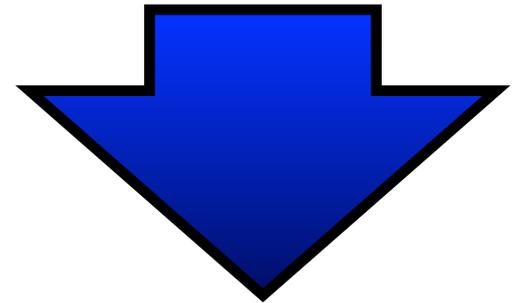
Biological Components

Carbon in the atmosphere



Respiration

Decomposition

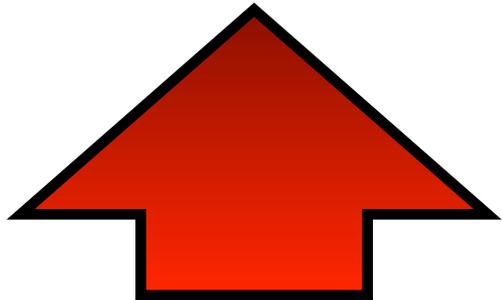


Photosynthesis

Stored in starches

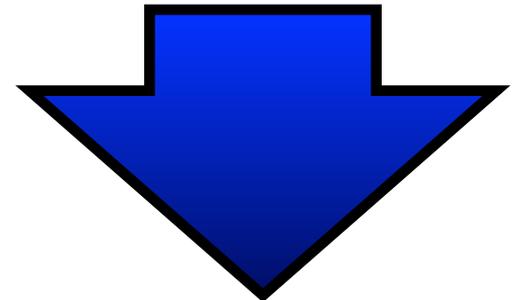
NonBiological Components

Carbon in the atmosphere



Deforestation

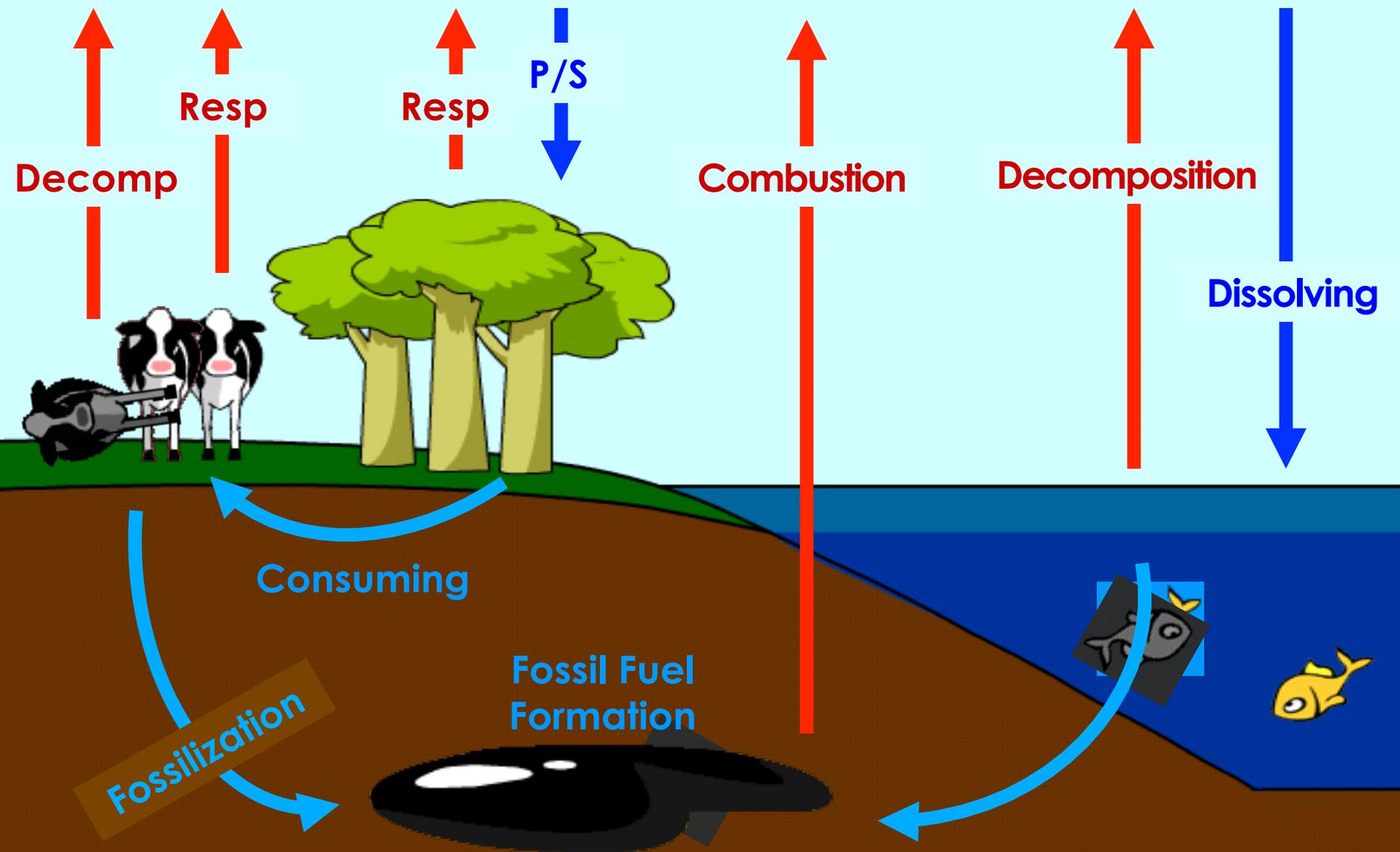
Burning Fossil Fuels



Oceans and Lakes

Forming Fossil Fuels

Carbon in the atmosphere





Any Questions?



Climate Change

Part 3: The Greenhouse Effect

Introduction

Earth is warmed by the **Greenhouse Effect**.

The Greenhouse Effect is a natural process that has been around for billions of years.

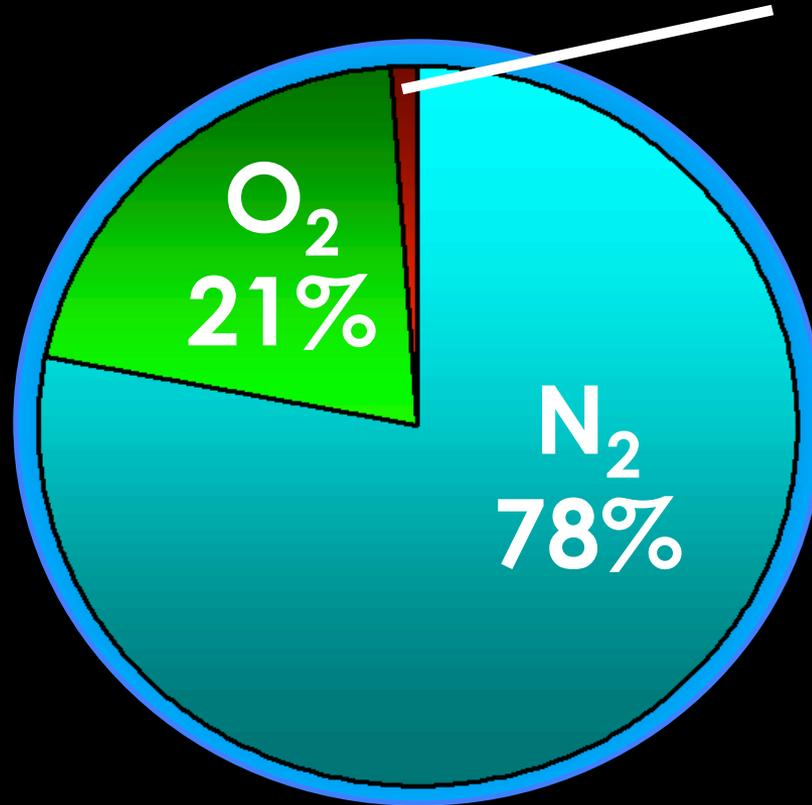
Without it, the Earth would be
33°C cooler, creating an
average temperature of -18°C!

This would kill most life on Earth!





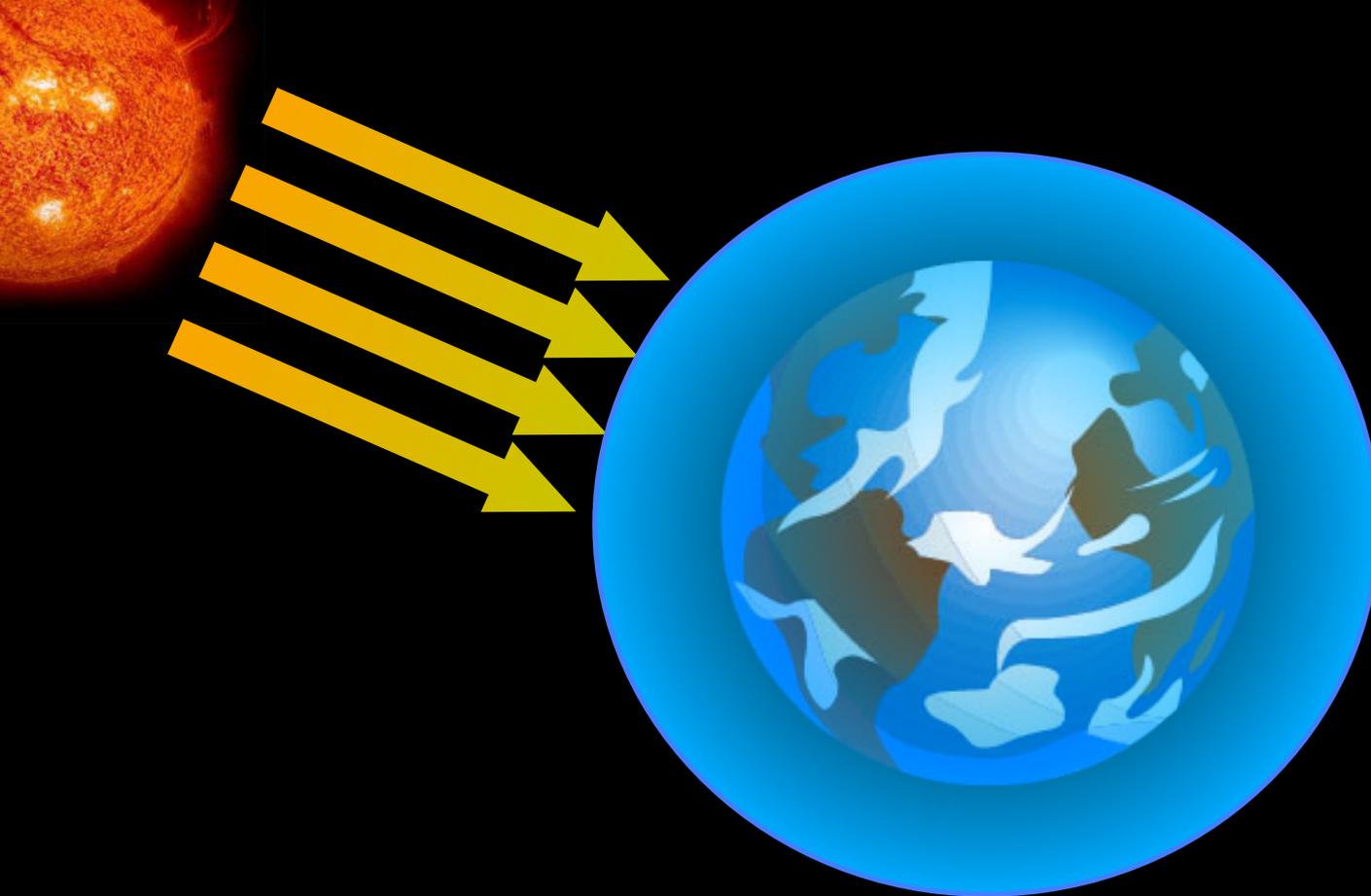
The Earth is surrounded by a layer of gases called the atmosphere.



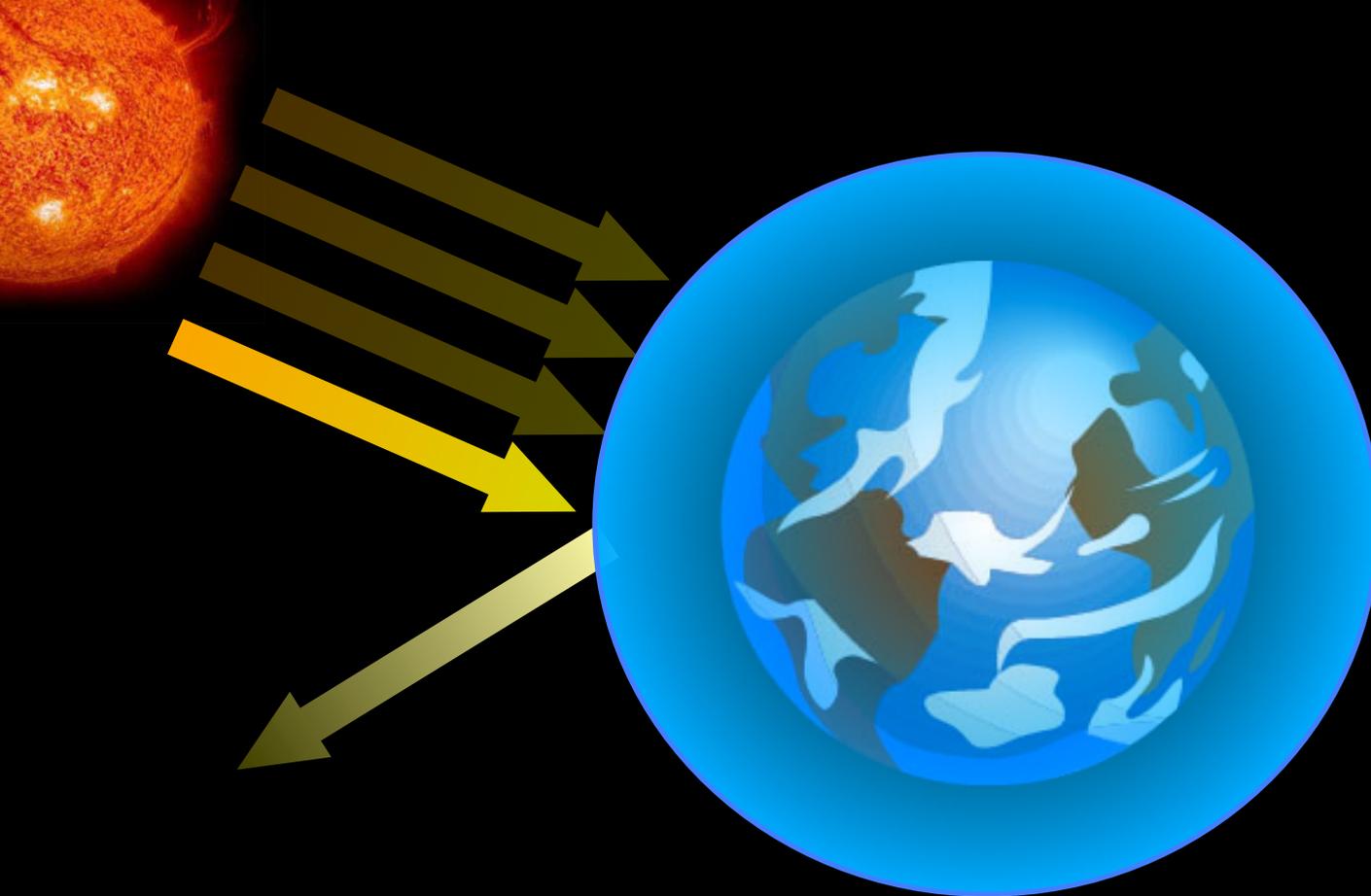
Greenhouse
Gases 1%



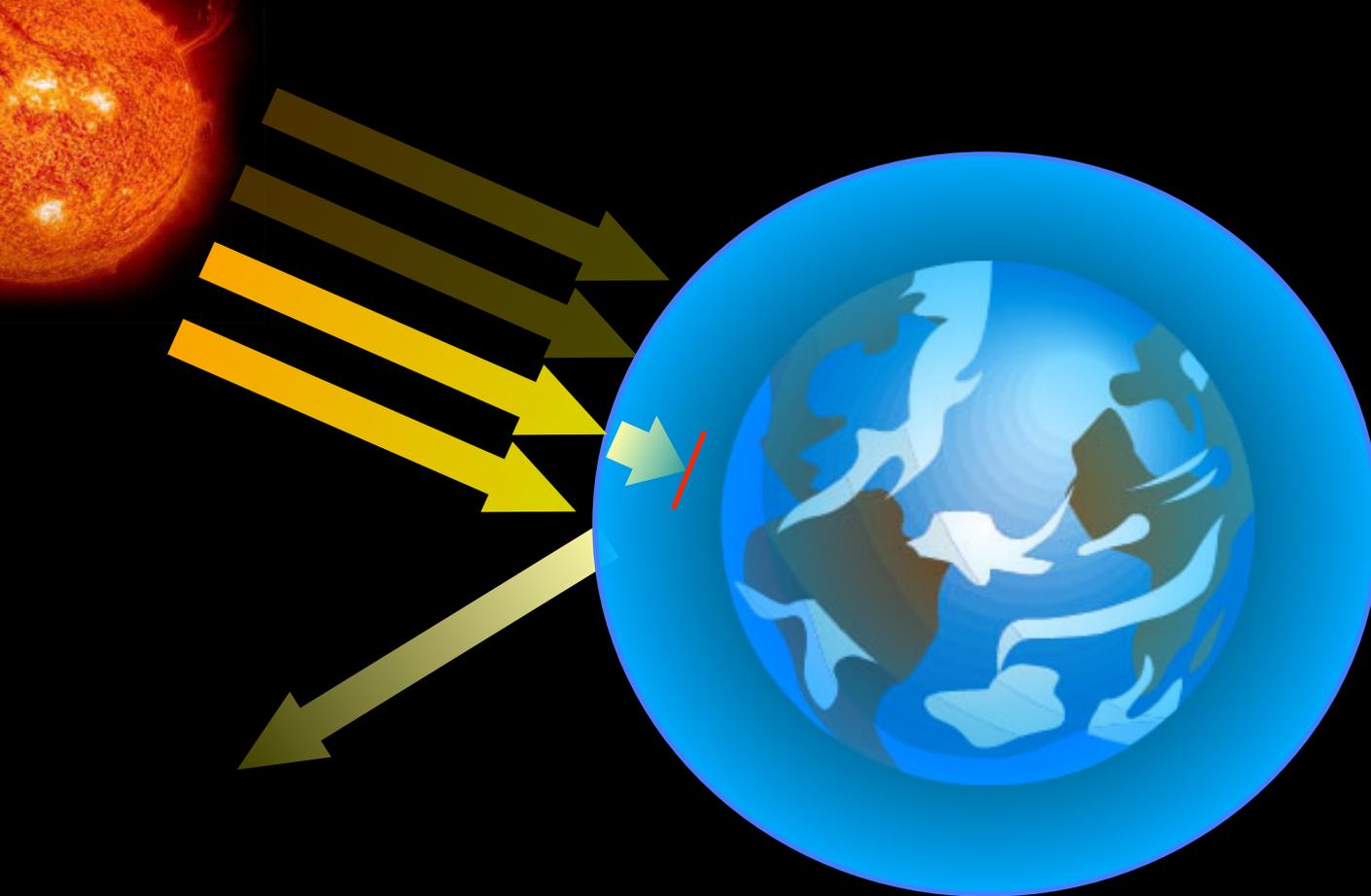
99% of the atmosphere is O_2 and N_2 . The other 1% is made of greenhouse gases.



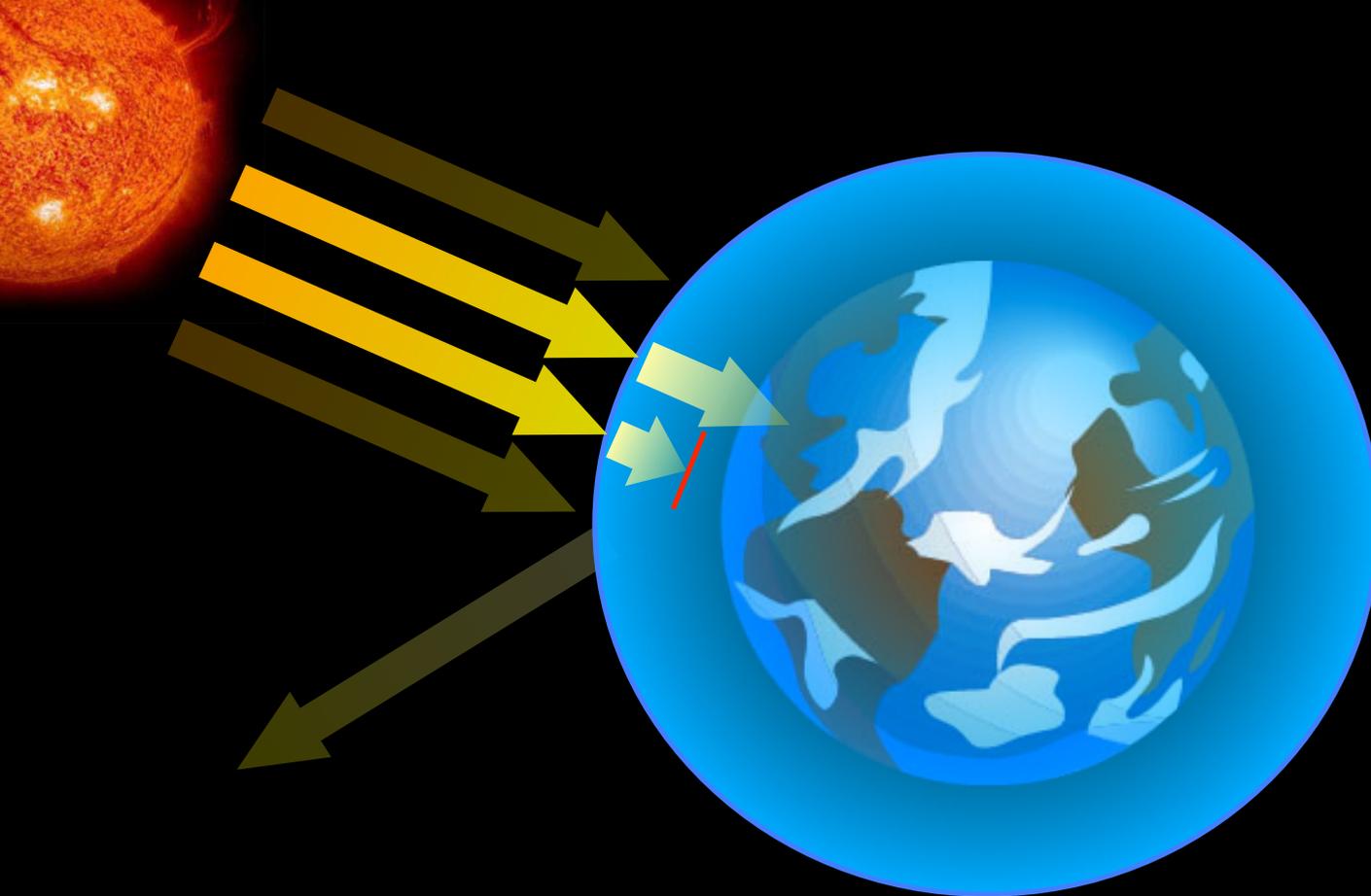
**Rays of sunlight (light and heat energy)
shine down on the Earth every day.**



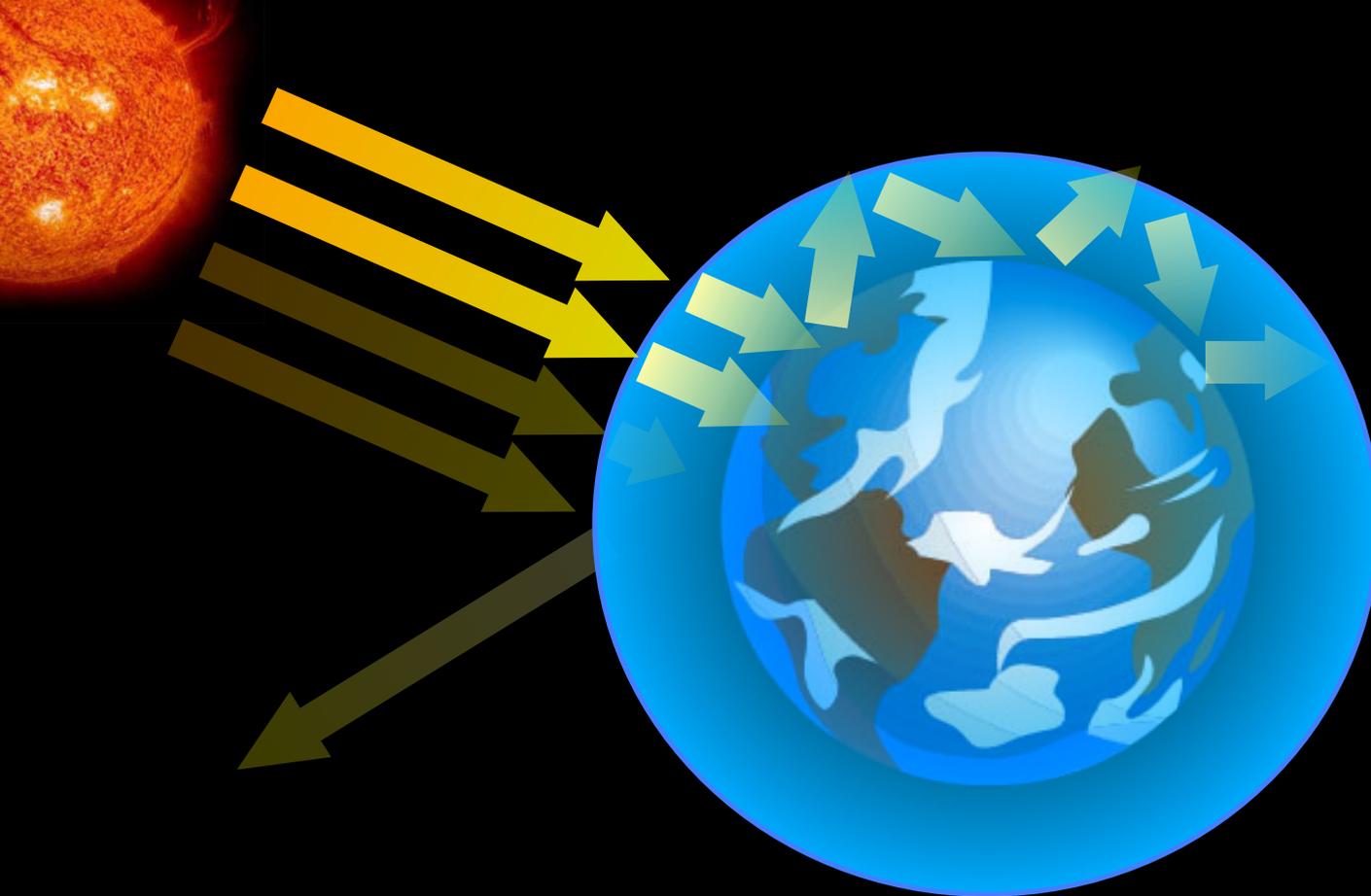
Some of the rays are reflected off the atmosphere and back into space.



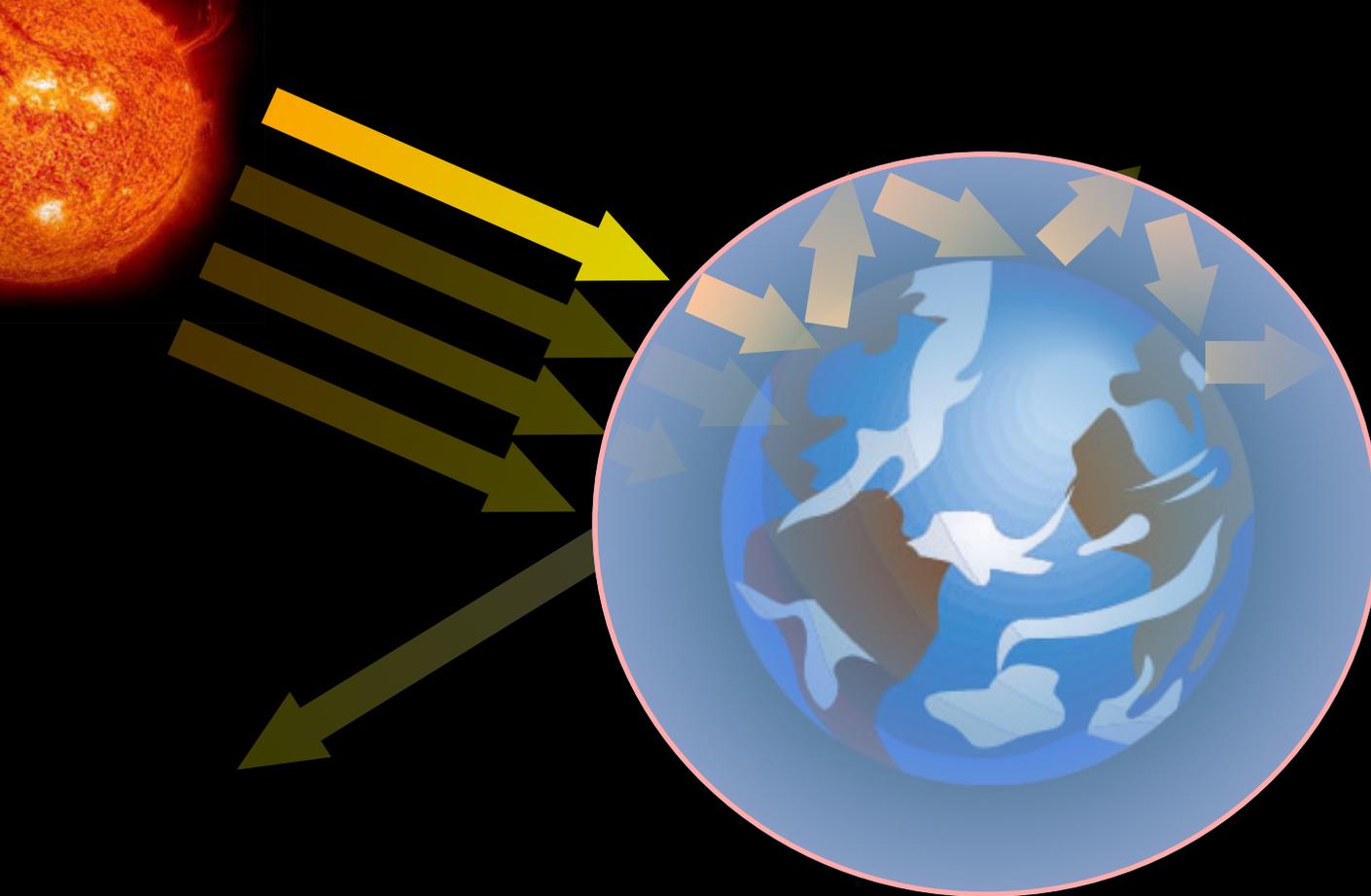
Some of the rays are absorbed by molecules in the atmosphere.



Some of the rays reach the Earth and turn into heat. Much of it is absorbed by Earth.



A small amount this heat energy is reflected back into the atmosphere.



This trapped heat is what warms the Earth.
This is called the Greenhouse Effect.

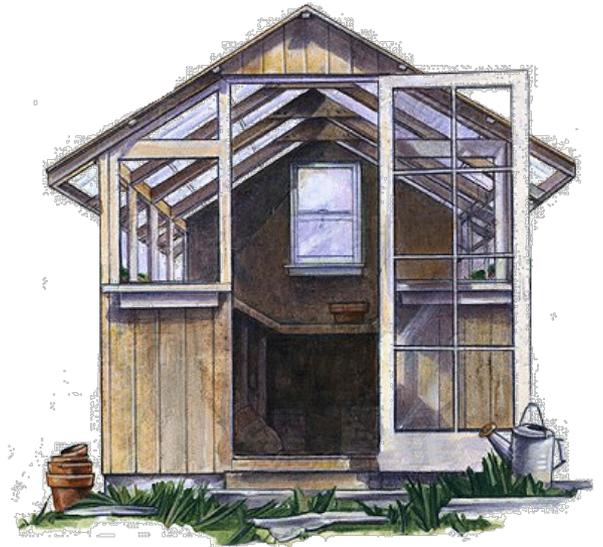
The Greenhouse Effect

Earth is warmed by the Greenhouse Effect.

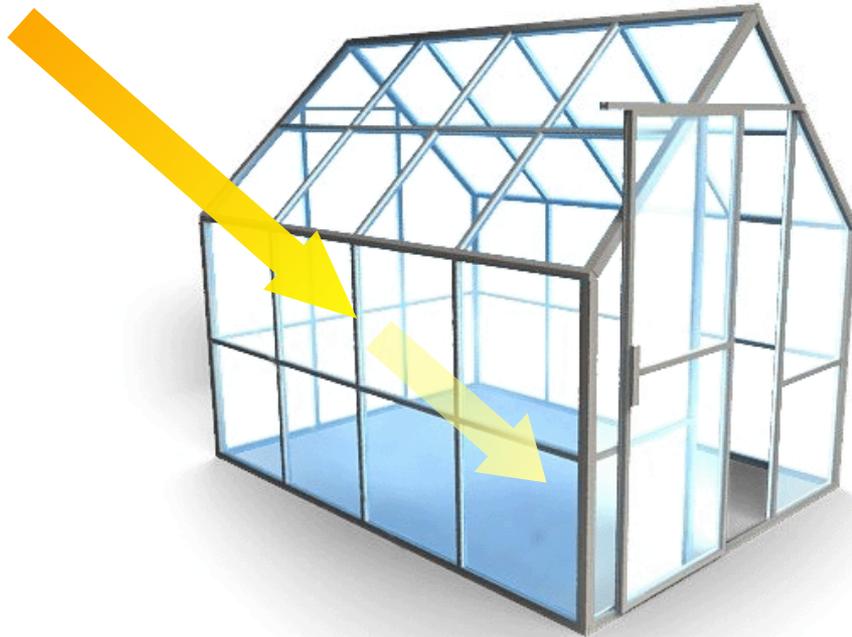
The Greenhouse Effect is the trapping of heat energy by the Earth's atmosphere.

It is called thus because it acts like a real greenhouse.

Greenhouses allow us to grow plants in cold weather...

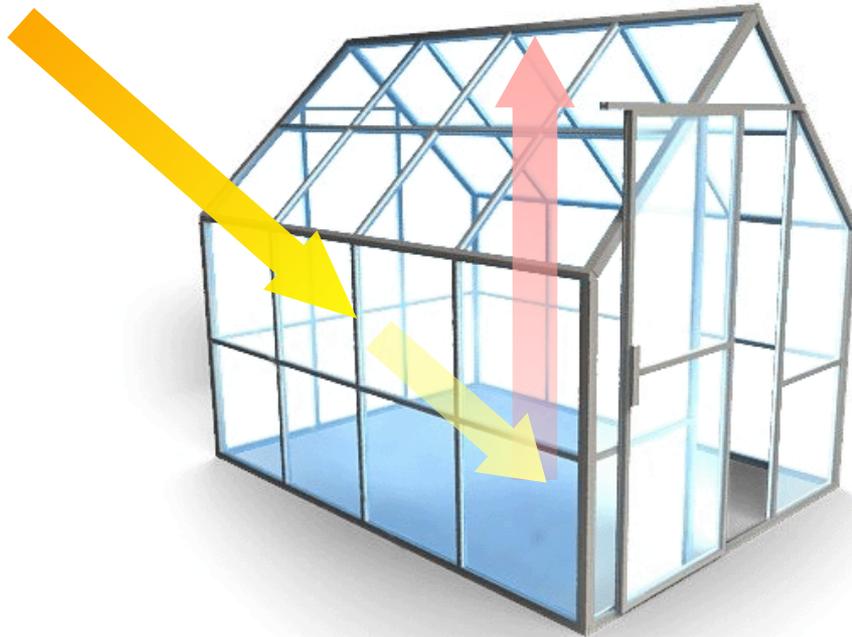


The Greenhouse Effect



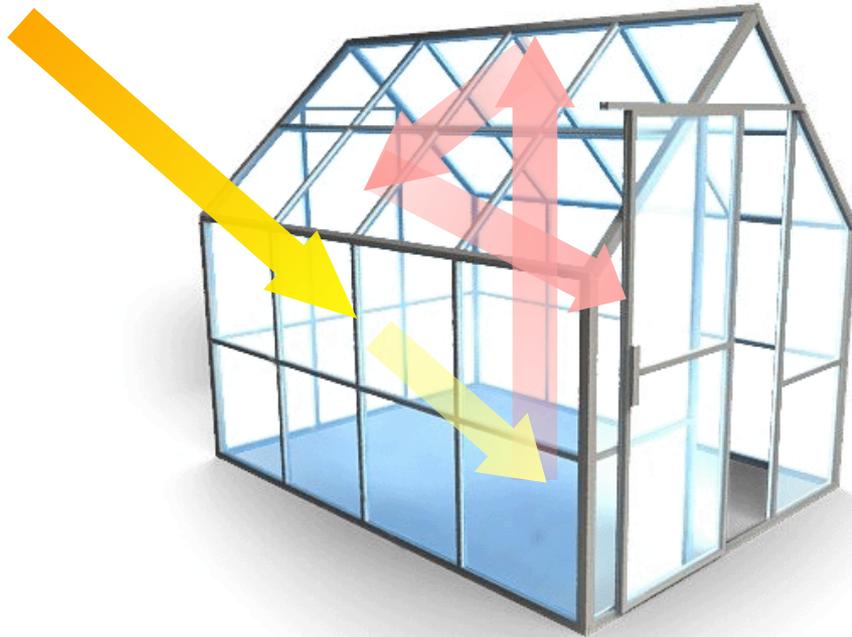
The glass of the greenhouse lets the sunlight in (light energy).

The Greenhouse Effect



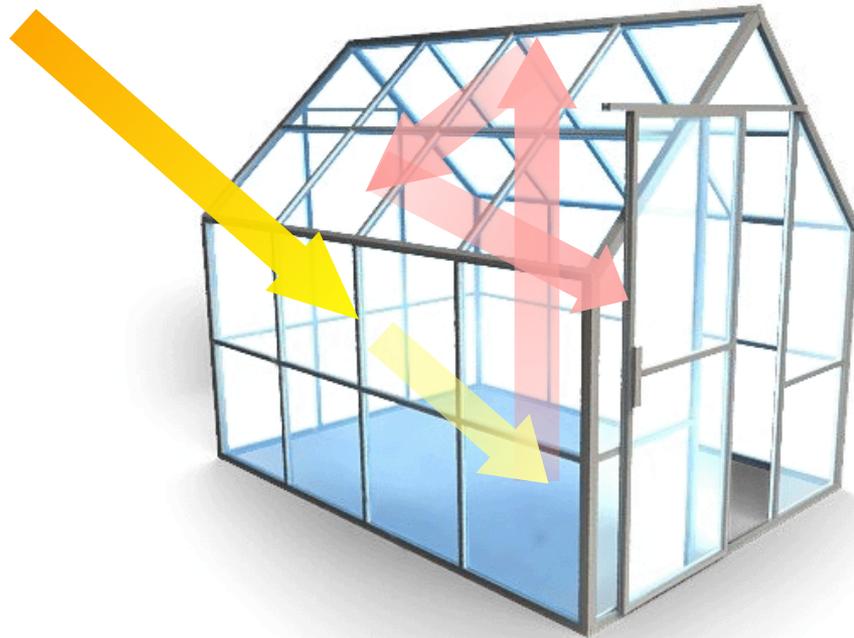
The sunlight turns to heat energy when it hits objects inside the greenhouse.

The Greenhouse Effect



The heat can't escape through the glass and becomes trapped inside.

The Greenhouse Effect



Feelin' hot!



This trapped heat keeps the greenhouse warm, even during the winter!

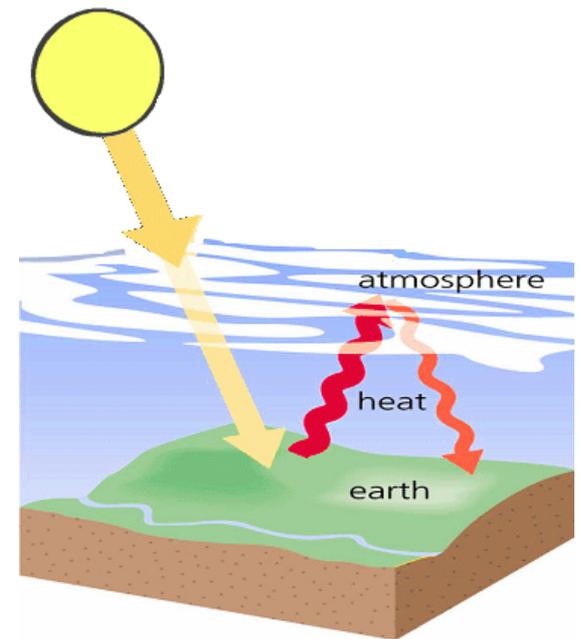
The Greenhouse Effect

Greenhouse gases cause the Greenhouse Effect.

Greenhouse gases in the atmosphere act like the glass panes in a greenhouse.

These gases are good at absorbing heat energy and sending it back to Earth.

These gases are mostly carbon dioxide and methane.



Climate Change

Our Earth is getting warmer.

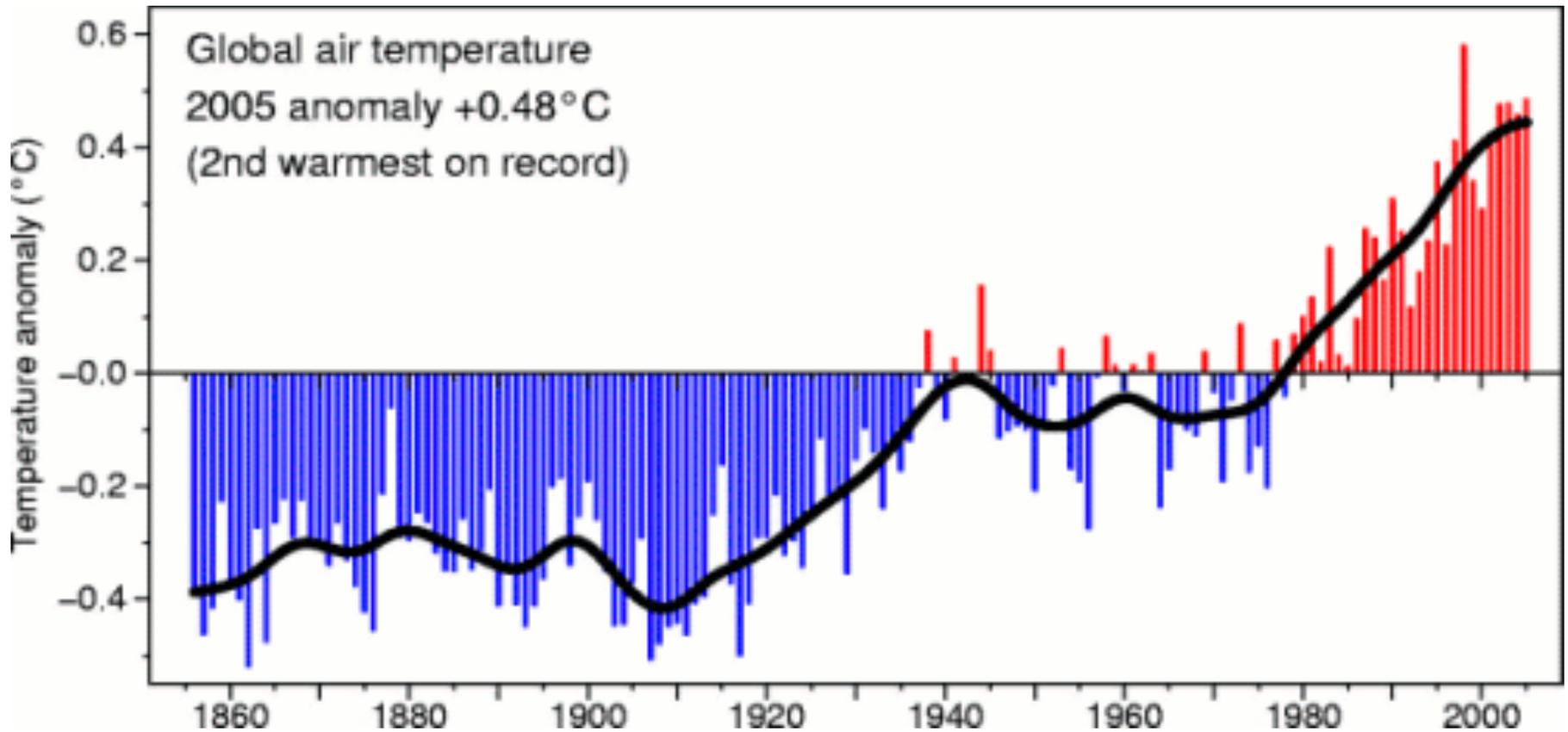
Scientists think that this is being caused by an increase in greenhouse gases.

The increase in gases (especially CO₂) traps more heat, causing the average temperature to rise.

This phenomenon is called climate change.



Climate Change



Human Intervention

Human activity is causing climate change.

We are doing many things that increase greenhouses gases in the atmosphere.

Let's look at several of these...

Cause: Burning Fossil Fuels

The burning of fossil fuels, such as oil, coal and natural gas, releases large amounts of CO₂. Greater amounts of fossil fuels are burned every year.

Cause: Vehicle Emissions

Exhaust from cars, airplanes and other vehicles contains CO₂ and other greenhouse gases. These enter the atmosphere and trap heat.

Cause: Burning Rainforests

When large areas of rainforest are burned, it releases huge amounts of CO₂. Every second of the day, 1 1/2 acres of rainforest is cut and burned.

Cause: Trapped Heat

With an increase in CO₂ more heat gets trapped in the atmosphere. As the planet warms, even by a fraction of a degree, major changes occur.

Cause: Thawing Permafrost

Arctic plants don't decompose when they die, but remain frozen in permafrost. With melting permafrost, plants decompose more, releasing CO₂ into the atmosphere.

Cause: Fewer Plants

Plants use CO₂ for photosynthesis. With fewer plants, less CO₂ is removed from the atmosphere.



Effect: Hotter Temperatures

Effect: Changing Ecosystems

Effect: Severe Weather

Effect: Extinctions

Heat Waves

Drought

Wildfires

Floods

Tornadoes

Hurricanes

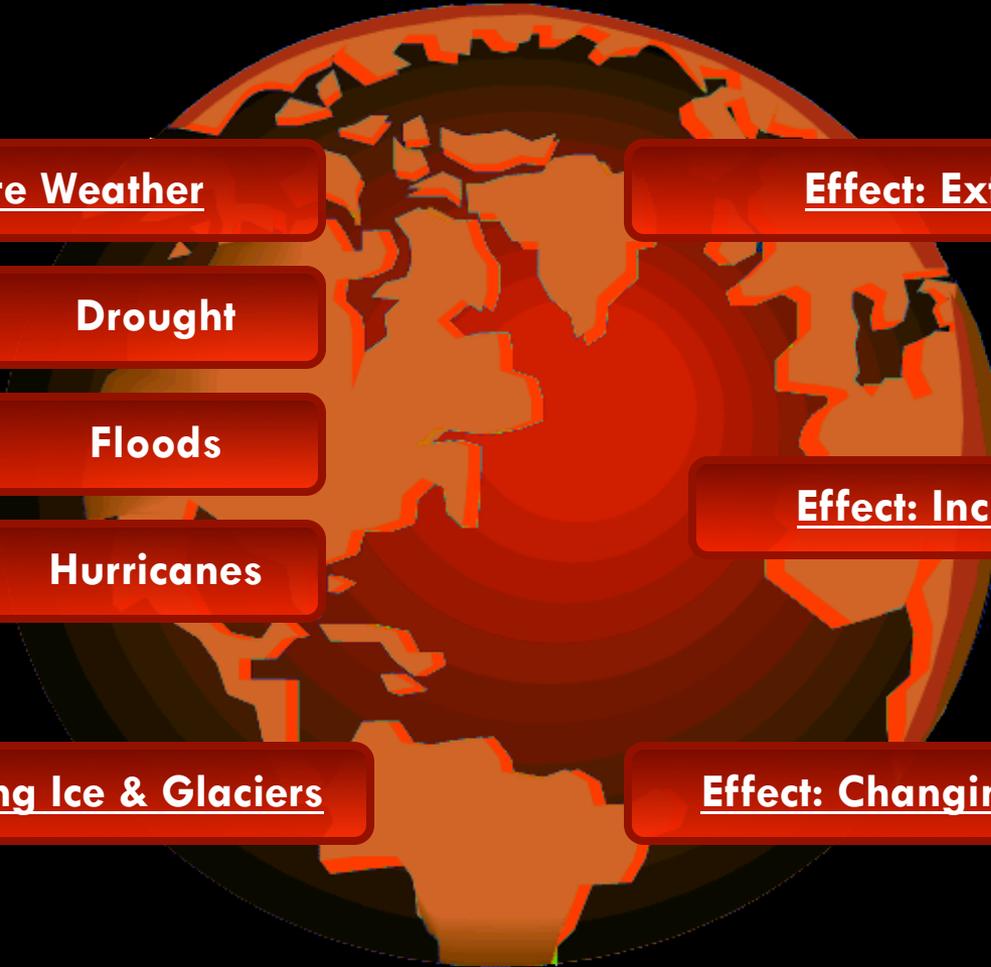
Effect: Increased Disease

Effect: Melting Ice & Glaciers

Effect: Changing Economies

Effect: Rising Sea Levels

Effect: Human Migrations





Any Questions?