St Benedict's
Journal of Science
including the
History & Philosophy of Science

Volume 7, No2; December 2022

St Benedict's
Catholic School

The Catholic Secondary School for West Suffolk

Editor-in-Chief: Mr J Gregory
Associate Editors: Ms E Coogan, Mr F Sousa and Miss A Dalby

Published by the Science Department, St Benedict's Catholic School, Bury St Edmunds, Suffolk, UK

Welcome to the second edition of the 7th volume of the Journal of Science.

The first edition, published in November, was a special edition to showcase the work in Physics and Chemistry of our 6th Form scientists. This second edition has work from our year 9 and 10 students on topics in Chemistry and Biology.

Ms E Coogan, Teacher of Chemistry, provides the following comment regarding the work produced by her Year 9 and 10 chemistry students:

"Yr9 have been studying the Earth 2 module in their Ms Coogan Science lessons. Part of this module is investigating the contribution that natural and human chemical processes make to our carbon dioxide emissions. Students produced a poster to use a diagram to show how carbon is recycled in the environment and through living things. This allowed us as a class to then compare the relative effects of human-produced and natural global warming. We had quite a heated debate on the question 'can we live without fossil fuels?' as part of us evaluating the implications of proposals to reduce carbon emissions. This class have been excellent during this topic, really engaging with the subject matter, from measuring the trees around our school site to calculate the carbon sequestration, to considering what our planet would be like without an atmosphere. I hope you enjoy seeing the work produced by 9x1 they work hard and consistently go above and beyond with their effort and it is fitting that you get to see their work in the St Benedict's Journal of Science.

Yr10 have been studying structure and bonding as part of their GCSE chemistry syllabus. To deepen their understanding and encourage independent research the students had to design and produce a poster on giant covalent structures, students were encouraged to research structures away from the specification of allotropes of carbon, as you will see some students found information on Silica, a crystalline structure similar to diamond. I am delighted to see so many hand-drawn diagrams detailing the covalent bonding and the intermolecular forces. I am also delighted to see the detail that students went into regarding some examples of nanoparticles. Chemical bonding is notoriously challenging for students, this yr10 class have risen to the challenge, completing the unit for the majority with very good mid-term assessments. They really seemed to enjoy the London fashion week link where we paused to move away from the syllabus to look at spray on fabric – the applications of this aspect of science in astonishing."

Miss A Dalby and Mr F Sousa, Teachers of Biology, comment on the work their Year 9s did to research the roles of various people in the discovery of the structure of DNA:

"In recent lessons, our year nines have been exploring the wonder that is DNA. 'The secret of life' as expressed by Watson and Crick, the controversial Nobel Prize winners for the discovery of the structure of DNA. But as the year nines recently explored with guidance from Mr Gregory, who was actually responsible for the ground breaking discovery? Was it the "Girl from Notting Hill?

In these published articles, the year nines explore Rosalind Franklin's role in the discovery of the structure of DNA and how the role of women in STEM has changed throughout the years. Rosalind left this world happy with her substantial work with viruses but she may have had more of a role in the "secret of life" than she realised. Please enjoy reading our year nine work and consider who you think had the greater role."

CONTENTS

EDITOR'S NOTE: Regarding posters, it is almost impossible to convey the full visual impact of a poster when it is reproduced in an A4 journal. Where it has been thought best to publish an image of the original poster, this has been done. In other cases the information and images on the poster have been transcribed, as the published work will still reflect the hard work and thought of the author.

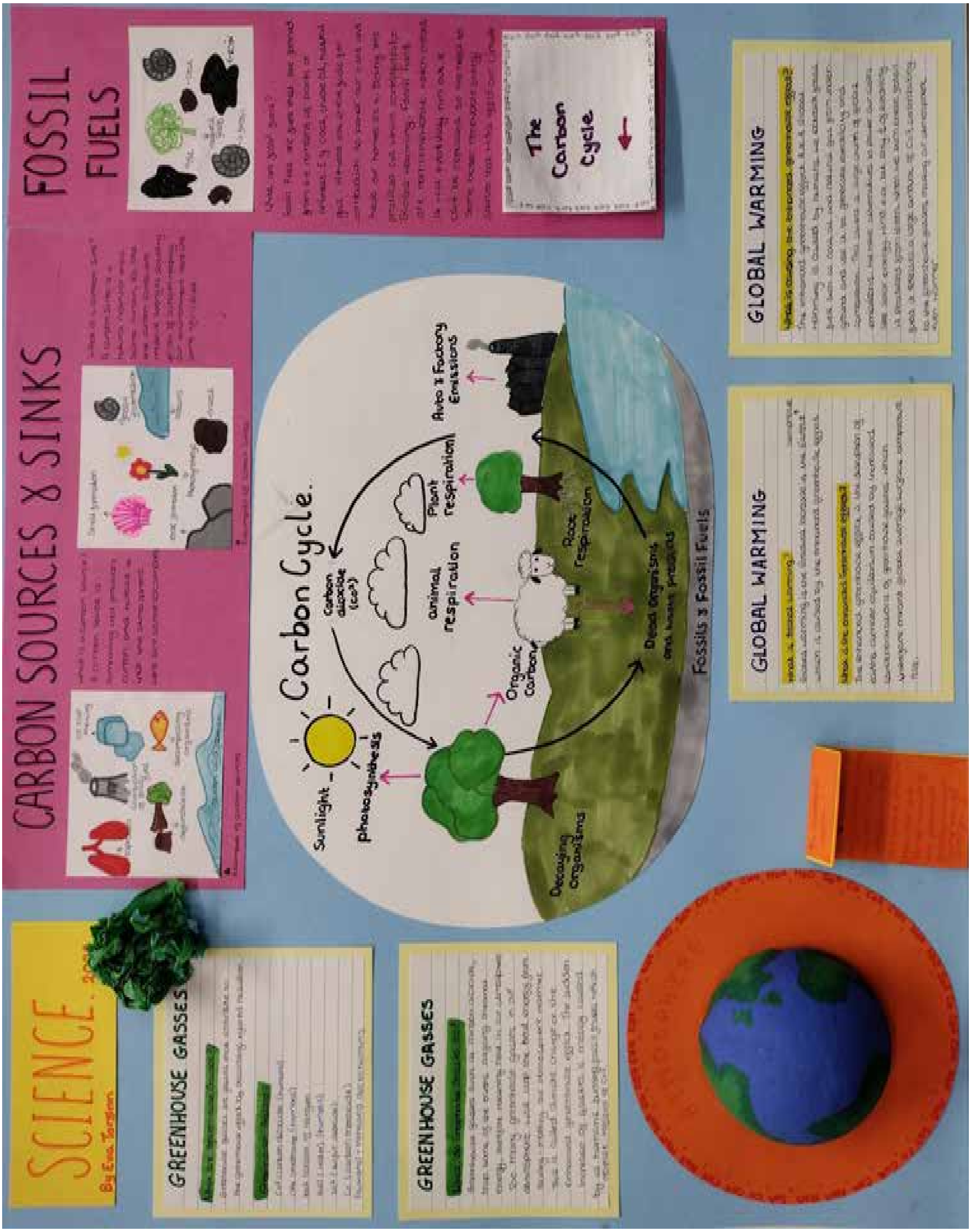
Year 9 POSTERS – THE CARBON CYCLE

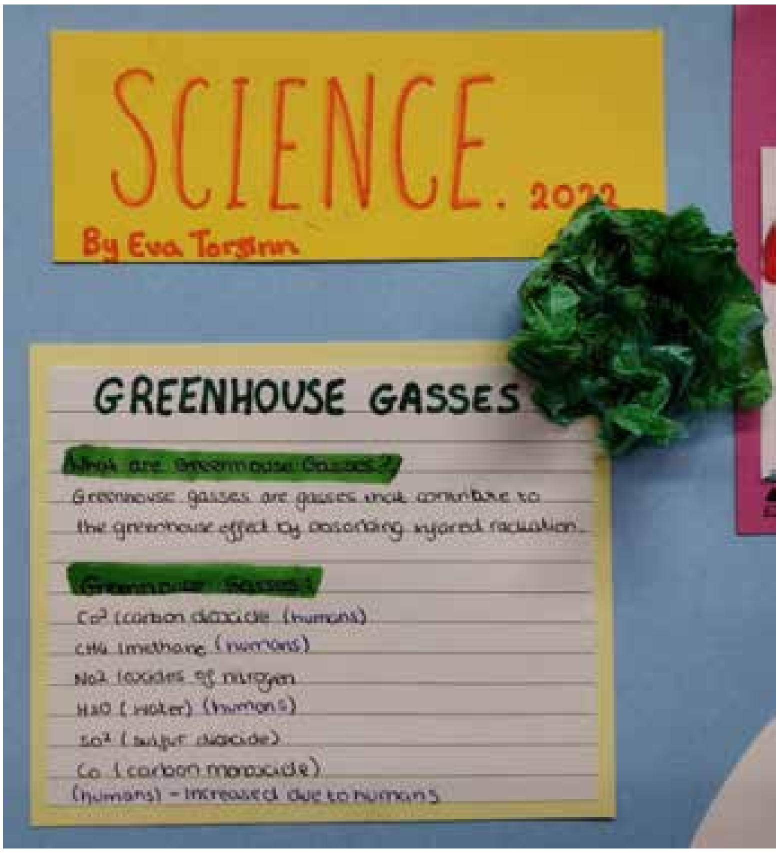
Year 9 - A HISTORY OF DNA

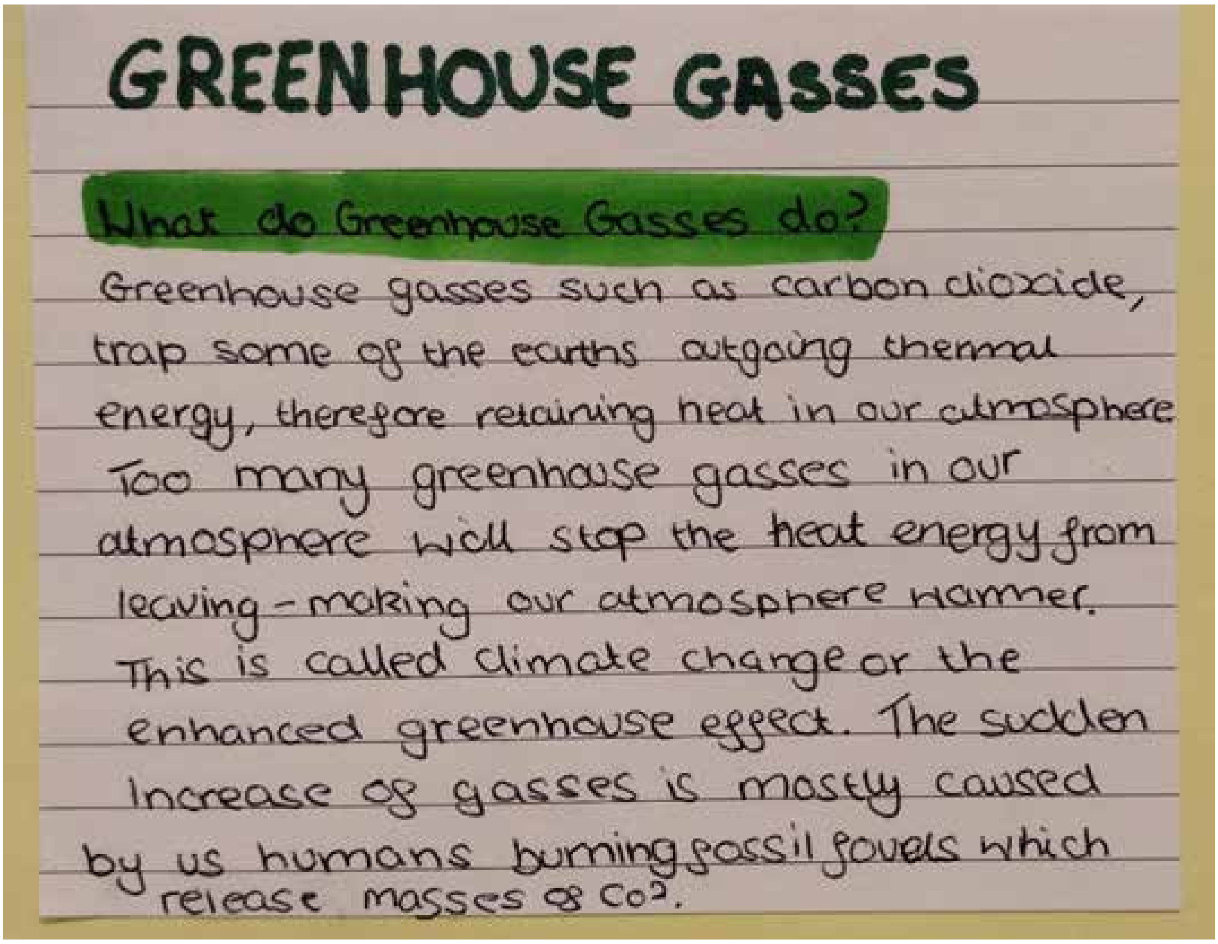
Year 10 POSTERS – GIANT COVALENT STRUCTURES

EDITORIAL INSERTS

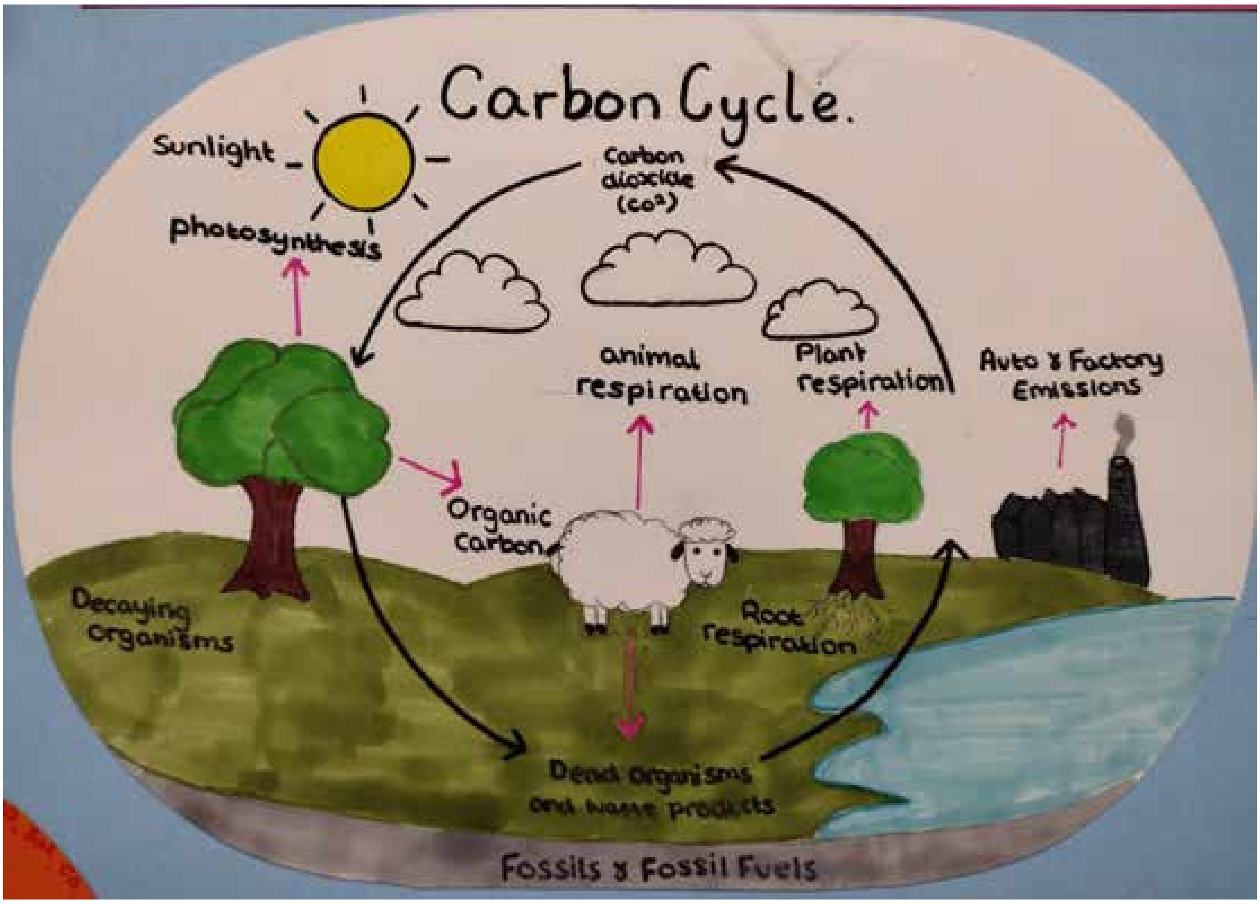
EVA TORFINN

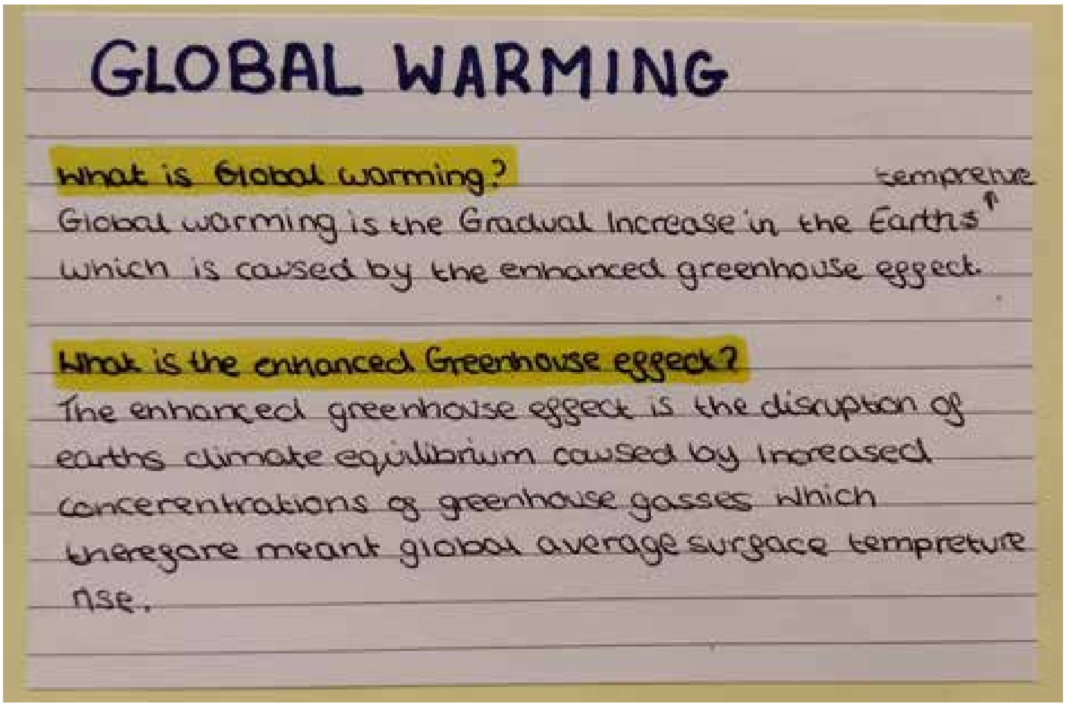

CARBON SOURCES & SINKS
FOSSIL FUELS
The Carbon Cycle
Carbon Cycle.
Sunlight
photosynthesis
Carbon dioxide (co²)
animal respiration
Plant respiration
Auto & Factory Emissions
Organic Carbon
Root respiration
Dead Organisms and waste products
Decaying organisms
Fossils & Fossil Fuels
GLOBAL WARMING
GLOBAL WARMING
SCIENCE
By Eva Torfinn
GREENHOUSE GASSES
GREENHOUSE GASSES

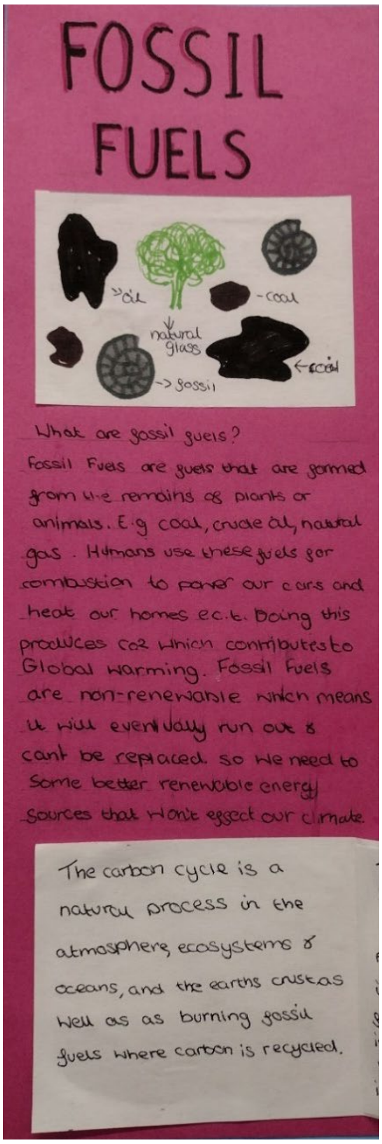

SCIENCE. 2022
GREENHOUSE GASSES
Co2 (carbon dioxide (humans)
Co (carbon monoxide)
(humans) - increased due to humans

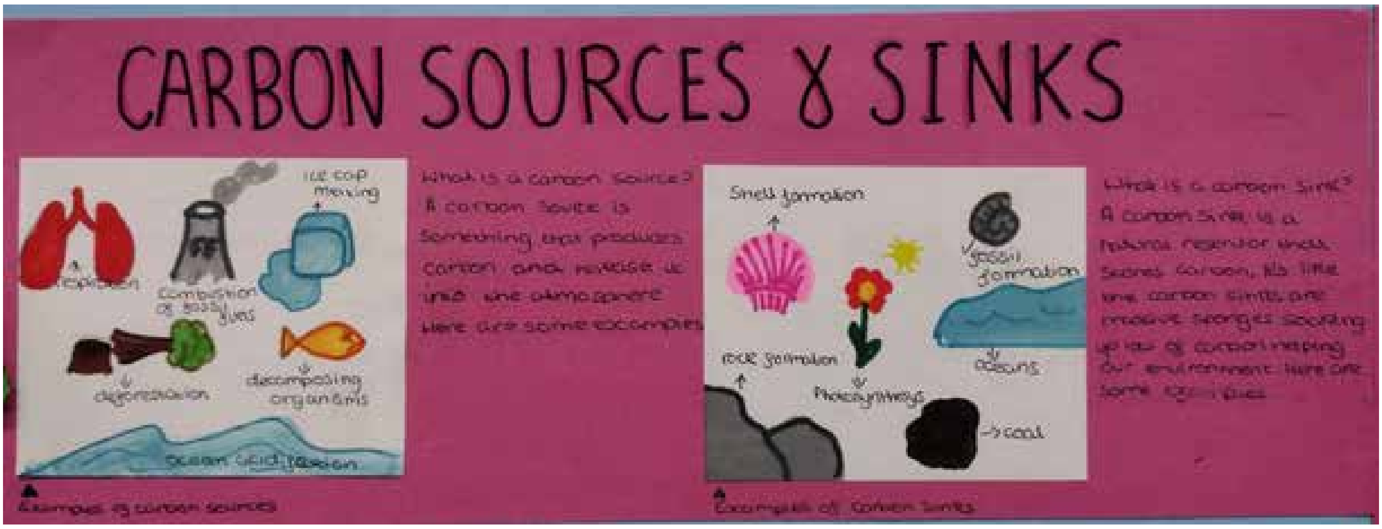

GREENHOUSE GASSES
What do Greenhouse Gasses do?
Greenhouse gasses such as carbon dioxide, trap some of the earths outgoing thermal energy, therefore retaining heat in our atmosphere Too many greenhouse gasses in our atmosphere will stop the heat energy from leaving - making our atmosphere warmer. This is called climate change or the enhanced greenhouse effect. The sudden increase of gasses is mostly caused by us humans burning fossil fouels which release masses of Co2.


ATMOSPHERE


Carbon Cycle.
Sunlight
photosynthesis
Carbon dioxide (co2)
animal respiration
Plant respiration
Auto & Factory Emissions
Organic Carbon
Decaying organisms
Root respiration
Dead organisms and waste products
Fossils & Fossil Fuels


GLOBAL WARMING
What is Global warming?
Global warming is the Gradual Increase in the Earths temprenure
which is caused by the enhanced greenhouse effect.
What is the enhanced Greenhouse effect?
The enhanced greenhouse effect is the disruption of
earths climate equilibrium caused by increased
concerentrations of greenhouse gasses which
therefore meant global average surface tempreture
rise.


FOSSIL
FUELS
oil
coal
natural glass
coal
fossil
What are fossil fuels?
Fossil Fuels are fuels that are formed from the remains of plants or animals. E.g coal, crude oil, natural gas. Humans use these fuels for combustion to power our cars and heat our homes e.c.t. Doing this produces co2 which contributes to Global warming. Fossil Fuels are non-renewable which means it will eventually run out & cant be replaced. so we need to some better renewable energy sources that won't effect our climate.
The carbon cycle is a natural process in the atmosphere, ecosystems & oceans, and the earths crust as well as as burning fossil fuels where carbon is recycled.



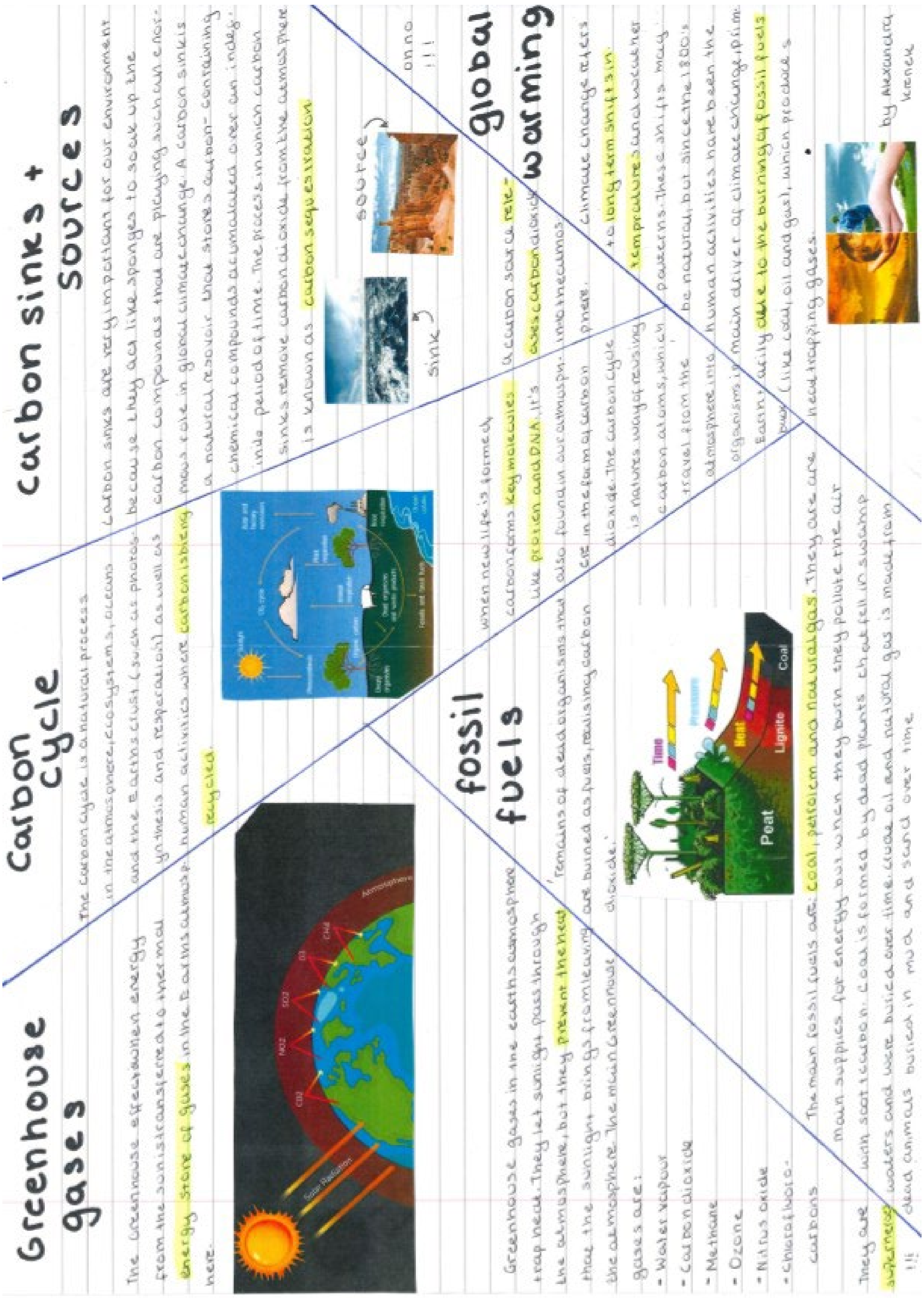
Our modern-day understanding of the "carbon cycle" has come through a remarkable series of scientific theories and discoveries, dating back to the 18th century. Here are just a few of the main contributions:

The French chemist, **Antoine Laurent Lavoisier** (1743–1794), was a key contributor to the foundation of the carbon cycle. Lavoisier introduced the term carbonic acid ("acide charbonneux") to describe an element/compound present in the atmosphere and he concluded, rightly, that it was the element Carbon. He went further and, by detailed experimentation, concluded that this "acide charbonneux" was maintained in equilibrium and, most importantly from an historical perspective, was involved in biological processes such as respiration and photosynthesis. It was Lavoisier who first proposed the idea of a "carbon reservoir" not just in the air and living organisms, but in the Earth's crust in the form of carbon compounds (carbonates). This aspect forms a critical component of our current understanding of the carbon cycle.

Shortly after these works by Lavoisier, the English chemist **Humphrey Davy** (1778–1829), both a fervent admirer and a critic of Lavoisier, reformulated the question of the compensating mechanism for respiration in 1799: *"Since the atmospheric composition is uniformly similar, we are led to inquire by what means a quantity of oxygen equal to that consumed by respiration and combustion is again supplied to the atmosphere."* Davy published the result of a series of 9 experiments showing, among other findings, the *"discovery of the production of oxygen by the various orders of the marine cryptogamia class of plants"* that has been grown in the laboratory using sea water. Thus, Davy explicitly introduced the question of compensating processes in the ocean and used the term "carbon" that had been recently used by Lavoisier.

Lavoisier and Davy's work was progressed into the 20th century and allowed a better understanding of the different components of the carbon cycle. Whilst it was known that processes in the sediments and rocks of the Earth's crust played a part, as had been mentioned by Lavoisier, a major discovery of the 20th century would add another component – plate tectonics. Tectonics was a new branch of geology that followed up the original theory of continental drift proposed by the German meteorologist, Alfred Wegener, in 1912. The theory of plate tectonics was defined in a series of papers between 1959 and 1967. Perhaps the most notable "founding father" of the theory was **Harry Hammond Hess** (1906-1969), an American geologist and a United States Navy officer in World War II. Thus the movements of sections of the Earth's crust and interactions with the mantle were also found to play a long-term role in the carbon cycle.

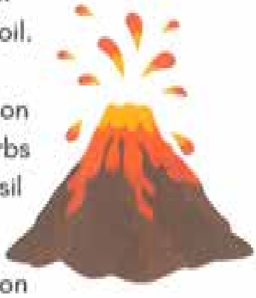
ALEXANDER KRENEK



CASSIUS COOPER

CARBON SINK/SOURCES

A carbon sink is anything that absorbs more carbon from the atmosphere than it releases - for example, plants, the ocean and soil. In contrast, a carbon source is anything that releases more carbon into the atmosphere than it absorbs - for example, the burning of fossil fuels or volcanic eruptions



A carbon source releases carbon dioxide into the atmosphere. Examples of carbon sources include the burning of fossil fuels such as gas, coal, and oil deforestation and volcanic erruptions

CARBON CYCLE

Carbon is an essential element for life on Earth. Every living organism has carbon compounds inside each of its cells, such as fats and proteins. The carbon cycle shows how atoms of carbon can exist within different compounds at different times and be recycled between living organisms and the environment.

GREENHOUSE GASES.

greenhouse gas, any gas that has the property of absorbing infrared radiation (net heat energy) emitted from Earth's surface and reradiating it back to Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapour are the most important greenhouse gases.

GLOBAL WARMING

Global warming occurs when carbon dioxide (CO2) and other air pollutants collect in the atmosphere and absorb sunlight and solar radiation that have bounced off the earth's surface. Normally this radiation would escape into space, but these pollutants, which can last for years to centuries in the atmosphere, trap the heat and cause the planet to get hotter.

CONNIE BALAAM

The carbon cycle

The carbon cycle describes the process in which carbon atoms continually travel from the atmosphere to the Earth and then back into the atmosphere. Human activities have a tremendous impact on this cycle. Burning fossil fuels, changing land use, and using limestone to make concrete all transfer massive quantities of carbon into the atmosphere. As a result, the amount of carbon dioxide in the atmosphere is rapidly rising Most carbon is stored in rocks a sediments, while the rest is stored in the ocean, atmosphere and living organisms.

Carbon sinks and sources

Carbon sinks extract carbon dioxide from the atmosphere and absorb more carbon than they release. Carbon sources, conversely, release more carbon than they absorb. They cover about 30% of the Earth's land surface and as much as 45% of the carbon stored on land is tied up in these sinks. Some examples of this are oceans being the main natural carbon sink in the world, forests are also significant carbon sinks examples as well. According to a report published in January 2021, forests absorb twice as much carbon as they release each year, absorbing a net 7.6 billion metric tonnes of carbon dioxide annually. Some processes release more carbon dioxide into the atmosphere than they absorb. Any process that uses fossil fuels such as burning coal to make electricity-releases a lot of carbon into the atmosphere. Raising cattle for food also releases a lot of carbon into the atmosphere. These processes that release carbon into the atmosphere are known as carbon sources.

Fossil fuels

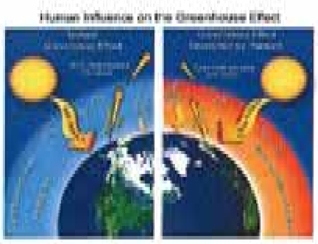
Fossil fuels are made from decomposing plants and animals. These fuels are found in the Earth's crust and contain carbon and hydrogen, which can be burned for energy. Coal, oil, and natural gas are examples of fossil fuels. Coal is a material usually found in sedimentary rock deposits where rock, dead plant and animal matter are piled up in layers. Oil is originally found as a solid material between layers of sedimentary rock, like shale. This material is heated in order to produce the thick oil that can be used to make gasoline.

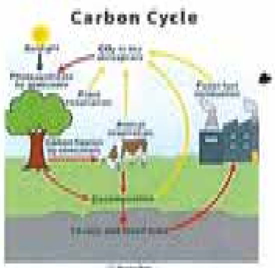
Greenhouse Gases

Greenhouse gases are gases like carbon dioxide (CO_2), methane, and nitrous oxide—that keep the Earth warmer than it would be without them. The reason they warm the Earth has to do with the way energy enters and leaves our atmosphere. When energy from the sun first reaches us, it does so mainly as light. But when that same energy leaves the Earth, it does so as infrared radiation, which we experience as heat. Greenhouse gases reflect infrared radiation, so some of the heat leaving the Earth bounces off the greenhouse gases in our atmosphere and comes back to the Earth's surface. This is called the "greenhouse effect," in a comparison to the heat-trapping glass on a greenhouse

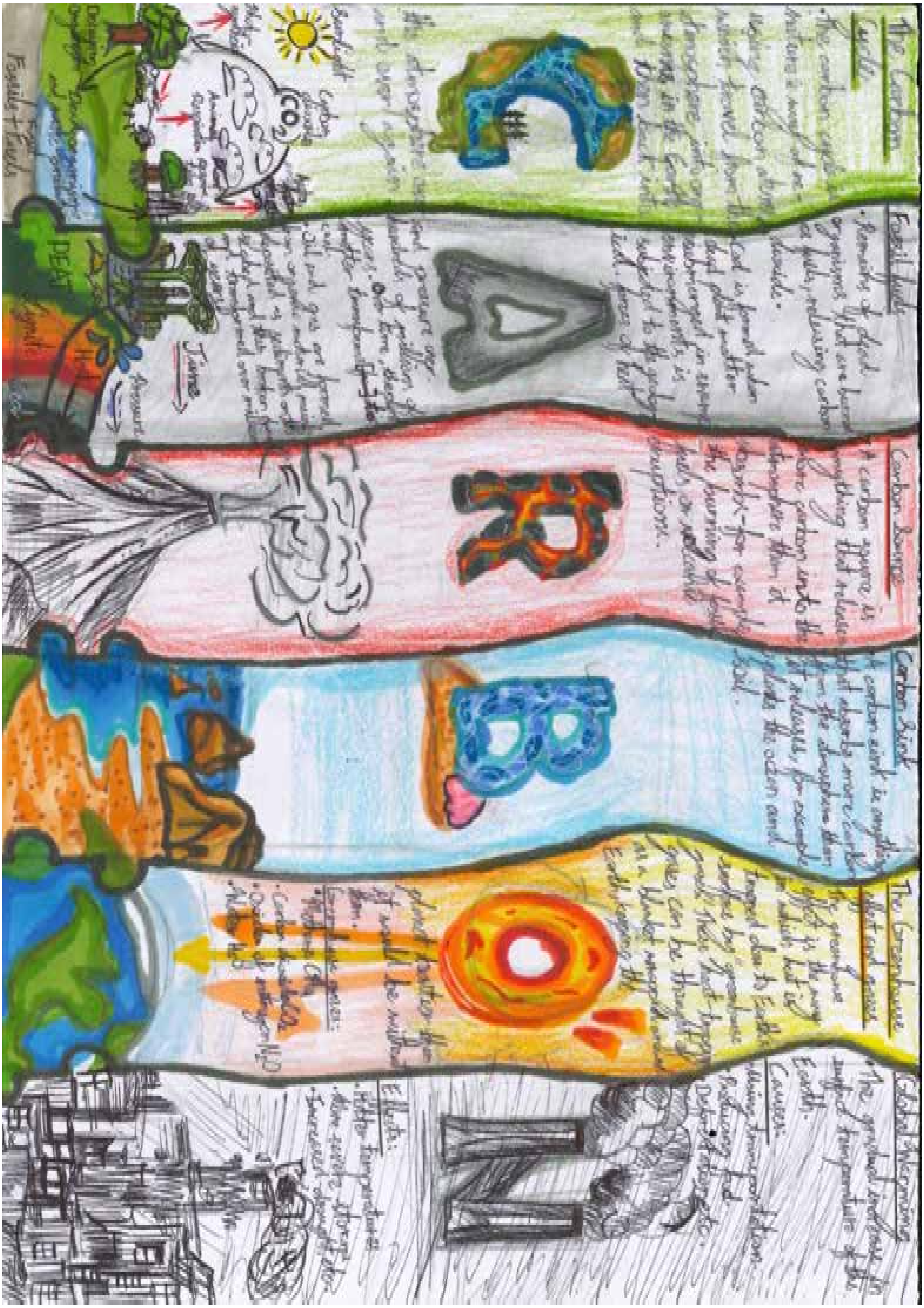
Global warming

Global warming is the unusually rapid increase in Earth's average surface temperature over the past century primarily due to the greenhouse gases released by people burning fossil fuels.





DARIEN ALMOJUELA

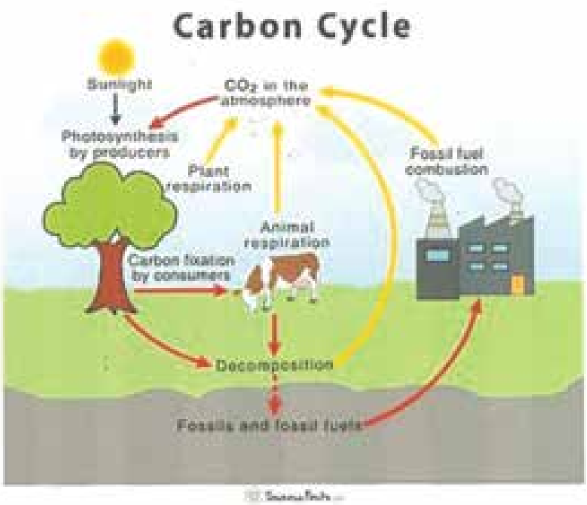


JOSEPH FERDINAND

THE CARBON CYCLE

WHAT IS THE CARBON CYCLE?

THE CARBON CYCLE IS A SERIES OF PROCESSES BY WHICH CARBON IS MOVED AROUND THE ENVIRONMENT, INVOLVING THE TRANSFER OF CARBON DIOXIDE INTO ORGANIC MATERIAL THROUGH PHOTOSYNTHESIS AND ITS RETURN TO THE ATMOSPHERE BY RESPIRATION, THE DECAY OF DEAD ORGANISMS, AND THE BURNING OF FOSSIL FUELS. THERE IS MANY WAYS THAT THE EARTH TRANSFERS CARBON AND STORES IT, FOR EXAMPLE ROCK FORMATION OFTEN TRAPS CARBON AND FOSSIL FUELS ARE HYDROCARBONS FORMED BY THE CARBON IN THE REMAINS OF DEAD LIFE (PLANT OR ANIMAL) OVER MILLIONS OF YEARS. THIS CARBON IS EVENTUALLY RELEASED BACK INTO THE ATMOSPHERE WHEN THE ROCK THAT TRAPS THE CARBON ERODES OR WHEN HUMANS DIG UP AND BURN THE FOSSIL FUELS WHICH HAVE FORMED.



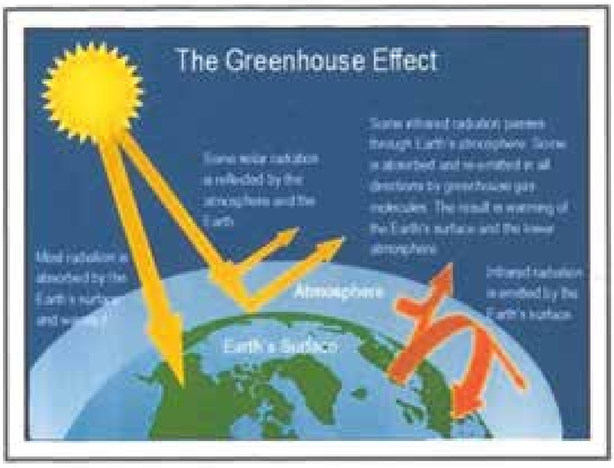
CARBON SINKS AND CARBON SOURCES

Carbon sinks are places where carbon and carbon compounds are stored and carbon sources are places that carbon is released. For example, a carbon sink is photosynthesis. This is because carbon is taken by plants from the atmosphere in order to produce glucose (a carbon compound) which the plant uses to grow and perform respiration. When the plant grows some of the carbon is trapped inside the newly formed tissue that makes up the plant and this is true for all carbon based life forms, including man. An example of a carbon source is respiration. Respiration uses glucose and oxygen to produce energy and in the process carbon dioxide and water are formed and released into the atmosphere.

FOSSIL FUELS

Fossil fuels are hydrocarbons formed from the remains of dead life through heat and pressure over millions of years. Examples of fossil fuels are coal, crude oil and natural gas. Coal is formed from the remains of dead plant life that falls into places such as bogs where it doesn't decompose and is drawn further into the Earth where pressure and heat from the Earth's core slowly turns it into coal. Gas and oil are formed from dead sea life which gets covered by layer after layer of sand until it too is transformed by pressure and heat into oil and gas. When you burn fossil fuels it releases a large amount of heat energy as well as greenhouse gasses such as carbon dioxide and dihydrogen monoxide (water).

THE GREENHOUSE EFFECT



The greenhouse effect is a process in which greenhouse gases such as methane and carbon dioxide warm the Earth. This is done by the suns rays which are being reflected of the Earth being reflected back at the Earth by the greenhouse gasses that are in our atmosphere. This is necessary for keeping the Earth warm and without it the planet would be freezing.

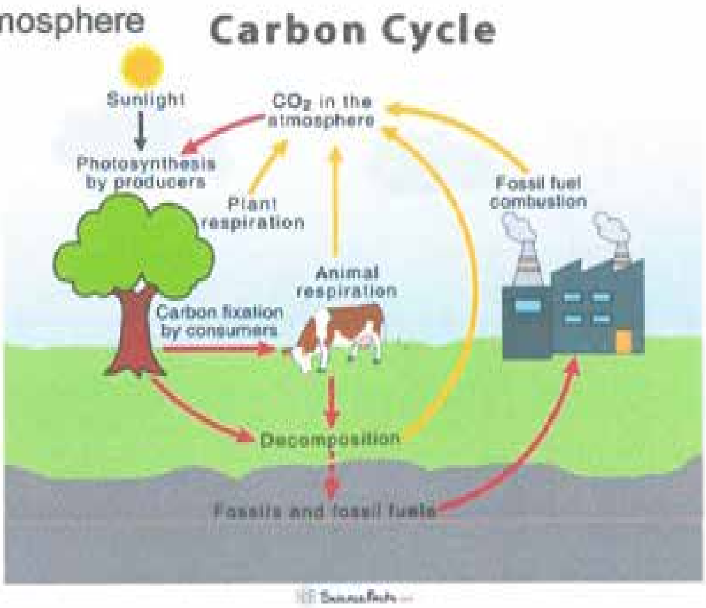
GLOBAL WARMING

Global warming is the rise in global temperature. Global warming is caused by, among other things, the enhanced greenhouse effect. This is like the greenhouse effect but on a much larger scale due to there being more greenhouse gases in the atmosphere. This means that much more heat is trapped on the Earth than normal which causes a global rise in temperature or global warming. Global warming is damaging to the environment as it can lead to things such as climate change, habitat loss and ice caps melting. The latter also leads to a rise in sea level which can mean that there is lots of flooding on coasts.

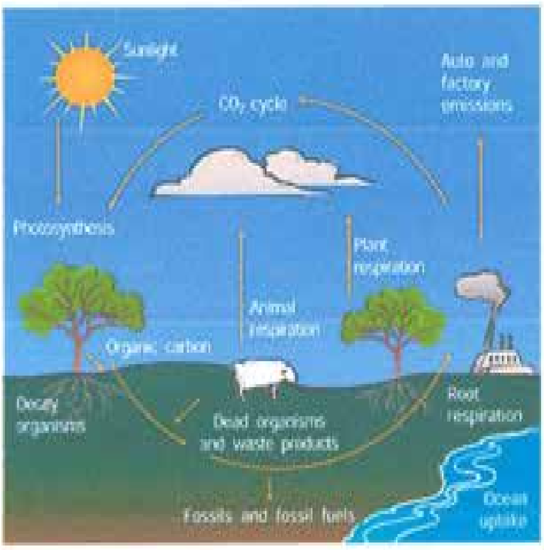
MATEUSZ NASILOWSKI

CARBON CYCLE

The carbon cycle describes the process in which carbon atoms continually travel from the atmosphere to the Earth and then back into the atmosphere. Since our planet and its atmosphere form a closed environment, the amount of carbon in this system does not change.



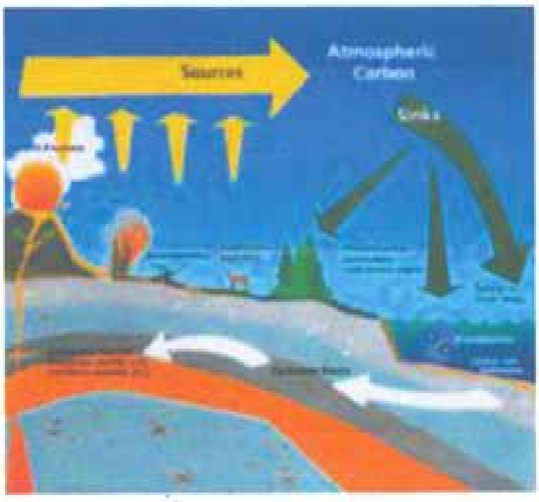
FOSSIL FULES

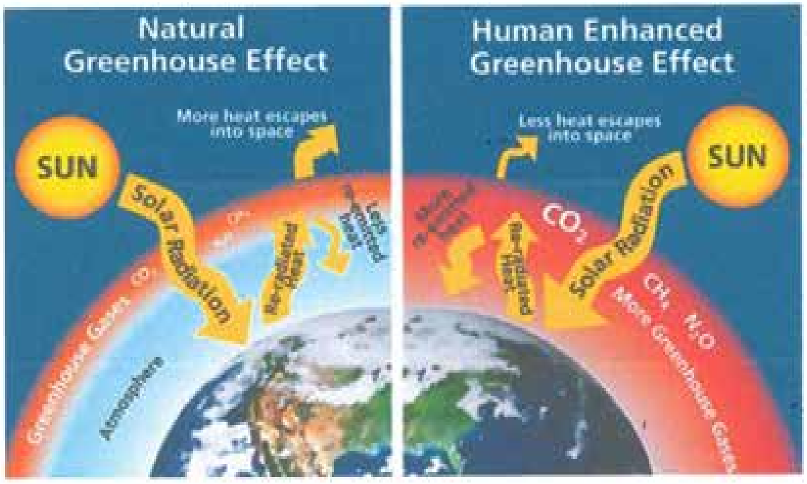


Fossil fuels are made from decomposing plants and animals. These fuels are found in the Earth's crust and contain carbon and hydrogen, which can be burned for energy. Coal, oil, and natural gas are examples of fossil fuels.

Carbon sinks and sources

A carbon sink is anything that absorbs more carbon from the atmosphere than it releases– for example, plants, the ocean and soil. In contrast, a carbon source is anything that releases more carbon into the atmosphere than it absorbs– for example, the burning of fossil fuels or volcanic eruptions.



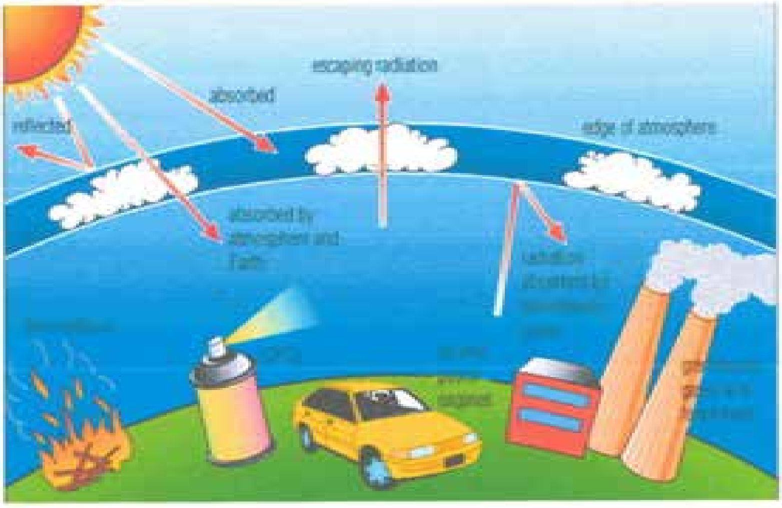


GREENHOUSE EFFECT

Greenhouse gases (also known as GHGs) are gases in the earth's atmosphere that trap heat. During the day, the sun shines through the atmosphere, warming the earth's surface. At night, earth's surface cools, releasing heat back into the air. But some of the heat is trapped by the greenhouse gases in the atmosphere.

Global warming

Global warming is the long-term warming of the planet's overall temperature. Though this warming trend has been going on for a long time, its pace has significantly increased in the last hundred years due to the burning of fossil fuels. As the human population has increased, so has the volume of fossil fuels burned.



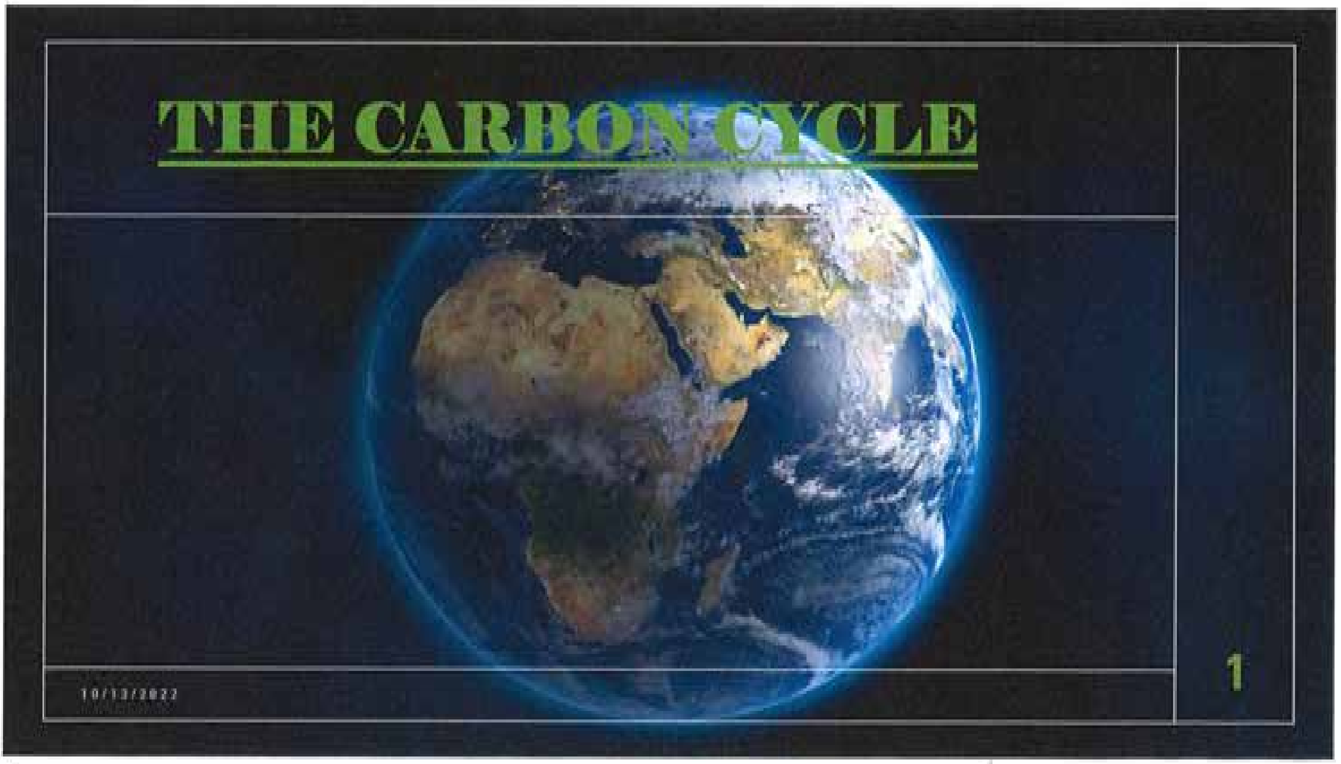
VENUS – GLOBAL WARMING GONE MAD!

Venus and Earth are planetary siblings. They were made at the same time and made of the same stuff, yet Venus is apocalyptic and awful in every possible way, while Earth is a relative paradise. Formed about 4.6 billion years ago, Venus and Earth are thought to have developed almost in parallel up until about 1-2 billion years ago. Venus, like Earth, would have had a significant, shallow ocean and habitable surface temperatures – but then something went seriously wrong. Around 1 billion years ago, the climate dramatically changed due to a runaway greenhouse effect. So why do we now have a paradise next to a paradise lost?

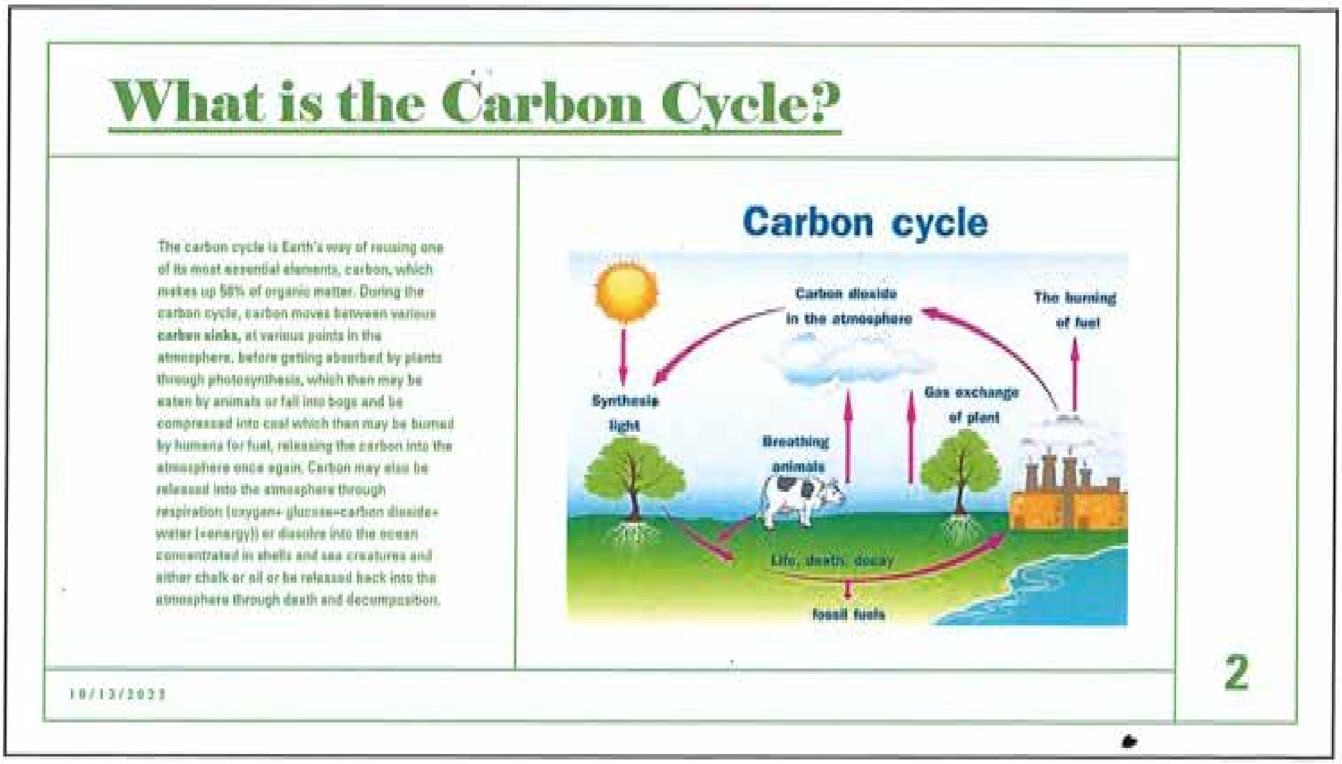
Venus currently has a surface temperature of 450℃ (the temperature of an oven's self-cleaning cycle) making it the hottest planet in the solar system, and an atmosphere dominated by carbon dioxide (96 per cent) with a density 90 times that of Earth's. There are two main theories of how this came about, both possibly involved: young stars are seen to be rather excitable and often go through a "flare up" before settling down again. This may have happened with the Sun and the sudden increase in temperature caused Venus' oceans to simply boil away, filling the atmosphere with water vapour which is a greenhouse gas.

The other theory involves a prolonged episode of volcanic eruptions that filled the atmosphere to a large extent with carbon dioxide. This actually happened on Earth 252 million years ago and the increases in global temperature and carbon dioxide resulted in 90% of all life dying out. But the Earth was able to recover, thanks to the carbon cycle. However, because of the sheer scale of the events on Venus, its own carbon cycle could not reverse the process and Venus has remained in its extreme greenhouse state.

AIDAN FEELY



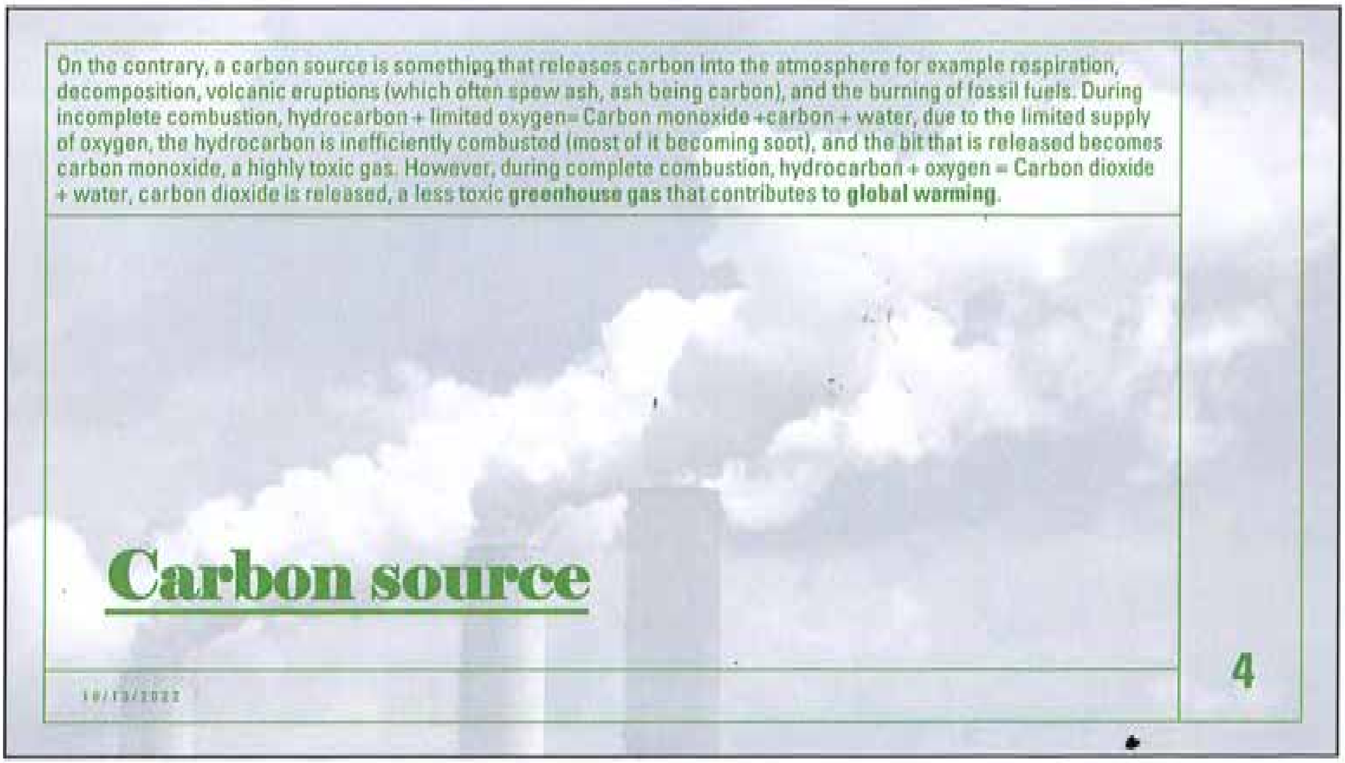
1



2


A carbon sink is a natural reservoir that stores carbon-containing chemical compounds, the process by which they absorb carbon dioxide is known as carbon sequestration. Carbon sinks are an important part of the larger environment as they can soak up carbon-containing **greenhouse gases**, preventing their levels from becoming too high. Examples of carbon sinks may include plankton, cement, rocks, coal, shells, and photosynthesis.
Carbon sinks
10/13/2022
3

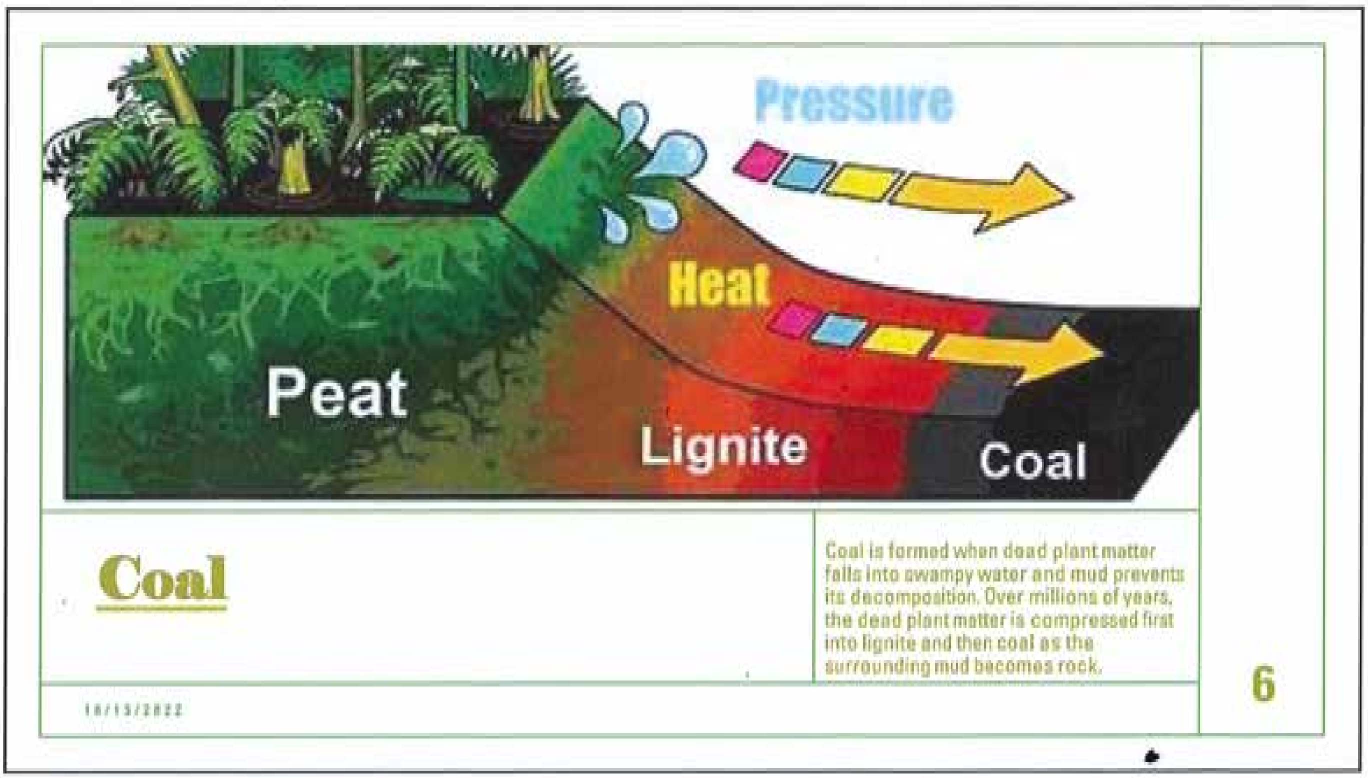
3

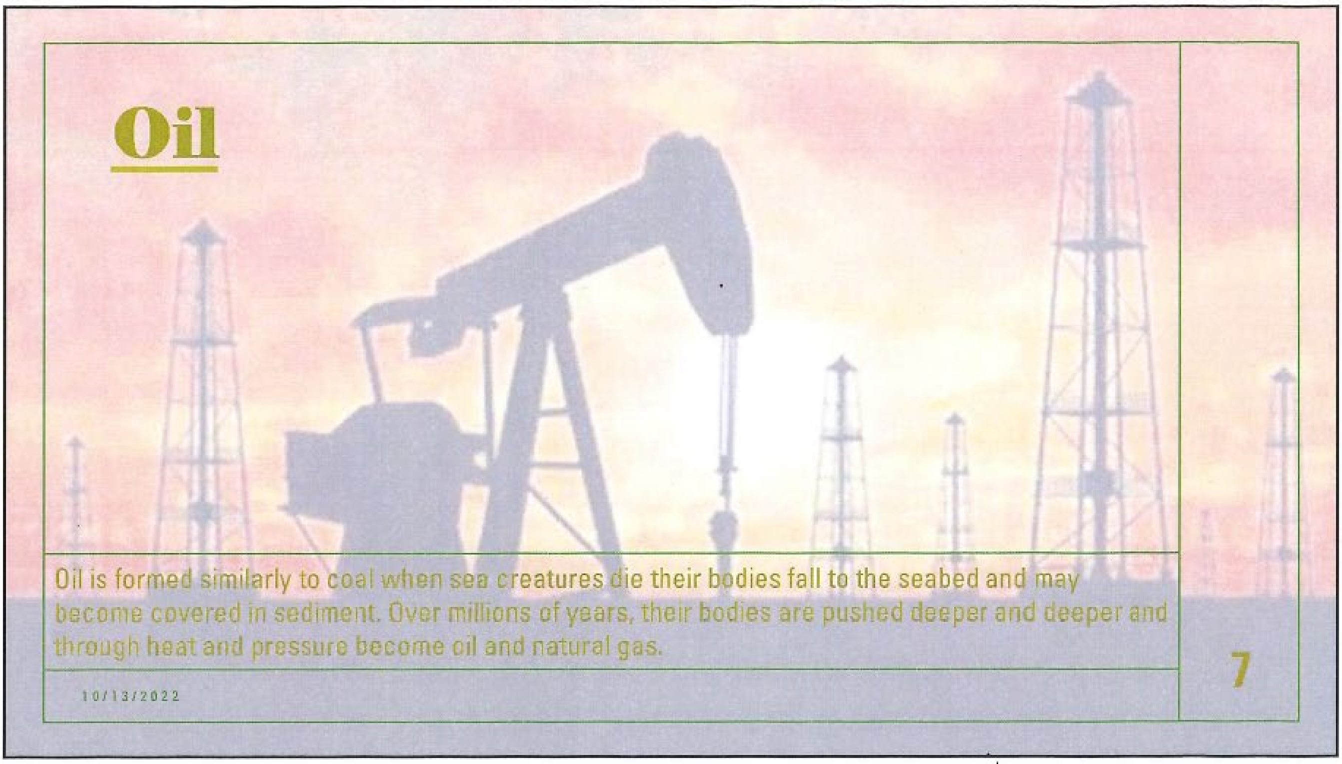

On the contrary, a carbon source is something that releases carbon into the atmosphere for example respiration, decomposition, volcanic eruptions (which often spew ash, ash being carbon), and the burning of fossil fuels. During incomplete combustion, hydrocarbon + limited oxygen= Carbon monoxide +carbon + water, due to the limited supply of oxygen, the hydrocarbon is inefficiently combusted (most of it becoming soot), and the bit that is released becomes carbon monoxide, a highly toxic gas. However, during complete combustion, hydrocarbon + oxygen = Carbon dioxide + water, carbon dioxide is released, a less toxic **greenhouse gas** that contributes to **global warming**.
Carbon source
10/13/2022
4

4

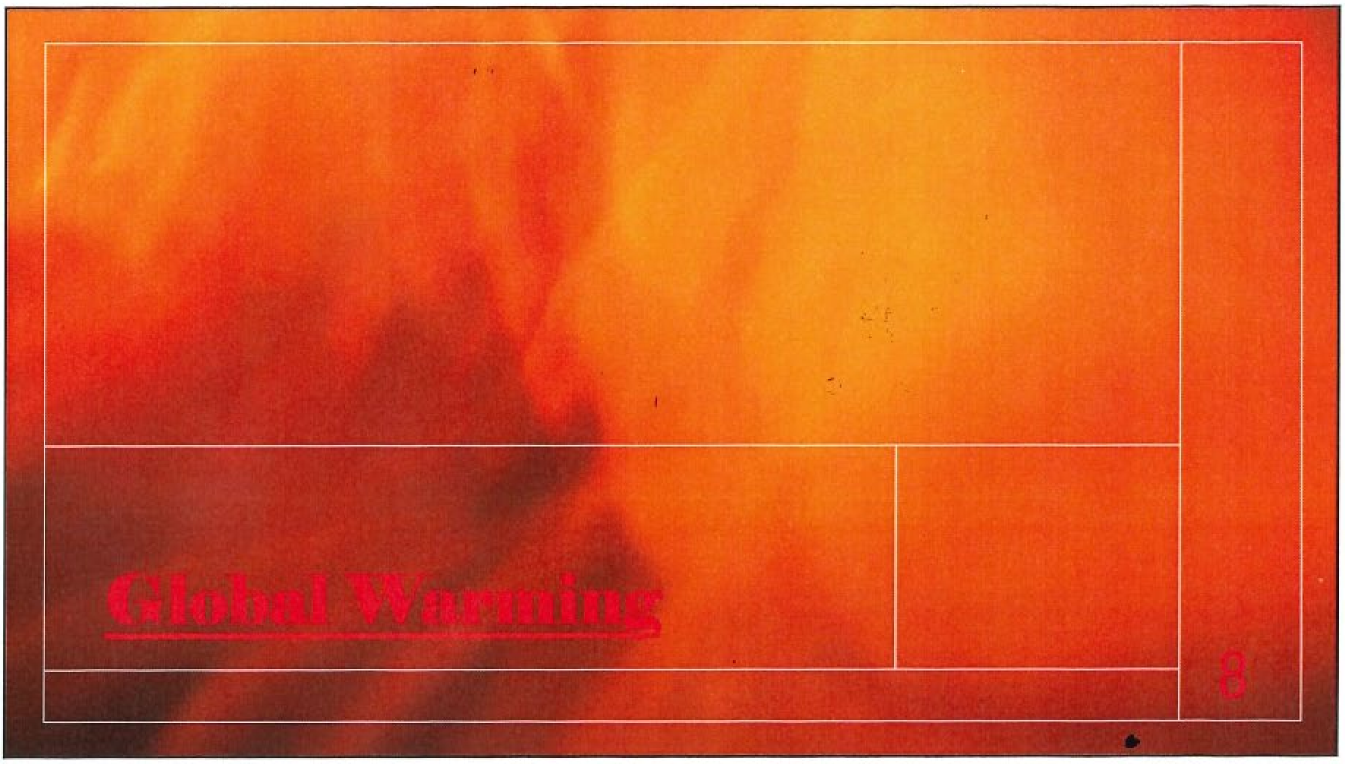

FOSSIL Fuels
10/13/2022
5

5

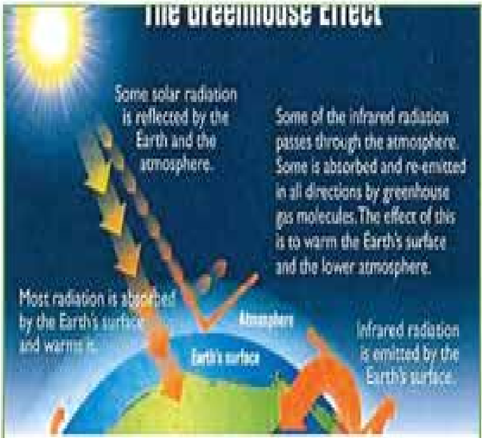

Pressure
Heat
Peat
Lignite
Coal
Coal
Coal is formed when dead plant matter falls into swampy water and mud prevents its decomposition. Over millions of years, the dead plant matter is compressed first into lignite and then coal as the surrounding mud becomes rock.
10/13/2022
6


Oil
Oil is formed similarly to coal when sea creatures die their bodies fall to the seabed and may become covered in sediment. Over millions of years, their bodies are pushed deeper and deeper and through heat and pressure become oil and natural gas.
10/13/2022
7

7


Global Warming
8

8



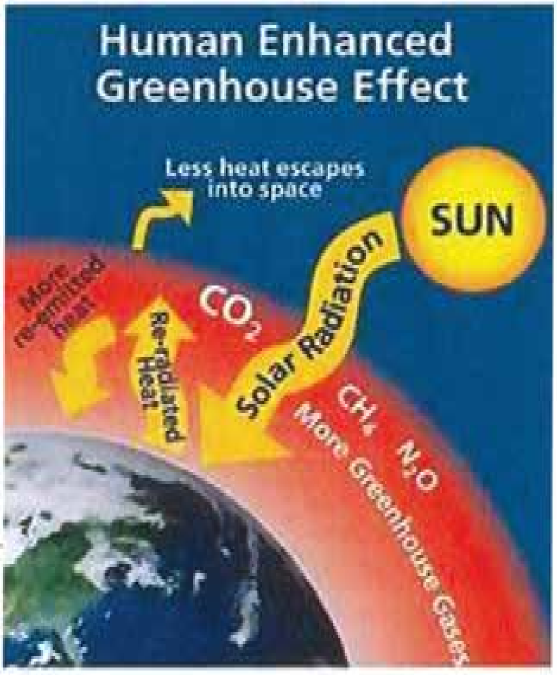
The greenhouse effect is the process by which the sun emits solar radiation which then travels through space to reach the edge of Earth's atmosphere. Some of this radiation will then be reflected back into space and the rest transmitted through the atmosphere before being absorbed by Earth's surface. This then heats the Earth's surface and then may begin being transmitted back into space, however it may be stopped and trapped within Earth's atmosphere for longer by greenhouse gases. Greenhouse gases (such as Co2, CH4, N2O, and H2O) keep the Earth's surface warm, far higher than the projected -20 degrees Celsius without them despite the most common (CO2) only making up 0.04% of our atmosphere. This shows how influential these gases are and how much damage even a small increase in their numbers could do.

The Greenhouse Effect

10/13/2022

9

9



The Enhanced Greenhouse Effect

- The enhanced greenhouse effect is used to refer to the greenhouse effect in its current (and currently likely future) state where human activity has caused increasing levels of greenhouse gases to trap more and more heat, warming Earth's surface above natural levels _otherwise known as **global warming**. The majority of human-caused greenhouse gases come from the burning of **fossil fuels** which may release carbon dioxide and methane (greenhouse gases), sulfur dioxide, and nitrogen oxides (causes of acid rain) or even carbon monoxide (a highly toxic gas) into the atmosphere. The other main man-related releaser of greenhouse gases is agriculture with cows often releasing methane and rice paddies flood during growth creating the perfect environment for bacteria to thrive on plant matter and perform anaerobic respiration, also emitting methane.

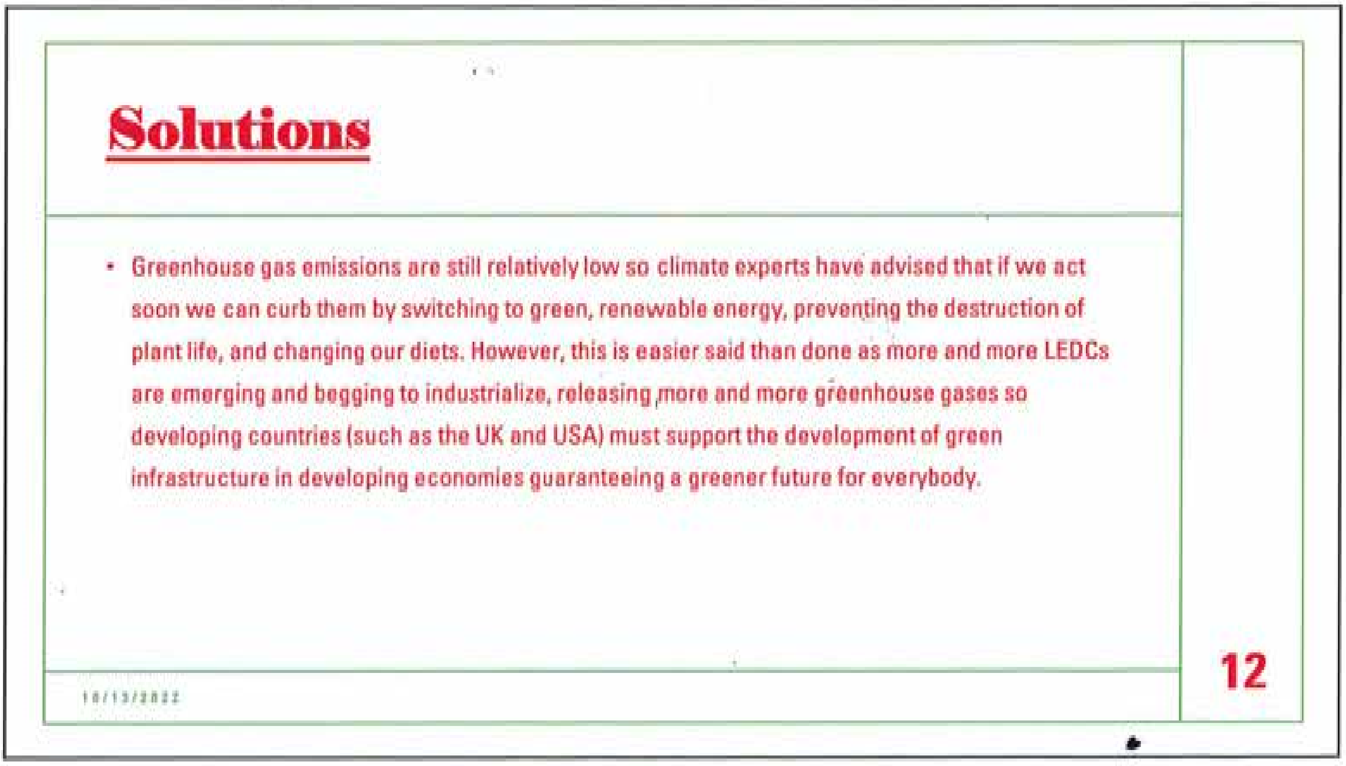
10/13/2022

10

10


The Effects of Global Warming
The heating of the Earth at an
has wide and varied consequences the
obvious being the gradual increase of the
average temperatures and an increase in
unpredictable weather events such as
hurricanes and droughts. In turn, this causes
white polar ice caps to melt which not only
accelerates the process (due to large areas of
white reflecting back some of the solar
radiation) but also increases sea levels
destroying many valuable and biodiverse
coastal habitats as well as human cities (the
largest of which are often on the coast). This
has and will cause a humanitarian crisis
surrounding refugees and the aforementioned
natural disasters and will put stress upon many
polar and coastal species that without enough
time to adapt may become extinct. Life in the
oceans will be no better with the rising sea
levels causing salinity in the water to change
affecting many crustaceans that have calcium-
based shells and the ranges of tropical species
may expand causing them to become invasive.
Even inland species will be effected as heating
temperatures may caure plants to bloom
earlier before many species have come out
hibernation meaning there may be a knock
effect up the food web as they
their food supply gone
10/13/2022
11

11

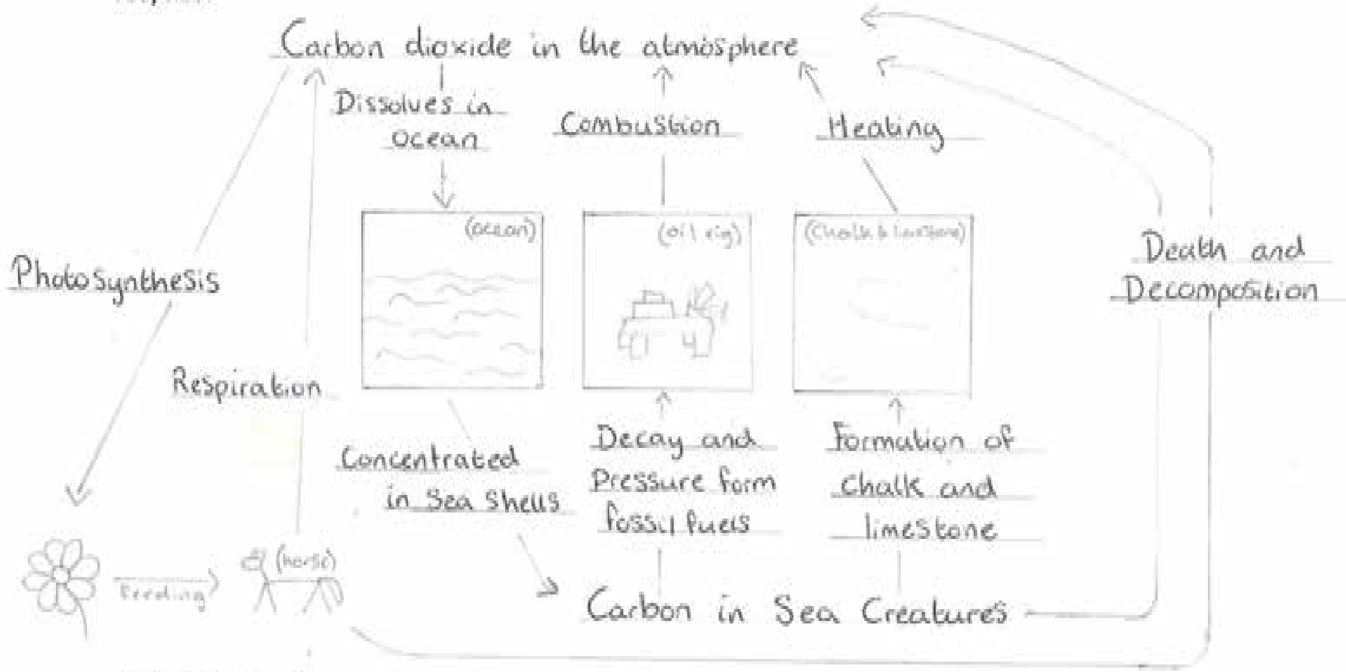

Solutions
• Greenhouse gas emissions are still relatively low so climate experts have advised that if we act soon we can curb them by switching to green, renewable energy, preventing the destruction of plant life, and changing our diets. However, this is easier said than done as more and more LEDCs are emerging and begging to industrialize, releasing more and more greenhouse gases so developing countries (such as the UK and USA) must support the development of green infrastructure in developing economies guaranteeing a greener future for everybody.
10/13/2022
12

12

EMILY VINCE

THE CARBON CYCLE

When new life is formed, carbon forms key molecules like protein and DNA. It's also found in our atmosphere in forms of carbon dioxide. The carbon cycle is nature's way of reusing carbon atoms, which travel from the atmosphere into organisms in the earth and then back into the atmosphere repeatedly.
The carbon cycle is natural processes in the atmosphere, ecosystems, oceans and the Earth's crust (such as photosynthesis and respiration) as well as human activities (burning fuels) where carbon is recycled.



FOSSIL FUELS

Fossil fuels are the remains of dead organisms that are burned as fuels releasing carbon dioxide. Coal, crude oil and natural gas are all examples of fossil fuels.

How is coal made?

About 300 million years ago, the earth was covered in lots of vegetation. Dead plants fell into swampy water and the mud prevented them from rotting away. Over the years, under heat and pressure, the mud became rock, and the plants became coal.

How is crude oil and natural gas formed?

Millions of years ago tiny animals lived in the sea. When they died, they fell into mud and sand at the bottom of the sea but did not rot away. Over millions of years, the animal remains were buried deeper by the mud and sand. The pressure changed the mud and sand into rock. The dead animals turned into crude oil and natural gas.

We use fossil fuels to produce energy, which is used to power engines, create plastics, heat and provide electricity for buildings. Unfortunately, fossil fuels are a non-renewable resource and waiting millions of years for new coal, oil, and natural gas to form is not a realistic solution. However, we also try to use renewable energy sources as they are better for our environment. Hydropower, solar-power, wind, tidal and steam are all examples of renewable energy sources.

CARBON SINKS AND SOURCES

Carbon sink= Areas of vegetation, the ocean or the soil, which absorb and store carbon.

A carbon sink is a natural reservoir that stores carbon-containing chemical compounds accumulated over an indefinite period. Carbon Sinks are very important for our environment because they act like sponges to soak up the carbon compounds that are playing such an enormous role in Global Climate Change. The process by which carbon sinks remove carbon dioxide (CO_2) from the atmosphere is known as Carbon sequestration.

A few examples of carbon sinks are:
Plankton growth, Ocean acidification, cement production, shell/rock/coal formation, and photosynthesis

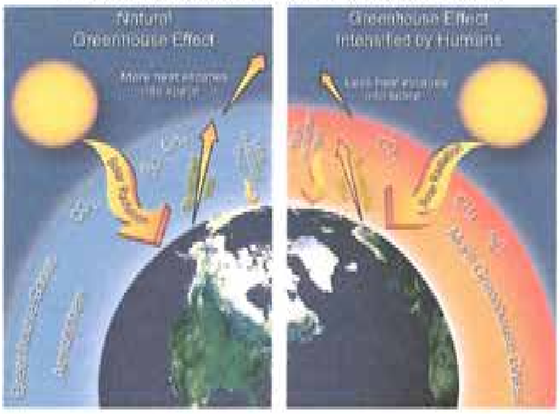
A carbon source is basically the opposite of a carbon sink. Instead of storing carbon, it creates carbon.

A few examples of carbon sources are:
Animal/plant respiration, volcanic eruptions, decomposing dinosaurs, burning fossil fuels, Deforestation and ice caps melting.

THE GREENHOUSE EFFECT

Greenhouse Effect is when energy from the sun is transferred to the thermal energy store of gases in earth's atmosphere.
Greenhouse gases are gases which are basically Responsible for global warming. They absorb heat Radiated from the Earth and the release energy In all directions, keeping the Earth warm.
Three greenhouse Gases are: Carbon dioxide, Methane and water Vapour.
Greenhouse gases keep the Earth warm, without them in the atmosphere, the World would be about 18 colder on average than it is now!
Humans are increasing the amount of greenhouse Gases in the atmosphere. For example: farming Cattle release methane.

Human Influence on the Greenhouse Effect



GLOBAL WARMING

Global warming is the gradual increase in Earth's surface temperature, which is caused by greenhouse gases like carbon dioxide and methane being released into the atmosphere, known as emissions.
Over the past century or so, Earth's surface temperature has increased by an average of between 1 and 1.2 degrees Celsius!
The increase in Earth's temperature effects many things including our climate. If we don't slow down climate change events such as sea levels rising, plant and insect loss and many more tragic events will start to occur, affecting our way of living.
To slow down global warming, we need to reduce our greenhouse gas emissions. We can do this by switching to renewable energy sources, as well as making small changes like using public transport and buying fewer items.

CLAUDIA SCOTT

EARTH'S ATMOSPHERE AND THE CARBON CYCLE

What is the Carbon Cycle?

The carbon cycle is a natural process in the atmosphere, ecosystems, oceans and the Earth's crust (such as photosynthesis and respiration), as well as human activities (burning fossil fuels) where carbon is recycled.

Why is the Carbon Cycle important?

When new life is formed, carbon forms key molecules. The carbon cycle is nature's way of reusing carbon atoms, which travel from the atmosphere into organisms and then back into the atmosphere over and over again.

Greenhouse gases and global warming

The greenhouse gases are: methane, carbon dioxide, sulphur dioxide, water vapour, soot, unburned fuels, nitrogen oxides and carbon monoxide. The Earth's atmosphere is composed of 78% nitrogen, 21% oxygen, 0.04% carbon dioxide and 0.96% other gases. Global warming is the gradual increase in the surface temperature of the Earth.

What are fossil fuels?

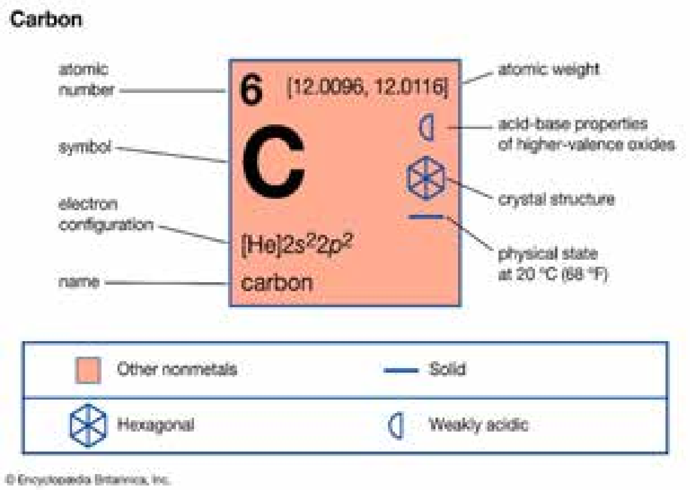
Fossil fuels are the remains of dead organisms that are burned as fuels, releasing carbon dioxide.

Carbon sinks and sources

Carbon sinks are areas of vegetation, the ocean or the soil that absorb carbon dioxide from the atmosphere and store it. Carbon sources release more carbon dioxide than they absorb. For example, any process that uses fossil fuels, such as burning coal for electricity. Carbon sinks are very important for our environment as they soak up the carbon from our atmosphere that is playing such a huge role in climate change. The process by which carbon sinks remove carbon dioxide from the atmosphere is known as carbon sequestration.

CARBON – THE ELEMENT

Although widely distributed in nature and is the 4th commonest element in the Universe, carbon is not particularly plentiful on Earth. In the crust of Earth, elemental carbon is a minor component, making up only 0.025%. However, carbon compounds (i.e., carbonates of magnesium and calcium) form common minerals (e.g., magnesite, dolomite, marble, or limestone) and form more compounds than all the other elements combined. Coral and the shells of oysters and clams are primarily calcium carbonate. Carbon is widely distributed as coal and in the organic compounds that constitute petroleum, natural gas. Carbon and its compounds are fundamental to all life on Earth.

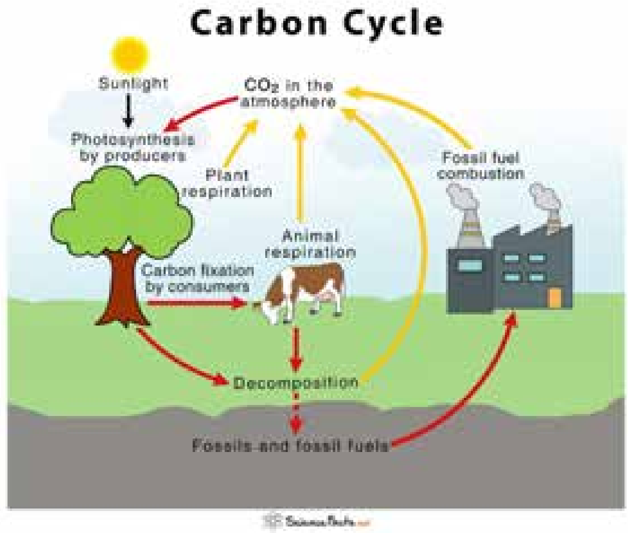


Carbon as an element was discovered by the first persons to handle charcoal from fire. Thus, together with sulfur, iron, tin, lead, copper, mercury, silver, and gold, carbon was one of the small group of elements well known in the ancient world. The word carbon probably derives from the Latin *carbo*, meaning variously "coal," "charcoal," "ember." The term diamond is a corruption of the Greek word *adamas*, "the invincible"; and graphite is derived from the Greek verb *graphein*, "to write".

Vol 7, No 2; December 2022

CHARLOTTE BUDD

OUR EARTH



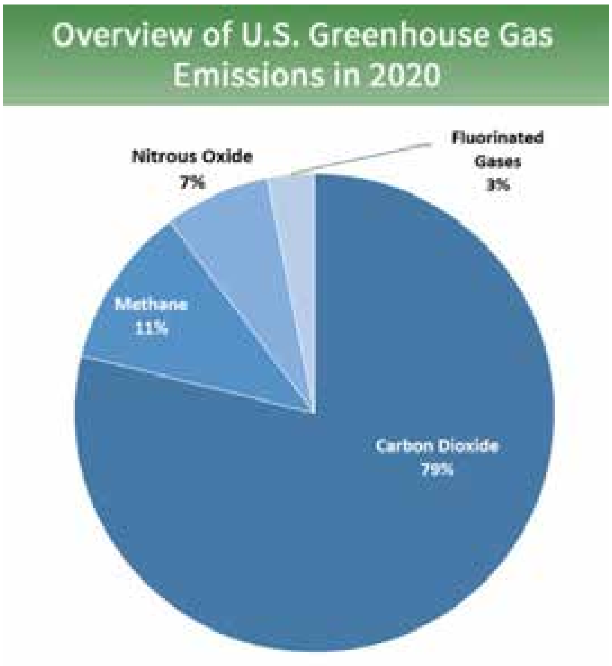
The **Carbon Cycle** is nature's way of recycling carbon atoms. Carbon is the foundation for all life on Earth. **Carbon sinks** extract carbon dioxide from the atmosphere and absorb more carbon than they release. They act like sponges soaking up CO_2. Two major carbon sinks are plants and the ocean. **Carbon sources** are things that release more carbon than they take in. A process such as burning fossil fuels is known as a carbon source because of the amount of carbon it releases.

Over the last century, primarily due to the **greenhouse gases** released by people burning fossil fuels, there has been an unusually rapid increase in the Earth's average temperature. This is called **global warming**. It heavily affects our natural ecosystems along with the wildlife that live there.

Fossil fuels are made from decomposing plants and animals. They are found in the Earth's crust and contain carbon that can be burned for energy. A few examples of fossil fuels are coal, oil and natural gas. They are technically renewable, but it would take millions of years.

Greenhouse gases are gases that trap heat in the atmosphere and are the things that cause our Earth to endure global warming. This is sometimes a good thing in terms of our planet not freezing. The principal greenhouse gases are:

- Water vapour
- Carbon dioxide
- Ozone
- Nitrogen oxides
- Chlorofluorocarbons (CFCs)

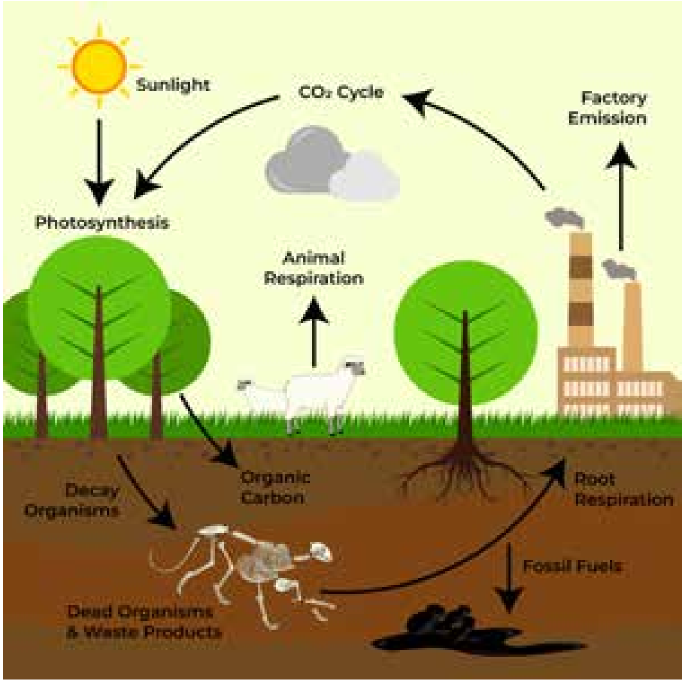


ALEX WALTON

CARBON, FUELS, GASES and GLOBAL WARMING

Carbon Cycle

The carbon cycle is nature's way of reusing carbon atoms, which travel from the atmosphere into organisms and then back into the atmosphere repeatedly.



Fossil Fuels

Fossil fuels are fashioned from the decomposition of buried carbon-based organisms that died hundreds of thousands of years ago. They create carbon-rich deposits that are extracted and burned for energy. They are non-renewable and presently furnish around 80% of the world's energy. Examples include crude oil, coal and natural gas.

Carbon Sinks

A carbon sink is something that absorbs more carbon from an ecosystem that it releases – for example, plants, the ocean and soil.

Greenhouse Gases

The "greenhouse effect" is the way in which heat is trapped close to the Earth's surface by greenhouse gases. The main gases responsible for the "greenhouse effect" include carbon dioxide, methane, nitrogen oxides, water vapour (which all occur naturally, and fluorinated gases (which are synthetic).

Global Warming

Global warming is the long-term heating of the Earth's surface considered to be due to human activities, mainly the burning of fossil fuels. This increases the heat-trapping greenhouse gases in the atmosphere.

The Royal Institution
Science Lives Here

CHRISTMAS LECTURES

Professor Dame Sue Black will reveal the secrets of forensic science in the 2022 CHRISTMAS LECTURES from the Royal Institution.

The CHRISTMAS LECTURES are the world's leading science lectures for young people and have been inspiring children and adults alike since 1825. In our 2022 lecture, Professor Dame Sue Black will reveal the secrets of forensic science.

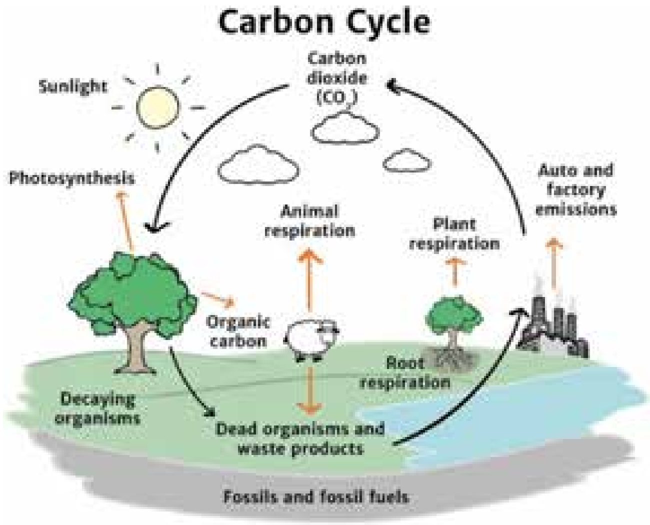
Initiated by Michael Faraday when organised education for children was scarce, the CHRISTMAS LECTURES established an exciting new way of presenting science to young people.

The Lectures have continued annually since 1825, stopping only during World War II. World-famous scientists have given the Lectures, including Nobel Prize winners William and Lawrence Bragg, Sir David Attenborough, Carl Sagan and Dame Nancy Rothwell.

This year's lectures will be broadcast on BBC Four between Christmas and New Year.

ERIKA OLIVEIRA

CARBON, FUELS, GASES and GLOBAL WARMING



Carbon Cycle

The carbon cycle is nature's way of recycling carbon atoms. Carbon is the foundation for all life on Earth.

Fossil Fuels

Fossil fuels are made from decomposing plants and animals. They are found in the Earth's crust and they contain carbon which can be burned. A few examples of fossil fuels are coal, crude oil and natural gas. Technically they are renewable, although it would take millions of years.

Carbon Sinks

Carbon sinks extract carbon dioxide from the atmosphere and absorb the carbon like a sponge. Plants and the ocean are good examples of carbon sinks.

Carbon Sources

Carbon sources are things that increase carbon more than they absorb. Burning fossil fuels is a good example.

Greenhouse Gases

Greenhouse gases are the gases that trap heat in our environment and they cause global warming. Some of the gases include:

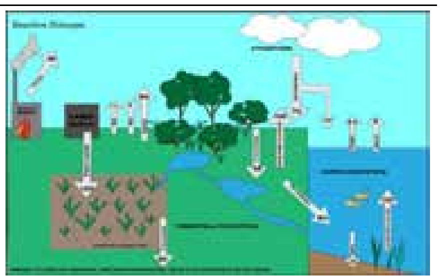
- Water vapour
- Carbon dioxide
- Methane
- Ozone
- Oxides of nitrogen

Global Warming

Over the past century, primarily due to the greenhouse gases released by people burning fossil fuels, there has been an unusually rapid increase in the Earth's average surface temperature. This is called global warming. It heavily affects natural ecosystems and wildlife, causing animals to have to migrate to fend off this warming effect

---

NITROGEN OXIDES (NOx)



Nitrogen is not involved in the carbon cycle, but it has come to play a significant role in global warming and atmospheric pollution. The reason the oxides are generically tagged as "NOx" is that there actually three and they are not all greenhouse gases.

Nitrous oxide (N_2O) gas should not be confused with **nitric oxide** (NO) or **nitrogen dioxide** (NO_2). Neither nitric oxide nor nitrogen dioxide are greenhouse gases, although they are important in the process of creation of tropospheric ozone which is a greenhouse gas. There are several sources of nitrous oxide, both natural and anthropogenic (human), to the atmosphere with many of these sources difficult to measure. Because of this, there is general agreement that the atmospheric sources and sinks of nitrous oxide are difficult to bring into balance.

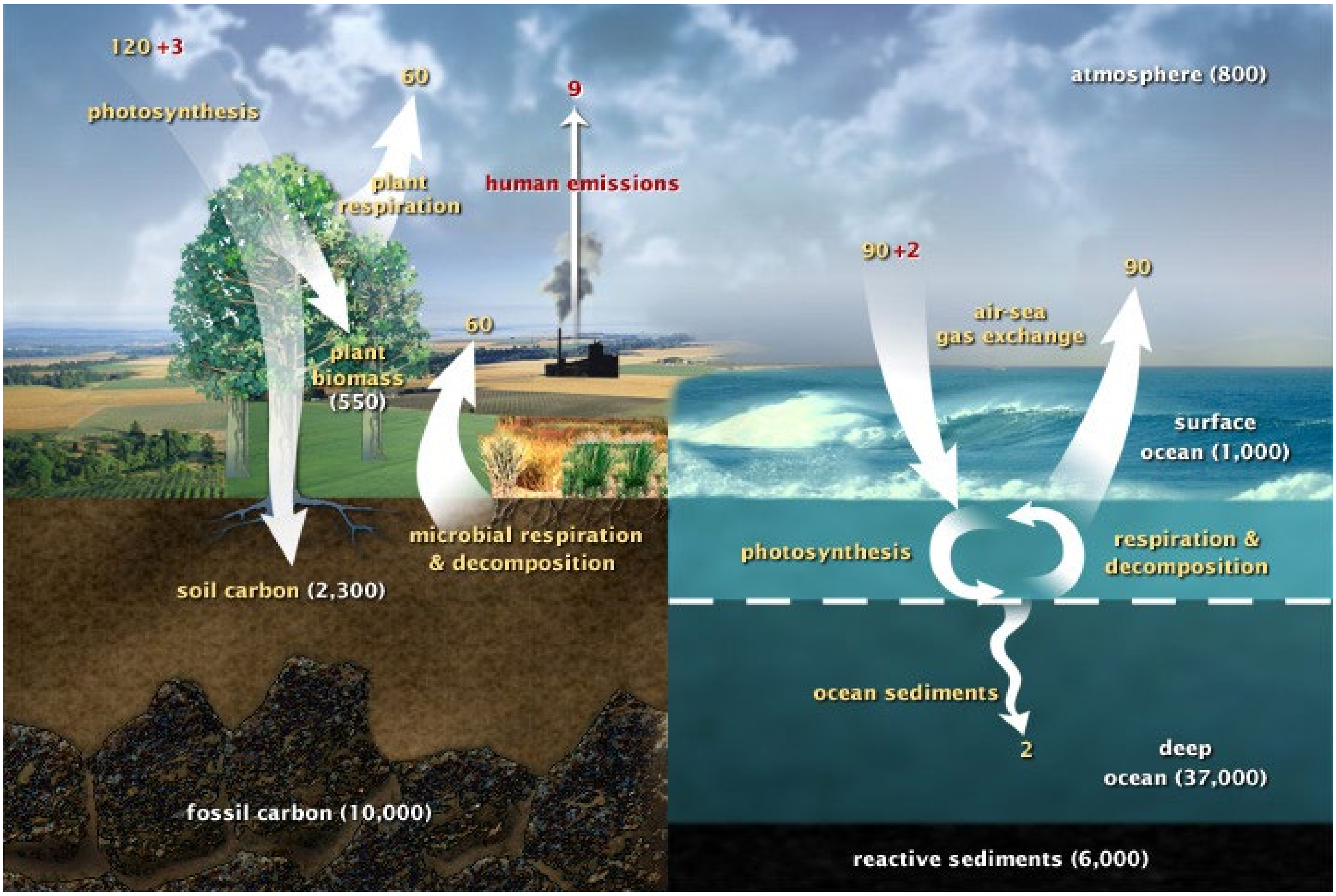
Nitrogen has its own cycle, but separate from the carbon cycle.

TEGAN FINDLEY
THE CARBON CYCLE

What is the carbon cycle?

The carbon cycle describes the process in which carbon atoms continually travel from the atmosphere to the Earth and then back into the atmosphere. Since our planet and its atmosphere form a closed environment, the amount of carbon on Earth does not change.

The carbon cycle is vital to life on Earth. Nature tends to keep carbon levels balanced, meaning that the amount of carbon naturally released from its reservoirs is equal to the amount that is naturally absorbed by those reservoirs. Maintaining this carbon balance allows the planet to remain hospitable for life.



CARBIN SINKS AND SOURCES

What is a carbon sink?

A carbon sink is a natural reservoir that stores carbon-containing chemical compounds accumulated over an indefinite period of time. Carbon sinks are very important for our environment because they act like sponges to soak up the carbon compounds that are playing such a big role in global climate change. Examples of carbon sinks are the ocean, the soil and plants.

What is a carbon source?

A carbon source is anything that releases more carbon into the atmosphere than it absorbs – therefore being a source of carbon. Carbon sources are mainly used for cell growth and product formation. Examples of carbon sources are fossil fuels, deforestation and volcanic eruptions.

FOSSIL FUELS

What are fossil fuels?

Fossil fuels are made from decomposing/decomposed plants and animals. Coil, oil and natural gas are examples of fossil fuels. Coal is formed in layers of dirt/silt that covered plants that lived in swampy forests. Pressure and heat turned the dead plants into coal.

Oil is formed by millions of years the algae, plants and animals that lived in shallow seas. After they died and sunk to the seafloor, the organic material mixed with other sediments and was buried. After millions of years of high pressure and temperature, they were transformed into oil.

Why can fossil fuels be bad?

Producing and burning fossil fuels creates air pollution that ca harm our health and generate toxic emissions that drive climate change. Air pollution alone from fossil fuels can cause acid rain, harm to wildlife, damage to forests and crops, along with much more. They pollute the environment and contribute to the greenhouse effect.

On the other hand, there are some positive things about fossil fuels, such as:

- They are quite cheap/affordable
- They can be stored and transported
- They can be more reliable than renewable energy, despite being a finite resource
- There are lots of them
- They can generate large amounts of electricity at a single location
- They can be cost-effective
- They can be easily found

IS COAL FORMING TODAY? Yes, but veeeeery slowwwwwwwwwwwwly!

The precursor to coal is peat which forms in wet, boggy conditions which are rich in plant material. Peat forms naturally on the surface, without compression. Over time, the "peat bogs" will be covered in layers of sediment until such time when the sheer weight of sediment above will compress the peat, expel the water, and pressures will become great enough to harden the peat into a relatively pure form of carbon that we call coal. There are areas in the world today where peat is accumulating, especially in the warm, shallow seas of Indonesia. Peat accumulates slowly, maybe only about 1-3mm per year. The problem is that the timescale from peat to coal is measured in hundreds of millions of years.

The formation of coal seams really kicked off with the diversification of land-based plants around 350 million years ago. The **Carboniferous period** (300-360 million years ago), aptly named, saw the evolution of tall lycopod trees that accelerated the rate at which peat could be formed in tropical equatorial mires. High sea levels and a warmer climate also encouraged coal formation, by extending the area of coastal mires and other wetlands.

The transformation from a plant substance to a metamorphic rock really starts once the peat is buried beneath 3 — 4 kilometres of sediment. At this depth, with an average rate of temperature increase of 30°C per kilometre, the temperature rises to over 100°C and sets off chemical reactions that transform the material into coal. The chemical reactions release volatiles that help to compress the peat even more and it changes from being a plant substance, like lignin or cellulose, to a geopolymer that contains concentrated carbon.

Ironically, warming of the Earth's climate may actually increase the number of swampy coastal environments that are perfect for coal formation. But these coal seams won't be ready for a many millions of years!

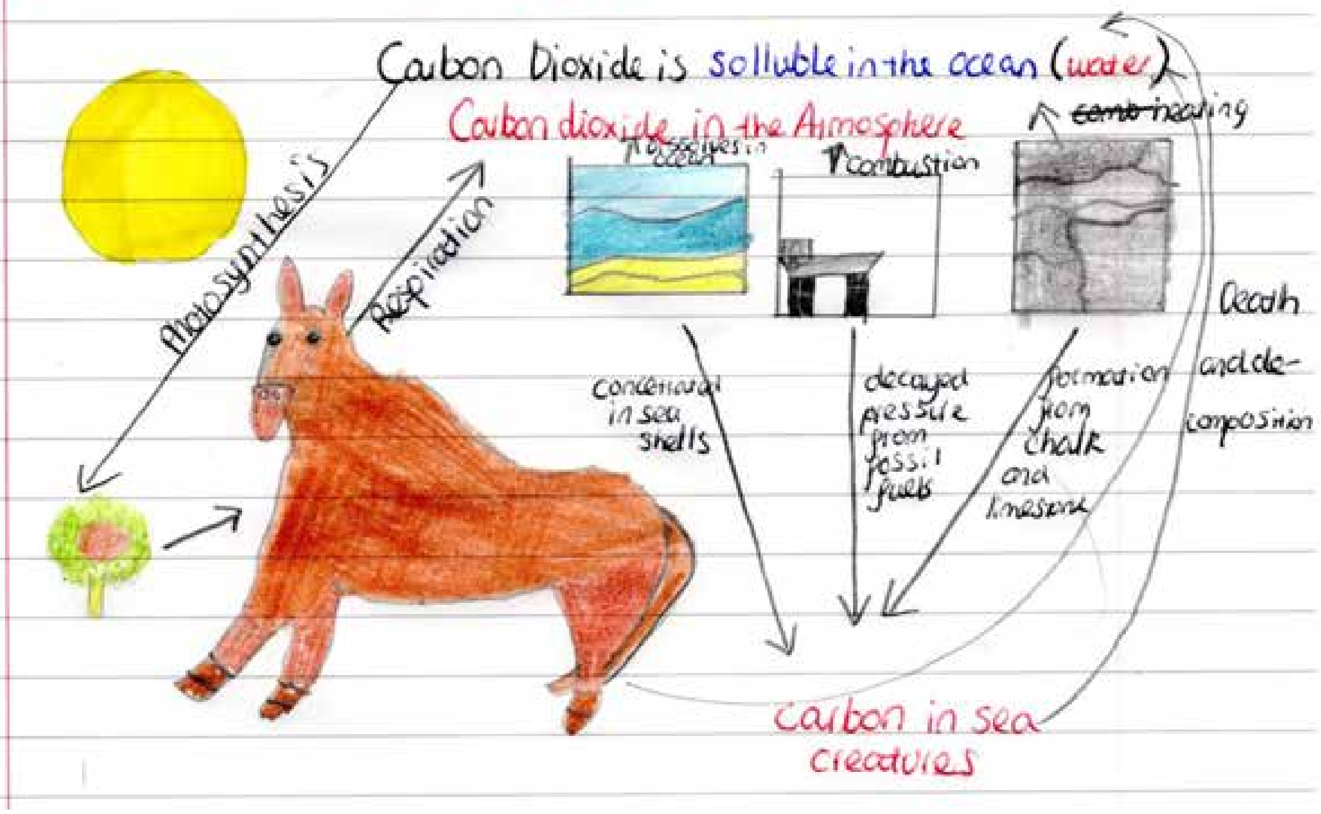
RYAN JOHN

THE CARBON CYCLE

When new life is formed, carbon forms key molecules like protein and DNA. It's also found in our atmosphere in the form of carbon dioxide. The carbon cycle is nature's way of re using carbon atoms which travel from the atmosphere into organisms in the Earth and then back into the atmosphere over and over again.

The carbon cycle is natural processes in the atmosphere, ecosystems, oceans and the Earth's crust (such as photosynthesis and respiration) as well as human activites (burning fuels through combustion) where carbon is recycled.

The carbon cycle is vital to life on Earth. Nature tends to keep carbon levels balanced meaning that the amount of carbon naturally released from reservoirs. Maintaining this carbon ballnce allows the planet to remain hospitable for life.



Carbon Sinks and Sources

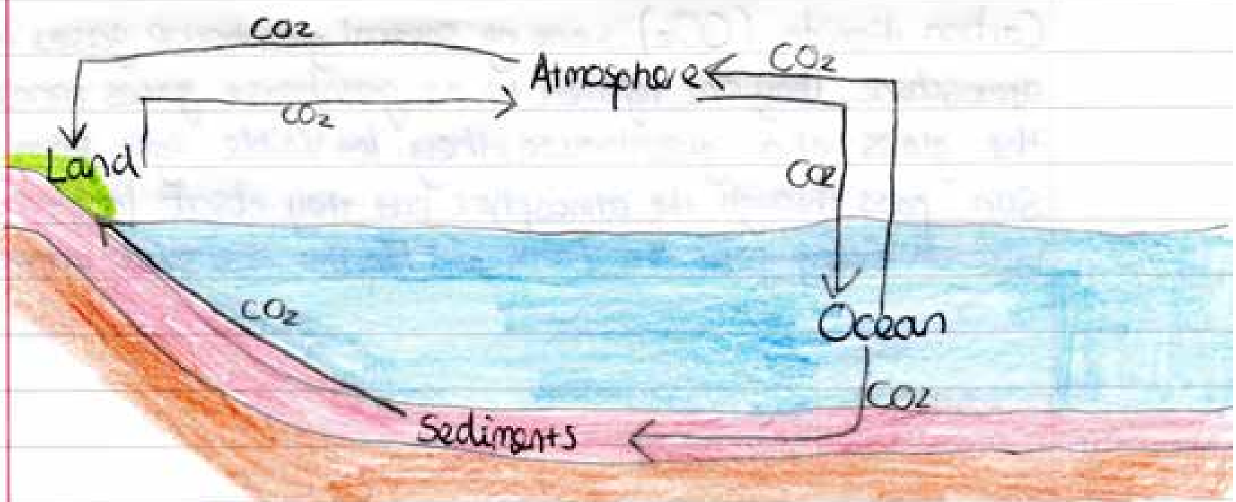
Carbon Sinks are very important for our environment because they act like sponges to soak up the carbon compounds that are playing such an enormous role in global climate change.

- A carbon sink is a natural reservoir that stores carbon-containing chemical compounds accumulated over an indefinite period of time.
- The process by which carbon sinks remove carbon dioxide (CO_2) from the atmosphere is known as carbon sequestration.

Animals are buried, carbon is taken up by plants and animals are buried and their remains became oil and gas (fossil fuels). This is called the Carbon Cycle.

4 carbon sinks can be plankton growth, volcanic eruption, coal formation and rock formation.

The difference between carbon sinks and sources are Carbon sinks are areas that store and absorbs carbon however carbon sources give off carbon for example combustion of fossil fuels

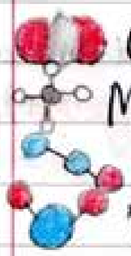


Greenhouse Effect.

The greenhouse effect is the way in which heat is trapped close to Earth's surface 'greenhouse gases'.

The greenhouse effect: Some of the infrared radiation from the Sun passes through the atmosphere, but most is absorbed and re-emitted in all directions by greenhouse gas molecules and clouds. The effect of this is to warm the Earth's surface and the lower atmosphere.

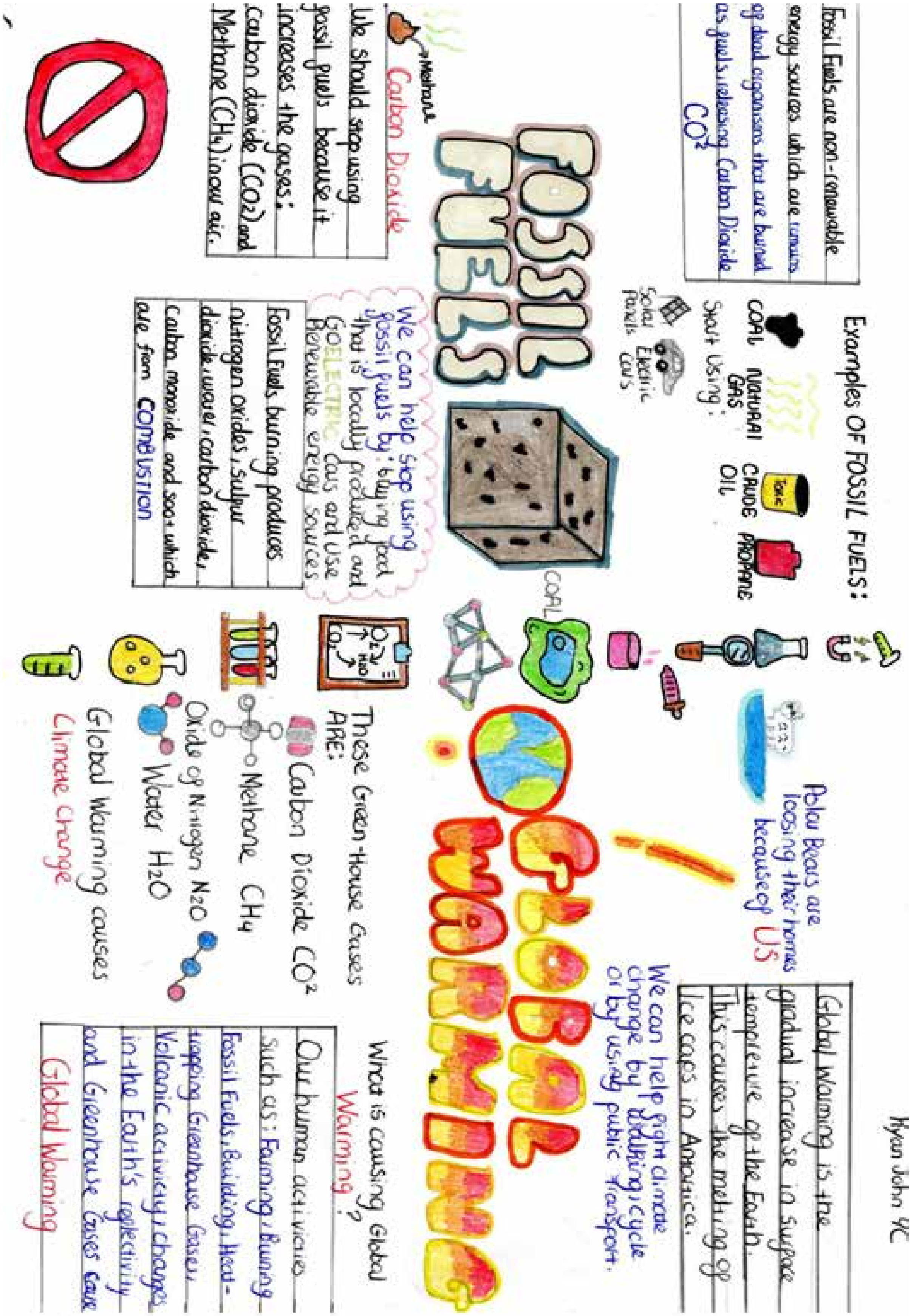
These greenhouse gases are:



Carbon Dioxide CO_2
Methane CH_4
Oxide of Nitrogen N_2O
Water H_2O

Greenhouse gas emissions can be reduced by making power on-site with renewables and other climate-friendly energy resources. Examples include rooftop solar panels, solar water heating, small-scale wind generation, fuel cells powered by natural gas or renewable hydrogen, and geo-thermal energy.

Carbon dioxide (CO_2) is one of several greenhouse gases in the atmosphere. They are referred to as greenhouse gases because, like the glass of a greenhouse, they let visible light from the Sun pass through the atmosphere but they absorb long-wavelength infrared energy from the Earth and keep the atmosphere warm.


Ryan John 4C
Fossil Fuels are non-renewable energy sources which are remains of dead organisms that are burned as fuels, releasing Carbon Dioxide CO^2
Examples OF FOSSIL FUELS:
COAL
NATURAL GAS
CRUDE OIL
PROPANE
Toxic
Start Using:
Solar Panels
Electric cars
FOSSIL FUELS
COAL
Methane
Carbon Dioxide
We should stop using fossil fuels because it increases the gases: carbon dioxide (CO_2) and Methane (CH_4) in our air.
We can help stop using fossil fuels by: buying food that is locally produced and GO ELECTRIC cars and use Renewable energy sources
Fossil Fuels burning produces nitrogen oxides, sulfur dioxide, water, carbon dioxide, Carbon monoxide and soot which are from COMBUSTION
Polar Bears are loosing their homes because of US
GLOBAL WARMING
Global Warming is the gradual increase in surface temperature of the Earth. This causes the melting of Ice caps in Antarctica.
We can help fight climate change by walking, cycle or by using public transport.
These Green-House Gases ARE:
Carbon Dioxide CO^2
Methane CH_4
Oxide of Nitrogen N_2O
Water H_2O
Global Warming causes Climate Change
What is causing Global Warming?
Our human activities such as: Farming, Burning Fossil Fuels, Building, Heat-trapping Greenhouse Gases, Volcanic activity, changes in the Earth's reflectivity and Greenhouse Gases cause Global Warming

KAYTRINA BABBOO
THE CARBON CYCLE

The Carbon Cycle

Kaytrina Babboo 9C

9Curie 9X1

What is meant by 'The Carbon Cycle'?

Natural processes in the atmosphere, ecosystems, oceans and the Earth's cruse (such as photosynthesis and respiration) as well as human activities (burning fuels) where carbon is recycled.

What is the most important part?

During photosynthesis, plants absorb carbon dioxide and sunlight to create fuel - glucose and other sugars - for building plant structures. This process forms the foundation of the fast (biological) carbon cycle.

How is carbon maintained in nature?

The natural carbon cycle is kept very nearly in balance; animals and plants emit CO_2 into the atmosphere through respiration, while plants absorb it through photosynthesis. The ocean also cycles CO_2 with the atmosphere, in an almost perfect balance.

Why is it important?

When new life is formed, carbon forms key molecules like protein and DNA. It's also found in our atmosphere in the form of carbon dioxide. The carbon cycle is nature's way of reusing carbon atoms, which travel from the atmosphere into organisms in the Earth and the back into the atmosphere over and over again.

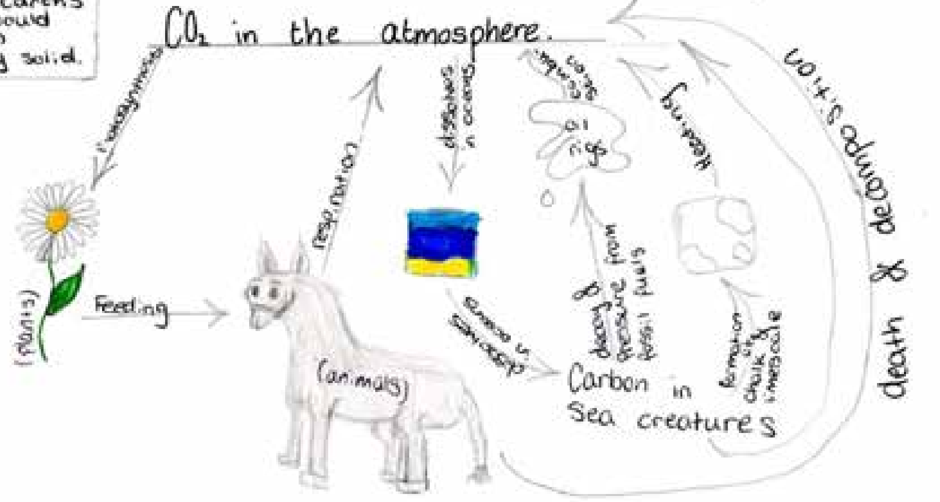
How does it affect Climate Change?

The changes in the carbon cycle impact each reservoir. Excess carbon in the atmosphere warms the planet and helps plants on land grow more. Excess carbon in the oceans make the water more acidic, putting marine life in danger.

How will our future energy use influence the carbon cycle?

More carbon will be released into reservoirs such as the atmosphere and oceans if we continue to burn fossil fuels. However, the total carbon in the carbon cycle does not change.

Without the carbon cycle, most, if not all life on Earth would likely be dead. The Earth's oceans would be frozen completely solid.



Kaytrina Babboo 9C

Fossil Fuels

What are fossil fuels?

Remains of dead organisms that are burned as fuels, releasing CO_2. For more than a century, burning fossil fuels has generated most of the energy required to propel our cars, power our businesses, and keep the lights on in our homes. Even today, oil, coal and gas serve about 80% of our energy needs. They are non-renewable.

How are crude oil and natural gas made?

Millions of years ago, tiny animals lived in the sea. When they died, they fell into mud and sand at the bottom of the sea but did not rot away. Over millions of years, the animals' remains were buried deeper by the mud and sand. The pressure changed the mud and sand into rock. The dead animals turned into crude oil and natural gas.

What does [illegible] contain?

Fossil fuels include, petroleum/oil, coal/natural gas. They can be used for electricity, heating, fuel for vehicles.

Pros to using fossil fuels:

- Easier to store & transport.
- Very cheap (there is much)
- It would be more reliable than a renewable source.

How is coal made?

About 300 million years ago, the Earth was covered in lots of vegetation. Dead plants fell in swampy water and the mud prevented them from rotting away. Over the years, the mud piled up and squashed the plant remains. After millions of years under pressure, the mud became rock and the plants became coal.

How are there consequences to burning fossil fuels?

When fossil fuels are burned, they release large amounts of CO_2, a greenhouse gas, into the air. Greenhouse gases trap heat in our atmosphere, causing global warming. Already, the average global warming temperature increased by 1°C.

Cons in using fossil fuels?

- They are non-renewable. Worldometers says that we will run out of oil in 47 years, natural gas in 53 years and coal in 133 years.
- Pollute environment, contribute to greehouse gas. The most harmful to the environment is coal, because it has many more combustion products than any other fossil fuels.
- In case of irresponsible use, fossil fuels can be very dangerous. It is a very flammable product. They should be used cautiously.

There have been a few oil spills. Eg. MV Wakashio which spilled oil on the South-east coast of Mauritius.

Kayarina Babboo 9C

Carbon Sinks & Sources

What is a Carbon Sink?

A Carbon Sink is an area of vegetation, the ocean or Soil which absorb and store Carbon.

3 examples of Carbon Sinks are:

Rock formation
Shell formation
Oceans

Why do we need Carbon Sources?

Carbon helps to regulate the Earth's temperature, makes all life possible, is a key ingredient in the food that sustains us, and provides a major source of the energy to fuel our global economy. Most of Earth's carbon is stored in rocks and Sediments. The rest is located in the ocean, atmosphere and in living organisms. These are the reservoirs which carbon cycle. Increased Concentrations of Carbon dioxide increase photosynthes, Spurring Plant growth. While rising Carbon dioxide levels are bene-ficial for plants, it is also the Chief culprit of climate Change.

Why do we need Carbon Sinks?

Carbon sinks are very important for our environment because they act like Sponges to Soak up the Carbon Compounds that are playing Such an enormous role in global Climate. A Carbon Sink is a natural reservoir that Stores Carbon-containing Chemical Compounds accumulated over an indefinite period of time. The process by which Carbon Sinks remove carbon dioxide (CO_2) from the atmosphere is known as Carbon Sequestration.

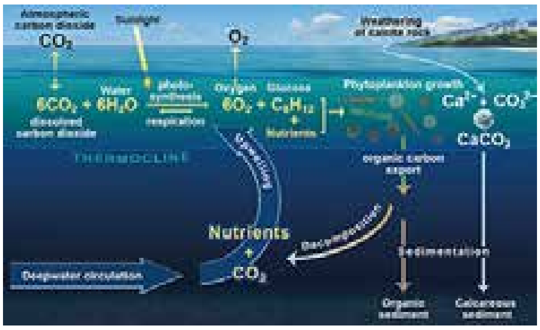
What is a Carbon Source?

A Carbon Source releases Carbon dioxide (CO_2) into the atmosphere.

3 examples of Carbon Sources:

Burning fossil fuels
Animal respiration
Plant respiration

OCEANS ARE THE LUNGS OF THE EARTH



Given that about 70% of our planet's surface is covered in water, it should come as no surprise that oceans are crucial to the carbon cycle and regulating the amount of carbon dioxide in the atmosphere. And it is not just the passive dissolving of the gas in the ocean water, the ocean and its living organisms become a **biological carbon pump**.

Just like plants on land, microscopic marine phytoplankton take up carbon dioxide [CO2] and water [H2O] from their surrounding and use energy from sunlight to turn it into glucose [C6H12] and oxygen [O2]. The glucose powers the metabolism of the plankton cells, and can be turned into other organic compounds. If enough nutrients are available the plankton will grow and multiply. Phytoplankton are the 'grass of the sea' - at the bottom of the marine food chain. Respiration by animals, bacteria and plants 'remineralises' the organic carbon - turning it back into carbon dioxide and water.

Kayerina Babboo 9C

Greenhouse Gases/Effects

What are Greenhouse Gases?

A gas that contributes to the greenhouse effect by absorbing infrared radiation. Carbon dioxide and Chlorofluorocarbons are examples of Greenhouse Gases.

4 examples of Greenhouse gases:

Carbon dioxide CO_2
Methane CH_4
Nitrous oxide N_2O
Water H_2O

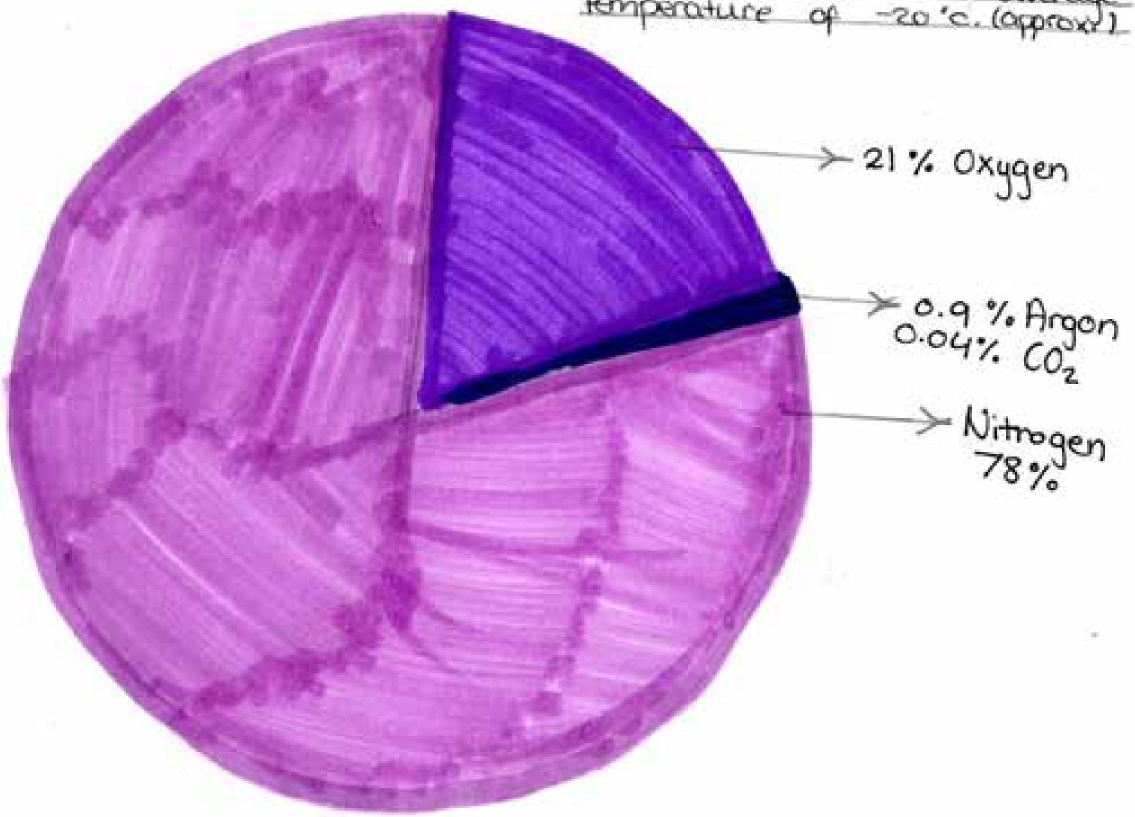
What effect does Radiation give?

Radiation is the energy that comes from a source and travels through space at the speed of light. This energy has an electric field and a magnetic field associated with it, and has wave-like properties. You could also call radiation "Electomagnetic Waves".

Why are Greenhouse gases important?

Greenhouse gases are crucial to keeping our plant at a suitable temperature for life. Without the natural greenhouse effect, the heat emmited by the Earth would simply pass outwards from the Earth's surface into space and the Earth would have an average temperature of -20°c. (approx)

The air we breathe in is made up of 4 things:



Kaytrina Babboo
9C

Global Warming

What is Global warming?

A gradual increase in the overall temperature of the Earth's atmosphere generally attributed to the greenhouse effect caused by increased levels of Carbon dioxide, CFC's and other pollutants. Basically, the gradual increase in the Earth's sufface temperature.

3 effects of globAl warming are:

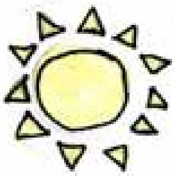
- Melting glaciers
- Sea levels rising
- Warmer temperatures

3 causes of global warming are:

- use of greenhouse gases.
- Lots of volcanic activity
- Changes in orbit and rotation

Wildlife effects?

The wildlife we love and their habitat will be destroyed, leading to mass extinction of species. Superstorms, droughts and heat waves would become increasingly common and more extreme, leading to major health crisis and illness. Agricultural production would plummet, likely leading to global food shortages and famine.



Light from the sun:

The sun emits solar radiation

↓

Radiation passes through the Earth's atmosphere and hits the surface.

↓

When something has radiation passed through it, it means it has been transmitted.

↓

Radiation hits the Earth's surface but not all of it bounces back into space. This means it has been absorbed.

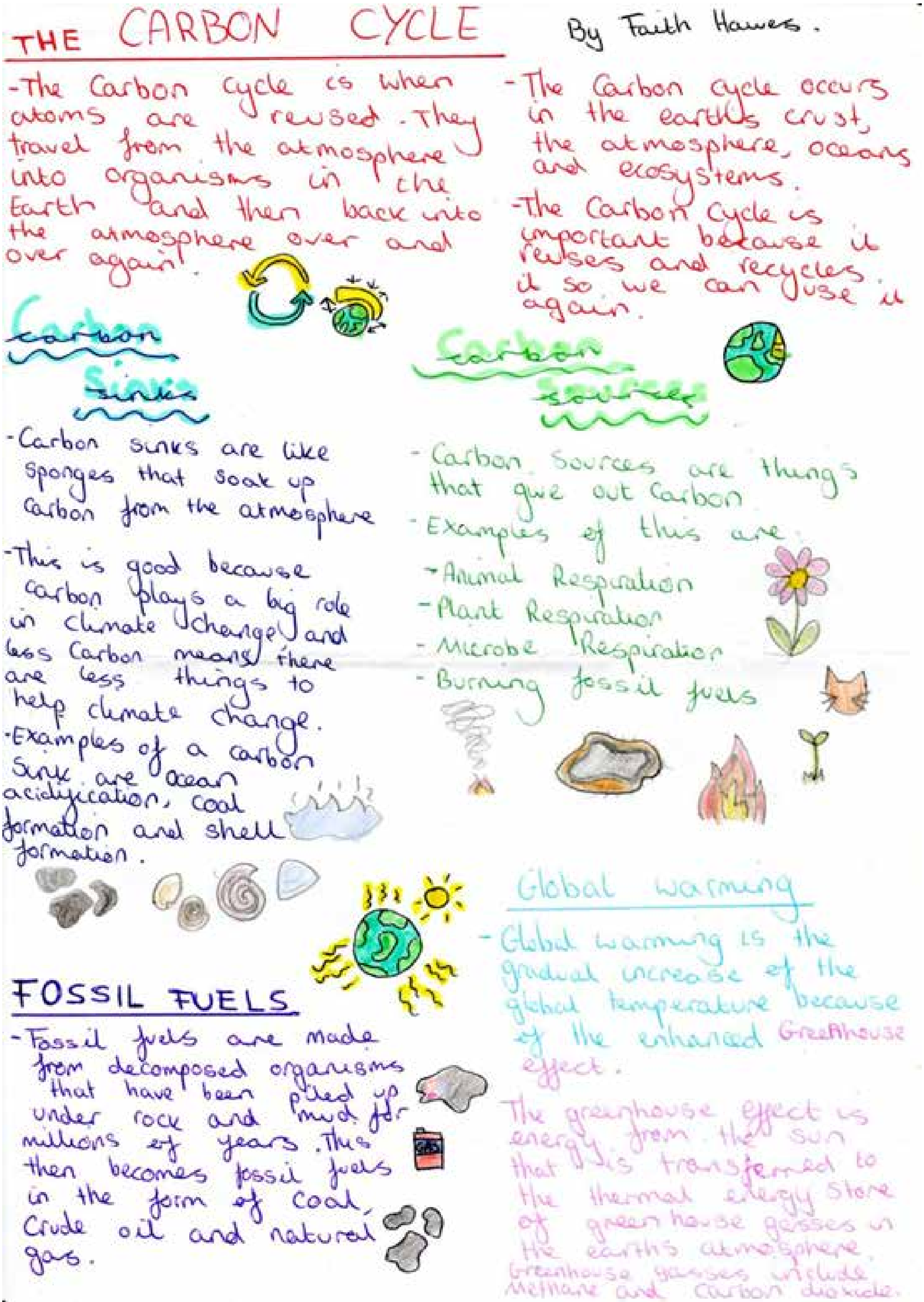
↓

The radiation that does bounce back is called reflection. →

Radiation that warms up the Earth is called infrared radiation.

FAITH HAWES

THE CARBON CYCLE



ISABEL BASHAM

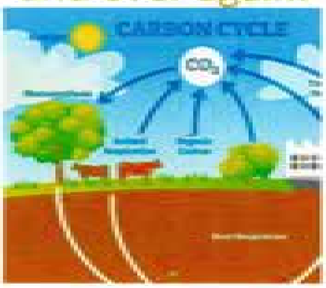
The Carbon Cycle

What is the carbon cycle?

The carbon cycle is natural processes and human activities where carbon is recycled. This is in the atmosphere, oceans, ecosystems and in the Earth's crust as well as humans burning fuels.

Why is the carbon cycle important?

The carbon cycle is important because it is nature's way of reusing carbon, which travels from the atmosphere to the Earth and back, over and over again.



Carbon Sinks and Carbon Sources

A carbon sink is a natural reservoir that absorbs carbon dioxide from the atmosphere.

A carbon source is a natural or man-made reservoir that produces carbon dioxide into the atmosphere.

Carbon sequestration is the process by which carbon sinks to remove carbon dioxide from the atmosphere and store it.

Some examples of carbon sinks are: coal formation,
photosynthesis and
the ocean.

Some examples of carbon sources are: animal respiration,
plant respiration and
burning fossil fuels.

Fossil Fuels

How is coal made?

Coal used to be vegetation. About 300 million years ago, dead plants fell into swampy water and the mud prevented the plants from rotting away. Over the millions of years, the mud piled up and started to squash the plant remains. Under the pressure, the mud became rock and the plants became coal.

How is crude oil and natural gas made?

Crude oil and natural gas used to be tiny animals. Millions of years ago, tiny sea animals died and fell to the bottom of the sea. The mud in the sand prevented them from rotting away and over the years the animal remains were buried deeper in the sand and mud. Under the pressure, the mud and sand became rock and the animal remains became crude oil and natural gas.

Greenhouse Gases

There are many gases in Earth's atmosphere, but the main ones are nitrogen (78%), oxygen (21%), argon (0.9%), carbon dioxide (0.04%) and hydrogen (almost none at all in the atmosphere).

However, there are other gases which make up the greenhouse gases. These are methane, nitrates and nitrites, water, sulphur dioxide and carbon monoxide. Carbon dioxide is also a greenhouse gas.

A greenhouse gas is a gas in the atmosphere which absorbs, reflects and transmits heat energy from the sun.

The greenhouse effect is when energy from the sun is transferred to the gases in the atmosphere that store thermal energy.

Carbon dioxide, nitrates and nitrites, methane and water stop the heat in the atmosphere from escaping because they absorb, reflect and transmit heat energy. The levels of carbon dioxide and methane in the atmosphere have increased due to humans doing things like burning fossil fuels, farming and planting rice fields.

Global Warming

Light from the sun

The sun emits solar radiation. This radiation is transmitted (passed) through Earth's atmosphere and is absorbed into Earth's surface. Some of this radiation is reflected back into space. The radiation warms Earth's surface and then the heat energy is radiated back into space. This is called infrared radiation.

Climate and weather

Weather is atmospheric conditions and climate is weather in a specific region over a long period of time. The Earth's climate has gotten warmer over the last 150 years and to prevent the Earth from warming even more, people are using more electric cars, wind turbines, solar panels and hydro electric dams. However, the negative effects of climate change are still rapidly continuing. This includes ice bergs melting and sea levels rising, ruining some animals habitats and potentially causing those animals extinction.

GLOBAL WARMING vs CLIMATE CHANGE – some facts and figures

"Climate change" and "global warming" are often used interchangeably but have distinct meanings. Similarly, the terms "weather" and "climate" are sometimes confused, though they refer to events with broadly different spatial- and timescales.

Global warming is the long-term heating of Earth's surface observed since the pre-industrial period (between 1850 and 1900) due to human activities, primarily fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere. This term is not interchangeable with the term "climate change." Since the pre-industrial period, human activities are estimated to have increased Earth's global average temperature by about 1 degree Celsius (1.8 degrees Fahrenheit), a number that is currently increasing by more than 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade. The current warming trend is unequivocally the result of human activity since the 1950s and is proceeding at an unprecedented rate over millennia.

Climate change is a long-term change in the average weather patterns that have come to define Earth's local, regional and global climates. These changes have a broad range of observed effects that are synonymous with the term. Changes observed in Earth's climate since the mid-20th century are driven by human activities, particularly fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth's atmosphere, raising Earth's average surface temperature. Natural processes, which have been overwhelmed by human activities, can also contribute to climate change, including internal variability (e.g., cyclical ocean patterns like *El Niño*, *La Niña* and the *Pacific Decadal Oscillation*) and external forcings (e.g., volcanic activity, changes in the Sun's energy output, variations in Earth's orbit).

KEIRA CARTWRIGHT
THE CARBON CYCLE

The carbon cycle describes the continuous movement of carbon atoms from the atmosphere to the Earth and then back into the atmosphere. Because our

The carbon cycle is nature's method of recycling carbon atoms, which travel from the atmosphere into organisms on Earth and then back into the atmosphere.

planet and its atmosphere form a closed system, the amount of carbon in this system remains constant. The location of carbon, whether in the atmosphere or on Earth, is constantly changing.

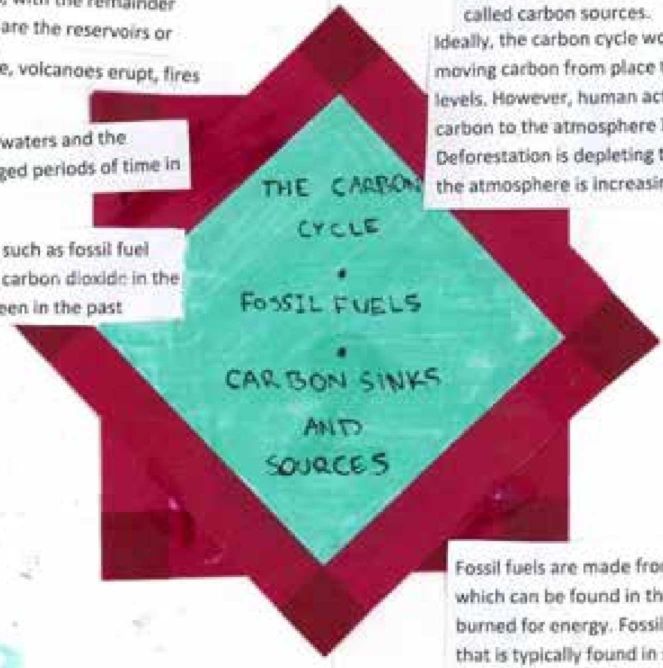
The majority of carbon on Earth is kept in rocks and sediments, with the remainder deposited in the ocean, atmosphere, and living species. These are the reservoirs or sinks where carbon cycles.

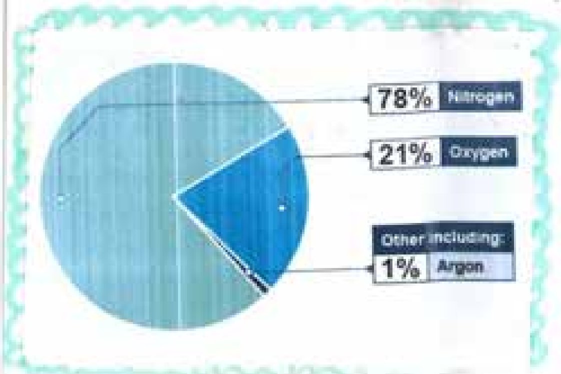
Carbon is released back into the atmosphere as organisms die, volcanoes erupt, fires burn, and fossil fuels being used, among other things.

Carbon is constantly transferred between the ocean's surface waters and the atmosphere in the case of the ocean, or it is stored for prolonged periods of time in the ocean depths.

Humans play a significant role in the carbon cycle via activities such as fossil fuel combustion and land development. As a result, the amount of carbon dioxide in the atmosphere is fast increasing; it is now far higher than it has been in the past 800,000 years.

atoms back recycling





A carbon sink is anything that absorbs significantly more carbon than it emits. Forests are typically carbon sinks, absorbing more carbon than they emit. Through the process of photosynthesis, they continuously remove carbon from the atmosphere. The ocean is another example of a carbon sink, absorbing a significant amount of CO2 from the atmosphere.

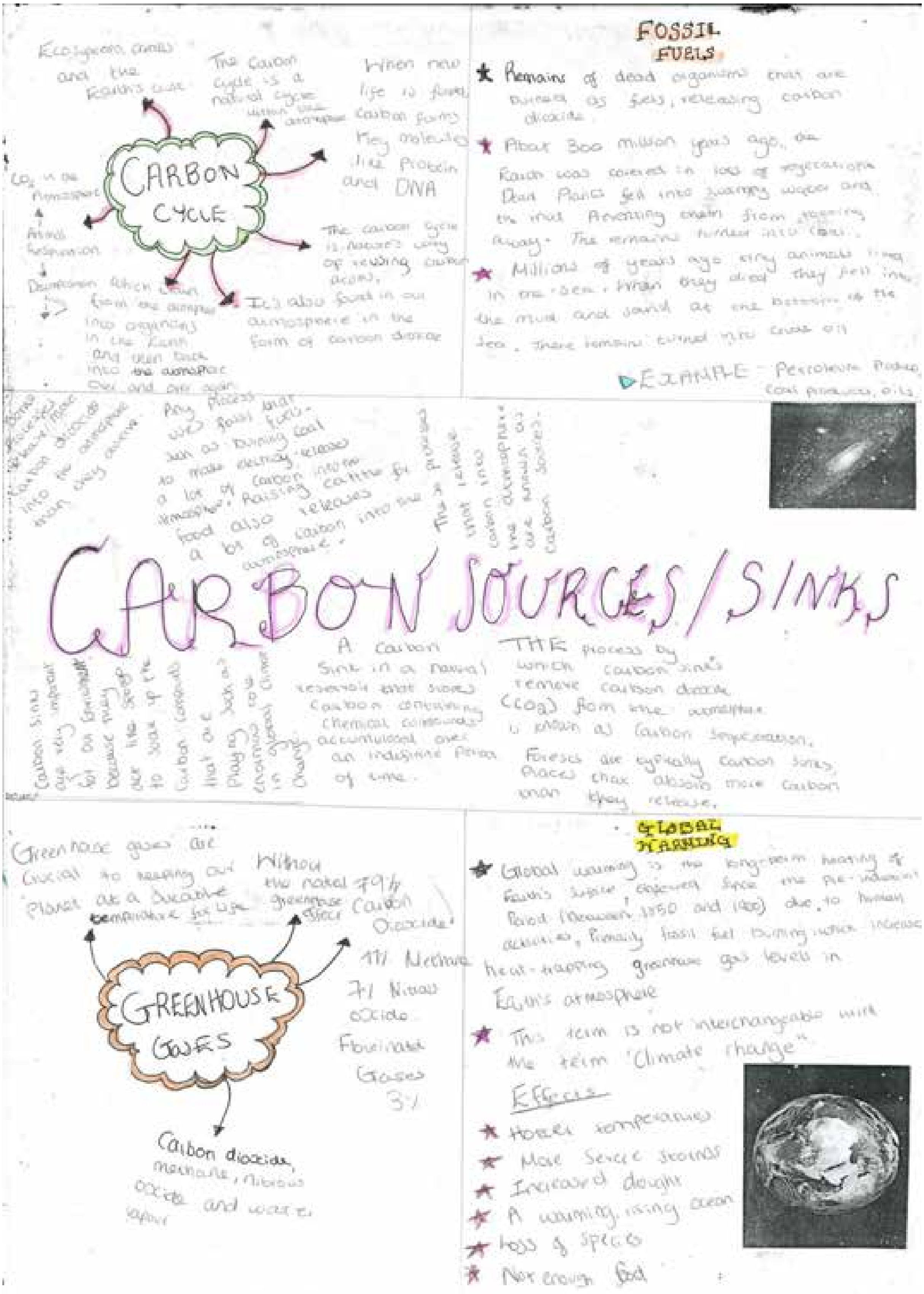
Some processes release more CO2 into the atmosphere than they absorb. Any process that uses fossil fuels, such as burning coal to generate electricity, releases a significant amount of carbon into the atmosphere. Cattle farming also does the same. These processes that release large amounts of carbon into our atmosphere are called carbon sources.

Ideally, the carbon cycle would maintain Earth's carbon concentrations in balance by moving carbon from place to place and keeping a good atmospheric carbon dioxide levels. However, human activity is altering the carbon cycle. People are adding more carbon to the atmosphere by burning fossil fuels and raising large livestock herds. Deforestation is depleting the Earth's carbon sinks. As a result, the carbon content of the atmosphere is increasing.

Fossil fuels are made from the decomposition of plants and animals. These fuels, which can be found in the Earth's crust and contain carbon and hydrogen, can be burned for energy. Fossil fuels include coal, oil, and natural gas. Coal is a material that is typically found in sedimentary rock deposits where layers of rock and dead plant and animal matter are built up over time. Oil was discovered as a solid material between layers of sedimentary rock. This material is heated to create the thick oil that can be used to make gasoline. Natural gas is commonly discovered in pockets above oil deposits. It can also be found in sedimentary rock layers that do not contain oil. Methane is the primary component of natural gas. Because fossil fuels are nonrenewable, waiting millions of years for new coal, oil, and natural gas deposits to form is not a reasonable solution. In addition, fossil fuels are responsible for nearly three-fourths of the emissions from human activities in the last the last 20 years. Scientists and engineers are still looking for ways to reduce our reliance on fossil fuels while also making their combustion cleaner and healthier for the environment.

DEENA ELDHO

THE CARBON CYCLE

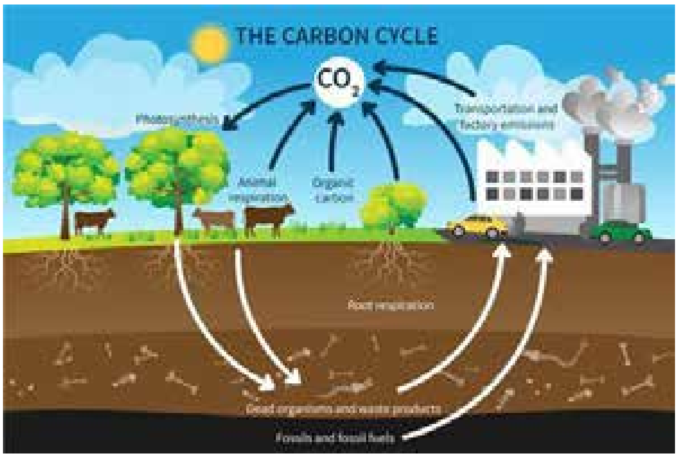


Vol 7, No 2; December 2022

DELFINA WARREN BARBIERI

THE CARBON CYCLE AND EARTH'S ATMOSPHERE

The Carbon Cycle



The carbon cycle is a natural process in the atmosphere, ecosystems, oceans and the Earth's crust – including photosynthesis and respiration – as well as human activities, such as burning fossil fuels, where carbon is recycled.

The carbon cycle is important because when new life is formed carbon forms key molecules like protein and DNA. Carbon is also found in our atmosphere in the form of carbon dioxide. The carbon cycle is nature's way of reusing carbon atoms which travel from the atmosphere into organisms and then back into the atmosphere over and over again.

Carbon Sinks and Sources

A carbon sink is an area of vegetation, the ocean or the soil which absorbs and stores carbon. Examples of a carbon sink would include plankton growth, photosynthesis, shell formation, oceans and the forming of fossils and coal.

A carbon source refers to the molecules used by an organism as the source of carbon for building its biomass. A carbon source can be an organic compound or an inorganic one.

Fossil Fuels

Fossil fuels are the remains of dead organisms that are burned as fuel, releasing carbon dioxide. We use fossil fuels because they produce energy and are quite efficient. They are also used in producing plastics. We class fossil fuels as "non-renewable", although they are technically renewable but very, very slowly taking millions of years. Coal is an example of a fossil fuel.

Greenhouse Gases

A greenhouse gas is when energy from the Sun is transferred to the thermal energy store of gases in the Earth's atmosphere.

GLOBAL WARMING & CLIMATE CHANGE – the future

Global climate change is not a future problem. Changes to Earth's climate driven by increased human emissions of heat-trapping greenhouse gases are already having widespread effects on the environment: glaciers and ice sheets are shrinking, river and lake ice is breaking up earlier, plant and animal geographic ranges are shifting, and plants and trees are blooming sooner. Effects that scientists had long predicted would result from global climate change are now occurring, such as sea ice loss, accelerated sea level rise, and longer, more intense heat waves and other extreme weather events.

Scientists have high confidence that global temperatures will continue to rise for many decades, mainly due to greenhouse gases produced by human activities. It is therefore imperative that we do something now to stop it. On 20th November, the 27th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP27), that took place in the Egyptian coastal city of Sharm el-Sheikh, concluded. Although there was an agreement to provide financial help to countries for "loss and damage", there was little progress on the most essential component: the reduction and eventual elimination of the burning of fossil fuels.

This was hugely disappointing to the majority of the world's communities, especially those that have been most affected in recent years. UN Secretary-General António Guterres said that more needs to be done to drastically reduce emissions now - *"The world still needs a giant leap on climate ambition."*

NATANIEL MIGULA

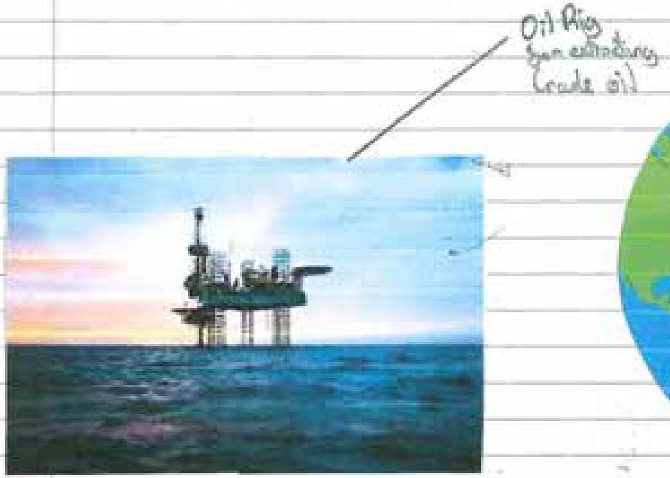
THE CARBON CYCLE

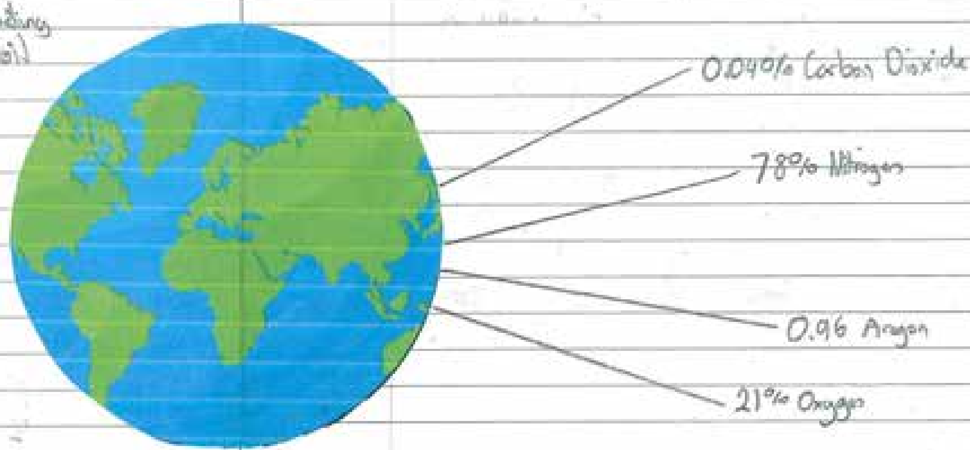
Greenhouse Effect and Global warming

The greenhouse effect is when energy from the sun is transferred to the thermal energy store of greenhouse gases in the earth's atmosphere. The enhanced greenhouse effect is what causes global warming, the enhanced greenhouse effect is the impact on the climate from the additional heat retained due to the increased amount of carbon dioxide and other greenhouse gases that humans have released into the earth's atmosphere.

Carbon Sinks and Sources

A carbon sink is a natural reservoir that stores carbon containing chemical compounds accumulated over an indefinite period of time. Carbon sinks are very important for our environment because they act like sponges to soak up the carbon compounds that are playing such an enormous role in climate change. A carbon source releases carbon dioxide into the atmosphere. The burning of fossil fuels is a carbon source.





The Carbon Cycle

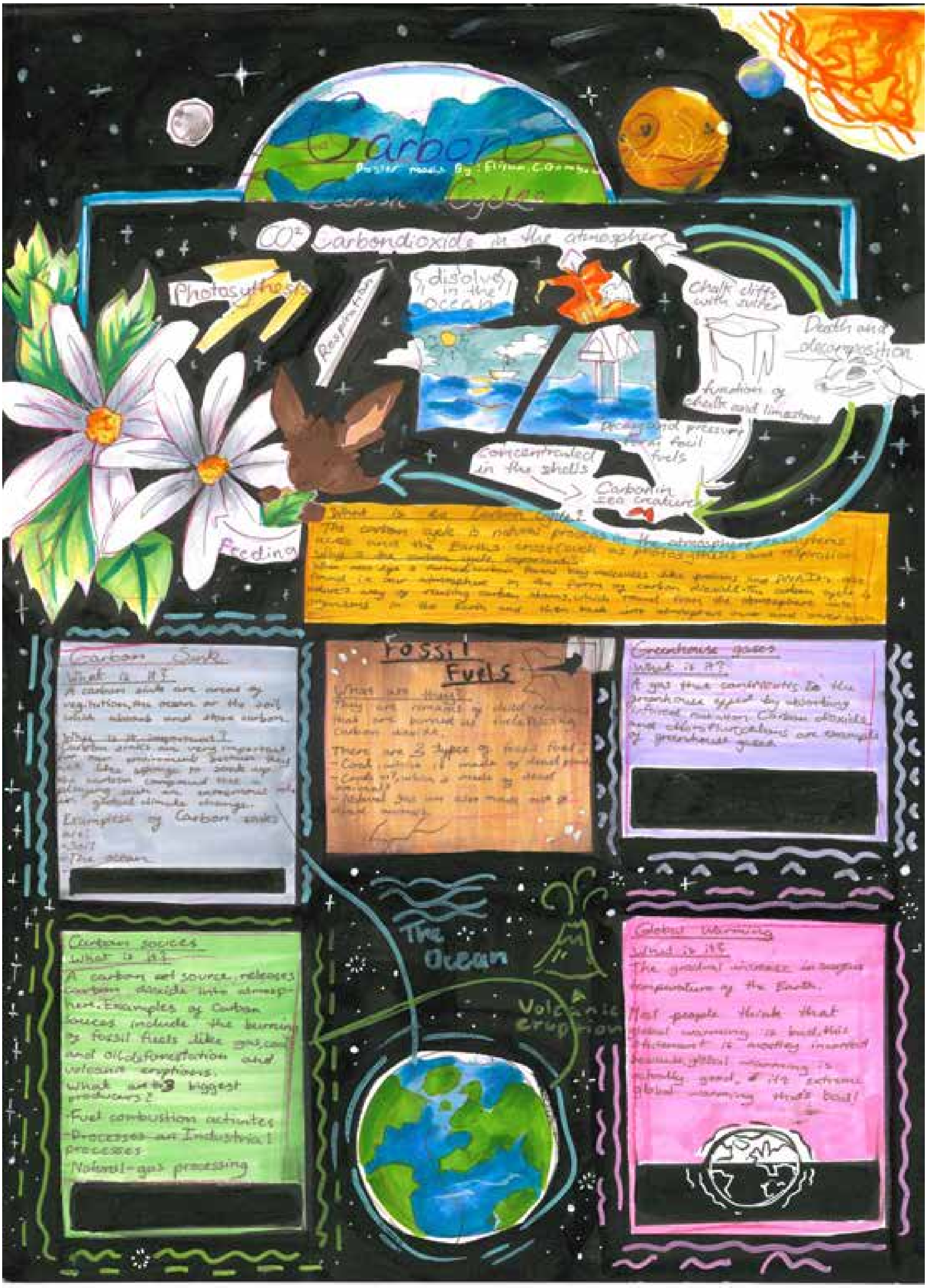
The carbon cycle is a natural process in the atmosphere, ecosystems, oceans and the earth's crust. The carbon cycle is nature's way of reusing carbon atoms which travel from the atmosphere into organisms on earth and then back into the atmosphere, this process is repeated.

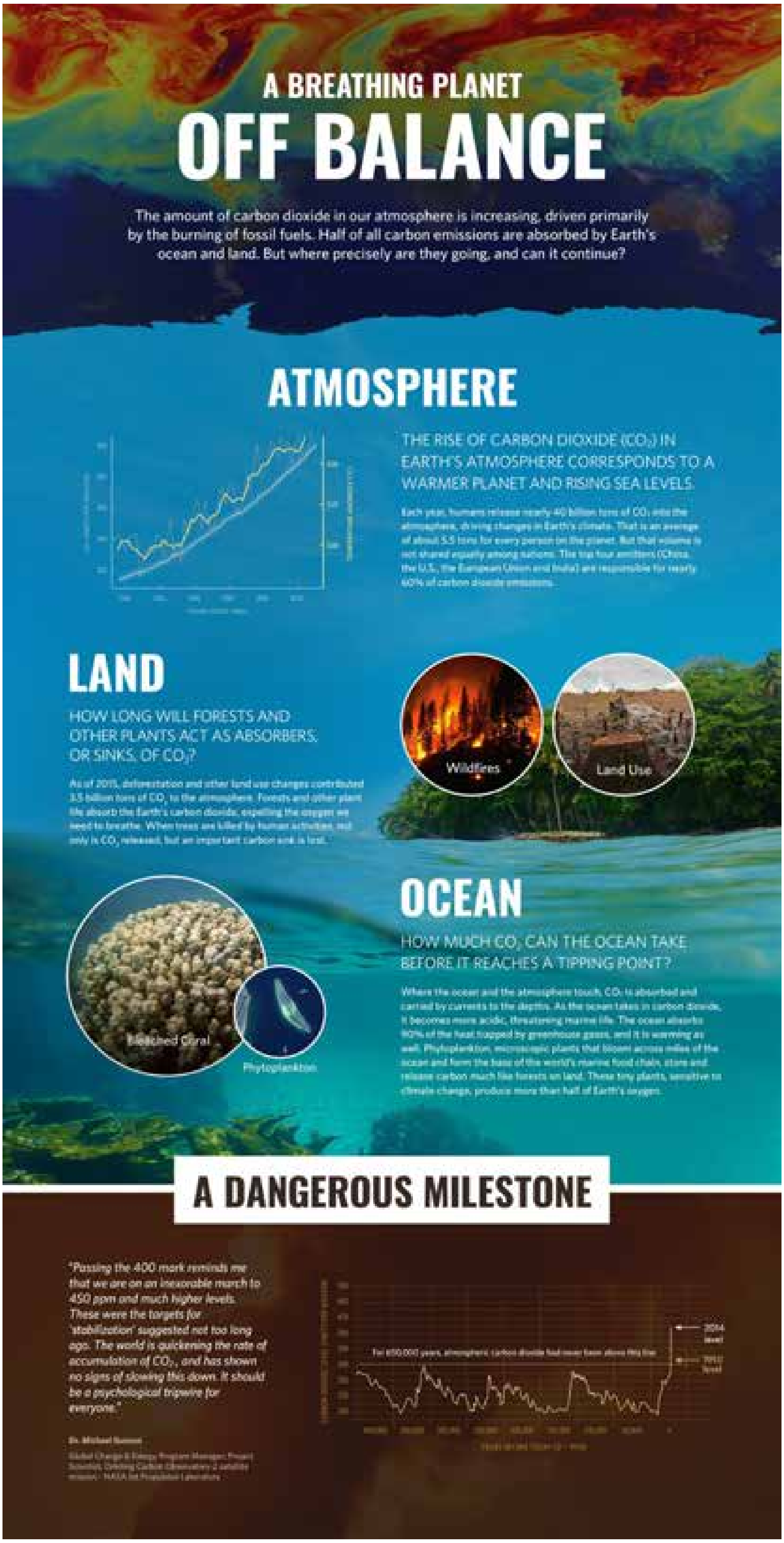
Fossil Fuels

Fossil Fuels are remains of dead organisms that are burned as fuels releasing carbon dioxide into the atmosphere. Crude oil and coal are both fossil fuels, Crude oil is made by tiny animals living in seas and oceans but when they die they do not rot away, over millions of years the animals are buried deeper by mud and sand and the pressure changes them into crude oil and natural gas.

ELISHA GAMBOA

THE CARBON CYCLE





GLOBAL CLIMATE CHANGE
Vital Signs of the Planet

From space, sky, sea, and land, NASA provides detailed climate data and research to the world.

How SWOT will look at the world's water. The international **Surface Water and Ocean Topography** mission will provide high-definition data on the salt- and fresh water on Earth's surface.

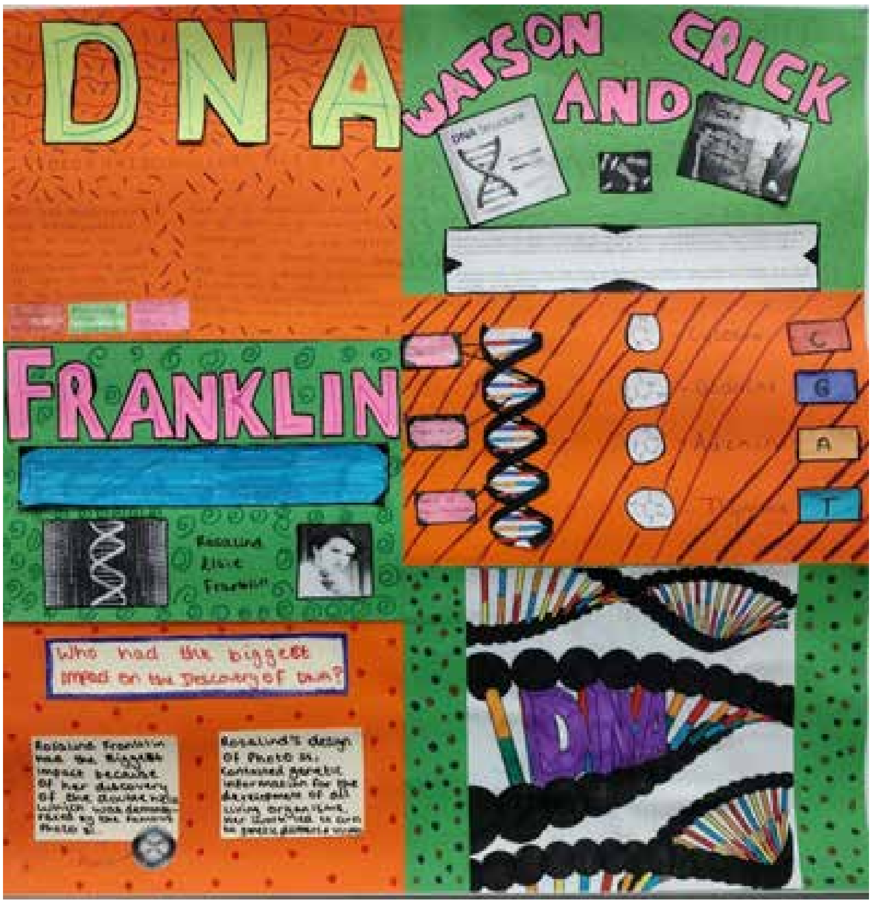
On Dec. 12, NASA will launch the Surface Water and Ocean Topography (SWOT) satellite into Earth orbit from Vandenberg Space Force Base in California atop a Falcon 9 rocket. The mission is a collaborative effort between NASA and the French space agency Centre National d'Études Spatiales (CNES) – with contributions from the Canadian Space Agency (CSA) and the UK Space Agency – that will survey water on more than 90% of the planet's surface.

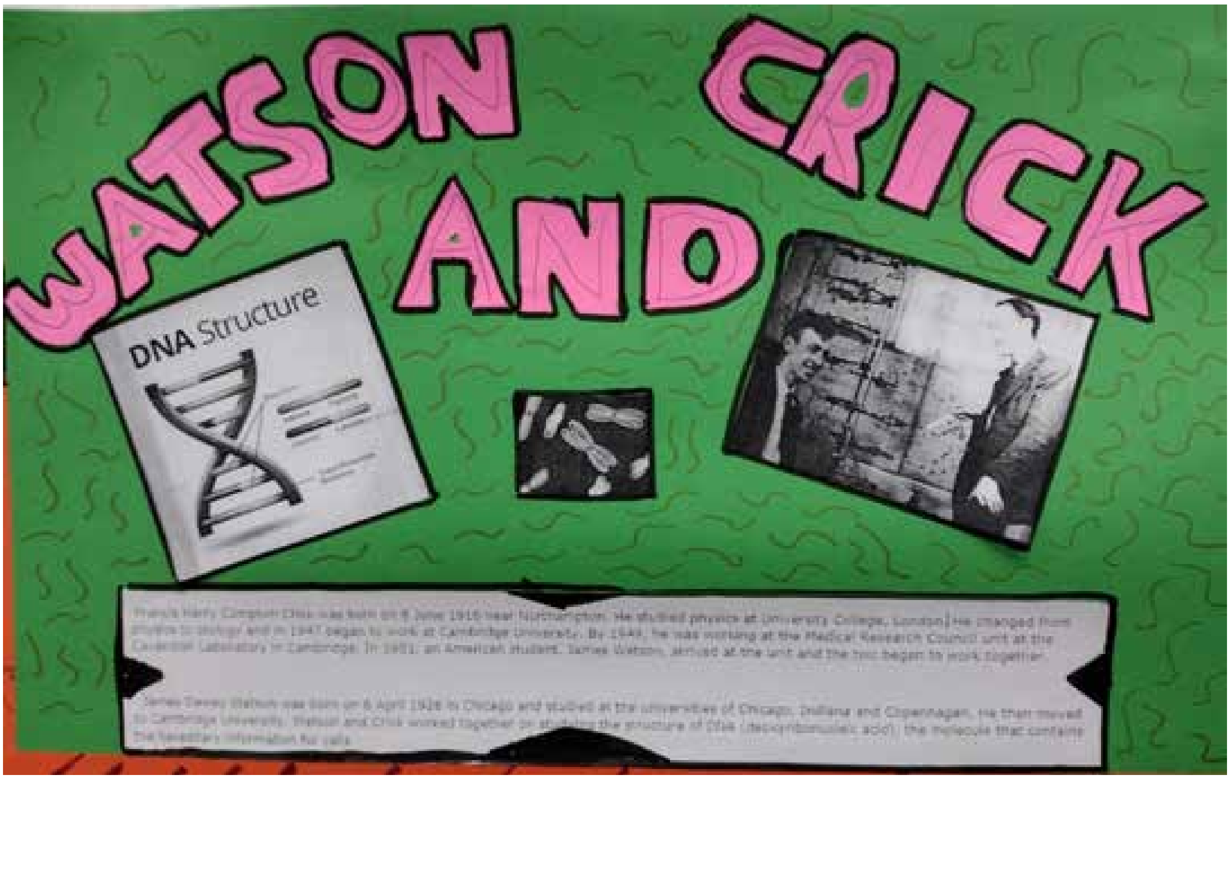
The satellite will measure the height of water in Earth's freshwater bodies and the ocean, providing insights into how the ocean influences climate change; how a warming world affects lakes, rivers, and reservoirs; and how communities can better prepare for disasters, like floods.

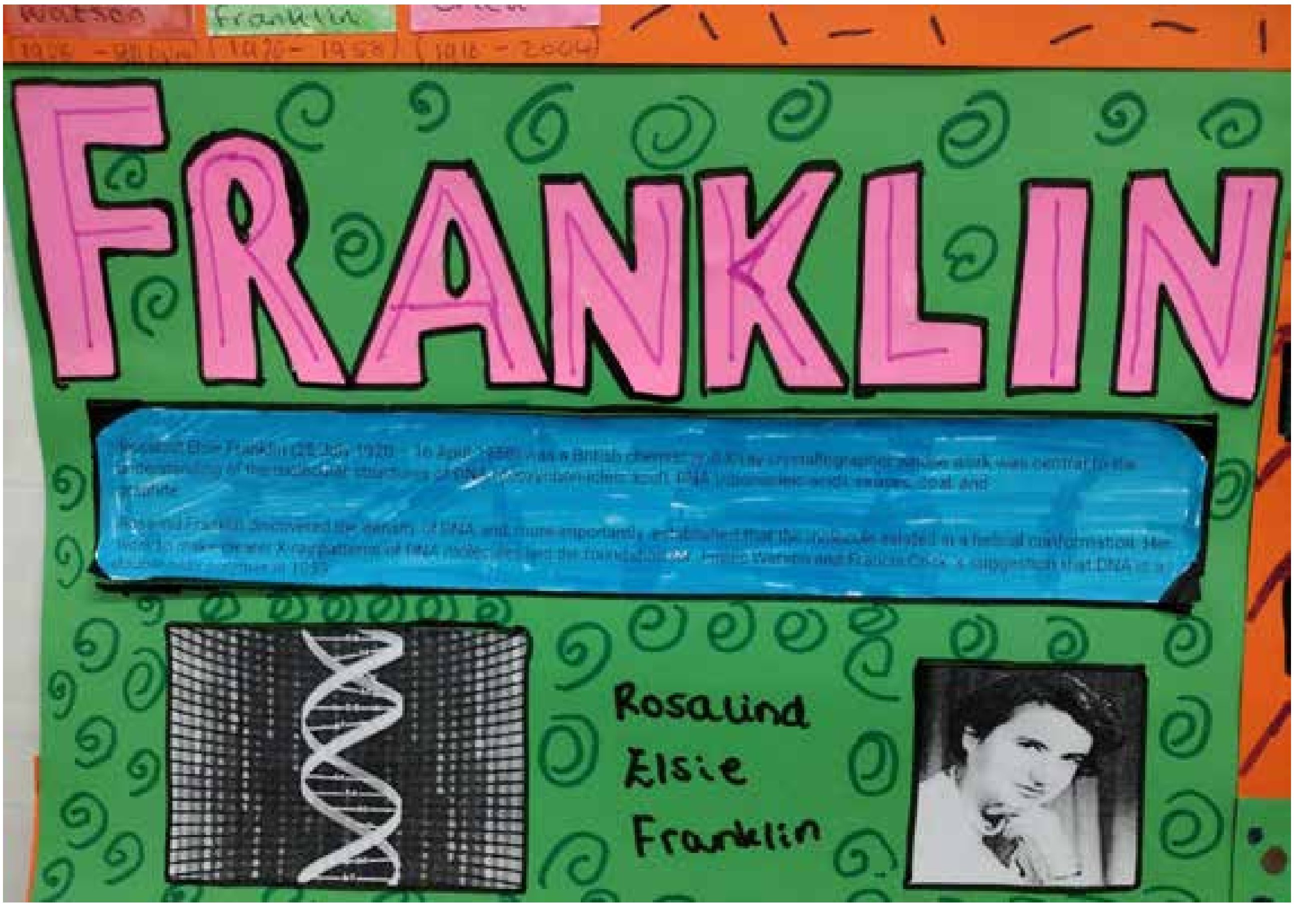
An important part of predicting our future climate is determining at what point the ocean slows down the absorption of excess heat trapped in the atmosphere and starts releasing it back into the air, where it could accelerate global warming. SWOT will provide crucial information about this global ocean-atmosphere heat exchange.

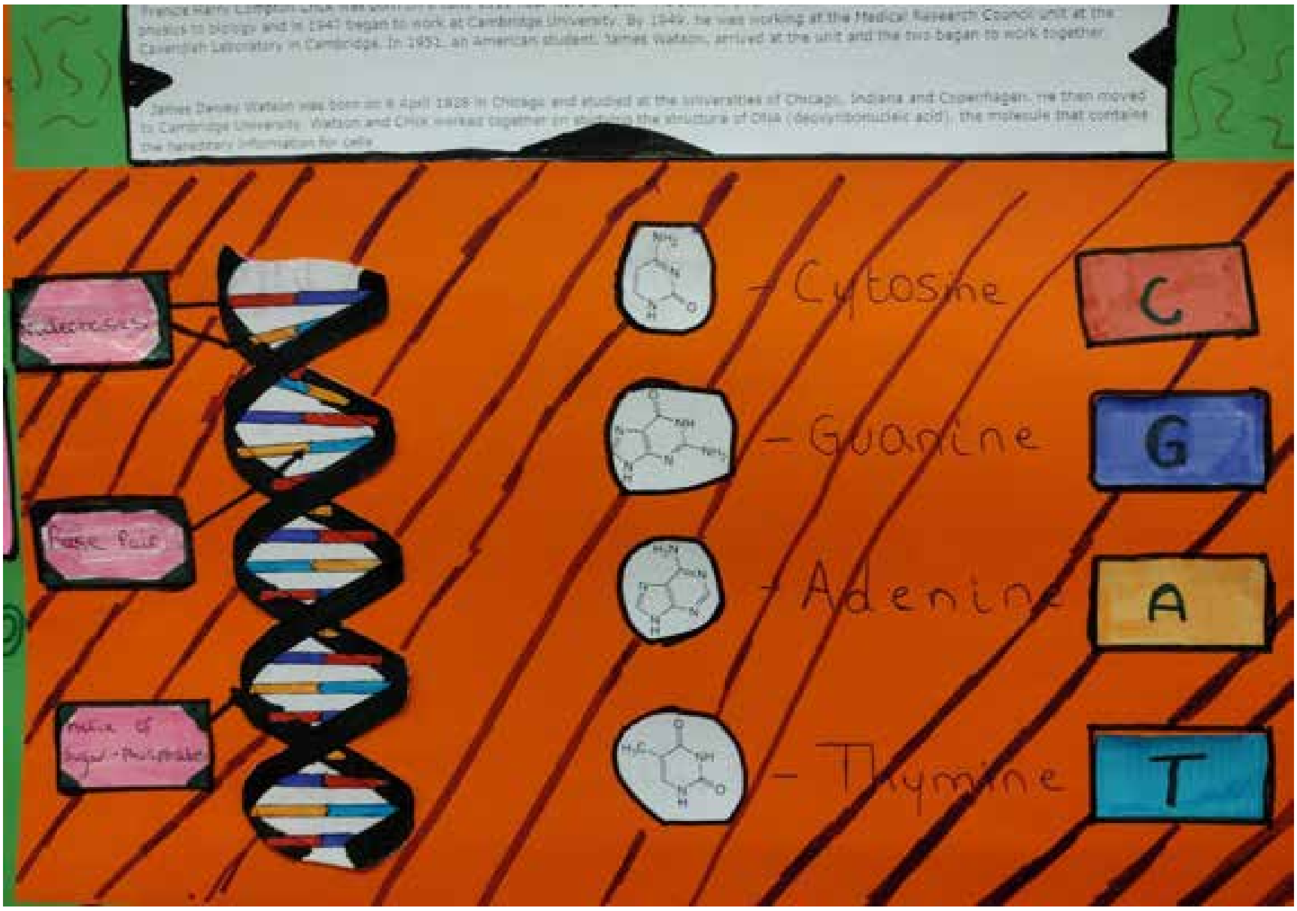
MIA BAGELOW

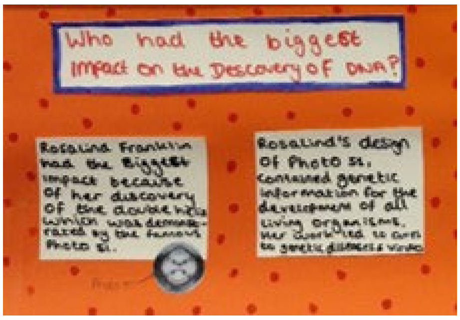
A HISTORY OF DNA






FRANKLIN
Rosalind
Elsie
Franklin


Cytosine
C
Guanine
G
Adenine
A
Thymine
T



[EDITOR'S NOTE: the following is a transcription of this author's opinion as to who had the biggest impact on the discovery of the structure of DNA, Watson & Crick or Rosalind Franklin]

Rosalind Franklin had the biggest impact because of her discovery of the double-helix which was demonstrated in the famous "Photo 51". Rosalind's "Photo 51" showed that DNA contained the genetic information for the development of all living organisms. Her work led to cures for genetic diseases and viruses.

X-RAY DIFFRACTION CRYSTALLOGRAPHY

For millennia, humans have wondered about how the building blocks of the universe fit together. In the 20th century the science of **x-ray crystallography** revealed our molecular world at a level previously unimaginable, far beyond the limits of the microscope. How did X-ray crystallography transform science and our ability to 'see' atoms?

X-ray crystallography is a scientific field concerned with revealing the structure of matter at the atomic level. The essential method involves exposing a crystallised sample of a substance to x-rays, usually with an instrument called an x-ray camera. The resulting photograph shows the pattern of diffracted x-rays as they passed through the crystal, from which scientists can then visually map its molecular structure using mathematics (now done using a computer). It all began in 1912………..

Max von Laue, a German physics professor, was performing experiments with the relatively recently discovered x-rays. By bombarding crystals with x-rays, he hoped to find out if the rays consisted of particles or waves—the pattern they displayed on a photographic plate indicated the latter. That same year a father-and-son duo, William and Lawrence Bragg, realised the vast potential of von Laue's crystal patterns.

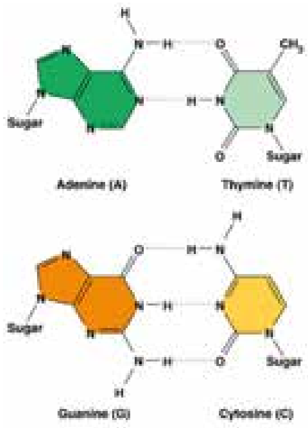
Employing a clever instrument (an x-ray spectrometer) and mathematics, the Braggs developed x-ray photographs of crystals, revealing how their atoms were arranged. From there, they were able to construct three-dimensional models or diagrams of atomic structures. This is the method that Rosalind Franklin used in her investigation of the crystal form of DNA and that resulted in the famous **Photo 51.**

Interestingly, women (including Franklin) have featured prominently in the development and use of x-ray crystallography since 1912. Three women, all British, stand out and are pictured below from left to right, **Dame Kathleen Lonsdale** (1903–1971), **Rosalind Franklin** (1920-1958) and **Dorothy Crowfoot Hodgkin** (1910-1994):

HELENA BULACZ

WHO HAD THE GREATER IMPACT ON DISCOVERING DNA?

INTRODUCTION TO DNA

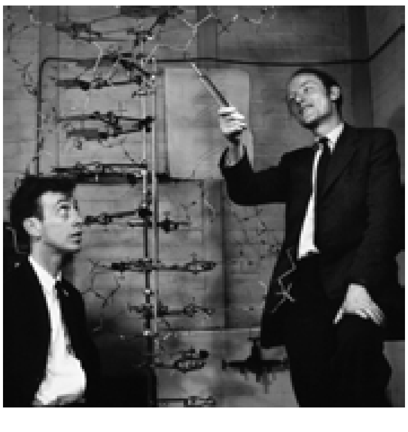


Long before anything happened with the scientists and Rosalind Elsie Franklin, a man named Johann Gregor Mendel discovered the fundamental laws of inheritance through his work on pea plants (1866). He deduced that genes come in pairs and are inherited as distinct units, one from each parent. Mendel tracked the segregation of parental genes and their appearance in the offspring as dominant or recessive traits.

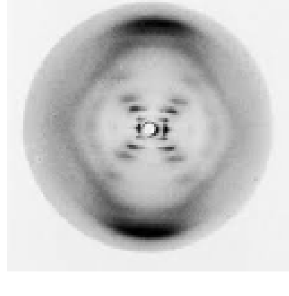
Not long after, in 1869, Friedrich Miescher isolated "nuclein," DNA with associated proteins, from cell nuclei. He was the first to identify DNA as a distinct molecule. After that, 1933 Jean Brachet was able to show that DNA was found in chromosomes, then Oswald Avery, Colin MacLeod, and Maclyn McCarty showed that DNA (not proteins) can transform the properties of cells, clarifying the chemical nature of genes. Finally, Erwin Chargaff found that in DNA, the ratios of adenine (A) to thymine (T) and guanine (G) to cytosine (C) are equal.

None of these go into full detail, however this leads us to a point in 1950 in London, Kings College which accommodated Maurice Wilkins and the Girl from Notting Hill, and Cambridge, the Cavendish Lab which accommodated famous scientists Francis Crick and James Watson.

A TALE OF THE SCIENTISTS AND A GIRL FROM NOTTING HILL



“The Secret of Life” opens with the famous moment in 1953 in Cambridge, England, when Watson and Crick had just made their discovery and rushed to share it with the world. Their breakthrough was astronomical and incredibly important for science. Prior to 1953, no one really understood heredity, genetics, how we pass on traits to the next generations and not to mention all the issues that DNA led to in terms of viruses. However, they discovered the exact structure of DNA and how it works, this revolutionary milestone all thanks to a single image that began everything. Although, what many people don’t know is that a major part of their work was thanks to a different scientist.



In 1951, a young woman aged 31, Rosalind Franklin joined the Biophysical Laboratory at King's College, London, as a research fellow. There she applied X-ray diffraction methods to the study of DNA, becoming an expert in X-ray crystallography. On the 6 May 1952, Franklin photographed her fifty-first X-ray diffraction pattern of DNA, also known as Photo 51. **Arguably the most important photo ever taken.** Without Franklin’s knowledge or permission, Maurice Wilkins (a colleague) showed James Watson that very photo; which he copied onto and old newspaper, and Crick was shown one of her progress reports. Armed with that information, the two men figured out that the structure of DNA had to be a double helix. Crick himself admitted “We didn’t do the double helix because things go in pairs or something dreamy like that. We did it for a reason, because we had Rosalind’s data.” Some claim that the pair ‘forgot’ to credit her, but I firmly believe that they simply stole Rosalind Franklin’s data.

Franklin died of ovarian cancer in 1958, four years before the Nobel Prize was awarded to Watson, Crick and Wilkins for their work on DNA structure. She never learned the full extent to which Watson and Crick had relied on her data to make their model, and it is without a doubt that they would not have gotten there absent her data, perhaps eventually but Rosalind played a crucial role. Furthermore, with the knowledge that they were so set in denying her that recognition, I think that it was chauvinism which was very common in academic science. Coming back to the cancer, it is written that it was possibly caused by her extensive exposure to radiation while doing X-ray crystallography work, and after all her extreme hard work during the 16 years, not only did she not get the recognition she deserved (up until recently) the same work she did most likely led her life to a close.
Moreover, it is 100 percent definite that if Watson and Crick themselves hadn't figured out the secret, Franklin herself would've done it herself. The progress she made on her own, increasingly isolated and without the benefit of anyone to exchange ideas with, was simply remarkable. Franklin's laboratory notebooks reveal that she initially found it difficult to interpret the outcome of the complex mathematics but by 24 February, she had realised that DNA had a double helix structure and that the way the component nucleotides or bases on each strand were connected meant that the two strands were complementary, enabling the molecule to replicate. However she did not get the chance to prove this to the world as Watson and Crick had already crossed the finishing line, and even after her publishing her work in the newspaper - it only further proved the male scientist's point to which they had managed to publish before her. (This was the three articles in Nature, the work of the three of them and Wilkins too, who was working with Franklin at the time.) Rosalind Franklin stopped working on DNA, going to work at Birkbeck.

THE NOBEL PRIZE

Franklin never did receive a Nobel Prize (that I think she deserved) unfortunately, as Nobel prizes aren't awarded posthumously, or so people say. But Nobel prizes were awarded after death several times until 1974; including Swedish economist Dag Hjalmar Agne Carl Hammarskjöld and Swedish poet Erik Karlfeldt. The real reason she was not named is that, as archived letters show, the surviving scientists in the DNA triangle competed to be nominated. Only three scientists could be named in the prize and when American scientist Linus Pauling, who had also competed in the race to find its structure, was asked for his opinion by the Nobel Committee, he cited Wilkins, not Franklin, as the originator of King's College's much-prized X-ray photographs of DNA. The only thing that makes me feel a bit better is that Franklin did receive a prize, the Louisa Gross Horwitz prize from Columbia University (in 2008, once she was already dead) for her contributions to discovering the structure. I feel genuine pity for Franklin and believe that she does deserve justice and publication, so that everyone knows her part in the story but still, at least she is finally getting the recognition she deserves 65 years later. To discover important information about this case, it is worth reading The Secret of Life by Dr. Howard Markel, the story of genius and perseverance but also a saga of cronyism, misogyny, anti-Semitism and misconduct. He brilliantly recounts the intense intellectual journey-and the fraught personal relationships-that resulted in the discovery of DNA.

FROM WATSON AND CRICK'S POINT OF VIEW

If you look from Watson and Crick's point of view, however, they were the ones who figured out the double helix, they did all the work and Franklin's photo just aided them with it. This is not my opinion, but some could argue that Franklin does not deserve too much acknowledgement, as she took a simple image, and did not help Watson or Crick in any other way.

DR JAMES WATSON

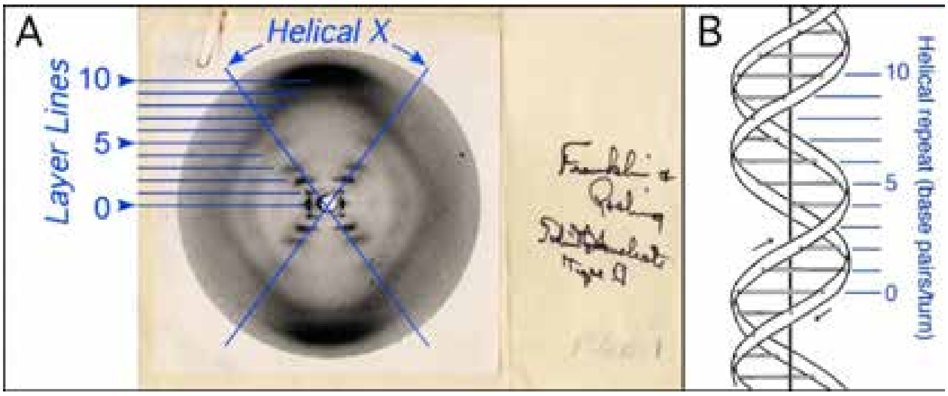
There are incredibly comments that Dr James Watson (still alive today at age 94) said about Franklin that suggest he is capable of doing something like stealing and not crediting her work, as I believe he did. In his 1968 memoir, he made an assessment of Rosalind Franklin based on her appearance. He said "Though her features were strong, she was not unattractive, and might have been quite stunning had she taken even a mild interest in clothes. This she did not.' It is evident that he had a clear dislike in Franklin and was not afraid to show it. Then, in an interview with The Big Think Watson says he thought she had Asperger's syndrome and was 'paranoid'. He continued: 'I don't think her name deserved to be on the paper... because of her failure to interact effectively, it was hard to know how bright she was.' He spoke to an audience at the Collège de France in Paris this month and said: 'There was no reason to give her the Nobel Prize. She was a loser.' In private letters, Dr Watson often referred to Dr Franklin as 'Rosy the witch'. All of those things look as if he is trying to discourage the world from the truth and making people think she did nothing special.

Sites used for information: https://www.theguardian.com/science/2015/jun/23/sexism-in-science-did-watson-and-crick-really-steal-rosalind-franklins-data

PHOTO 51

Photo 51, a clear X-ray diffraction pattern of DNA, showed structural features of DNA necessary for scientific understanding of DNA´s three-dimensional structure. By understanding DNA structure, scientists could learn about how DNA functioned as genetic material. The DNA structure revealed in Photo 51 related the essential functions of a gene how its information is preserved and carried from cells to cell and from parent to offspring.

Using the available knowledge about DNA´s composition and mathematical techniques, Franklin learned of some key features regarding the structure of B-Form DNA from Photo 51. The presence of the X shape in the diffraction pattern indicated to Franklin that DNA strands were helical. Each dash of the X shape marks the repetition of atoms, or atomic repeats, in DNA. Therefore, based on the distances between the dashes, Franklin determined the distance between nucleotides, the smallest repeating units in DNA. The angles of the X shape revealed to Franklin the radius of DNA, or half the horizontal distance from one side of the molecule to the other. From the distance between the top and bottom of the outer diamond shape, Franklin found that there are ten nucleotides between each turn of the DNA molecule. Lastly, the lighter nature of the diamond on the top and bottom of the film showed Franklin that the DNA bases face the inside of the helix whereas the phosphate groups face outside. With knowledge of the density, mass per unit volume, of her DNA samples, Franklin also concluded that DNA contained two strands – an antiparallel double helix.



Structure of B-DNA. A. Photograph 51 of B-DNA. X-ray diffraction photograph of a DNA fibre at high humidity (Franklin and Gosling, 1953b). Interpretation of the helical-X and layer lines added in blue. B. Watson-Crick model of B-DNA, adopted from (Watson and Crick, 1953b), with the helical repeat associated with the layer lines labelled.

EMMA PAYNE

WHO HAD THE GREATER IMPACT ON DISCOVERING DNA?

Many people believe that James Watson and Francis Crick discovered the structure of DNA in the 1950s. DNA was first identified in the 1860s by Friedrich Miescher. Following Miescher's discovery, Phoebus Levene and Erwin Chargaff carried out a series of research about the DNA molecule. Without these pioneers, Watson and Crick may never have reached their conclusion of 1953 that DNA exists in the form of a three dimensional double helix.

Rosalind Franklin was studying DNA using X-ray diffraction crystallography – beaming X-rays through the molecule yielded a shadow picture of the molecular structure, by how the X-rays diffracted off the component parts. Rosalind's partner in this discovery, Maurice Wilkins, showed some of Franklin's findings to James Watson in January 1953 without her knowing.

Referring to Franklin's X-ray image, known as "*Exposure 51*", James Watson is reported to have said *"The instant I saw the picture, my mouth fell open and my pulse began to race."* Shortly after, Watson and Francis Crick made a crucial advance when they proposed that the DNA molecule was made up of two chains of nucleotides paired in such a way as to form a double helix, rather like a spiral staircase. This structure, announced in their famous paper in the April 1953 issue of the journal *Nature*, explained how the DNA molecule could replicate itself during cell division, enabling organisms to reproduce themselves with amazing accuracy except for occasional mutations.

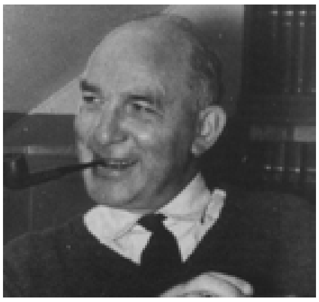
For their work, Watson, Crick and Wilkins received the Nobel Prize in 1962. Despite her contribution to the discovery of DNA's double helix structure, Rosalind Franklin was not named a prize winner due to the fact that she had died of cancer four years earlier at the age of 37.

I think that Rosalind Franklin had a bigger impact on the discovery of the structure of DNA, because she found out what that structure was by using X-rays to produce a picture of the molecule's structure. I also think that without this information, Crick and Watson would not have been able to identify that DNA exists in the form of a three dimensional double helix.

Sources of information

www.nature.com
www.pbs.org.com

CHROMOSOMES AND DNA – JEAN BRACHET



Of all the famous names in the DNA story, from Miescher to Avery to Chargaff to Watson, Crick, Wilkins and Franklin, one name that rarely pops up is that of **Jean Louis Auguste Brachet** (1909-1988). He was a Belgian biochemist who made a key contribution in understanding the roles of DNA and RNA in cells.

Chromosomes are structures within the cell nucleus that become apparent when cells divide. They were first observed and studied in the 1880s and became the subject of much debate as it became obvious that they may be involved in transferring genetic information. By the 1920s, after the finding and confirming of Gregor Mendel's work on inheritance, people became interested in exactly what chromosomes were made of and if they might contain Mendel's *"particles of inheritance"*.

In 1929 an American biochemist, Phoebus Levene, showed that cell nuclei contained a compound he called "thymus nucleic acid" (now known as DNA) containing a deoxyribose sugar and a string of four nucleotide units linked together through the phosphate groups. Jean Brachet repeated this work and went further: he showed that DNA was contained in the cell's chromosomes. You would think that people would have made the connection that DNA must contain the *"particles of inheritance"*, but everyone assumed that whatever these *"particles"* were, that they must be proteins – and DNA is <u>not</u> a protein.

Only later, in 1944, would it be proven that it <u>is</u> the DNA in chromosomes that is responsible for inheritance.

KIARA SUTHAKARAN

WHO HAD THE GREATER IMPACT ON DISCOVERING DNA?

James Watson and Francis Crick were scientists who discovered the structure of DNA. Because of this, they won the Nobel Prize in physiology or medicine. But without Rosalind Franklin's information, would they have been able to win this prize?

Watson and Crick did no experiments of their own. Instead, they studied the work of others and discussed it for hours on end in their office at Cambridge University. They gathered information and soon realised that, regarding the bases within the DNA molecule, Adenine=Thymine and Cytosine=Guanine. After some crucially important X-ray crystallography work by the English researchers, Rosalind Franklin and Maurice Wilkins, Watson and Crick were able to find out the three dimensional, double helix structure of DNA. Watson and Crick arranged models on their desks, like pieces of a puzzle using cardboard cut-outs that represented the different chemical components of DNA – especially the four bases of the nucleotides. They had a mistaken notion about the arrangement of different atoms in the bases. Watson decided to create new cut-outs after advice from a friend, Jerry Donohue. It worked – with each base pair being held together by hydrogen bonds, the complementary bases now fit together properly: A(adenine) with T(thymine) and C(cytosine) with G(guanine).

However, the discovery of the structure of DNA in 1953 was made possible by Dr Rosalind Franklin's X-ray diffraction crystallography work at King's College, London. Her creation of the famous *"Photo 51"* demonstrated the double helix structure of deoxyribonucleic acid (DNA) – the molecule containing the genetic instructions for the development of all living organisms. Franklin had joined the laboratory of John Randall at King's College in 1950, with a PhD from Cambridge and experience in X-ray diffraction crystallography in Paris. She showed how the molecule could exist in two forms, A and B. In May 1952, she and a PhD student, Ray Gosling, captured the image of the B form that James Watson (from Cambridge) saw early in 1953. This gave Watson and Francis Crick vital information for the building of their DNA model in March of that year. In May 1953, Franklin and Gosling's report appeared in the journal *Nature* alongside one by Maurice Wilkins and colleagues (King's College), together with the report from Watson and Crick of their historic discovery.

I think that Rosalind Franklin had the greater impact in the discovery of the structure of DNA because it was she who showed that the molecule existed in a double helical conformation. We can see this in her X-ray crystallography work and *"Photo 51"*. Watson and Crick were not the discoverers of DNA, but rather the first scientists to formulate an accurate description of the molecules complex, double helical structure. Moreover, Watson and Crick's work was directly dependent on the researches of numerous scientists before them; for example, right back to Friedrich Miescher in 1869 when he first isolated a compound from the nuclei of cells. This compound that he called *"nuclein"* would later be identified as DNA.

In conclusion, I think that Rosalind Franklin had the greater impact on the discovery of the structure of DNA.

AIDAN FEELY

WHO HAD THE GREATER IMPACT ON DISCOVERING DNA?

The Build-up

In 1869, a little-known Swiss chemist, Friedrich Miescher, ordered a local surgical clinic to send him puss-covered bandages. He hoped he would be able to separate out the white blood cells within the puss and extract the proteins that they were composed of, making him the first person to characterize white blood cells. However, this experiment would lead to something far more exciting. As he was gathering the white blood cells he noticed a strange substance, a protein with properties the likes of which he had never seen. Miescher quickly realized he had discovered an entirely new substance and called the alien substance *nuclein*. Miescher realized his discovery was important, predicting a whole family of nucleins would be.discovered in the coming years but unfortunately, Miescher was unable to decipher the make-up of this nuclein and died mostly unknown. .

Fortunately, 16 years later Albrecht Kassel began working on nuclein. He began work on the substance's chemical composition and discovered four bases: adenine, cytosine, thymine, and guanine. He also renamed the strange substance coining the term deoxyribonucleic nucleic acid, or DNA.

Following Kassel, nuclein was picked up again by a scientist known as Phoebus Levene who began to paint an image of the chemical makeup of what was known as DNA. He correctly theorized that nuclein was made up of equal amounts of the four bases, adenine, guanine, cytosine, and thymine. In addition to this, he went on to propose what he called a tetranucleotide structure, in which the compounds making up the DNA were ordered in the same repeating pattern.

Ever Since Darwin's theory of evolution, scientists had been searching for the hereditary material (.the substance that passed down information from parent to offspring) and in 1944, nearly a century later a scientist called Oswald Avery found it. Avery used the bacteria that causes pneumonia, which has two types: one with an outer layer (S type) and one without (R type).Throughout a series of experiments, Avery discovered something remarkable, that DNA (and only DNA) could change R type bacteria into S type. This meant that something about DNA allowed it to transfer genetic instructions across individuals (as aforementioned a quality unique to it) making it the best candidate for the hereditary material. However, this also disproved Levene's theory on the structure of DNA, as his simple tetranucleotide structure could not contain the library of information that needed to be passed down hereditarily.

The final major discovery prior to the researchers at Cambridge and London entering the limelight were the rules formulated by Erwin Chargaff, who (after reading the now famous 1944 paper by Oswald Avery and his colleagues that concluded that genes were composed of DNA) proposed that, firstly, DNA was varied among different species and, secondly, that within DNA there were equal amounts of adenine and thymine, together with equal amounts of cytosine and guanine. Unfortunately, Chargaff fell short of discovering why these peculiar parallels existed, leaving that discovery to a pair of even more famous scientists, James Watson and Francis Crick.

The Discovery

For decades it has been commonly credited that Francis Crick and James Watson were the discoverers of the structure of DNA; however, it has more recently been told that they had help from one Rosalind Franklin.

James Watson was a 23-year-old American who recently moved to Cambridge and Francis Crick was a trained physicist who yearned to make up for the lost time during WW2. In 1951 they sparked a quick friendship and began work on DNA. At the same time, Maurice Wilkins began using X-ray Crystallography (an accurate but sometimes Sisyphean form of X-raying) at Kings College London alongside a talented young scientist Rosalind Franklin. Franklin excelled in getting a scholarship and degree from Cambridge whose previous work on coal helped to improve British gas masks, saving lives during WW2. When Franklin and Wilkins Met, they immediately butted heads with it being possible both were under the interpretation that they were running the operation or that Wilkins (likely due to Franklin's gender) assumed Rosalind to be an assistant and not a qualified researcher depending on your source. The result is consistent with the timid Wilkins asking to work individually. In 1951, Watson (in an attempt to get ahead of his London counterparts} attended a talk by Franklin on some of her early X-rays of DNA in which (either out of overconfidence or excitement) Watson failed to take accurate notes. This led him and Crick to underestimate the amount of water in the structure and create a model of it as a triple helix with the bases on the outside. When shown to Franklin she immediately recognized the model as incorrect and quickly disregarded it, either out of necessary assertiveness due to the misogynistic environment at the time, or due to her callous and undesirable personality. Watson and Crick left in shame. In 1952, Franklin made a crucial breakthrough in photo 51, a crystallography photo showing a faint X. Franklin had made the first true discovery on the shape of DNA. Shortly afterward, Watson visited Kings College and encountered Wilkins who (without Franklin's knowledge) stole a copy of photo 51 and showed the instrumental photo to Watson. He immediately recognized it as a helix and based on the photo further hypothesized it to be a double helix. Soon after, Crick was shown a report on Franklin's work that commented on the DNA's symmetry leading him to believe that the two backbones ran in opposite directions with the bases running down the middle and (combined with Chargaff's discoveries) came to the DNA model known today.

Watson and Crick quickly published their findings alongside Franklin in the same journal, *Nature*. However, the two men had their paper put first, not only ahead of other rivals', but also (possibly due to one if not the primary author being a woman) ahead of Franklin's which was put last demoting her to a mere confirmation of the men's findings.

Franklin continued her work in crystallography, but she began having trouble moving from the X-rays (in the basement) to her office; She had developed cancer and died in 1958,forgotten and likely never knowing Wilkins showed her photographs to Watson and Crick. Four years later Watson, Crick, and Wilkins all received Nobel prizes. Years later Watson wrote a book on the discovery of DNA describing Franklin as a plainly dressed, belligerent and uncooperative woman and bragged about the theft of her work. Franklin's family and friends still maintain her as a kind, brilliant woman who made many ground-breaking discoveries and fought sexism in science. So, was Rosalind Franklin a nasty know it all or a victim of academic theft and sexism?

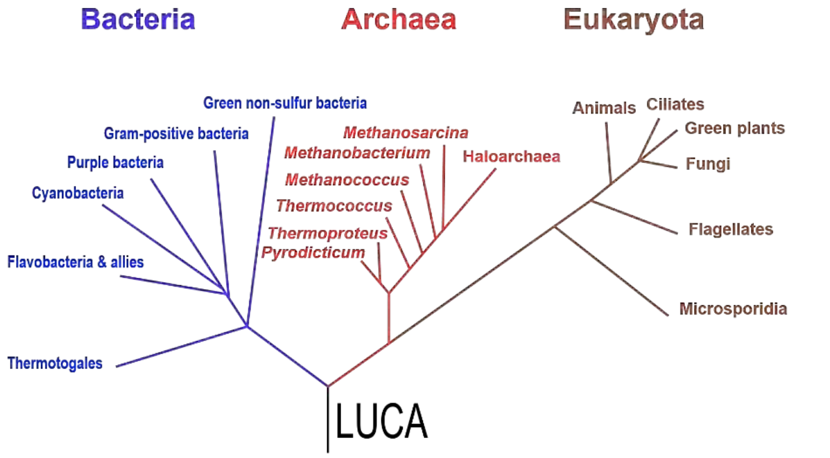
Personally, I believe the person primarily responsible for the discovery of the double helix was Rosalind Franklin. This is due to the fact that many of her male colleague's accusations revolve around Rosalind's personality and clothing (such as Watson's aforementioned description) which has little to no bearing on her work and which is plainly immature and may possibly infer that they saw her as less of a well-qualified researcher than she definitely was. This demeaning view of Franklin gives her reason to dislike her colleagues and may further imply they were, even if subconsciously, undervaluing her work. As well as this, Watson later recanted his less than flattering account of her showing that his description may have been founded in sexism that has since become far less socially acceptable. It is for this reason I believe Rosalind Franklin had the largest impact on the discovery of the double helix. It is time that she is recognised as the kind woman she likely was - a passionate researcher who fought sexism in science and discoverer of the double helix.

DNA AND THE "SINGLE COMMON ANCESTOR" HYPOTHESIS

It is a profound fact that DNA is present in all living organisms and is the molecule that carries all the genetic information necessary to reproduce, grow and maintain those organisms. Given the huge diversity of life forms, both plant and animal, it may seem unlikely that all life would be based on the same biochemical processes. This, and the unique role of DNA, has led to a theory called the **Universal Common Ancestry hypothesis.**

Such a notion is not new and begins with Charles Darwin's *On the Origin of Species*, published in 1859. Darwin wrote: *"I should infer from analogy that probably all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed."* Our modern knowledge of DNA has added credence to this. But proving the hypothesis is actually very tricky and, although the available evidence is strong, no one has been able satisfactorily confirm the notion. But how does the "common ancestor" work?

The hypothesis proposes that all life on Earth evolved from a single-celled organism that lived roughly 3.5-4 billion years ago. There is good fossil evidence in rocks of this age that single-celled life did indeed exist. Such an organism is called the **last universal common ancestor (LUCA).** While there is no specific fossil evidence of the LUCA, the detailed biochemical similarity of all current life points to its existence. The LUCA almost certainly had genes and a genetic code and its genetic material was most likely DNA. Its characteristics can therefore be inferred from shared features of modern genomes. These genes describe a complex life form with many co-adapted features, including transcription and translation mechanisms to convert information from DNA to RNA to proteins. The LUCA probably lived in the high-temperature water of deep sea hydrothermal vents. Bacteria proliferate around these vents to this day.



A 1990 phylogenetic tree linking all major groups of living organisms to the LUCA, based on ribosomal RNA sequence data.

The fact that LUCA was a relatively complex organism even up to 4 billion years ago, with multiple biochemical processes, genes and a genetic code, must point to it not being the earliest form of life. So what could have come before it? To explain this, there is a branch of biology called **abiogenesis** - the natural process by which life has arisen from non-living matter, such as simple organic compounds. The prevailing scientific hypothesis is that the transition from non-living to living entities was not a single event, but an evolutionary process of increasing complexity that involved the formation of a habitable planet, the prebiotic synthesis of organic molecules, molecular self-replication, self-assembly, autocatalysis, and the emergence of cell membranes.

A habitable world is formed with a supply of minerals and liquid water. Prebiotic synthesis creates a range of simple organic compounds, which are assembled into polymers such as proteins and RNA. Eventually a membrane forms to enclose the protein/RNA processes and a single-celled organism is formed – eventually this would lead to LUCA.

CARL CONWAY

GIANT COVALENT STRUCTURES

Giant covalent structures.

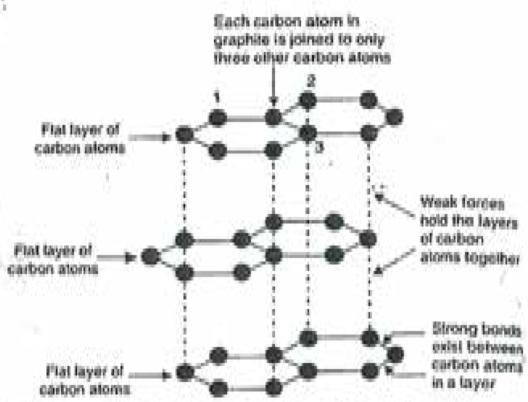
A giant covalent structure is a structure that is made up of many, many atoms. Each of these atoms is connected by a covalent bond and the atoms are arranged in a lattice structure which means a repeating pattern. For example, graphite and diamond are two examples of a giant covalent structure.

Diamond.

Diamond is a giant covalent structure and an allotrope of carbon. Its atoms form a tetrahedron, which makes diamond the strongest substance on earth, as triangles are immensely strong.

Diamond is extremely hard and has an extremely high melting point. This is due to the extremely strong 4 covalent bonds that diamond has. These leave no free electrons or ions, which means diamond cannot conduct electricity due to having no delocalised electrons. Because diamond is so hard, it is used for many things like drill bits and cutting tools, making it an extremely useful and sort after substance. Not to mention the fact that diamond is lustrous and sparkles which makes it a hugely wanted in the jewellery industry.

Graphite



Like diamond, graphite is also a giant covalent structure and an allotrope of carbon. Graphite is made up of many layers of carbon atoms that are held weakly held together by a sea of delocalised electrons. Graphite only has 3 strong covalent bonds per atom meaning one atom spare which then forms the sea of delocalised electrons.

These delocalised electrons allow graphite to be a conductor of electricity. But as they are weak, the layers of graphite and easily slide off and break! Therefore, graphite is used in a pencil lead. These layers are also extremely slippery which is why graphite is a can be used as a lubricant. For example, graphite is used in bicycle chain oil as a lubricant.

Graphite has got a very high melting point due to its 3 strong covalent bonds which takes a lot of energy to break and separate. But it's not very durable as it's structured very weakly. This is why pencil lead is so easy to accidentally snap or break.

CHARLIE BIGGIN

GIANT COVALENT STRUCTURES

Giant Covalent Structures

Diamond

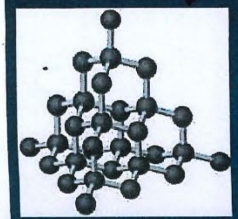
Diamond is a form of carbon in which each **carbon** atom is joined to four other carbon atoms, forming a giant covalent structure. As a result, diamond is **very hard** and has a high melting point. This explains why it is used in cutting tools. It does not conduct electricity.

Uses

Cutting tools, jewellery , used in the petroleum and mining industries.

Where to find it

Africa, India, Russia, USA



Silica (silicone dioxide)

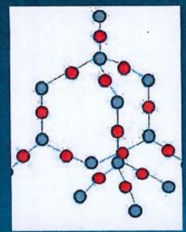
Silica, which is found in **sand**, has a similar structure to diamond, so its properties are similar to diamond. It is hard and has a high melting point, but contains **silicon** and **oxygen** atoms, instead of carbon atoms.

Uses

Used in silica gel packets, industries like pharmaceutical, food, chemical, electronics, construction

Where to find it

In sand



Graphite

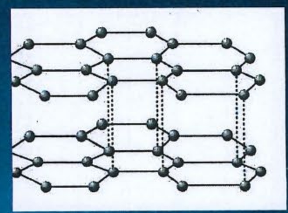
Graphite is a form of **carbon** in which the carbon atoms form **layers**. These layers can slide over each other, so graphite is much **softer** than diamond. It is used in pencils, and as a **lubricant**. Each carbon atom in a layer is joined to only three other carbon atoms. Graphite conducts electricity.

Uses

Used in writing materials, nuclear reactors, lubricants, refractory, batteries

Where to find it

It is an uncommon material is Astroneer and igneous rocks



CONSTANCE D'MELLO

GIANT COVALENT STRUCTURES

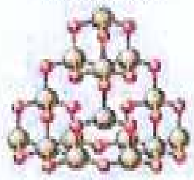
Giant covalent structures

Properties of Giant Covalent structures

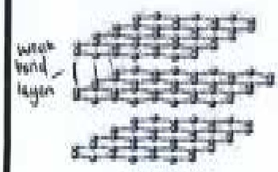
Very high melting points- this is because a lot of strong covalent bonds must be broken. Graphite for example has a melting point of more than 3,600 oC.

Conductivity-Diamond does not conduct electricity

Diamond



Silica



Graphite

What Giant covalent structures are used for.

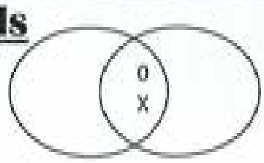
Diamond	Graphite	Silica
Each carbon atom is joined by 4 other carbon atoms therefore it is a strong structure. Due to this it is used to as a cutting tool.	Graphite is joined to 3 other carbon atoms. It has layers which are loosely connected therefore it can be put into thin wires. Due to its delocalised electrons, it can conduct electricity therefore it is used on electrodes	Silica has similar structure to diamond, but it contains silicon and oxygen atoms instead of carbon. Silica has a high melting point due to strong covalent bonds

Carbon Fullerenes

Fullerenes are used for drug delivery into the body. Carbon fullerene is a hollow structure.

How to show Covalent Bonds

A hydrogen atom when joined by another try to form a full outer shell. Therefore, they share electrons to get closer to full outer shell.



Two hydrogen atoms sharing their atoms.

OSCAR WOOD

GIANT COVALENT STRUCTURES

Giant Covalent Structure

Giant covalent structure

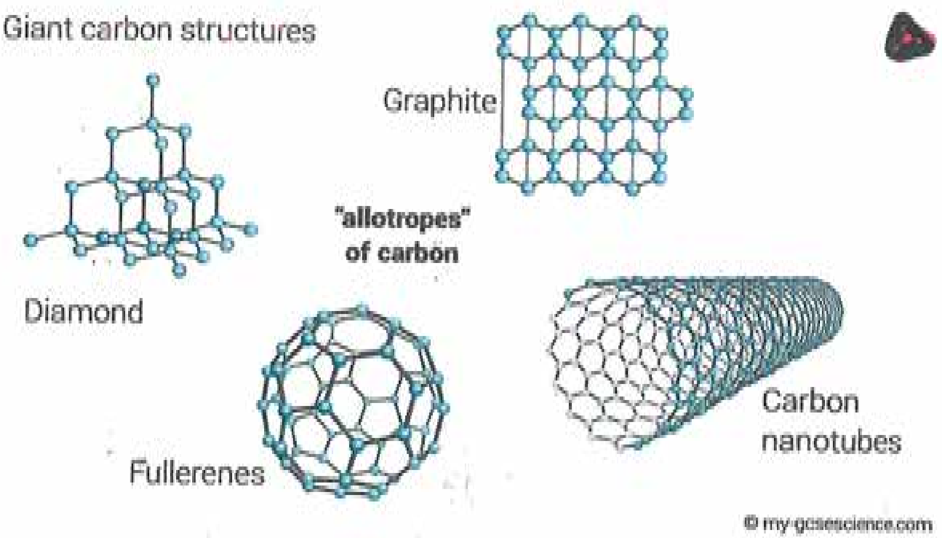
- High melting and boiling point, diamonds many covalent bonds are strong and substanial energy is needed to break them.
- It does not conduct electricity, diamonds has no free ions or delocalised electrons to move and carry the charge
- It is hard

Diamond

graphite

Diamond is a giant covalent structure where each carbon Atoms are joined to four carbon atoms by string covalent bonds. The carbon Atoms form a regular tetrahedral network Structure. There are no free electrons

Graphite has a giant covalent structure where each carbon atom forms three covalent bonds with each covalent atom. The carbon atoms form layers of hexagonal rings, there are no covalent bonds between the layers



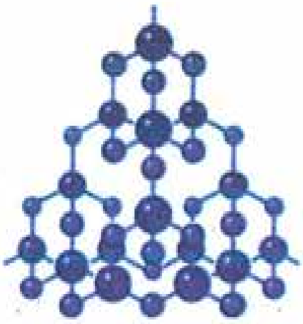
Fullerenes are molecules of carbon atoms With hollow shapes. Their structure are based On hexagonal rings of carbon atoms by Covalent bonds. Some fullerenes include Rings with 5 or 7 atoms.

Nanotubes are strong and they conduct electricity because they have delocalised electrons. buckyballs are spheres or squashed spheres of carbon atoms. They are made up of large Molecules but do not have giant covalent Structure. Weak intermolecular forces exist Between individual buckyballs.

PATRICK SAUL
GIANT COVALENT STRUCTURES

Giant covalent structures

Giant covalent structures contain many atoms that are joined together by covalent bonds. Normally they are arranged into lattices which makes them very strong as they can have a sea of delocalised electrons flowing in between the lattice.



Silicon dioxide, also known as silica, is the main compound found in sand. It is a substance with a giant covalent structure. It contains many silicon and oxygen atoms. All the atoms in its structure are linked to each other by strong covalent bonds. The atoms are joined to each other in a regular arrangement, forming a giant covalent structure. There is no set number of atoms joined together in this type of structure.

The properties of silicon dioxide

Silicon dioxide

- has a high melting point - varying depending on what the particular structure is (remember that the structure given is only one of three possible structures), but around 1700°C. Very strong silicon-oxygen covalent bonds have to be broken throughout the structure before melting occurs.
- It is very hard. This is due to the need to break the very strong covalent bonds.
- doesn't conduct electricity. There aren't any delocalised electrons. All the electrons are held tightly between the atoms, and aren't free to move.
- is insoluble in water . There are no possible attractions which could occur between solvent molecules and the silicon or oxygen atoms which could overcome the covalent bonds in the giant structure.

There are lots of different examples of giant covalent bonds. Gilbert Newton Lewis discovered the giant covalent bond and his discovery has been used lots since.

Vol 7, No 2; December 2022

PORTIA RATCLIFFE

GIANT COVALENT STRUCTURES

Giant Covalent Structure

A Giant Covalent Structure is a structure made up of atoms, held together by very strong covalent bonds - which must be brocken to melt the substance. All covalent structures have high melting and boiling points.

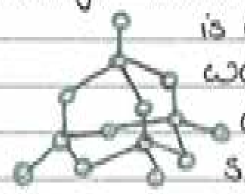
Properties of Covalent Structures:

- High melting and boiling points
- Only covalent structures with delocalised electrons can conduct electricity, eg. Graphite
- Covalent structures with no charge cannot conduct electricity.
- They form in Regular arrangements

Examples of Covalent Structures:

Diamond

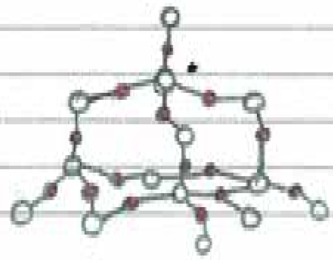
Diamond is made up of purely carbon. Carbon has an electronic arrangement of 2,4. Each carbon shares electrons with 4 other carbon atoms, forming 4 single bonds. ~~In~~ A diamond is insoluble in water and organic solvents.



There are no possible attractions which could occur solvent and molecules and carbon atoms which could outweigh attraction between the covalently bound carbon atoms

Silicon dioxide

Crystalline silicon has the same structure as diamond to turn the structure into a silicon one is to add oxygen atoms. It has the same properties as diamond. It is found in the tissues of the body. It is mainly used in food supplements.

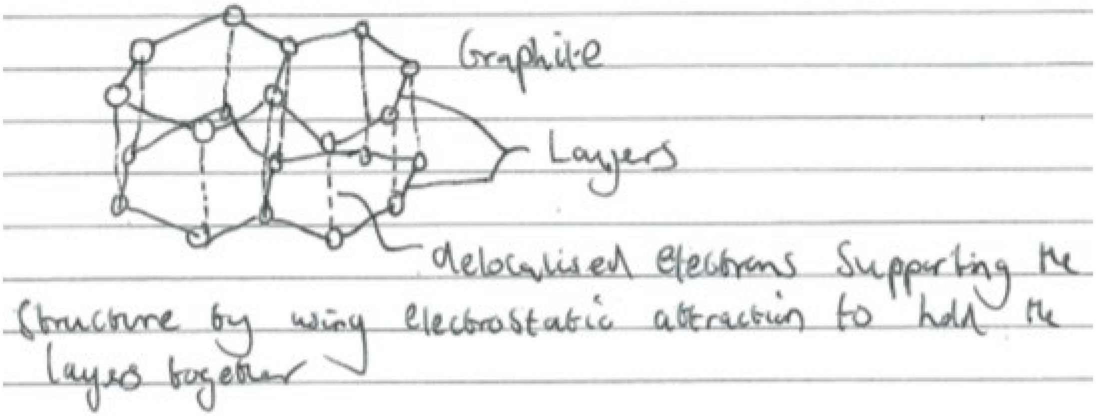


ADAM O'FLYNN

GIANT COVALENT STRUCTURES

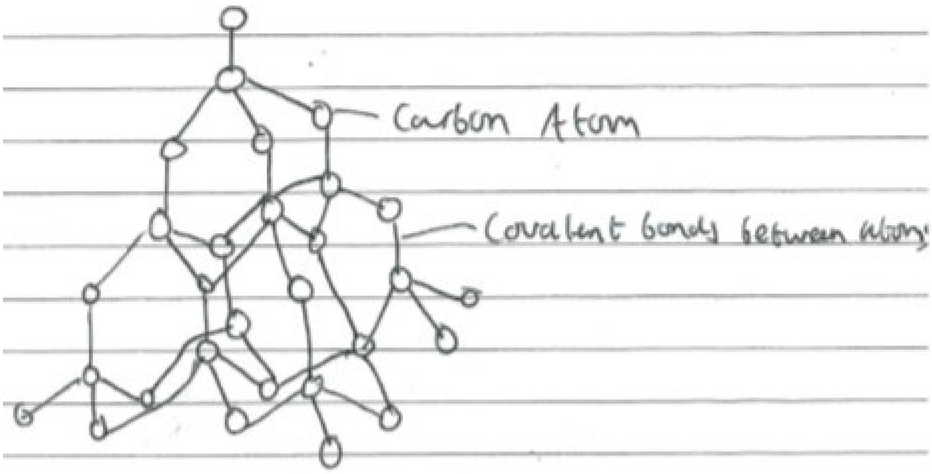
Diamond and graphite comparison

A large difference between diamond and graphite is their ability to conduct electricity. Graphite, which has a layered structure, has delocalised electrons between each layer. This forms a sea of delocalised electrons allowing electricity to pass through. Diamond, on the other hand, has no delocalised electrons meaning it is incapable of conducting electricity.



Diamond has a hard, rigid, tetrahedral structure consisting of 4 covalent bonds on each atom of carbon. This makes it very strong and difficult to break. In fact, diamond is the hardest material on Earth. Because of this, it is a popular material for the end of drill bits and saws.

Graphite, however, is quite the opposite. It has a layered structure where each layer is held together by electrostatic forces. This means that the layers can move about, which is why graphite has its slippery texture. Unlike diamond, graphite is quite brittle and easy to break. You may have experienced this when breaking a pencil. Speaking of pencils, graphite's slippery property is what allows pencils to leave marks on paper.



This is a rough sketch of the tetrahedral structure of diamond.

However, graphite and diamond are not completely different. Both consist purely of carbon atoms and are called allotropes of carbon. Due to their many strong covalent bonds (4 per atom in diamond; 3 per atom in graphite) they both have very high melting points. A more obvious similarity would be that they are both giant covalent structures. They are also both naturally occurring.

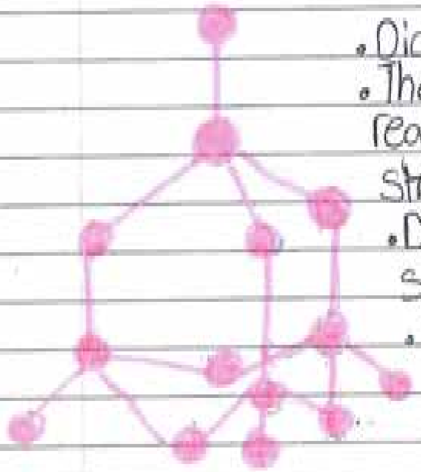
ALEXA KAYINGA

GIANT COVALENT STRUCTURES

Giant Covalent Structures

Giant covalent structures are solids with very high melting points. All the atoms are linked by strong covalent bonds which must be broken to melt the substance. Examples of Giant covalent structures are Diamond, graphite and Sillicon dioxide.

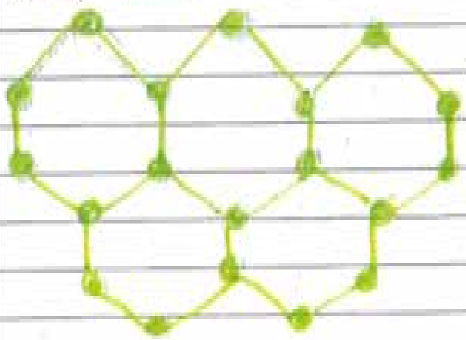
Diamond



- Diamond has 4 covalent bonds
- The carbon atoms form a regular tetrahedral network structure
- Diamond is a really tough/hard substance
- Very strong intermolecular forces
- cannot conduct electricity

Uses:
Since diamond is strong it is used for industrial applications such as drilling, cutting and polishing.

Graphite



- Graphite has 3 covalent bonds
- Graphite is made up of several layers.
- Weak intermolecular forces
- delocalised electrons, therefore can conduct electricity

Uses:

Since Graphite is soft it can be used as a l
~~S~~ricant ~~fe~~ It is also used in Pencils, ~~lubricants~~
polishes, arc lamps and brushes for electric motors.

Silicon dioxide

- Silicon dioxide has 4 covalent bonds
- Silicon dioxide is a compound that consits of Si (Silicon) and O_2 (Oxygen)
- Most commonly found in nature as quartz
- Silicon dioxide is a plastic polymer

Uses:

Silicon dioxide is used in the construction industry to produce Concrete. In its crystalline form it is used in hydraulic factoring. Also is used as an anticaking agent/substance to prevent lumps in baking.

SILICON-BASED LIFEFORMS? Nice idea, but sorry, no!

Carbon, of course, is the building block of life as we know it. So is it possible that a planet exists in some other solar system where silicon substitutes for carbon? Several science fiction stories feature silicon-based life-forms–sentient crystals, gruesome golden grains of sand and even a creature in a *Star Trek series 1* episode.

Indeed, carbon and silicon share many characteristics. Each has a so-called valence of four–meaning that individual atoms make four bonds with other elements in forming chemical compounds. Each element bonds to oxygen. Each forms long chains, called polymers, in which it alternates with oxygen. In the simplest case, carbon yields a polymer called poly-acetal, a plastic used in synthetic fibres and equipment. Silicon yields polymeric silicones, which we use to waterproof cloth or lubricate metal and plastic parts.

But when carbon oxidises–or unites with oxygen say, during burning–it becomes the gas carbon dioxide; silicon oxidizes to the solid silicon dioxide, called silica. The fact that silicon oxidizes to a solid is one basic reason as to why it cannot support life. Silica, or sand is a solid because silicon likes oxygen all too well, and the silicon dioxide forms a lattice in which one silicon atom is surrounded by four oxygen atoms. Silicate compounds that have SiO_4^{-4} units also exist in such minerals as feldspars, micas, zeolites or talcs. And these solid systems pose disposal problems for a living system.

Also consider that a life-form needs some way to collect, store and utilise energy. The energy must come from the environment. Once absorbed or ingested, the energy must be released exactly where and when it is needed. Otherwise, all of the energy might liberate its heat at once, incinerating the life-form. In a carbon-based world, the basic storage element is a carbohydrate having the formula $C_x(HOH)_y$. This carbohydrate oxidises to water and carbon dioxide, which are then exchanged with the air; the carbons are connected by single bonds into a chain, a process called catenation. A carbon-based life-form "burns" this fuel in controlled steps using speed regulators called enzymes. This would be impossible for a silicon-based lifeform.

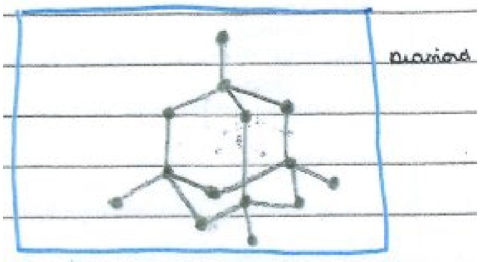
ALICE ELLISON

GIANT COVALENT STRUCTURES

DIAMOND

- Each carbon atom in diamond is connected to 4 others by covalent bonds
- The atoms are arranged in a regular lattice
- All the electrons are in bonds

Diamond is very hard due to the strong covalent bonds that hold the atoms together. Because of this, diamond is often used for tools such as diamond-tipped glass cutters and drill bits.

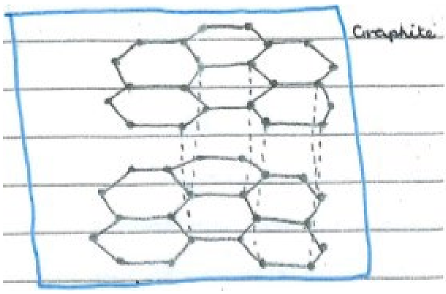


Diamond is insoluble since the attractions between the carbon atoms in the structure are not strong enough to overcome the covalent bonds.

GRAPHITE

Giant covalent structures can also be MACROMOLECULES

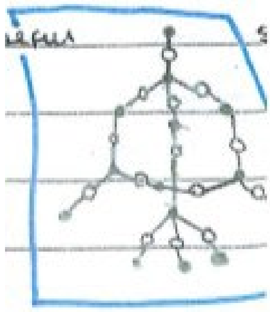
- Each carbon atom is covalently bonded to 3 others
- The atoms are in layers of hexagonal arrangements
- The forces between the layers are weak
- Each atom has 1 electron in its outer shell that is not in a bond – it is delocalised
- Electrons that are delocalised can move around the structure , therefore graphite is able to conduct electricity
- The layers of graphite can slide over each other due to the weak forces between them
- This makes graphite a lubricant because it is slippery



Non-metal atoms bond with non-metal atoms

SILICA (SILICON DIOXIDE SiO_2

- Silica has a similar structure to diamond, therefore similar properties
- Silica contains silicon and oxygen atoms
- Silica is a semi-conductor, midway between a conductor and a non-conductor
- Being a semi-conductor means it is useful in the electronics industry, as most transistors are made of silica



WHY DO WE USE THE TERM "PENCIL LEAD" TO DESCRIBE THE GRAPHITE IN PENCILS?

Most pencil cores are made of **graphite powder** mixed with a clay binder. Graphite pencils (traditionally known as "lead pencils") produce grey or black marks that are easily erased. But why do call them "lead pencils"?

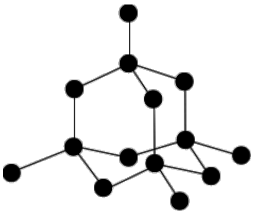
The closest predecessor to the pencil was called a *silverpoint* or *leadpoint* until in 1565 (some sources say as early as 1500), a large deposit of graphite was discovered on the approach to Grey Knotts from the hamlet of Seathwaite in Borrowdale parish, Cumbria, England. This particular deposit of graphite was extremely pure and solid, and it could easily be sawn into sticks. It remains the only large-scale deposit of graphite ever found in this solid form. Chemistry was in its infancy and the substance was thought to be a form of lead. Consequently, it was called plumbago (Latin for "lead ore"). Because the pencil core is still referred to as *"lead"*, many people have the misconception that the graphite in the pencil really is lead!

BENJAMIN RYDER

GIANT COVALENT STRUCTURES

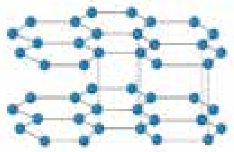
Giant covalent structures contain many atoms. Each atom is joined to other atoms by covalent bonds. The atoms are usually arranged into giant, regular lattices. They are extremely strong structures because of the many covalent bonds involved.

DIAMOND



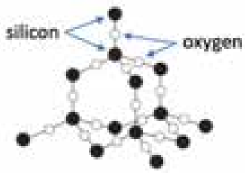
Diamond is a form of carbon in which each carbon atom is joined to 4 others, forming a giant covalent structure. This makes diamond very hard, with a very high melting and boiling point. Diamond does not conduct electricity.

GRAPHITE



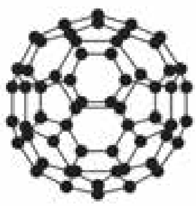
Graphite is a form of carbon in which the carbon atoms form layers. These layers can slide due to the weak bonds between them. Graphite is much softer than diamond and can be used as a lubricant. Each carbon atom is joined to 3 others. Graphite conducts electricity due to the delocalised electrons between the layers.

SILICON DIOXIDE (SILICA)



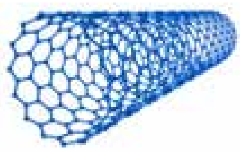
Silica is found in sand and has a similar structure to diamond. However, rather than having carbon atoms, it has atoms of silicon and oxygen. Silica's properties are similar to diamond and it has a high melting and boiling point. Silica is also very hard.

BUCKMINSTERFULLERENE



Fullerenes are molecules of carbon atoms with hollow shapes. Buckminsterfullerene is made up of 60 carbon atoms joined together by strong covalent bonds. There are weak intermolecular forces between the molecules of C_{60} that need little energy to be overcome. Therefore, buckminsterfullerene is slippery and has a low melting point.

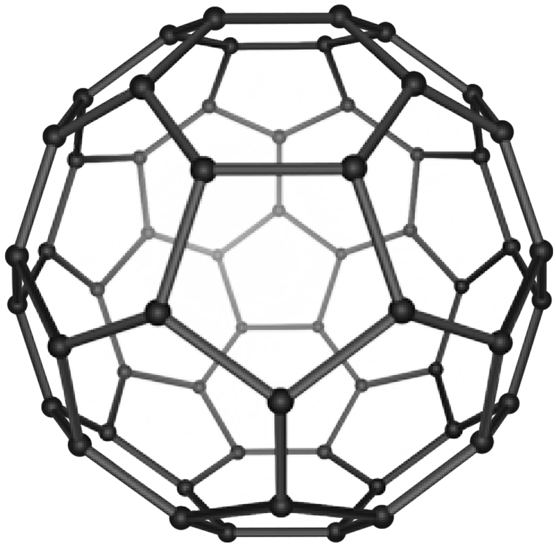
NANOTUBES



Nanotubes are made of carbon, have a high length to diameter ratio and have a high tensile strength. Graphene nanotubes are strong and can conduct electricity because they have delocalised electrons.

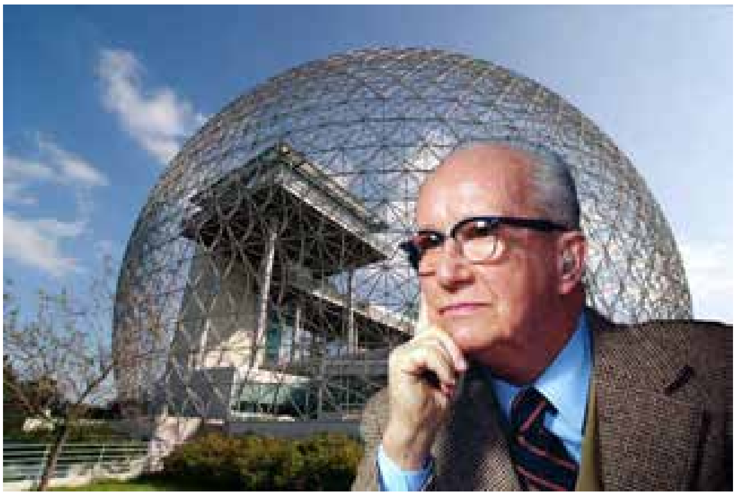
BUCKMINSTER FULLERENE AND THE FIFA WORLD CUP!

Spot the difference:



You would not immediately connect a molecular model of C_{60} BUCKMINSTERFULLERENE and a World Cup football but, when you look at them, it's obvious!

The sports firm Adidas started to make footballs in 1963 but made the first official FIFA World Cup ball in 1970 for the competition in Mexico. This is the first ball used in the World Cup to use the **Buckminster type of design**. Also, the first ball with 32 black and white panels. The TELSTAR was more visible on black and white televisions (1970 FIFA World Cup Mexico™ was the first to be broadcast live on television). The football's design was also used in World Cups up to 2002, when a new design was introduced. A new version of the original Telstar ball was used in the 2018 competition. But why is the design of the football called the "Buckminster" and the C_{60} molecule Buckminsterfullerene?



RICHARD BUCKMINSTER FULLER was an American architect, systems theorist, writer, designer, inventor, philosopher, and futurist. He styled his name as R. Buckminster Fuller in his writings, publishing more than 30 books. Fuller developed numerous inventions, mainly architectural designs, and popularized the widely known **geodesic dome**.

A humanitarian with the idealistic goal of making the world work for 100% of humanity, Fuller sought to create a structure that would cover the largest amount of space using the least amount of material. 'Bucky' Fuller approached research questions from a whole systems viewpoint to solving complex problems, rather than a linear, fragmented perspective. He would ask, *"What are the resources?" "How can we ever do so without ever advantaging one human at the expense of another?"* Buckminster Fuller called his whole-systems strategy *"comprehensive anticipatory design science… the effective application of the principles of science to the conscious design of our total environment in order to help make the Earth's finite resources meet the needs of all humanity without disrupting the ecological process of the planet."*

Perhaps the most famous of Buckminster Fuller's geodesic domes is located in Parc Jean-Drapeau on Saint Helen's Island, Montreal, Canada. The dome houses a museum, the **Montreal Biosphere**, one of five museums in the city that focus on the natural world. The geodesic dome that now houses the Montreal Biosphere was originally the American Pavilion at the Universal and International Exhibition of 1967, better known as Expo 67.

JACK NICE

GIANT COVALENT STRUCTURES

Giant covalent structures

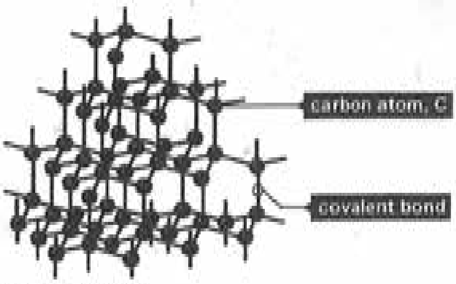
A giant covalent structure is a three-dimensional structure of atoms that are joined by covalent bonds.

Allotropes are different forms of the same element, in the same state.

Graphite, graphene and diamond are allotropes of the same element (carbon) in the same state (solid). Carbon can form up to four covalent bonds.

Diamond

Diamond is a giant covalent structure in which each carbon atom is covalently bonded to four other carbon atoms in a tetrahedral, three-dimensional structure. Diamond's properties include:



- **high melting and boiling points.** Diamond's many covalent bonds are strong and substantial energy is needed to break them.
- **does not conduct electricity.** Diamond has no free ions or delocalised electrons to move and carry the charge.
- **hardness.** Diamond's three-dimensional tetrahedral structure with strong covalent bonds makes it very hard.

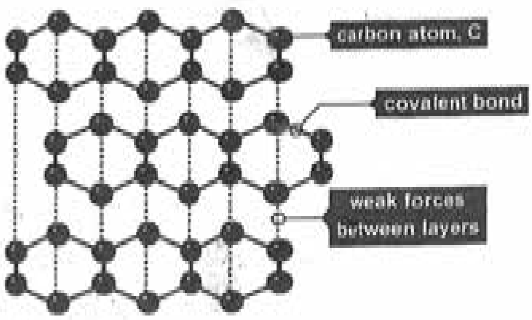
Graphite

- each carbon atom forms three covalent bonds with other carbon atoms
- the carbon atoms form layers of hexagonal rings
- there are weak forces of attraction between the layers
- there is one, non-bonded – or delocalised – electron for each atom

Graphite's properties include:

- **high melting and boiling points.** Graphite's many covalent bonds are strong and substantial energy is needed to break them.
- **good electrical conductivity.** Each carbon atom has an unbonded electron. The unbonded electrons are delocalised electrons that are free to move and carry charge.
- **softness.** The weak forces between graphite's layers allow them to slide.

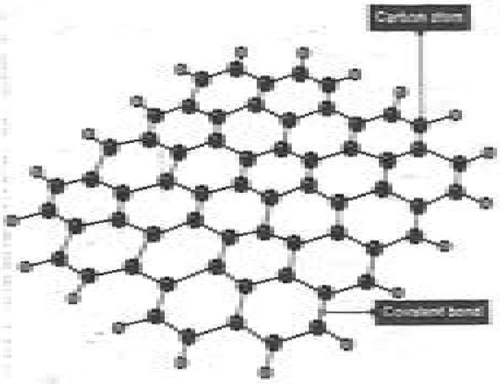
Graphite is used as a lubricant and in pencils.



Graphene

Graphene is a single-atom thick layer of graphite with strong covalent bonds between each carbon atom. The atoms are arranged in hexagons. Its properties include:

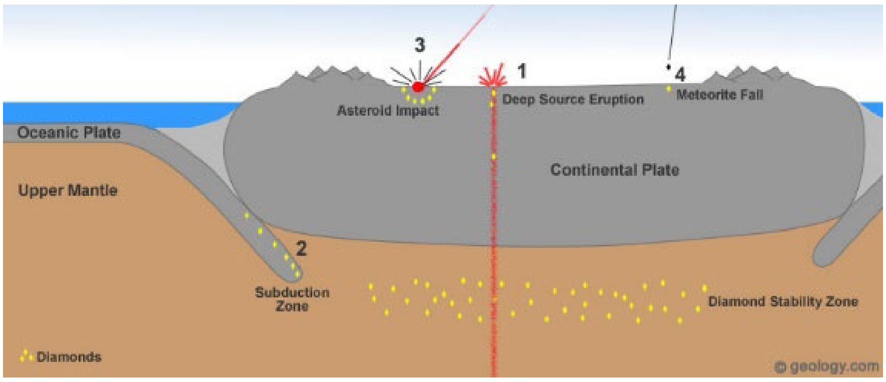
- **high melting and boiling points**. Graphene's many covalent bonds are strong and substantial energy is needed to break them.
- **good electrical conductivity**. Each carbon atom has an unbonded electron. The unbonded electrons are délocalised electrons that are free to move and carry charge.
- **very strong**. Graphene's strong covalent bonds makes it 100 times stronger than steel. It is also the thinnest material possible – one atom thick – and very lightweight and transparent.



DIAMONDS ARE A GIRL'S BEST FRIEND (But where do they come from? Not coal!)

Diamonds are formed when carbon-rich materials are subjected to great pressure and temperature. Many have been told that coal at great depths and pressure is a great source of diamonds, but this is a fallacy.

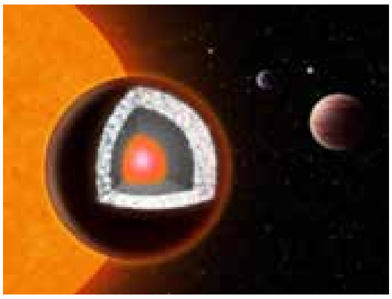
The most convincing evidence that coal did not play a role in the formation of most diamonds is a comparison between the age of Earth's diamonds and the age of the earliest land plants, the origin of coal. Almost every diamond that has been dated formed during the Precambrian Eon - the span of time between Earth's formation (about 4,600 million years ago) and the start of the Cambrian Period (about 542 million years ago). In contrast, the earliest land plants did not appear on Earth until about 450 million years ago - nearly 100 million years after the formation of virtually all of Earth's natural diamonds. So where do diamonds come from?



Diamonds found at or near Earth's surface have been formed by one of four separate processes. The plate tectonics diagram shows the four ways:

1. Deep source volcanic eruptions
2. Tectonic plate subduction
3. Asteroid impact
4. Meteorites

The majority of diamonds, nearly 100%, were formed over the last 1-3 billion years deep within the Earth's upper mantle under conditions of intense heat and pressure that cause carbon atoms to crystallise forming diamonds, in the so-called "diamond stability zone". The semi-liquid magma of the mantle occasionally bursts upwards through the crust, resulting in volcanic eruptions on the surface. Afterwards, over time the "magma pipe" cools and hardens and may contain diamonds that can then be mined.

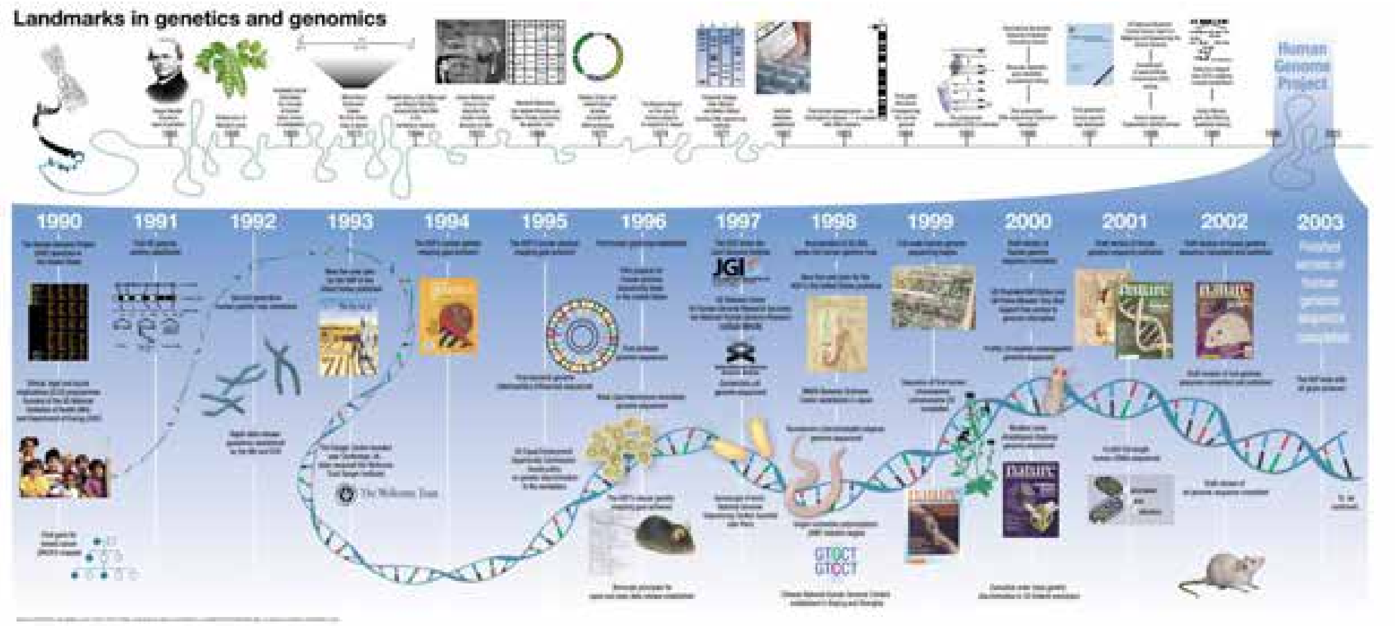


Of the other methods of diamond formation, meteorites are interesting. Certain types of meteorite are known to contain diamonds, although on an almost microscopic scale. Exactly how such meteorites originate is still a mystery. Even more mysterious is the discovery of an exoplanet that may have a crust entirely composed of crystallised carbon – diamond.

The alien planet, a so-called "super-Earth", is called *55 Cancri e* and was discovered in 2004 around a nearby star about 40 million light years distant in our Milky Way galaxy. After estimating the planet's mass and radius, and studying its host star's composition, scientists now say the rocky world is composed mainly of CARBON (in the form of DIAMOND and GRAPHITE), as well as iron, silicon carbide, and potentially silicates.

National Human Genome Research Institute

The Human Genome Project is one of the greatest scientific feats in history. The project was a voyage of biological discovery led by an international group of researchers looking to comprehensively study all of the DNA (known as a genome) of a select set of organisms. Launched in October 1990 and completed in April 2003, the Human Genome Project's signature accomplishment – generating the first sequence of the human genome – provided fundamental information about the human blueprint, which has since accelerated the study of human biology and improved the practice of medicine.



What's a Genome?

Genome is a fancy word for all your DNA and any other living thing's DNA. All living organisms have their own genome. Each genome contains the information needed to build and maintain that organism throughout its life.

Your genome is the operating manual containing all the instructions that helped you develop from a single cell into the person you are today. It guides your growth, helps your organs to do their jobs, and repairs itself when it becomes damaged. And it's unique to you. The more we know about our genome and how it works, the more we'll understand our own health.

What's a Gene?

A gene is a segment of DNA that provides the cell with instructions for making a specific protein, which then carries out a particular function in your body. Nearly all humans have the same genes arranged in roughly the same order and more than 99.9% of your DNA sequence is identical to any other human. Still, we are different. On average, a human gene will have 1-3 letters that differ from person to person. These differences are enough to change the shape and function of a protein, how much protein is made, when it's made, or where it's made. They affect the colour of your eyes, hair, and skin. More importantly, variations in your genome also influence your risk of developing diseases and your responses to medications.

It is incredible to think that it was only in 1953 that we discovered the structure and precise nature of the DNA molecule yet, in just 50 years, the total sequence of the entire molecule was determined.