Earth's atmosphere

This resource accompanies the infographic and fact sheet **Earth's atmosphere** in *Education in Chemistry,* which looks at the makeup of the layers in Earth's atmosphere and compares Earth's early atmosphere and today's. The infographic can be viewed at: rsc.li/3YKjs94

Learning objectives

1. Name of the distinct layers of Earth's atmosphere.
2. Analyse data on the composition and temperature of Earth's atmosphere.
3. Explain the role of the atmosphere for sustaining life on Earth.

Introduction

This is a Directed Activity Related to Text (DART). Instruct learners to use the infographic poster and fact sheet, as well as any common scientific knowledge they have about global warming to complete the associated questions and calculations.

How to use the infographic and fact sheet

Display the poster on the wall in your classroom, project it onto an interactive whiteboard or print and hand out individual copies to learners. If you are using printed copies of the poster then you can opt to ask learners to annotate the poster using information from the fact sheet.

Ask learners to read the fact sheet before answering the questions. You can read as a whole class with individuals reading a few lines each, in small groups, pairs or as individuals, depending on what best suits your class.

Scaffolding

An unscaffolded (three stars in the header), partially-scaffolded (two stars) and fully-scaffolded (one star) worksheet are available. Each version offers a different level of assistance and complexity.

The unscaffolded worksheet contains no multiple-choice questions, with more open-ended questions and opportunities for learners to express their thoughts. The partially- and fully-scaffolded versions contain some multiple-choice questions and questions where learners can circle the correct answer or omit the incorrect answer.

Answers

1. *Unscaffolded/partially scaffolded*
   Troposphere, stratosphere, mesosphere, thermosphere, exosphere

   Fully scaffolded
   Introsphere

2. *Unscaffolded/partially scaffolded*
   The ozone layer acts like a blanket which protects us from harmful rays and scatters UV radiation.

   Fully scaffolded
   The ozone layer acts as a protection around the Earth by blocking **most** of the harmful rays of the Sun.

3. *Unscaffolded*
   Early atmosphere: mainly carbon dioxide.
   Current atmosphere: mainly nitrogen and oxygen.

   Partially scaffolded/fully scaffolded
   - Earth's early atmosphere had **more** carbon dioxide than today's.
   - Earth's early atmosphere had **less** oxygen than today's.

4. *Unscaffolded/partially scaffolded*
   Carbon dioxide was used by plants in photosynthesis and was also locked up in rocks.

   Fully scaffolded
   During photosynthesis plants **take in** carbon dioxide and **release** oxygen. The number of plants on Earth has **increased.**

5. Simple single-cellular life forms e.g. bacteria and archaea.

6. Thermosphere

7. The thermosphere absorbs radiation from the Sun.
   Note to teacher: it is not the exosphere as the particles are too far apart.

8. Any one or two from the list below. Learners may give other sensible answers with explanations:
   - **Burning fossil fuels**: the combustion of coal, oil and natural gas for electricity, heating and transportation releases large amounts of CO_2.
   - **Land use changes**: urbanisation and other land development activities often involve the removal of vegetation, which decreases CO_2 absorption and increases emissions.

- **Deforestation**: clearing forests for agriculture, urban development and logging reduces the number of trees that can absorb CO_2, leading to higher atmospheric levels.
- **Industrial processes**: industries such as cement production, steel manufacturing and chemical processing emit substantial amounts of CO_2.
- **Agriculture**: agricultural practices, including soil cultivation and the use of synthetic fertilizers, release CO_2 and other greenhouse gases.

9. We can slow down global warming by:
   - reducing greenhouse gas emissions
   - switching to renewable energy
   - walking/using public transport instead of cars
   - recycling
   - reducing energy usage at home
   - planting more trees
   - any other sensible answer

10. This question is an opportunity for learners to be creative and use the information provided to give an account of what they think the early Earth may have been like. Learners may talk about the lack of life, hot temperatures due to increased carbon dioxide, volcanoes, the first oceans being formed, thick air, the smell of toxic gases etc. This is a good discussion to have as a class.

Example answer

The air is thick with a toxic mix of gases like methane, ammonia and water vapour, with almost no free oxygen to breathe. The sky is a hazy, reddish colour due to the different atmospheric composition and the Sun's dimmer, younger state.

I can see violent volcanic eruptions spewing lava and ash, contributing to the dense, suffocating atmosphere. The ground is barren, rocky and lifeless, with no plants or animals in sight. Instead, I see vast oceans covering much of the planet, their waters teeming with simple, single-celled organisms like bacteria and archaea, the earliest forms of life.

As I explore further, I notice the intense ultraviolet radiation from the Sun bombarding the surface, as there is no protective ozone layer yet. The temperature fluctuates wildly, with scorching heat by day and freezing cold by night. The landscape is rugged and unstable, with constant tectonic activity reshaping the land.

This hostile environment is where life on Earth began its slow and arduous journey, eventually leading to the diverse and complex forms we know today.

Answers to calculations

1. Ans = 15 – (-50) = 15 + 50 = **65°C**
2. Mesosphere, stratosphere, troposphere, sea level, exosphere, thermosphere.
3. As the altitude in km increases, the pressure in kPa **decreases**.
   This is a good way to for learners to become used to this style of exam question as they advance through describing trends from a table or graph.
4. The percentage of oxygen is 20.95%
   Therefore, in decimal this is 20.95 / 100 = 0.2095
   There are 1,000,000 molecules present, therefore to calculate the amount of oxygen molecules
   1,000,000 x 0.2095 = **209,500 oxygen molecules**