So you want to study Environmental Science?

A-level Environmental Science

GCSE 'bridging' work, summer 2025

Please bring this to your first lesson when you start in September.

I want you get used to some of the skills needed in this fascinating subject: observation, investigation and research skills.

Activity 1: Conditions for Life on Earth

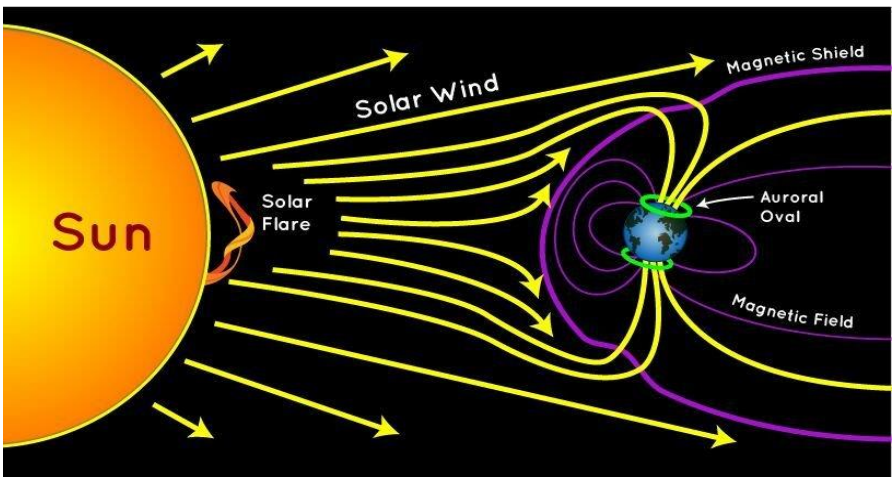
The position of planet Earth within the Solar System and its physical features: size, lithology, rotation and structure have combined to produce the only body in the Solar System that we know has suitable conditions for life to develop and evolve.

It is important in A-level Environmental Science to be able to synthesise complex ideas and interpret them for your own understanding.

Read the two attached documents: (1) first chapter of the A-level Environmental Science textbook and (2) Conditions for Life on Earth (pdf) to find out why the Earth is known as the 'Goldilocks' planet in our Solar System, with conditions perfect for life.

- **Complete the following tasks:**

1. Make notes or highlight key principles in the chapter to produce a mind-map revision resource on a separate piece of paper which answers the following questions:
   a. Why do the following physical factors (mass, distance from sun, rotational speed and axis and Earth's magnetic field) of the Earth support conditions for life?
   b. Why is liquid water so important for life on Earth?
   c. How do the following factors (temperature range, atmosphere and solar insolation) help support life on Earth?

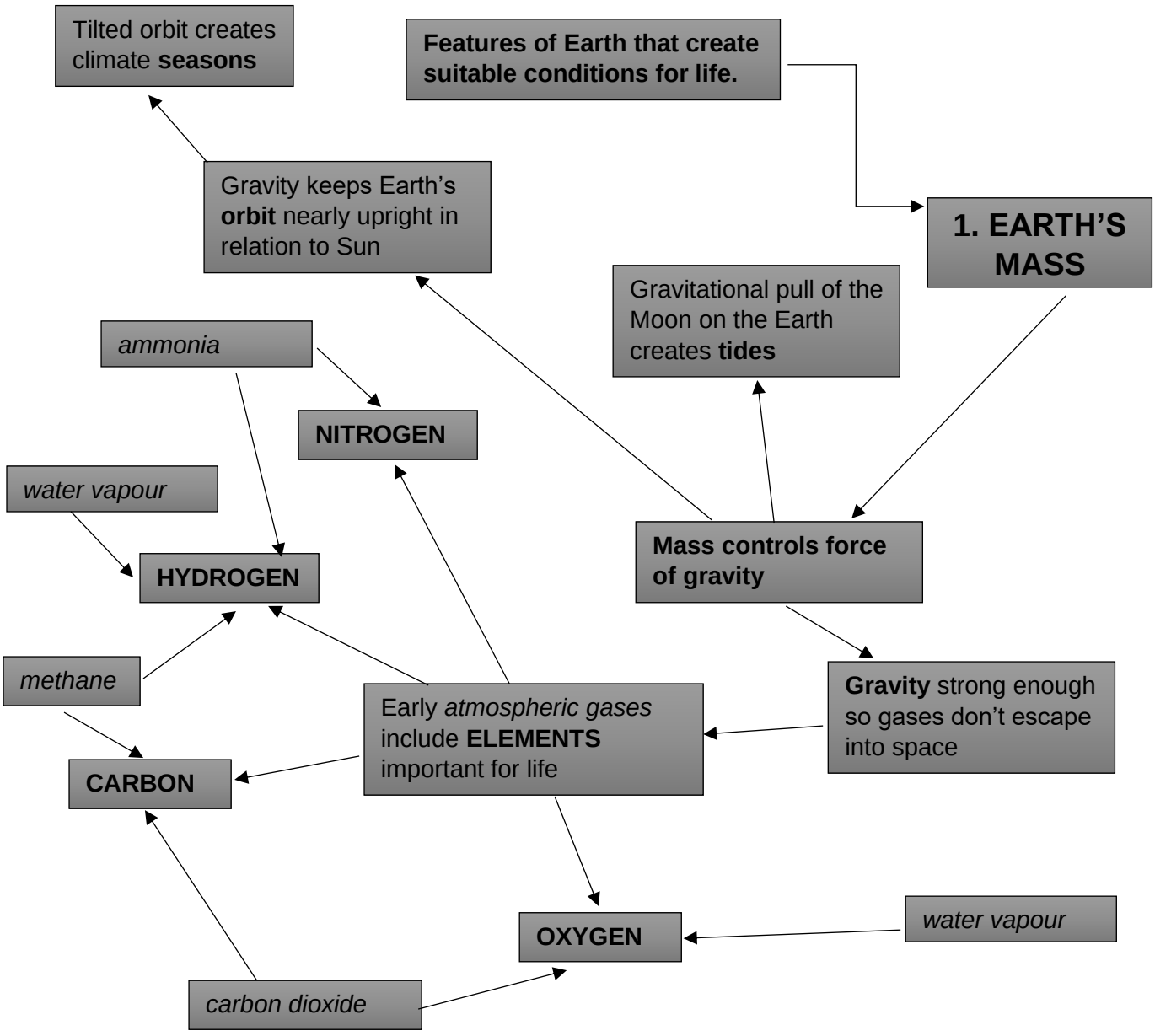


Example Mind-Map on next page.

2. On a separate piece of paper or in a word document, produce a glossary with meanings of the following key terms:

ambient gases	**atmosphere**	**biosphere**	**greenhouse gases**
hydrosphere	**insolation**	**lithosphere**	**physiological function**
photolysis	**specific heat capacity**		**thermophilic**

Example mind map showing how mass is important:



3. Answer the following exam questions:

Summary Questions

Q1. Outline how the following features of the Earth have provided conditions that allowed life to develop:

- Position in the solar system [2]
- Structure [2]
- Rotation and tilt [2] [6 marks]

Q2. Outline 3 ways in which the properties of water allows living organisms to survive on Earth [3 marks]

Q3. Explain why the temperature range found on Earth is suitable for the survival of living organisms

[2 marks]

Activity 2: Investigation of organisms in your local park/garden

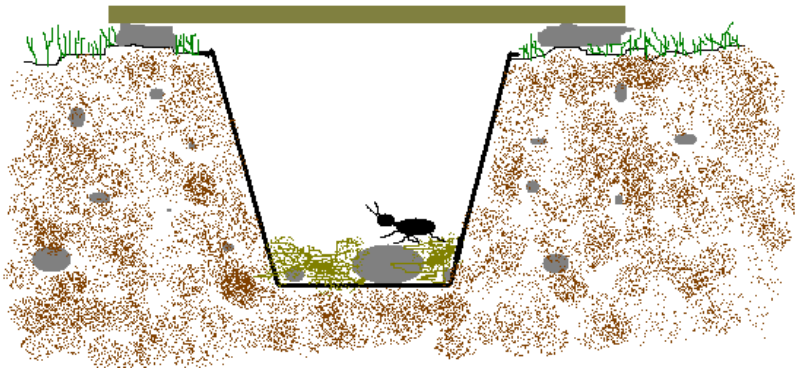
Environmental science also includes practical and field-based ecological investigation.
These activities involve using your observation and sampling skills, please try to do one of the following simple investigations. ***Please ensure that any organisms caught in the following investigations are returned safely to where you found them and not harmed in the studies.***

Homemade pitfall trap

Mobile invertebrate animals that move about on the ground surface can be trapped in a pitfall trap and observed (instructions https://www.nhm.ac.uk/discover/how-to-make-pitfall-trap-to-catch-insects.html)

You will need:

- a trowel
- a large washed, clean yoghurt or cream pot
- a tray
- ID guides



1. Choose a location for your trap on flat ground near/underneath vegetation.
2. Use a trowel to dig a hole.
3. Place the clean pot in the hole. Fill in any empty space around the pot with soil. Make sure that the top of the pot is level with the ground, or you won't catch anything.
4. Place some small stones and a little dry grass or leaves in the bottom of the trap for them to hide in but don't put in too much or they will be able to climb out.
5. Cover the trap with a piece of wood or tile, raised a little above the ground using a couple of stones so that the mini-beasts can crawl underneath.
6. Set up the trap in the morning and check it that evening or set it in the evening and check it the next morning.

7. Empty the trap into a tray to see what creatures wandered in. Use ID guides (books, online resources or apps – see below for weblinks) to help you identify what kind of invertebrates they are.
8. Record your findings: make a note of what you caught, the date and location (see section on **Recording Your Data**). You could also draw the creatures or take photographs.
9. Carefully release the creatures, returning them to a safe, sheltered place. Return the area back to how you found it.

Moth trapping for beginners

Some flying insects such as moths are attracted to light and can be trapped for observation.

(instructions https://www.lancswt.org.uk/blog/charlotte-varela/moth-trapping-beginners)

You will need:

- White sheet
- Washing line and clothes pegs
- Bright lamp or torches

1. Choose a warm night with little wind and preferably decent cloud cover.
2. Hang and peg a sheet over the washing line.
3. Turn off nearby house and garden lights.
4. Shine your light/torch onto the sheet and make sure you are comfortable!
5. Wait patiently for the moths to gather on the sheet
6. ID and record (you may wish to photograph them) the moths you observe.
7. Do not handle the moths' wings, they are very delicate.

- For this exercise you may find a magnifying glass or hand lens would be useful. They are available from various places e.g. from museums and visitor centres or online. There are x10 hand lenses on Amazon for about £5 and magnifying glasses for around £2.
- You may also want to purchase or download the Identification charts for your own use. The Field Studies Council do a range of fold out ID sheets that can be purchased from their website https://www.field-studies-council.org/shop/publications/garden-bugs-and-beasties/ . There are also various Apps and online ID resources. For example:
  Buglife UK https://www.buglife.org.uk/ Butterfly conservation https://butterfly-conservation.org/moths/identify-a-moth

Recording Data

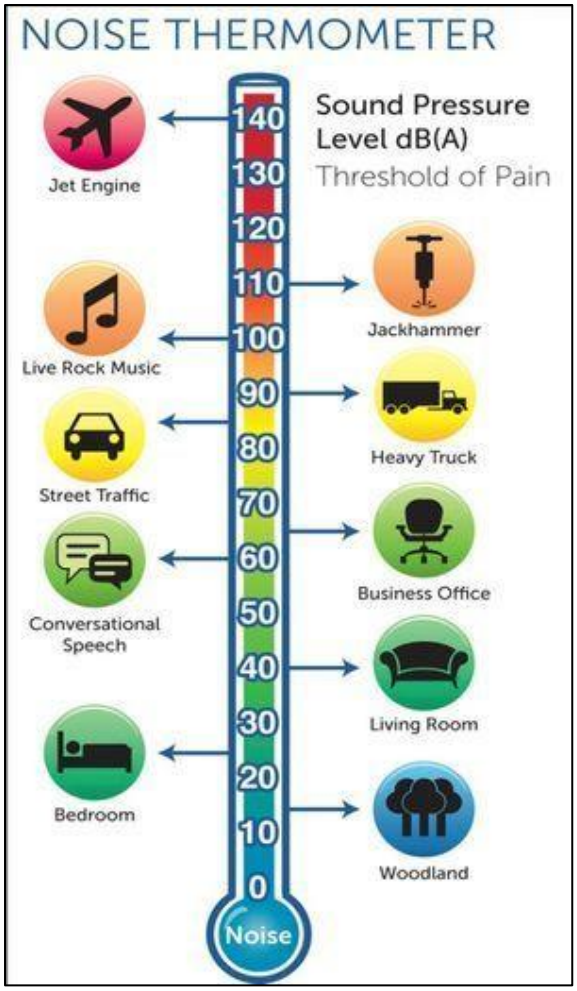
How should you record your findings?

A good idea would be to produce a Table to record the types and numbers of species observed – this could be as simple as a Tally chart. You may wish to process this data into a bar chart.

If you do observations over several nights/days, then how will you know whether you are simply observing the same individual on numerous occasions? Research capture-mark-recapture as a method for avoiding counting the same individual more than once.

You can also photograph and sketch the animals observed.

Activity 3: Investigation of noise pollution in your local area



A-level Environmental Science includes monitoring how human activities – called '**anthropogenic factors'** affect the environment, from the release of CO_2 into the atmosphere causing manmade global warming to farming, fishing and forestry.

Introduction: Noise pollution can negatively impact humans and wildlife. It can also have an impact on buildings through acoustic fatigue and/or vibration damage. In humans noise pollution can cause hearing damage and stress related health problems such as high blood pressure, type 2 diabetes and heart attack. In wildlife feeding and breeding can be affected as well as inducing behavioural change in organisms. In this investigation you will monitor how noise levels change with increasing distance from a road junction or other source of loud and frequent noise.

Method

1. Locate a suitable source of loud and persistent noise – a busy road junction or roundabout is ideal, but other sources might be an airport, farm, hospital or factory
   Record your source here ……
2. Use a distance measuring App on your phone to measure a straight-line distance 'transect' of between 100-250m from the source.
3. Download a (free) phone App to record noise levels (dB) e.g. Sound Level Meter
4. A compass is also handy to record the direction you are walking in away from the noise source. If you haven't got one, some phones have this in their settings and Google or Bind Maps.
   Direction of travel = …….
5. Decide what time of day you are going to take the measurements = ……
6. Decide in advance the timing of each measurement at the sample sites.
   Timing for your survey for each sample site = …….. minute(s)
7. You are going to record the noise level at each location, starting at the source.
   Decide in advance the number of sample sites along your transect = …… and distance between them = ……..m

Make sure to record any random noise e.g. dog barking or ambulance sirens that might affect your readings.

Recording Data

How should you record your findings?

A good idea would be to produce a Table to record the noise measurements and distances along the transect, you could also produce a scatter graph to show how distance from the source and noise levels (dB) correlate. You should aim for at least 20 readings to be reliable.

You could repeat this investigation at different times of the day to see how the noise levels change or conduct more transects in different directions.

Go further activities

If you are interested in finding out more about the fascinating subject of Environmental Sciences, the following are FREE online courses that aimed at an introductory level run by universities:

OpenLearn courses run by the Open University

https://www.open.edu/openlearn/nature-environment

FutureLearn courses run by collaboration between universities in the UK and abroad

https://www.futurelearn.com/subjects/nature-and-environment-courses

I cannot wait to meet you in September. Have a great and productive summer!

Sara Metcalf

Geology and Environmental Science Teacher

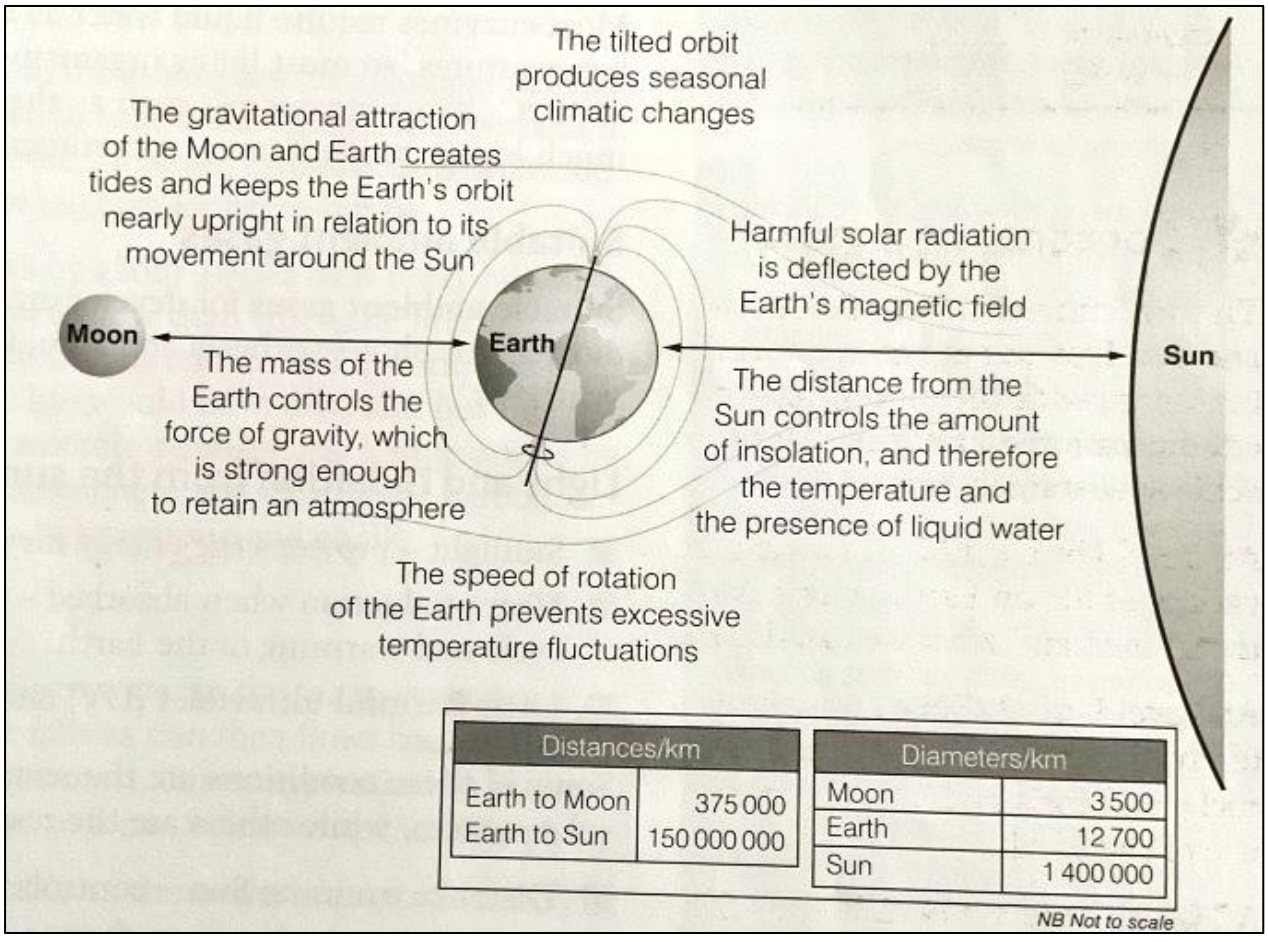
The next pages are resources to help you with your the activities above

1 The Living Environment

Learning objective: how have the features of the Earth allowed life to develop?

1.1 Conditions for life on Earth

The position of the Earth in the solar system, and its size, structure, composition, and rotation have combined to produce conditions that allowed life to develop and evolve about 4 billion years ago.



Distances/km	
Earth to Moon	375 000
Earth to Sun	150 000 000

Diameters/km	
Moon	3 500
Earth	12 700
Sun	1 400 000

Fig. 1.1 How the features of the Earth create conditions that are suitable for life.

1.2 The early conditions on Earth

Large amounts of water

Water is essential to all living organisms, firstly because it has **physiological functions** in organisms meaning that water is involved in chemical reactions that take place in living cells.

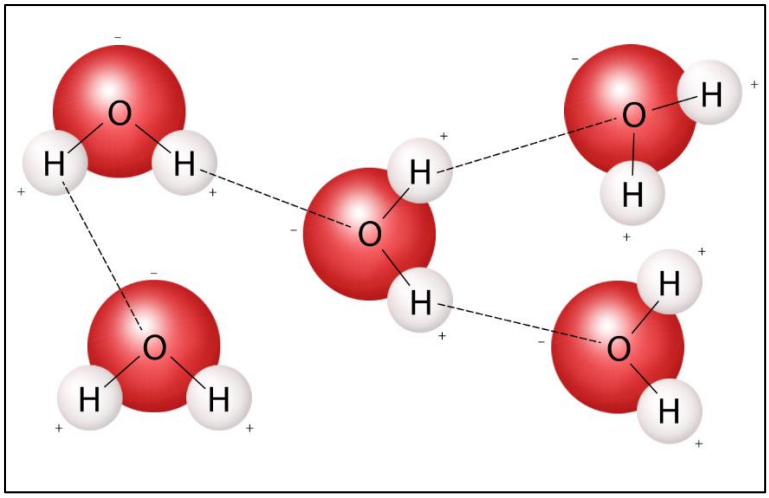


Fig. 1.2 The water H_2O molecule is polar making it a good solvent .

Water's main functions and processes in living organisms are:

Physiological solvent	Most chemical reactions in cells take place dissolved in water. Water is a polar molecule meaning it is a good solvent.
Transport	Water is the solvent in blood in animals and in sap in plants. These transport dissolved oxygen, sugars, amino acids, waste products, mineral resources, nutrients etc.
Temperature control	The evaporation of water from skin in vertebrate animals is used to cool the body when too hot. Heat can be transported in the blood, for example transported from core organs to the skin to increase heat loss

Living organisms on Earth are known as the **biosphere**. Water is also important as it changes the wider environment in terms of providing aquatic habitats for life – such as lakes, rivers, oceans. Along with the atmospheric water (rain, snow), ice caps, groundwater and water in soil, these habitats are collectively called the **hydrosphere**.

Water has high **specific heat capacity** – the measure of the amount of heat energy measured in joules required to heat up a mass of material by a certain temperature rise. Having a high specific heat capacity means that water heats up and cools down slowly, moderating temperature changes in the environment.

Water also has an odd freezing property – it expands when frozen, meaning that ice floats on water. This keeps very cold air from the water below the ice and prevents the water cooling as much so that lakes in cold areas of Earth do not freeze solid in winter.

Appropriate temperature range

Most areas on Earth have a temperature above 0°C, allowing liquid water to be present. Most enzymes require liquid water as a solvent and denature at higher temperatures – so living organisms tend to be found within a range of 0°C-40°C. Only a few bacteria which can

live at much higher temperatures such as around volcanic vents and springs, these are known as **thermophilic** bacteria and can withstand temperatures up to 80°C.

Suitable ambient gases

Ambient gases are those surrounding organisms in the environment. Those suitable for developing and sustaining life are carbon dioxide which is used for photosynthesis and climate control and ammonia, which contains nitrogen for protein synthesis. These were present in the early **atmosphere** – the layers of gases that surrounds the Earth's surface. Carbon dioxide is a **greenhouse gas** which absorbs infrared radiation from the Sun helping to retain heat in the atmosphere.

They can also be found in the **lithosphere** – the uppermost layers (crust and upper mantle) of the Earth within inclusions in crystals and rocks and in the hydrosphere as dissolved components.

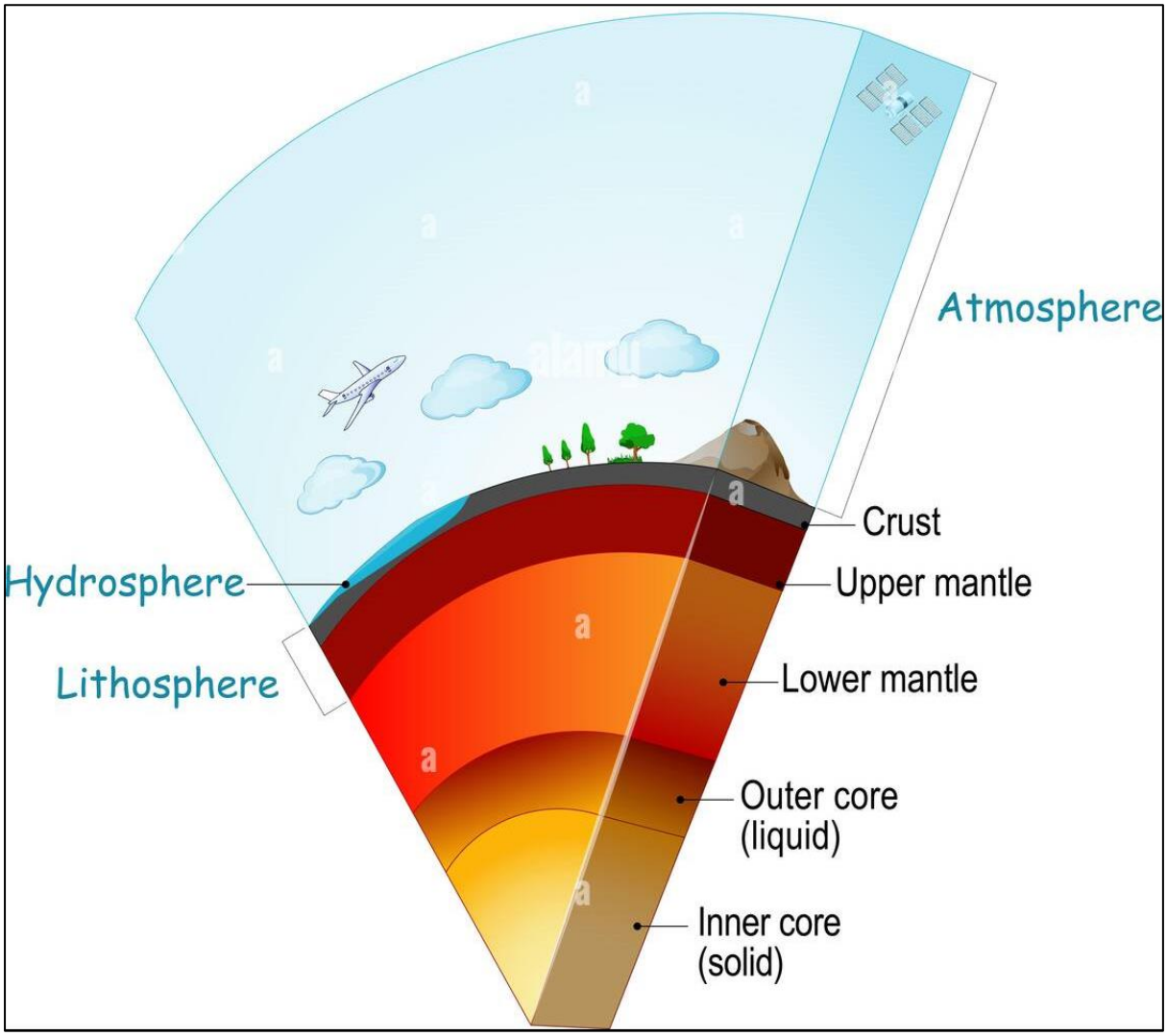


Fig. 1.3 The layers of the Earth (not to scale).

Light and radiation from the Sun

- Sunlight – provides the energy for photosynthesis by organisms such as photosynthetic bacteria and plants;
- Heat production when absorbed – the source of infrared energy for the water cycle and warming the Earth through the Greenhouse Effect. The amount of heat energy reaching the surface in a given time period is called **insolation**.
- Little harmful ultraviolet (UV) an ionising radiation.

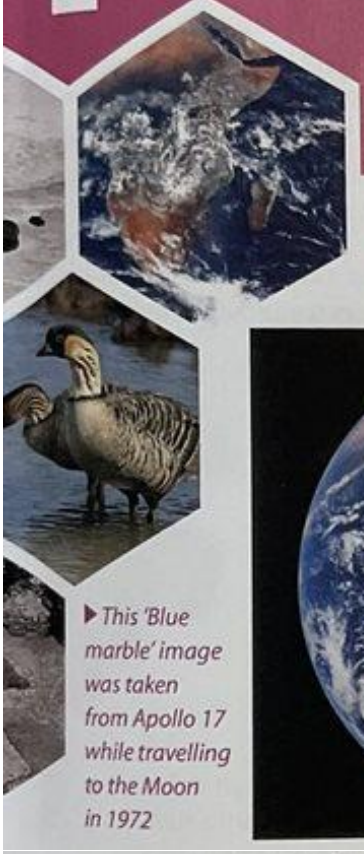
Some of these conditions come from the position of the Earth in the Solar System (it is in just the right place known as the 'Goldilocks Zone'), while others result from features of the Earth itself:

- Distance from the Sun – controls light levels and temperatures;
- Daily rotation – controls duration of day and night, and therefore the range of temperatures;
- Tilted axis – produces seasonal variation of summer and winter;
- A molten Outer Core – this produces the Earth's magnetic field which deflects harmful ionising radiation coming from the Sun into outer space.

Modified extract taken from AQA Environmental Studies by Richard Genn, published by Nelson-Thorne Ltd, 2009

Chapter 1

The conditions for life on Earth



Chapter topics

- Earth before life
- Development of life on Earth

Earth before life

This 'Blue marble' image was taken from Apollo 17 while travelling to the Moon in 1972

The Earth was formed about 4.6 billion years ago as gravity pulled rock fragments in space together. The huge amount of energy absorbed as the rocks joined, created heat and produced a ball of molten rock. The surface gradually cooled to produce a surface crust of solid rock.

The physical features of Earth made it suitable for the eventual development of life by controlling the abiotic factors that are needed by living organisms.

Features of Earth that created suitable conditions for life

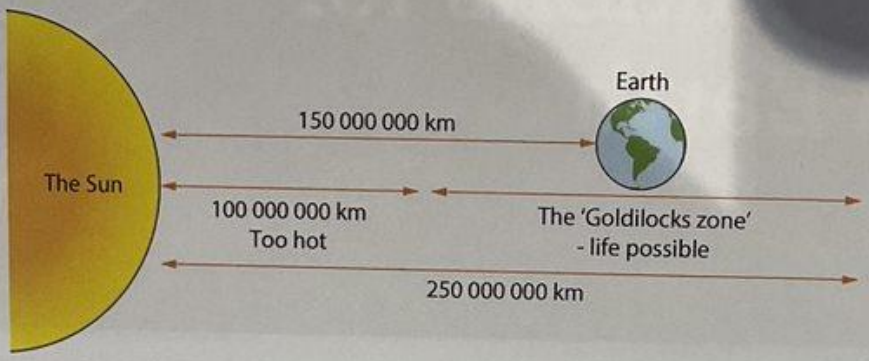
A range of features of the structure, position and behaviour of Earth made the development of life possible.

Mass

The mass of the Earth was great enough to prevent most gases from escaping into space. This atmosphere included the elements essential for life: carbon, hydrogen, oxygen, and nitrogen. They were present in compounds such as methane, ammonia, and carbon dioxide. The atmospheric pressure was high enough to prevent all the liquid water from boiling. Water is vital for living organisms as it is the general physiological solvent in which most biological reactions take place. It is also important in transport and temperature regulation.

Distance from the Sun

The light emitted from the Sun and the distance from the Sun were suitable to produce temperatures on Earth that would be suitable for life. Being too close or too far away from the Sun would prevent liquid water being present. The time taken for the Earth to rotate on its axis produced a day/night cycle that was fast enough to minimise excessive heating or cooling.



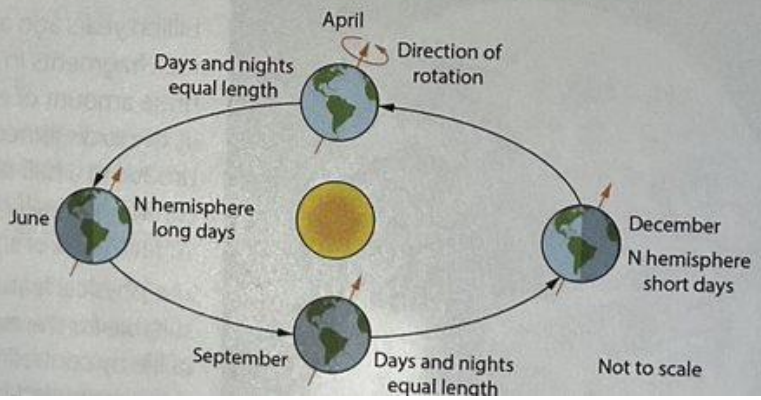
▲ *How Earth's position in the Solar System affects the survival of living organisms*

Axis of rotation

The axis of rotation is at an angle to its orbit around the Sun which produces seasonal variations in conditions as the Earth orbits the Sun.

Speed of rotation

The temperature of the Earth's surface rises when it is exposed to sunlight and falls when it is not. The 24-hour period of rotation of Earth around its axis reduces temperature extremes.

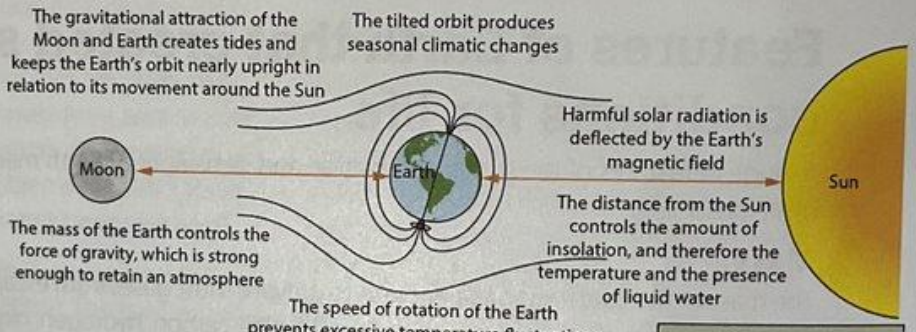


▶ *How the Earth's orbit around the Sun produces seasonal changes.*

Magnetic field

The molten layers beneath the crust produce the Earth's magnetic field that deflects the 'solar wind' and prevents biologically damaging radiation reaching the Earth's surface.

▶ *How the features of the Earth create conditions that are suitable for life*



Distances / km	
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Diameters / km	
Moon	3500
Earth	12 700
Sun	1 400 000

Life first developed on Earth about 3.5 billion years ago. The conditions on Earth then were very different from those that exist now. The atmosphere contained some toxic gases, like ammonia, but no oxygen. The solar energy reaching the ground included high levels of ultra-violet radiation.

The chemical composition of the sea included increasingly complex organic molecules.

Development of life on Earth

Eventually, simple single-cells formed, possibly around volcanic geothermal vents on the seabed where the warm temperatures and rich mix of chemicals made biological processes more likely. These Archaea were single-celled organisms similar to bacteria. They still survive in many habitats, especially the oceans. Some are anaerobic, such as the methanogenic archaea that live in intestines and marshes.

Early conditions on Earth that allowed life to develop

After the formation of the Earth about 4.6 billion years ago, the conditions changed, eventually becoming suitable for life to develop.

Presence of liquid water

All living organisms require water for survival. It performs essential physiological functions and controls many environmental conditions.

- **Solvent water:** the 'general physiological solvent'. Most chemical reactions in living organisms involve reactants that are dissolved in water.
- **Transport within organisms:** water is the solvent in blood and sap where it transports dissolved gases, sugars, amino acids, mineral nutrients, waste products.
- **Temperature control:** the evaporation of water absorbs heat, causing temperatures to decline.
- **Anomalous expansion on freezing:** water is most dense at 4°C so water that is cooler than this floats, stopping the convection current that may have cooled the whole water body.
- **High specific heat capacity:** water warms up and cools down slowly, which helps to moderate the rate and size of temperature changes.
- **Aquatic habitats:** oceans, seas, lakes, marshes, and rivers.
- **Absorption of UV radiation:** this protected living organisms in the oceans before the ozone layer developed which absorbed UV in the stratosphere.

Temperature range

Most areas of Earth have temperatures between 0°C and 35°C, so most areas are warm enough to have liquid water but not hot enough to denature proteins.

Atmospheric gases

- Carbon dioxide for photosynthesis and the synthesis of carbohydrates, proteins, and lipids.
- Nitrogen for protein synthesis.

Solar insolation

Sunlight provides the energy for photosynthesis. The heat produced by the absorption of sunlight provides the energy that drives the water cycle and warms the Earth's surface and the oceans. The amount of sunlight that is absorbed by the Earth's surface depends upon the albedo of the surface. The composition of the atmosphere controls the amount of infrared energy that is absorbed and converted to heat.