Student book answers

5.1 The Earth’s spheres are balanced

Pages 112–115

Check your learning 5.1

Remember and understand

1 What is the lithosphere made up of?

The lithosphere is the outermost rocky layer of the Earth. It is made up of the mantle and crust.

2 What makes up the biosphere?

The biosphere is made up of all living things on Earth and is located where the three major spheres of Earth – hydrosphere, lithosphere and atmosphere – interact.

3 What happens to the amount of air as you go higher into the atmosphere?

The amount of air decreases as you reach higher into the atmosphere.

Apply and analyse

4 In which layer of the atmosphere do we live?

We live in the troposphere, which is the bottom layer of the atmosphere.

5 What is the difference between the hydrosphere and the cryosphere?

The hydrosphere is all the Earth’s water. The cryosphere makes up the part of the hydrosphere that is frozen water.

6 How does the hydrosphere interact with the other spheres?

The hydrosphere interacts with and is influenced by each of the other spheres:

• In the atmosphere, water exists in three different states: liquid, vapour and solid (glaciers and ice).

• In the lithosphere, water is required for plants and animals to survive.

• In the biosphere, water exchanges between the other spheres.

Create and evaluate

7 Draw a Venn diagram with four interlocking circles, one for each of the spheres studied. Label each sphere and include all features they share.

Students should have three circles joined, where the overlap of all circles is the biosphere:

• Biosphere: All the ecosystems linked together on Earth form the biosphere. The biosphere is located where the three major regions of Earth – hydrosphere, lithosphere and atmosphere – interact.

• Hydrosphere: This sphere encompasses all the water found on Earth, such as oceans, lakes, rivers, ponds, water vapour, glaciers and ice sheets.

• Lithosphere: This sphere forms the outermost solid layer of Earth and includes the crust and upper mantle.

• Atmosphere: This is the gaseous envelope of air surrounding Earth that protects life on Earth from harmful radiation and cosmic debris.

Student book answers

5.2 Matter cycles through the Earth’s spheres

Pages 116–119

Check your learning 5.2

Remember and understand

1 What are the three reservoirs of oxygen?

The three reservoirs of oxygen are the atmosphere, Earth’s crust/lithosphere and living organisms.

2 Name three important molecules in your body that contain phosphorus.

In the human body, phosphorus is mostly found in DNA, RNA and ATP.

Apply and analyse

3 Why might plants struggle to grow in nitrogen-poor soils?

Without nitrogen in the soil, bacteria cannot convert nitrogen within the soil into nitrates, which the plant then uses to build the protein and amino acids that are essential for growth. The nitrogen must come from the atmosphere, and this is a much longer process as it requires nitrogen-fixing microbes to convert atmospheric nitrogen into ammonia, the nitrifying bacteria to convert ammonia into nitrites and finally the nitrifying bacteria to convert nitrites into nitrates for uptake by plants.

4 Explain why the cycling of nutrients is referred to as a ‘biogeochemical’ cycle. Use an example to explain your answer.

Cycling of nutrients is referred to as a biogeochemical cycle because they contain living (bio), geological (geo) and chemical (chemical) components. Students’ examples will vary.

Evaluate and create

5 Draw a concept map that shows the contribution of microorganisms to the cycling of nutrients in an ecosystem.

Students’ answers will vary; however, students should include all cycles in their answer.

Student book answers

5.3 The water cycle is a global cycle

Pages 120–123

Check your learning 5.3

Remember and understand

1 What is the difference between weather and climate?

Weather is the day-to-day changes in temperature, rainfall, air pressure and so on, whereas climate is concerned with longer periods of time and involves the collection and analysis of large amounts of data.

2 What is meant by ‘air pressure’?

Air pressure refers to the pressure exerted by the atmosphere.

3 What happens to the pressure of the air when it is heated?

The pressure of air increases when it is heated.

Apply and analyse

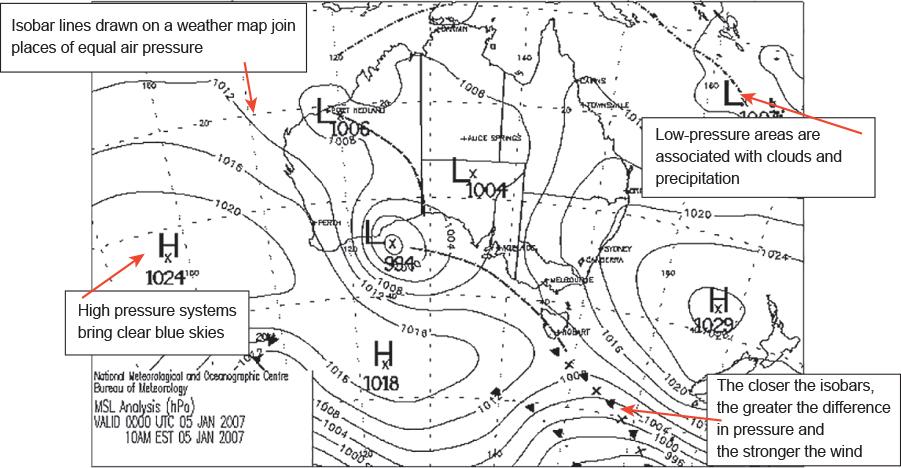
4 How are winds related to rising air?

Wind is the movement of air, and differences in air pressure cause air to move from areas of high pressure to areas of low pressure. Therefore, warmer air near the equator rises and heads towards the poles, and colder air near the poles moves towards the equator.

5 What conditions must occur for water vapour in clouds to fall as precipitation?

In order for water vapour in clouds to fall as precipitation, a drop in temperature and pressure must occur. Water vapour must reach the cooler parts of the atmosphere, condense and form into clouds. Once the clouds are supersaturated and no longer able to hold the condensed water droplets, they fall as precipitation.

6 Print out and label this weather map with as many of the terms listed in this section as you can.



Student book answers

5.4 Human activity affects the carbon cycle

Pages 124–125

Check your learning 5.4

Remember and understand

1 What is a carbon sink? Give two examples of carbon sinks.

A carbon sink is any feature of the environment that absorbs and/or stores carbon, keeping it from the atmosphere, such as forests and the ocean.

2 Explain how you are part of the carbon cycle.

Humans are part of the carbon cycle as carbon is the basic component of living organisms: it is the basis of carbohydrates, protein and lipids; is part of the by-product of respiration; and is stored in the body of organisms and returned to the atmosphere once the organism dies. Humans tap into the carbon cycle by extracting oil, natural gas and coal, and have increased carbon dioxide levels in the atmosphere through the large-scale removal of plants and the burning of fossil fuels.

Apply and analyse

3 What is the difference between the geological carbon cycle and the biological/physical carbon cycle?

The geological carbon cycle is a long-term cycle that occurs over hundreds to millions of years and has resulted in the bulk of carbon being locked in rocks or in sediments as fossil fuels. The biological/physical carbon cycle is a short-term cycle that occurs over days, weeks, months and years and involves the cycling of carbon through photosynthesis and cellular respiration.

4 List two ways human activity affects the carbon cycle.

Students’ answers will vary but could include:

• Burning of fossil fuels: releases excess carbon into the atmosphere as CO2.

• Deforestation: results in less CO2 being absorbed from the atmosphere and fixed into the trees.

5 Compare the speed at which carbon is released into the atmosphere through the biosphere and burning. How does this compare with carbon being released from the hydrosphere?

The carbon that is released into the atmosphere though:

• the biosphere is very fast (less than 1 year) as carbon is cycled by photosynthesis and cellular respiration

• burning is fast (1–10 years) as fires consume biomass and organic matter, producing carbon dioxide as well as methane, carbon monoxide and smoke (solid carbon particles).

Carbon released from the hydrosphere can be fast or very slow (over 100 years). This is because carbon is dissolved into the ocean, making it more acidic. Similarly, it can be released just as fast. It can also be consumed by the ocean food web. It will sink to the bottom when organisms die, storing it for long periods of time.

Student book answers

5.5 Evidence supports enhanced global warming

Pages 126–129

Check your learning 5.5

Remember and understand

1 Name the two most significant carbon-containing greenhouse gases.

The two most significant carbon-containing greenhouse gases are carbon dioxide and methane.

2 Explain why the greenhouse effect is actually good for life on Earth.

The natural greenhouse effect is critical for maintaining life because it warms the Earth’s surface. If it didn’t exist, the temperature could drop or rise to extreme temperatures outside tolerance ranges for life on Earth to exist.

3 By how much has the temperature on Earth risen over the past century?

The Earth’s temperature has risen 0.6°C over the past century.

4 What is permafrost and why does it add to emissions if it melts?

Permafrost is permanently frozen ground that stores carbon from plant material frozen during the last ice age. It will add to carbon dioxide emissions if it melts because it will release thousands of years’ worth of carbon into the atmosphere.

Apply and analyse

5 Global warming scientists compare trends over many decades rather than data for one or two years. Explain why.

Data is compared over very long periods of time, often hundreds or thousands of years. For this reason the data is not gathered as often in order to better observe the trend more clearly. It may also be because it is harder to collect the data or it is expensive to do so. As the historical data was collected at 10-year intervals, current data will be collected in a similar fashion.

6 Climate-change deniers suggest that the increase in sea levels is part of a normal cycle. Compare the time scale of previous global warming events to current climate changes.

Previous global warming events have occurred over an approximately 100 000-year time scale. Current climate changes are happening to an extent that has never occurred before and on a much shorter time scale of years as opposed to thousands of years.

Create and evaluate

7 Examine the data shown in this section. Use the data to support your opinion of the validity of enhanced global warming.

Students’ answers will vary. Students should refer to the graphs to support their opinions.

Student book answers

5.6 Enhanced global warming has widespread effects

Pages 130–133

Check your learning 5.6

Remember and understand

1 Why is a change of only 1–2°C sometimes enough to cause problems to species on Earth?

A change of only 1–2°C is enough to cause problems to species on Earth because they exist within a tolerance range. Temperature changes affect survival, carrying capacity, amount of light available for photosynthesis and the rate of biogeochemical cycling of nutrients.

2 Explain why an increase in the number of cases of malaria is expected as a result of enhanced global warming.

Enhanced global warming causes higher temperatures and malaria thrives in warm, moist conditions.

3 Why is loss of biodiversity a problem?

Drought affects the biosphere as there is a risk of serious environmental damage, particularly through soil erosion, habitat loss, loss of biodiversity, malnutrition/dehydration and diminished plant growth. Water quality also suffers and toxic algae outbreaks may occur, further threatening plants and animals. Bushfires and dust storms often increase during drought.

Apply and analyse

4 Why are ocean currents responsible, in part, for global temperature?

Deep ocean currents are like conveyor belts because they move heat through various parts of the world and regulate temperature.

5 How does the temperature of the Pacific Ocean affect Australia’s climate?

Warm water from the Pacific Ocean cycles across Australia’s north. When the Pacific Ocean is warmer than normal, El Niño events occur. This in turn causes more rain to fall in the Pacific Basin instead of northern Australia, resulting in dry/drought conditions.

Student book answers

5.7 Humans can reduce global warming

Ppages 134–135

Extend your understanding 5.7

1 What is the Kyoto Protocol?

The Kyoto Protocol is an international agreement towards a global emission reduction. Issues that can impact whether countries can come together on environmental issues include cost, knowledge, political situation and impact of change. Ninety-three countries are involved.

2 What is the difference between a carbon tax and a carbon trading scheme?

A carbon tax is a fee that some governments charge for each tonne of carbon that a business emits. A business is allowed to release a predetermined amount of carbon emissions. A carbon trading scheme is a buying scheme where a company can purchase some of another company’s allocated emissions it they need to release more carbon dioxide or methane as part of their production process.

3 What is a carbon credit?

Carbon credit is the extraction of carbon dioxide from the atmosphere that some companies sell for profit to other companies that need to release more carbon dioxide into the atmosphere.

4 Explain two ways carbon dioxide can be removed from the atmosphere.

Carbon dioxide can be removed by geosequestration. This involves capturing carbon dioxide from power station chimneys, separating it and compressing it into a liquid. The liquid is then pumped into depleted oil or gas wells and sealed with a solid plug of thick clay. Carbon farming is the process by which plants remove carbon dioxide from the air by photosynthesis. This carbon dioxide is converted into sugars and proteins that are then used by the plant to grow. Therefore, the greenhouse gas becomes part of the plant’s structure. The carbon is considered to be locked in the plant for as long as it lives.

5 How have the values and needs of contemporary society influenced research on global warming?

Students’ answers will vary, but students should focus on:

• the needs of contemporary society, such as farmland, crops, plastic to fabric shopping bags and more energy created by renewable resources (wind, solar, tide)

• the values of contemporary society, such as recycling, waste reduction, less pollution and preservation of biodiversity.

Student book answers

Review 5

Pages 136–137

Remember and understand

1 Name the three different layers of the Earth.

The three different layers of the Earth are the crust, mantle and core.

2In which layer of the Earth are the tectonic plates found?

Tectonic plates are found in the crust.

3What gases are found in our atmosphere and why are they important to life on the Earth?

The gases that make up the atmosphere are oxygen, ozone, carbon dioxide and nitrogen. Oxygen allows organisms to respire, ozone offers protection from the Sun’s UV radiation, carbon dioxide traps heat to keep us warm, and nitrogen dilutes oxygen gas to levels our lungs can handle.

4 What is a drought and which sphere does it relate to?

A drought is a prolonged abnormally dry period when there is a lack of water. Therefore, drought relates to the hydrosphere.

5 Even though the Earth’s inner core is hotter than its molten outer core, it is thought to be solid. How can this be the case?

The inner core is thought to be solid because the weight of the Earth is pushing down on it.

6 What input from the solar system has the greatest influence on our weather?

The Sun has the greatest impact on our weather.

7 Will salty water sink to the bottom or rise to the top of the ocean?

Salty water sinks to the bottom because it is heavier/denser.

8 Make a list of three ways that increasing industrialisation, particularly since the 19th century, has affected ecosystems.

Industrialisation has affected ecosystems in many ways, including reducing the number of species, increasing greenhouse gases in the atmosphere, changing the composition of ecosystems, acidification and pollution.

9Describe the most significant way in which humans have affected ecosystems.

The most significant way in which humans have affected ecosystems is through changes to the natural flow of energy (that is, biogeochemical cycles and interruption of food webs), which has, in turn, increased the level of greenhouse gases in the atmosphere and affected the global climate.

10 List some of the predicted outcomes of climate change.

Predicted outcomes of climate change include:

• changes in distribution and abundance of species

• species loss

• genetic changes in species

• changes in the composition of ecosystems

• increased weeds and other invasive species

• changes in life cycle events

• changes in metabolic processes

• destruction of and/or changes to coral reefs

• decrease in coastal mountain rainforests

• changes in river flows

• drying of ecosystems

• ocean acidification

• rising sea levels.

11 Explain how humans are shifting the distribution of energy in an ecosystem.

Humans are shifting the distribution of energy by preventing or diverting the flow of energy that is fixed by natural ecosystems. This is being done through agricultural pursuits, establishing urban areas and habitat degradation.

Apply and analyse

12 The hydrosphere can have a huge effect on the other spheres. Australia is prone to devastating droughts when there is not enough water available for the needs of Australians.

a How could drought affect the biosphere?

Drought affects the biosphere as there is a risk of serious environmental damage, particularly through soil erosion, habitat loss, loss of biodiversity, malnutrition/dehydration and diminished plant growth. Water quality also suffers and toxic algae outbreaks may occur, further threatening plants and animals. Bushfires and dust storms often increase during drought.

b How would this affect the atmosphere?

Drought can affect the atmosphere by causing a change in weather, change in atmospheric conditions and changes in the general inputs and outputs of the systems.

13What is the difference between water and water vapour? Would you find both in the air?

Water is a liquid, whereas water vapour is the gaseous phase of water. Both water and water vapour can be found in the air because water vapour condenses to form water. (If a plane flies through a cloud, water droplets hit the plane.)

14 Why is it warmer near the Equator than elsewhere on the Earth?

It is warmer near the equator because the Sun is directly overhead in the middle of the day, resulting in a concentrated amount of heat.

15 Over the past fifty years, the sea temperature along the Western Australia continental shelf has risen by between 0.6 and 1 degree Celsius. The coral-dominated ecosystems are sensitive to small rises in water temperature. Ningaloo Reef recorded its first ever coral bleaching events in the 2010s, with the most recent bleaching event occurring as a result of unusually high and prolonged temperatures.

Research on the internet the repeated effect of bleaching of the corals and the flow-on effects it has on the marine food chains, including impacts on fish and other species. Explain how a change of the ocean chemistry (increase in acidity) will affect the reef formation, the ecosystems and its overall impact in the near future.

Coral gets its colour from the algae that live inside the tissue of the coral. The algae use sunlight to photosynthesise, providing the coral polyps with sugars needed to grow. The algae develop heat stress when the ocean water becomes warmer and stop producing carbohydrates. Instead they produce toxic waste products which cause the coral polyp to expel it. The algae-less coral polyps are white, causing the coral to appear bleached. The bleached coral polyps may reabsorb the algae if water temperatures return to normal quickly.

If the coral remains bleached for a long period of time, other types of algae may start growing over it, resulting in changes in the population of fishes and other animals in the marine food chain.

As the levels of carbon dioxide in the atmosphere increase, the amount of carbon dioxide absorbed by the ocean also increases. The chemical reaction between the carbon dioxide and water molecules in the ocean, results in the formation of carbonic acid. This carbonic acid reacts with the calcium carbonate that makes up the shells on many sea creatures, resulting in the shells becoming thinner and weaker. As a result, the shells are not able to protect the sea creatures from their predators, resulting in a change in the balance of the food web.

16The glaciers on Mt Kilimanjaro in Tanzania are disappearing eight times faster than 20 years ago due to global warming. Explain how cloud cover can affect the atmospheric temperature and hence the melting of glaciers.

Cloud cover affects greenhouse warming by reducing both the amount of solar radiation reaching the Earth’s surface and the amount of heat energy radiated back into space. Without cloud cover, atmospheric temperatures rise, and glaciers are subjected to direct sunlight/heat for longer periods of time, causing the glaciers to melt at a much faster rate.

Evaluate and create

17The biosphere includes parts of the lithosphere, the troposphere (the lowest part of the atmosphere) and the hydrosphere. Create a list of the parts of the biosphere you may find in each of these three spheres.

Students’ answers will vary. Suggestions include (students may be more specific):

• Lithosphere: terrestrial animals/plants, bacteria, fungi, food, medicines

• Hydrosphere: aquatic animals/plants, food

• Troposphere: terrestrial animals/plants, humans, building materials.

18 How are water currents similar to air currents? How are they different?

Similarities between water currents and air currents:

• warmer parts rise and cooler parts fall

• currents cycle over a vast area, moving particles around

• both heat the Earth’s surface.

Differences between water currents and air currents:

• forms that they move/cycle (such as water versus air)

• cycle in different places on Earth (atmosphere versus hydrosphere)

• effects differ (wind versus swells/waves).

19 What do ‘H’ and ‘L’ represent on a weather map? How are they formed and what type of weather are they associated with?

On a weather map, ‘H’ represents ‘high pressure system’ and ‘L’ represents ‘low pressure system’. These are formed when air moves from areas of high pressure to low pressure – warmer air near the equator rises and heads towards the poles, and colder air at the poles moves towards the equator. Low pressure systems are frequently associated with clouds, and high pressure systems bring clear blue skies.

20 The human population was fairly stable until about 1 ce. Then it started to grow, and its growth accelerated until it almost reached an exponential rate. In the past century, the human population has almost quadrupled. What are the likely effects of the population increase on world ecosystems?

Population increase is likely to drastically affect world ecosystems in many ways, including the depletion of resources, loss of genetic and species diversity, increase in environmental toxicity and changes in ecosystem composition.

Critical and creative thinking

21Construct a chart or table that describes environmental carbon sinks and carbon producers.

The chart or table should indicate the following: carbon sinks – absorb and/or store carbon, keeping it from the atmosphere; and carbon producers – sources that produce carbon, such as decaying plant material, burning fossil fuels and fires.

22 Draw a mind map showing the potential connections and dependencies between the four spheres of the Earth and their components. Challenge yourself to find as many links as possible.

Students’ answers will vary. As a teacher, you may like to set students a challenge for the number of connections, or a minimum number of connections. Students could use this chapter to assist them to complete this question; however, they may also need to do additional research.

23 Imagine you had to reduce your energy impact on the environment. Look at all the appliances and gadgets you use in your home. Which one of these could you absolutely not bear to give up? Create an A4 page outlining why this one item is ‘essential’ to you and then make a list of appliances and gadgets that you could live without.

Students’ answers will vary. Students should justify why they could/couldn’t live without a certain appliance or gadget.

24 The Earth’s climate and weather are the result of global interactions between systems and cycles. How does this support the argument that logging in any country affects everyone else on the planet? What other human activities fit into a similar category? Discuss your thoughts with the class.

Students’ answers will vary. Logging in any country is a concern for everyone else on the planet because matter and energy flow continuously across the Earth. If trees are removed, the carbon, oxygen, nitrogen, water and phosphorus cycles are adversely affected. For example, soil becomes loose and erosion occurs; carbon dioxide levels in the atmosphere will increase, which alters temperature and rainfall patterns; and animals are displaced from their habitat. Other human activities that fit into a similar category include pollution (such as water and air), overuse of non-renewable resources (fossil fuels) and mining.

25 Over 80% of the Earth's energy resources are non-renewable and declining. In the 20th century, most energy use was concentrated in a few nations that make up only a small proportion of the Earth’s population. The seven largest economies at the beginning of the 21st century (with 10% of the global population) used approximately 45% of the total primary energy supply. Yet, approximately 2 billion people on Earth do not have access to electricity. In a group, discuss this concept and form an opinion. What actions could you take to improve this situation?

Students’ answers will vary. Students could conduct research to investigate options for enabling developing countries to access resources such as electricity or reliable water. They may also like to discuss the politics involved. Access to electricity is a potential indication of a country’s poverty status because it dictates what types of economic activities can occur in that area.

Research

26 Choose one of the following topics for a research project. Present your report in a format of your own choosing.

Peak oil

Our society runs on fossil fuels. Find out about the concept of peak oil and what implications it will have for our lives in the not-too-distant future.

Responding to climate change

The Kyoto Protocol is an agreement between 181 countries that aims to stabilise greenhouse gas emissions in the atmosphere at a level that would prevent danger to the Earth’s climate system. However, to date, the USA, the world’s largest emitter of greenhouse gases, has not ratified the agreement. What does this mean for the effectiveness of the agreement? Which other countries are also not assisting and what might their motives be?

Global warming or Ice Age?

Like the Earth, the Sun demonstrates cycles of behaviour. One such pattern that has been identified is a period during which sunspots are absent. The next predicted period of sunspot absence is around 2020 and could last a couple of decades. The lack of sunspots would likely result in a global temperature decrease for the Earth, potentially sending us into an Ice Age. Find out more about the potential impact of this solar cycle on the Earth’s future climate.

Students’ answers will vary.