BIOZONE

TEXAS
PROGRAMS

BIOZONE

Advanced Placement Titles

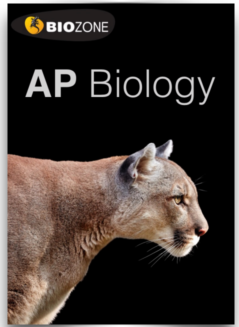
Overview:

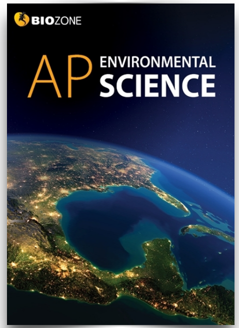
- BIOZONE's points of difference
- Environmental Science
- Earth and Space Science
- Digital platform: BIOZONE WORLD
- Wrap up and questions

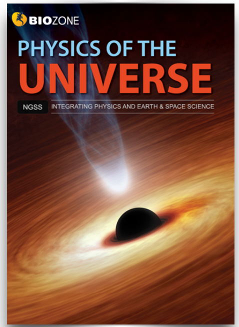
BIOZONE

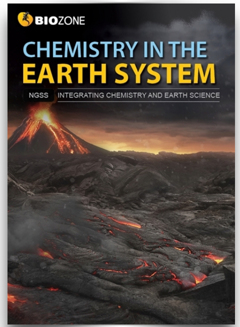
SCIENCE

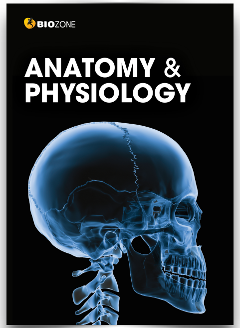
US PROGRAMS

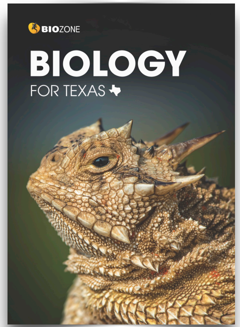


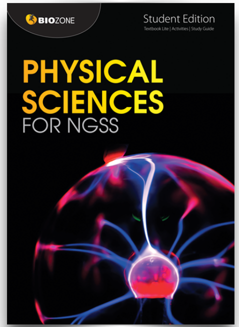


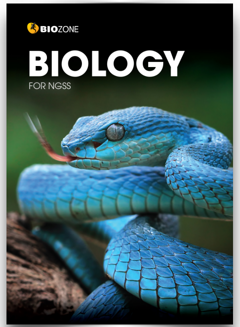


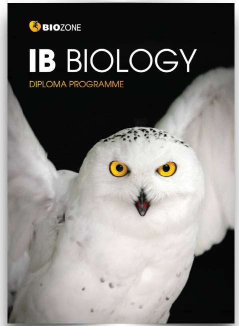


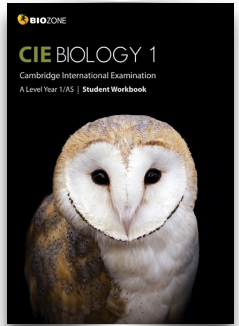


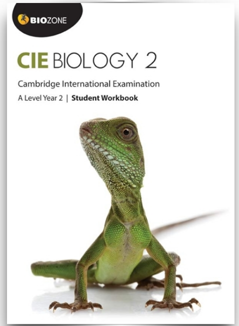




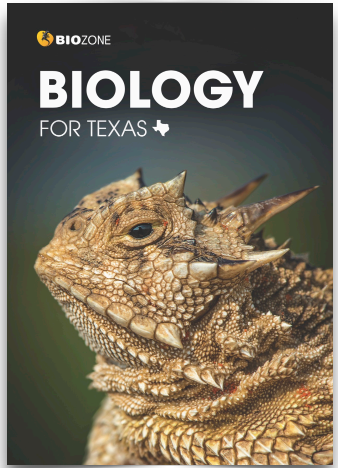


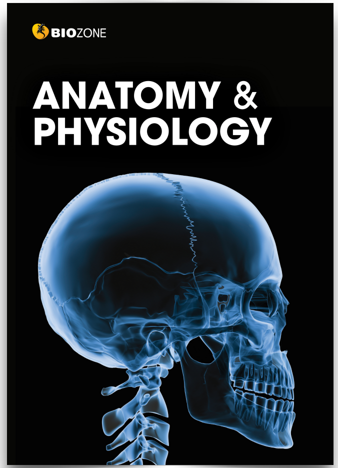


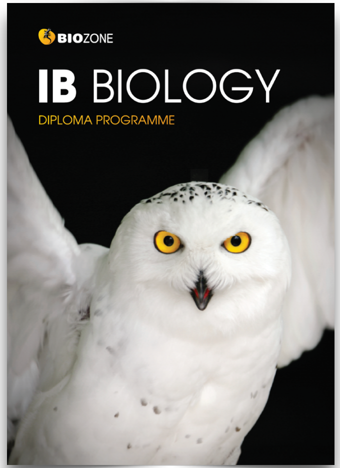




Recent Editions



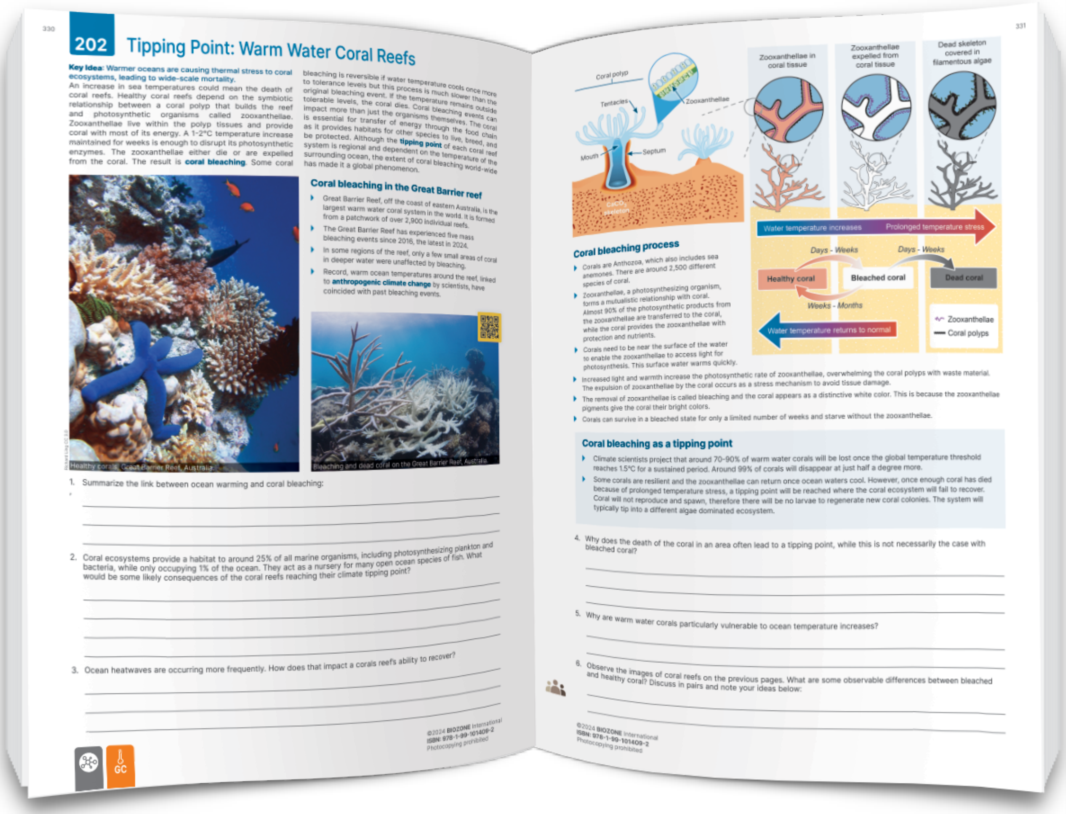




BIOZONE's delivery

Print | Digital | Blended

STUDENT OWNED RESOURCE



A 3-in-1 hybrid resource:

Part textbook

Part study guide

Part activity workbook

An all-in-one comprehensive resource,

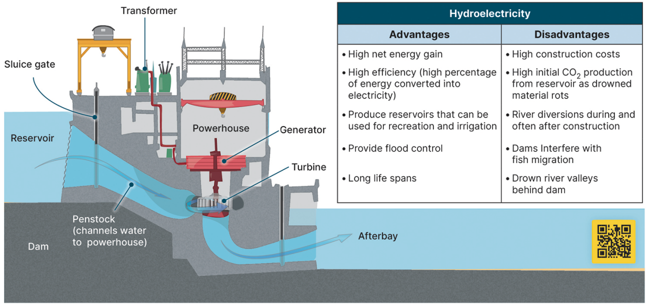
eliminating the need for

a separate textbook.

127 Hydroelectricity

Key Idea: Hydroelectricity dams have the dual usage of both producing electricity and storing water for domestic and agricultural use.

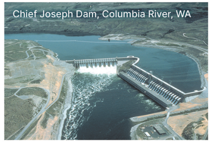
Hydroelectricity accounts for around 20% of global electricity production. Electricity is produced by utilizing the gravitational potential energy of water stored in reservoirs behind dams. As water falls, directed along pipes into the powerhouse, the potential energy is converted into kinetic energy, which turns turbines to generate electricity. The larger the volume of water and the further it has to fall, the greater the amount of energy it contains. Large dams can therefore produce large amounts of electricity. The generation of electricity itself produces no CO_2 emissions or other air pollution, but the construction of the dam requires massive amounts of energy and labor and often requires river diversions. Construction of large hydroelectric dams is highly controversial because creating a reservoir behind the dam often requires the submergence of towns and land. Dams constructed inefficiently can also fill up with silt and gradually decline in their generation capacity.



Hydroelectricity	
Advantages	**Disadvantages**
• High net energy gain	• High construction costs
• High efficiency (high percentage of energy converted into electricity)	• High initial CO_2 production from reservoir as drowned material rots
• Produce reservoirs that can be used for recreation and irrigation	• River diversions during and often after construction
• Provide flood control	• Dams Interfere with fish migration
• Long life spans	• Drown river valleys behind dam

Using hydroelectric power

The mass of water and the distance it falls are important in determining the amount of electricity that can be produced. The power (the energy produced per second) produced by a hydroelectric power plant can be approximated from the mass of water flowing past the turbine and the height of its fall.



Water doesn't have to be stored in a dam for a hydroelectric power plant to work. Water can be directed to flow past the turbine and simply use the force of the flowing water (called **run-of-the-river**). The dam is usually there to divert water towards the intake or powerhouse or to store water in case of lower river levels.

Pumped storage is a useful way of storing excess energy in hydroelectric plants. During off-peak times, water flowing through the turbine plant is used to pump water to a higher storage pond. During high demand, this water can be run through a separate powerhouse to provide extra electricity to the local grid.

1. (a) Explain how hydroelectric dams are used to generate electricity: ______________________

____

____

____

(b) Describe the relationship between water volume, height of the dam, and electricity production:

____

____

ISBN: 978-1-99-101409-2

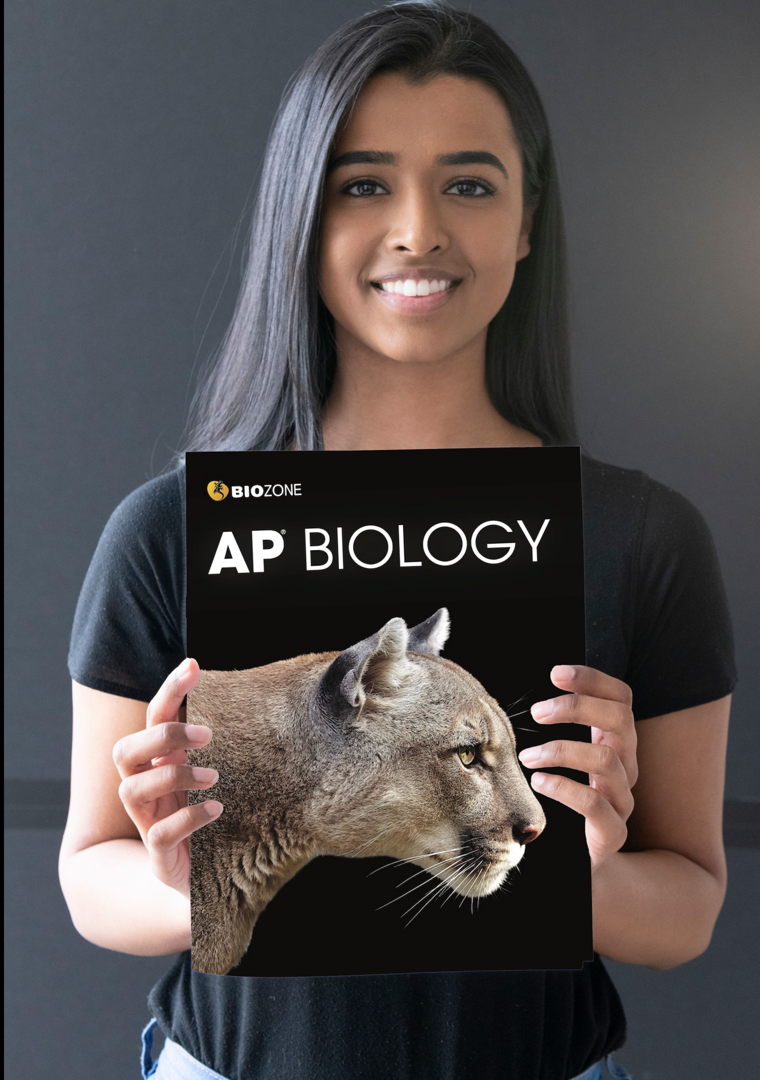
GR

Why are BIOZONE resources unique?

- A reputation for scientific rigor …
  … but our information is accessible.
  - Graphical delivery of science concepts.
  - Chunked text.
- Students interact directly with material: forms a record of work
  - Reinforces understanding.
  - Easy revision.
  - Self grading and answer refinement.

Advantages of the BIOZONE approach

- Student ownership and engagement
- Empowers students to be fully involved in their learning journey
- Flexible delivery modes
- Regular updates:
    - Content
    - Pedagogy
    - Features
    - Support tools

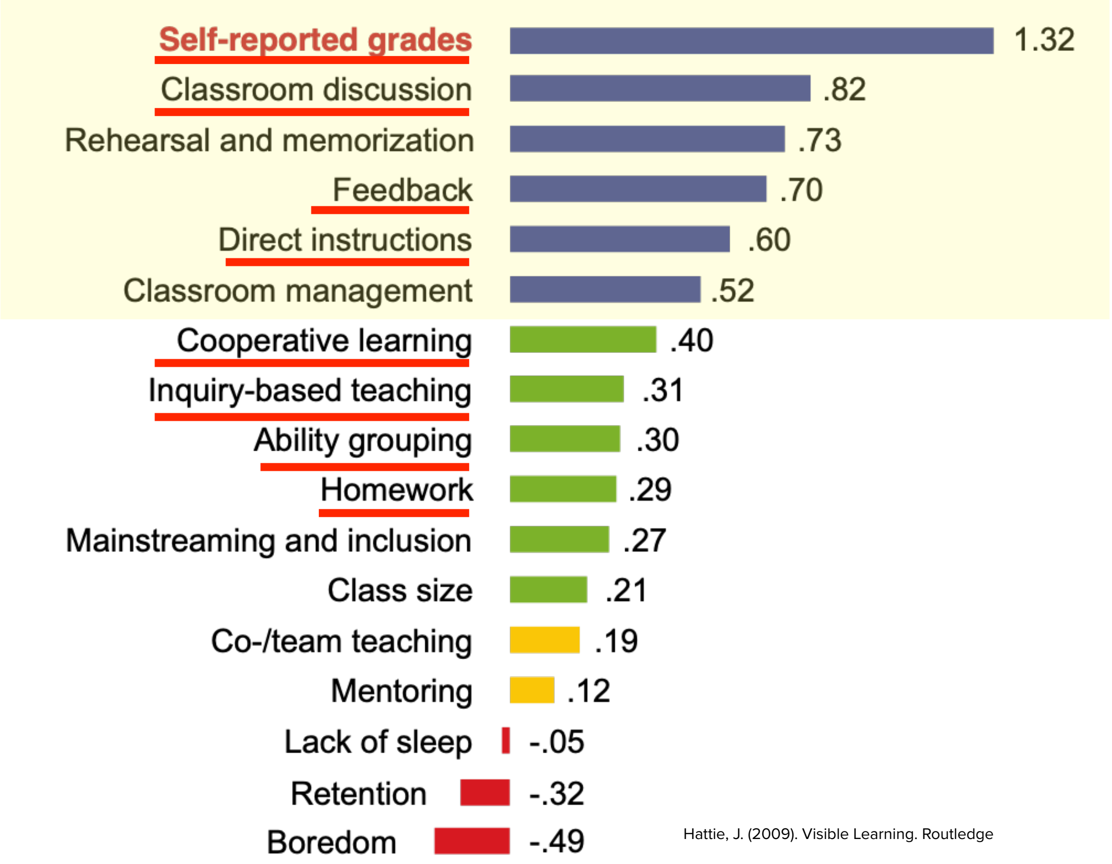


Pedagogical tools

- Where does the data come from?
  A synthesis of >1,500 meta studies involving over 90,000 individual studies and 300 million students.

- BIOZONE products incorporate many of the factors shown to positively influence student achievement.

Influences on student achievement



Hattie, J. (2009). Visible Learning. Routledge

SUPPORT & DIFFERENTIAL INSTRUCTION

Reading and ELL Support

Reading support:

Chunked text

increase accessibility.

Highly visual pages to reduce volume of text.

English language support

BIOZONE WORLD:

Translation into 150 languages including Spanish

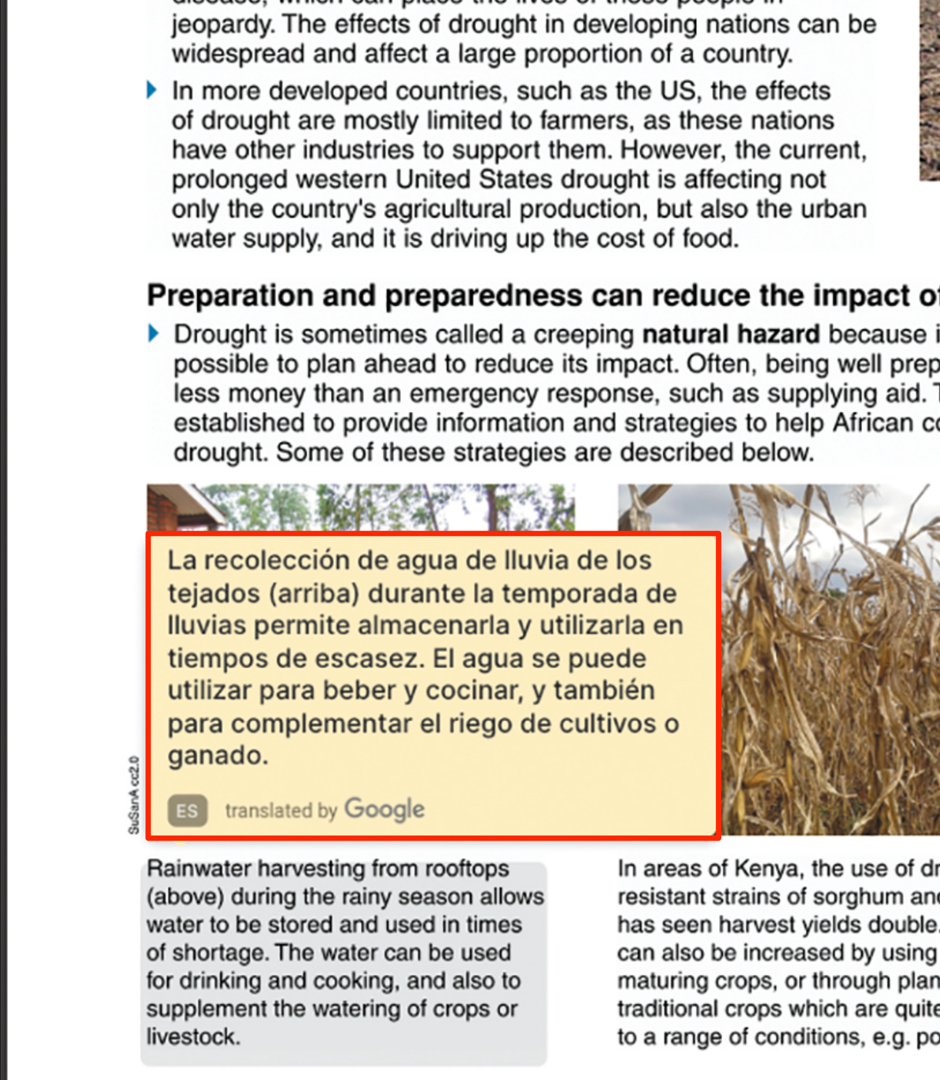
English and Spanish Glossary (some titles)

Translation

Digital platform

Translation into 150 languages

Dual language view



jeopardy. The effects of drought in developing nations can be widespread and affect a large proportion of a country.

- In more developed countries, such as the US, the effects of drought are mostly limited to farmers, as these nations have other industries to support them. However, the current, prolonged western United States drought is affecting not only the country's agricultural production, but also the urban water supply, and it is driving up the cost of food.

Preparation and preparedness can reduce the impact o

- Drought is sometimes called a creeping **natural hazard** because i possible to plan ahead to reduce its impact. Often, being well prep less money than an emergency response, such as supplying aid. T established to provide information and strategies to help African c drought. Some of these strategies are described below.

La recolección de agua de lluvia de los tejados (arriba) durante la temporada de lluvias permite almacenarla y utilizarla en tiempos de escasez. El agua se puede utilizar para beber y cocinar, y también para complementar el riego de cultivos o ganado.

ES translated by Google

SuSanA cc2.0

Rainwater harvesting from rooftops (above) during the rainy season allows water to be stored and used in times of shortage. The water can be used for drinking and cooking, and also to supplement the watering of crops or livestock.

In areas of Kenya, the use of dr resistant strains of sorghum an has seen harvest yields double can also be increased by using maturing crops, or through plan traditional crops which are quite to a range of conditions, e.g. po

Glossary

Building scientific literacy

59 Feedback in Earth's Systems

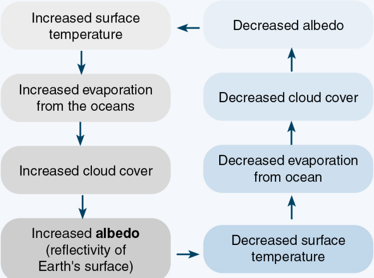
Key Question: What feedback systems operate on Earth, and how do they affect the climate?

Feedback on Earth

Feedback occurs when the output of a system is used as input in that system. On Earth, there are many feedback systems, both negative and positive, operating at the same time. **Negative feedback** systems tend to stabilize a system around a mean (average condition) whereas **positive feedback** tends to increase a departure from the mean.

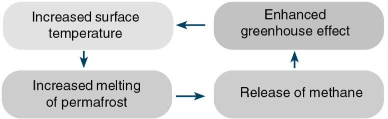
Negative feedback in nature

Feedback systems can be complex and the result of many interacting factors. The diagram below illustrates a simplified negative feedback system involving the production of clouds. Clouds reflect incoming sunlight back into space so have the effect of lowering the Earth's surface temperature.

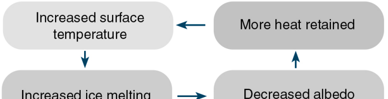


Positive feedback in nature

Positive feedback systems on Earth tend to drive large scale changes to environments and the climate. The current increase in CO_2 in the atmosphere is driving numerous positive feedback systems. The diagram below illustrates the effect of methane (a greenhouse gas) release from permafrost. As the Earth warms, the permafrost melts, releasing methane which in turn causes the Earth to warm further.



Increased surface temperatures also increase the amount of ice melting and so decreases the Earth's **albedo**:



English/Spanish Glossary

meteorite: A fragment of rock or iron from outer space that has survived both passage through the Earth's atmosphere and impact with Earth's surface.
meteorito: Un fragmento de roca o hierro del espacio exterior que ha sobrevivido tanto al paso a través de la atmósfera de la Tierra como al impacto con la superficie de la Tierra.

migration: Movement from one place to another.
migración: Movimiento de un lugar a otro.

mineral: Naturally occurring compound with an ordered structure.
mineral: Compuesto natural con una estructura ordenada.

negative feedback: A mechanism where a change the output of a system acts to oppose changes to the input of a system (prevents deviation from the norm).
comentarios negativos: Un mecanismo en el que un cambio en la salida de un sistema actúa para oponerse a los cambios en la entrada de un sistema (evita la desviación de la norma).

newton (N): Unit of force. The force required to accelerate a 1kg object by 1 m/s^2
newton (N): Unidad de fuerza. La fuerza requerida para acelerar un objeto de 1 kg en 1 m/s^2

Newton's law of gravitation: A rule stating that all matter in the universe ...

observation: The activity of watching or recording what is happening in a given, often experimental, setting.
observación: La actividad de observar o registrar lo que está sucediendo en un entorno dado, a menudo experimental.

oceanic crust: Part of Earth's crust that is rich in basalt, relatively dense, and geologically young. Found under ocean basins. **corteza oceánica;** Parte de la corteza terrestre que es rica en basalto, relativamente densa y geológicamente joven. Se encuentra bajo las cuencas oceánicas.

oil: A liquid fossil fuel formed by intense heat and pressure on the remains of ancient, dead marine organisms.
aceite: Un combustible fósil líquido formado por el intenso calor y la presión sobre los restos de antiguos organismos marinos muertos.

orbit: The path an object takes in space, going around another object.
órbita: La ruta que toma un objeto en ... [rod]eando a otro objeto.

negative feedback: A mechanism where a change the output of a system acts to oppose changes to the input of a system (prevents deviation from the norm).

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Math & science practices support

Dedicated chapter

Need help icon

identifies support for math and skills components of an activity.

80 Water's Role in the Melting of Rocks

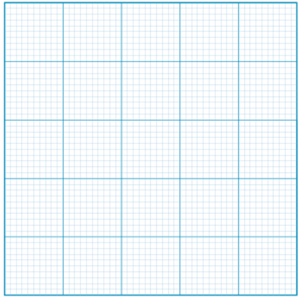
Key Question: How does water allow rocks in the solid lithosphere and asthenosphere to melt into liquid magma?

- The lithosphere and asthenosphere are solid; they are not liquid or molten. Yet volcanoes located above a hot spot or a subduction zone spew out molten lava (molten rock above ground), and magma (molten rock below ground) oozes out of fissures along mid-ocean ridges.
- This implies that special conditions must be encountered for magma to form. Three conditions that cause the local melting of rocks and the formation of magma chambers are:
  - 1. Heat: the most obvious, but not the most important cause.
  - 2. Decreased pressure: as hot material rises towards the crust, pressure on it decreases, allowing particles more room to move about. Decreased pressure causes magma to form at mid ocean ridges.
  - 3. Addition of water: **water** disrupts the bonds in rocks and lowers their melting point. This can be modeled using **ice** and salt (NaCl). In this model, ice acts as the rock in the mantle and salt as the water held inside the rock. The addition of water is responsible for magma forming at subduction zones.

Sodium chloride and water solution

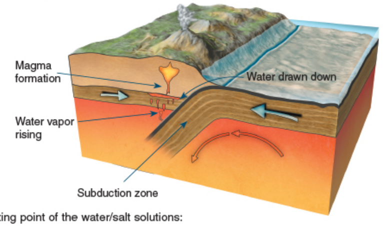
- Several solutions were made using fresh water and sodium chloride salt to produce concentrations of 0 g/L, 50 g/L, 100 g/L, 150 g/L, 200 g/L, and 250 g/L.
- These were poured into identical beakers and placed into a freezer at -50°C. The temperature of each solution was measured to record its freezing (and thus melting) point.
- The results are shown below:

Solution concentration (g/L)	Freezing/melting point (°C)
0	0
50	-3
100	-6.5
150	-10.9
200	-16.5
250	-24.5



Water and plate tectonics

- As a tectonic plate descends in a subduction zone, it drags down water-laden sediment and rocks. The rocks are heated and squeezed, and at a depth of about 100 km the water is driven out and begins to rise through the rock as vapor.
- As it rises, the vapor encounters hotter rocks above, that are close to their melting point. The water vapor enters these rocks, lowering their melting point and producing magma.



1. Use the tabulated data above to graph the melting point of the water/salt solutions:
2. Describe the shape of the graph: ______
3. Explain why water lowers the melting point of rocks: ______

ESS2.C SF

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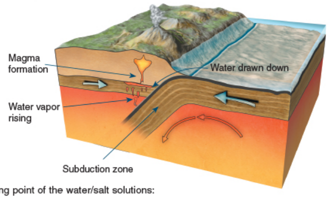

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ESS2.C SF

ISBN: 978-1-98-856693-1

4 Useful Concep

Key Question: What useful conce

Energy

- Energy is the ability of a system to do wo be transferred between systems and tran different forms, but it cannot be created o The amount of energy in a closed system before and after a transformation. Energy in joules (J).
- Energy can be classified as potential (sto kinetic (movement) (right).
- Energy can be transformed. For example top of a hill has gravitational potential en rolls down the hill, the ball loses gravitati energy and gains kinetic energy. Some o is also lost as heat and sound as it rolls

Light

- Visible light is part of the spectrum of ele radiation. Visible light is defined as the pa electromagnetic spectrum with a wavelen 400 and 700 nanometers. Light waves ne appear blue, while light at 700 nm appea travels in a vacuum at around 299,792,45
- The speed of light is sometimes called th speed limit. Nothing that we know of can above the speed of light. This speed limit paradoxes occurring, e.g. arriving somew your image.

1. What is energy? ______
2. What are the two main types of energy? (
   (a) ______
   (b) ______
3. Energy cannot be created or destroyed, I
4. What kind of energy is light? ______
5. (a) What is the wavelength of blue light?
   (b) What is the wavelength of red light?
6. Why is the universal speed limit of the sp

EM

6 Tables and Graphs

Key Question: How can we use tables and graphs to provide a way to organize and visualize data in a way that helps to identify trends?

- **Tables** and **graphs** are ways to present **data** and they have different purposes. Tables provide an accurate record of numerical values and allow you to organise your data so that relationships and trends are apparent.
- Graphs provide a visual image of trends in the data in a minimum of space. It is useful to plot your data as soon as possible, even during your experiment, as this will help you to evaluate your results as you proceed and make adjustments, as necessary, e.g. to the sampling interval.
- The choice between graphing or tabulating in the final report depends on the type and complexity of the data, and the information that you want to convey. Sometimes, both are appropriate.

Presenting data in tables

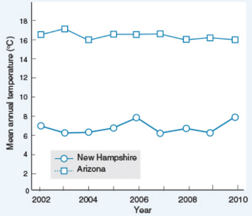
Table 1: Population, land area, and calculated population density in four US states.

State	Population	Land area (km^2)	Population density (people km^{-2})
Alabama	4,871,547	135,754	35.9
Florida	20,636,975	170,307	121.2
Montana	1,032,949	380,847	2.7
Texas	27,469,114	695,662	39.5

- Tables provide a way to systematically record and condense a large amount of information. They provide an accurate record of numerical data and allow you to organise your data, making it easier to see patterns, trends, or anomalies.
- Table titles, and row and column headings must be clear and accurate so the reader knows exactly what the table is about.
- Columns can be added for calculated values such as density, rate, and summary statistics, e.g. **mean** and standard deviation. For large data sets, it is often the summary statistic, e.g. mean temperature each year, that is plotted.
- Summary statistics make it easier to identify trends and compare different treatments. Rates are useful in making multiple data sets comparable, e.g. if recordings were made over different time periods.

Presenting data in graphs

Fig. 1: Mean annual temperature in New Hampshire and Arizona



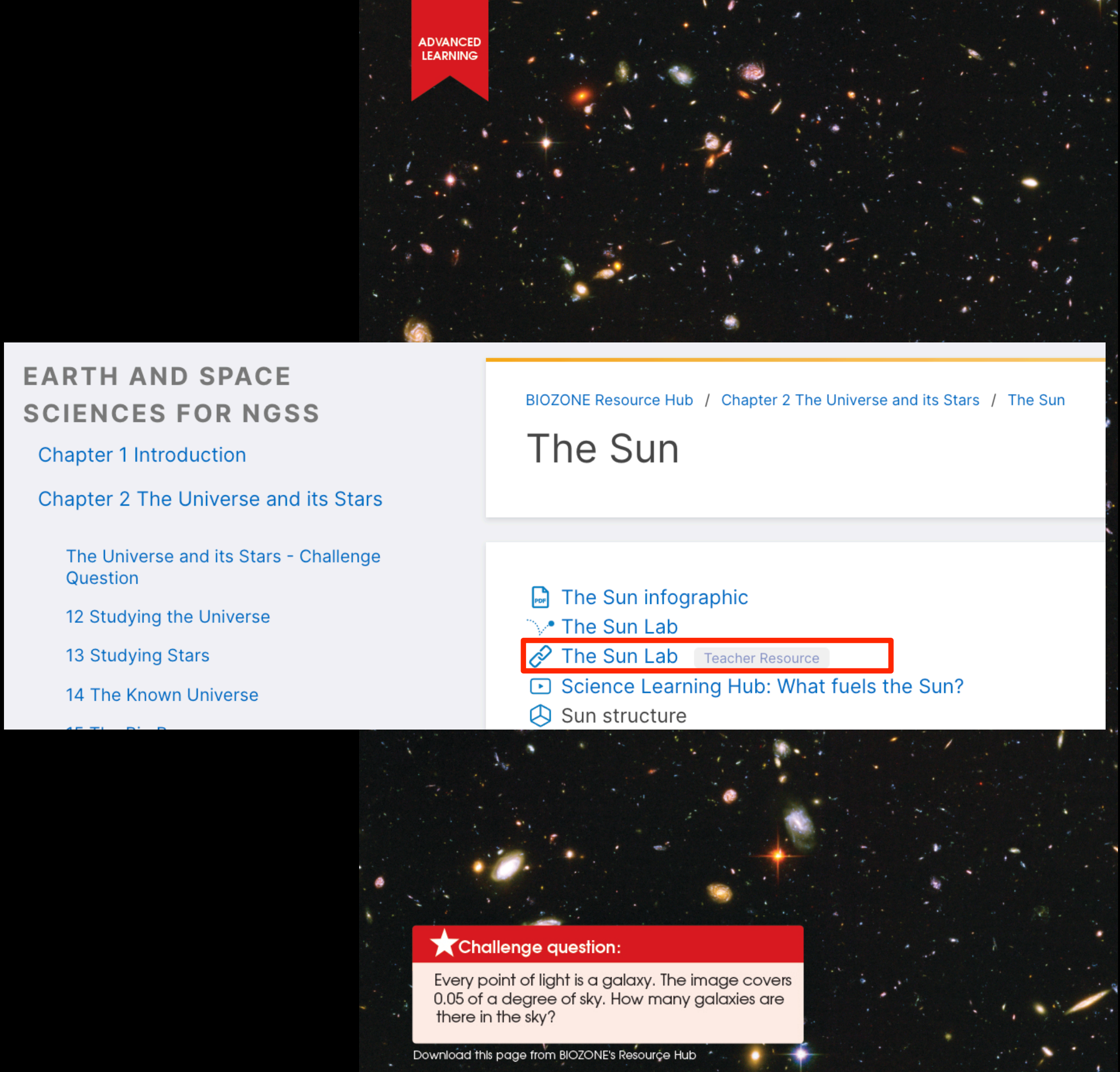
- Graphs are a good way of visually showing trends, patterns, and relationships without taking up too much space. Complex data sets tend to be presented as a graph rather than a table.
- Presenting graphs properly requires attention to a few basic details, including correct orientation and labeling of the axes, accurate plotting of points, and a descriptive, accurate title.

1. Describe the advantages of using a table to present information: ______
2. What is the benefit of including summary information, e.g. means or processed data, on a table? ______
3. What are the main advantages of presenting data in a graph? ______
4. Why might you include both graphs and tables in a final report? ______

ISBN: 978-1-98-856693-1

Extension

- **Extension material**:
  - Identified in Teacher's Edition with red flag
  - Tagged in Resource Hub
  - Challenge questions



BIOZONE

Environmental Science

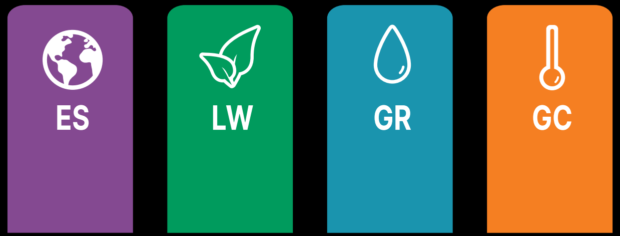
At a glance

- Print, digital, and blended delivery options
- Comprehensive resource
- New and updated content, case studies and data analysis tasks
- New assessments
- Expanded teacher support resources
- Translation tool
  digital platform: 150 languages

Chapters

Navigation & delivery

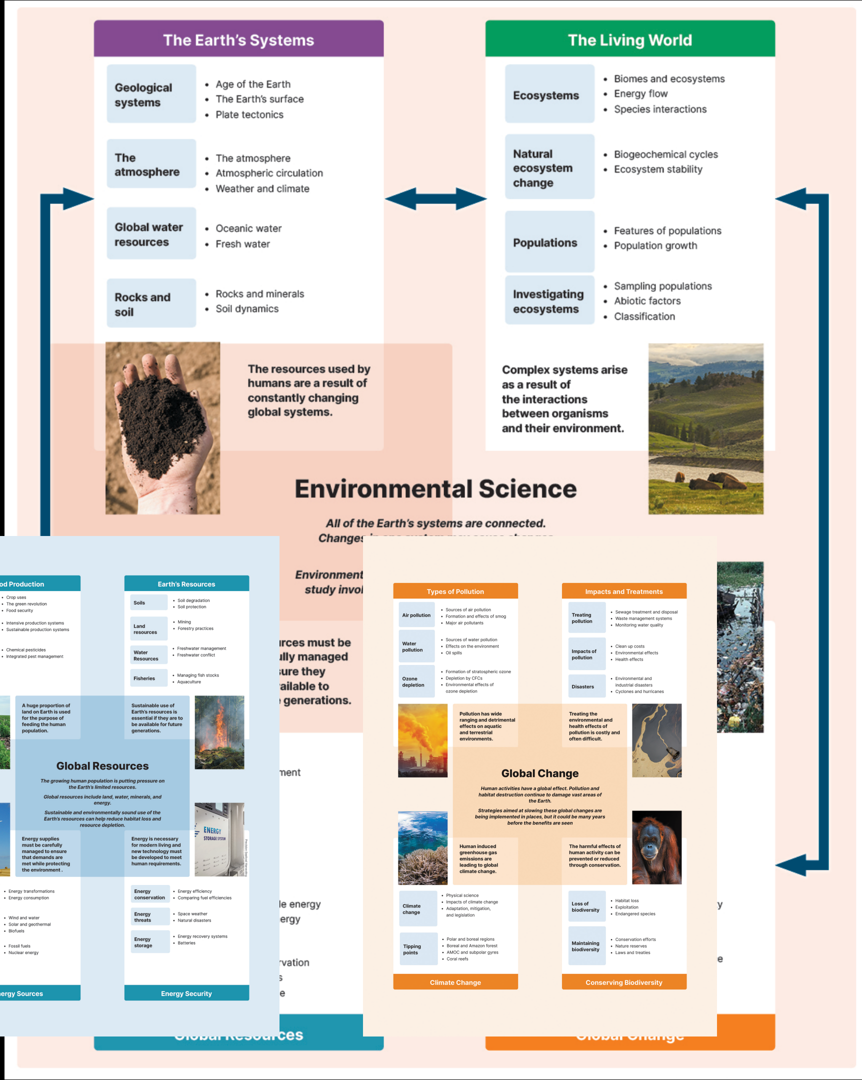
- Four sections, identified by colored tabs:
    - The Earth's Systems
    - The Living World
    - Global Resources
    - Global Change



- Flexible delivery order

Concept maps

- Content maps for navigation & orientation
  - Course overview map
  - Four section maps



ON TOP OF THE WORLD

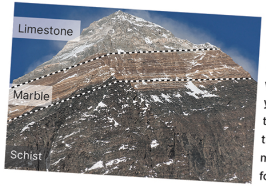
The Himalayas are a broad band of mountains forming a boundary between the Indian subcontinent to the South and the Tibetan plateau to the North. In geological terms, they are young mountains, having begun forming around 50 million years ago. The collision between two tectonic plates on which they sit continues to shape them today as one plate pushes against the other. Earthquakes are also relatively frequent in this seismically active area of Earth. There are more than 100 peaks exceeding 7,200 m in elevation, including Mount Everest (8,848.86 m). Mount Everest's height places its peak in the upper troposphere where it is exposed to the jet stream, with winds reaching 160 km/h.

Highest weather station in the world

In May 2022, a weather station was installed on Mt Everest at 8,810 m. It is the highest weather station in the world. At such heights, temperatures can drop to -40°C. Because the peak sits in the jet stream, wind speeds are commonly over 100 km/h, and wind gusts of over 250 km/h have been recorded there. The plume on this photo is snow and ice blasted off the summit by high winds.

Metamorphosis

The Himalayas illustrate various parts of the cycling of Earth's rocks. Pressure created during uplift of the mountains has metamorphosed limestones into marble, and sandstone, and mudstones into schist. The mountains undergo constant erosion via glaciers and weathering but, overall, are rising faster than they are being eroded.



The composition of a giant

Mt Everest itself is composed of limestone, marble and schist. Limestone rocks from near the top of the mountain were once marine sediments laid down around 500 million years ago. The rocks contain marine fossils, including trilobites, brachiopods, ostracods, and crinoids. Beneath the upper band of limestone, the pressure exerted by mountain building transformed limestone into marble, found in the 'yellow band', shown left.

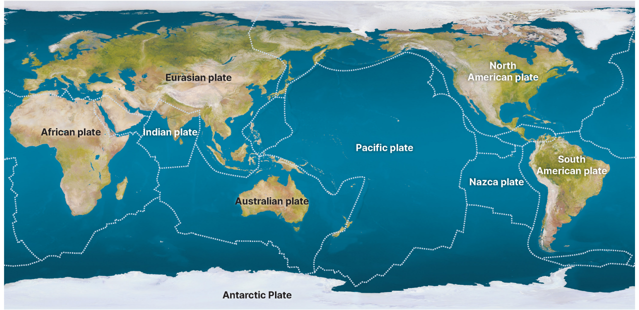
Take a Deeper Look

- What geological processes build mountains?
- What reasons might there be for the Himalayas being, on average, so much higher than other mountains ranges around the world?
- What evidence is there for the age of the rocks that make up Mount Everest and the Himalayas?

9 Mechanism of Plate Movement

Key Idea: Convection currents in the mantle cause the movement of the tectonic plates.

Evidence from earthquakes, volcanoes, and land formations has helped formulate the theory of plate tectonics, which describes the large scale movement of the Earth's crustal plates. The key principle of the theory is that the rigid plates are able to ride on the fluid-like underlying **asthenosphere.** The energy for this movement comes from dissipation of heat from the mantle. It is the movement of the plates that produces phenomena such as earthquakes and volcanism.

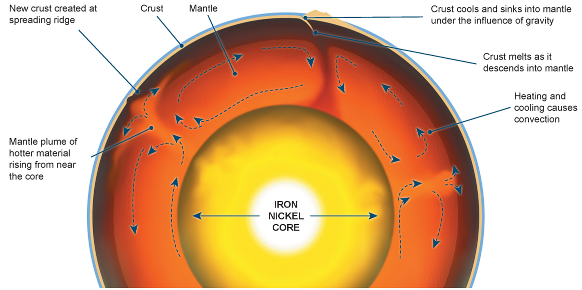


Background image: NASA

- The evidence for past plate movements has come from several sources: mapping of plate boundaries, the discovery of sea floor spreading, measurement of the direction and rate of plate movement, and geological evidence such as the distribution of ancient mountain chains, unusual deposits, and fossils. The size of the plates is constantly changing, with some expanding and some getting smaller. The extent of the tectonic plates is shown in the diagram above. The Pacific plate is by far the largest, measuring 103 million km^2.

The mechanism of plate movement

- The relatively cool lithosphere covers the hotter, plastic, and more fluid asthenosphere. Heat from the mantle drives two kinds of asthenospheric movement: convection and mantle plumes. Plate motion is partly driven by the weight of cold, dense plates sinking into the mantle at trenches. This heavier, cooler material, sinking under the influence of gravity, displaces heated material, which rises as mantle plumes.
- The movements of the tectonic plates puts the brittle rock of the crust under strain, creating faults where rocks fracture and slip past each other. Earthquakes are caused by energy release during rapid slippage along faults. Consequently, the Earth's major earthquake (and volcanic) zones occur along plate boundaries.



ISBN: 978-1-99-101409-2

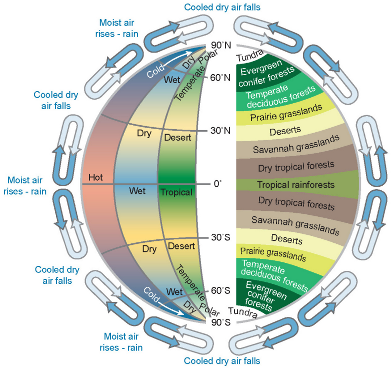
25 Factors Affecting Biome Distribution

Key Idea: The circulation of the Earth's atmosphere produces large and specific climatic areas on either side of the equator.

Biomes represent large areas with the same or similar climate and vegetation characteristics. These biomes exist in part because of the arrangement of weather conditions around the planet. The Earth is circled in the northern and southern hemispheres by three air cells. The interaction of these cells plays a major role in the formation of biomes. The cells form areas of rising or descending air, affecting the amount of rainfall. Surface features, such as oceans and mountain ranges, affect the final positions and size of these biomes but four general areas in each hemisphere can be identified.

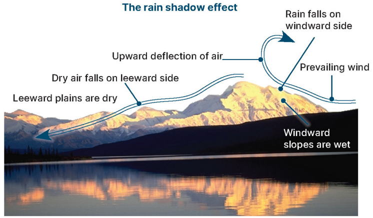
Earth's climate and biomes

- Biomes are closely related to the major air cells that circle the Earth and are reflected in the northern and southern hemispheres.
- The Earth's biomes are the largest, geographically-based, biotic communities that can be conveniently recognized.
- Biomes are large areas where the vegetation type shares a particular suite of physical requirements.
- Terrestrial biomes are recognized for all the major climatic regions of the world. They are classified by their predominant vegetation type. Biomes are closely related to the major air cells that circle the Earth and are reflected in the northern and southern hemispheres.



Biomes and landscapes

Climate is heavily modified by the landscape. Where there are large mountain ranges, wind is deflected upwards causing rain on the windward side and a rain shadow on the leeward side. The biome that results from this is considerably different from the one that may have appeared with no wind deflection. Large expanses of ocean and flat land also change the climate by modifying air temperatures and the amount of rainfall.



1. Explain why the pattern of biomes is reflected in the northern and southern hemispheres:

2. What kind of features might prevent these patterns from matching exactly?

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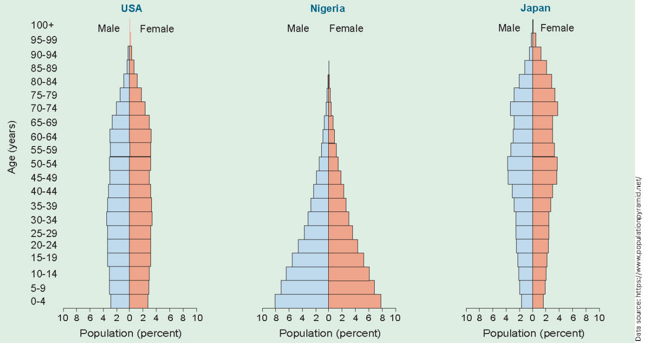
68 Population Age Structure

Key Idea: The age structure of a population refers to the relative proportion of individuals in each age group in the population.

Population age structure shows how many individuals are in each age group in a **population**. Populations can be classified according to specific age categories, e.g. years, life stage, e.g. egg, larvae, pupae, or size class, e.g. height or diameter in plants. A higher proportion of reproductive and pre-reproductive individuals indicates greater growth potential than in a population dominated by older individuals. Age structures are often shown as pyramids (below). The proportions of individuals in each category are plotted with the youngest individuals at the pyramid's base. The number of individuals moving from one age class to the next influences the age structure of the population from year to year. The loss of an age class can influence a population's viability and can even lead to population collapse (next page).

Age structures in human populations 2023

Population pyramids are useful tools for visualizing the age structure of a population and the ratios of males to females. The graphs show at a glance if a population is growing, declining, or stationary, and the information can be used to predict trends and plan for services in the future. e.g. more aged-care facilities in countries with an ageing population. The population pyramids below show three different population structures.



Stationary (USA): Stable populations are characterized by an even, pillar shape pyramid, reflecting the population is neither growing or declining. There are relatively equal numbers of individuals at each age category and ratios of males and females remains fairly constant too. This pyramid is typical of developed countries where birth rates are low and the overall quality of life is high.

Expansive (Nigeria): Rapidly growing populations are characterized by a classic triangle shape. The birth rate is high so the base of the pyramid is broad, reflecting the high number of young individuals within the population. Life expectancy is often lower, so fewer individuals live to old age. This pyramid structure is common in developing countries where access to health care and support services may be limited.

Constrictive (Japan): Declining populations have a small base of young and are top heavy, reflecting a higher proportion of older individuals. This shape occurs because the birth rate is low and a high proportion of the people live to be very elderly. This pyramid is common in developed countries with high levels of education and where excellent health care and other services are available to a large proportion of the population.

1. How does population distribution differ between a stationary age pyramid and constrictive age pyramid?

2. Carry out some research to find out what age structure pyramid the country you live in shows. Write the answer here:

LW

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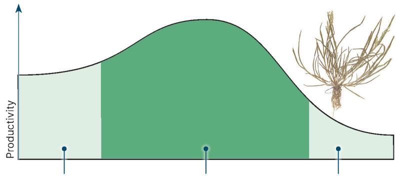
105 Managing Rangelands

Key Idea: Careful management of grazing animals on rangelands is necessary to preserve the natural environment and reduce environmental damage.

Rangelands are large, relatively undeveloped areas populated by grasses, grass-like plants, and scrub. They are usually semi-arid to arid areas and include grasslands, tundra, scrublands, coastal scrub, alpine areas, and savanna. Globally, rangelands cover around 50% of the Earth's land surface. The US has about 3.1 million km^2 of rangeland, of which 1.6 million km^2 is privately owned. Rangelands cover 80% of Australia, mostly as the outback, but only 3% of Australia's population live in rangeland areas. Rangelands are often used to graze livestock such as sheep and cattle but, because they occur in low-rainfall areas, they do not regenerate rapidly. Careful management is required to prevent damage and soil loss as a result of overgrazing.



Undergrazing
Net productivity is reduced because standing dead material leaves little room for new growth to come through.

Optimum grazing
Old material is removed so new growth can come through, but enough growing material is left to allow recovery.

Overgrazing
Too much material is removed and new growth cannot become established. Plants die and erosion occurs.

Grasses (left) grow continuously from a meristem close to the ground, so the leaf can be cropped without causing growth to stop. This allows a field to be grazed in a near-continuous fashion. Grazing by animals stimulates grass to grow and removes dead material. Grasslands cropped at their optimum capacity can be much more productive than if left uncropped (left).

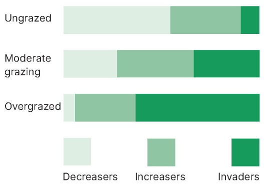
Overgrazing occurs when too many animals are grazed for too long on a section of pasture and the grass does not have enough time between cropping to regrow. Overgrazing may destroy the meristem, in which case plant regeneration stops. Exposed soils may become colonized by invasive species (below) or eroded by wind and rain.

Total net primary production and efficiency of grazed and ungrazed grasslands

		Net production (kcal/m^2)	Efficiency %
Grazed	Desert	1081	0.13
	Shortgrass plains	3761	0.80
	Mixed grasslands	2254	0.51
	Prairie	3749	0.77
Ungrazed	Desert	1177	0.16
	Shortgrass plains	2721	0.57
	Mixed grasslands	2052	0.47
	Prairie	2220	0.44

Effect of grazing on plant species composition

Intensive grazing causes changes in the species composition. Species that perform better under grazing will increase their range, while others will reduce their range. Grazing also opens gaps in plant distribution which allows invasive species to establish or increase in range.



1. Explain how carefully managed grazing on a rangeland can increase its productivity:

2. Describe the effect of grazing on the diversity of rangeland plants:

GR

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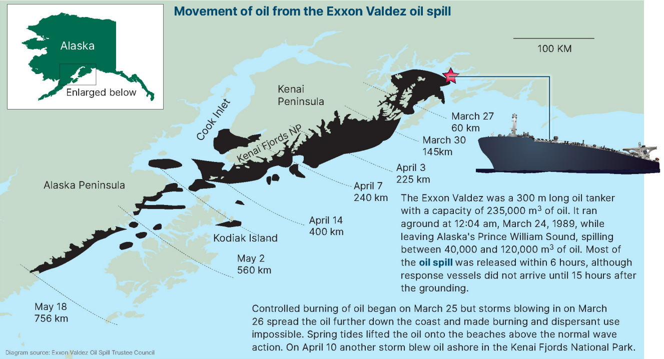
158 Effect of Oil Spills

Key Idea: Accidental oil spills have occurred during the history of oil extraction, causing widespread and long-lasting damage to the aquatic ecosystems and organisms nearby.

Oil is arguably one of the most important chemicals in human economics. It provides power for transport and electricity, and the raw materials for many consumer products, including plastics. Billions of dollars a year are spent on removing it from the ground and billions more made in revenue from its sale.

However, crude oil is a very toxic substance and removing it from reservoirs is fraught with difficulty and danger. Some of the biggest, man-made **environmental disasters** have occurred because of the search for and transport of oil. Oil tankers carry huge volumes of crude oil over the seas and are some of the largest ships afloat. As a result, there is enormous potential for disaster if one is grounded. The grounding of the Exxon Valdez is one of the most infamous examples.



The Exxon Valdez was a 300 m long oil tanker with a capacity of 235,000 m^3 of oil. It ran aground at 12:04 am, March 24, 1989, while leaving Alaska's Prince William Sound, spilling between 40,000 and 120,000 m^3 of oil. Most of the **oil spill** was released within 6 hours, although response vessels did not arrive until 15 hours after the grounding.

Controlled burning of oil began on March 25 but storms blowing in on March 26 spread the oil further down the coast and made burning and dispersant use impossible. Spring tides lifted the oil onto the beaches above the normal wave action. On April 10 another storm blew oil ashore in the Kenai Fjords National Park.

There were several causes of the disaster. The crew of the Exxon Valdez had not had their mandatory rest period and were fatigued. They had also failed to maneuver the ship correctly (probably due to fatigue), and the radar system that could have informed the crew of a collision had not been repaired and was not operating.

The clean-up operation was made more difficult by the remote location of the oil spill. Food, equipment, and shelter had to be brought in for up to 11,000 workers, along with fuel and dispersant equipment and vehicles. The clean-up stopped in September due to the approach of the Alaskan winter, but was restarted in April 1990.

357 sea otters were treated after the spill, at an estimated cost of US$51,000 per otter. Fisheries in the area were closed, including black cod and Pacific herring. It is estimated that around 87% of the herrings' spawning grounds were oiled. Mollusks were found to contain higher than normal levels of aromatic chemicals after the spill.

Approximately a quarter of a million seabirds, 2800 sea otters, 300 harbor seals, 250 bald eagles, 22 killer whales, and countless fish were killed in the first weeks of the spill. Oil was still found 20 years later, not far beneath the surface of many of the affected beaches, despite one of the biggest clean-up operations in US history.

1. (a) Explain how the Exxon Valdez spill could have been avoided: ______

(b) Describe some of the effects of the spill: ______

(c) Explain why the clean up of this spill was particularly difficult: ______

172 Habitat Fragmentation

Key Idea: Habitat fragmentation is detrimental to ecosystems as it reduces species diversity, disrupts gene flow, and increases the likelihood of species extinction.

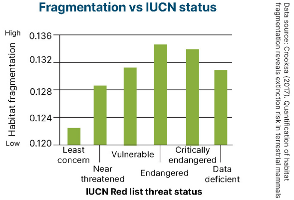
Habitat fragmentation is a major concern for global **biodiversity**. **Human activities** such as urbanization and road construction are encroaching upon natural areas, resulting in a loss of **species** diversity. This loss not only affects the stability and resilience of **ecosystems** but also hinders their ability to adapt to environmental changes.

Habitat fragmentation, whether caused by natural processes or human activities, leads to the separation of species **populations**. This division prevents them from interacting with each other, which can ultimately result in their local **extinction**. This occurs because a population becomes isolated and too small to effectively breed or experiences inbreeding, and the flow of genes between fragmented areas stops. If this pattern persists across fragmented habitats, it can ultimately lead to the complete extinction of the species.

Habitat fragmentation and biodiversity

- Habitat fragmentation is the process by which large habitats become divided up into smaller ones, usually with areas of completely changed (and often uncrossable) land between them. This can happen naturally (e.g. lava flows dividing areas of forest) but more often it occurs as a result of human activities.
- Habitat fragmentation can be a driver of evolution, creating greater biodiversity by separating species' populations. However, this is usually a response of smaller organisms, such as insects and small lizards in island ecosystems.
- Usually habitat fragmentation causes a loss of biodiversity, especially in larger animals that are territorial or require large areas of land to find food. Habitat fragmentation reduces population sizes and can reduce gene flow because individuals are unable to move easily between habitat fragments. This can lead to inbreeding because access to mates is limited.
- **Invasive** plant species are more able to invade fragments due to more open edges, which often provide disturbed land where they can easily become established.
- The degree of fragmentation of a species' habitat is a significant predictor of the likelihood of a species going extinct. The **IUCN** (International Union for Conservation of Nature) lists species from least concern to critically endangered (see activity 176). When the species in these categories are matched against the degree of their habitat's fragmentation a clear pattern emerges (right).

Forest fragmentation, Brazil



1. The mountain gorilla lives in just two separated groups in the hills of Rwanda, Uganda, and DRC. Fragmentation of surrounding land due to farming, deforestation for firewood, and demand for living space are creating challenges for the remaining apes. Explain how fragmentation increases the risk of mountain gorilla extinction: ______

2. The Texas ocelot, *Leopardus pardalis*, is an endangered wild cat that was once found across Texas and is important to the ecosystem. Two small populations are isolated from each other due to surrounding farm and human occupied land. Giving reasons, suggest what effect human activity might have on the biodiversity of the Texas ocelot ecosystems? ______

186 What's the Concern for Climate Change?

Key Idea: Climate change is happening now, and our responses will determine future impacts.

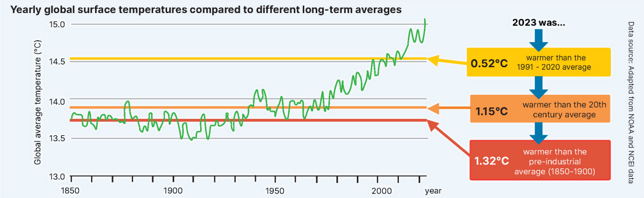
Over the past two centuries, human activities and industrialization have led to a rise in **greenhouse gas** levels in the atmosphere, affecting the climate. In more recent times, the term 'Anthropocene' has been used to describe the current geological epoch. This term, although not officially recognized as a geologic designation, highlights the influence of human-induced changes on the climate, known as **anthropogenic** forcing. Notably, **global warming** has been a prominent consequence of these activities, with the Earth's average surface temperature increasing by at least 1.19°C in 2024 compared to the mid-19th century.

To determine the precise average global temperature, data is collected from (100,000 plus) weather stations worldwide, along with weather balloons, ships, buoys, radars, and satellites that record daily temperature variations. This data is used to calculate an **average global temperature.** The average temperature is then compared with pre-industrial temperature data, obtained before substantial industrial source greenhouse gas **emissions**. The recent rise in the global average means specific regions are encountering notably higher and more harmful temperature extremes. Unprecedented heatwaves in **polar** areas and regions already struggling from human habitation are driving certain Earth systems towards irreversible tipping points.

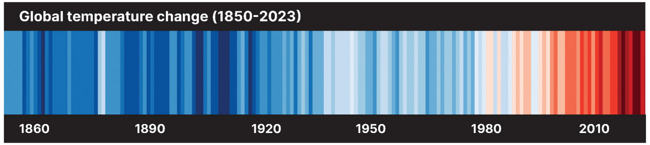
The world is warming - What's the big deal about 1.5°C anyway?

Many students may have heard about a **'1.5°C'** global warming 'line in the sand' not to be overtaken in order to prevent the worst impacts of climate change. Yet, despite the seemingly small '1.5°C' target, exceeding this threshold can activate **tipping points** in the climate system, causing irreversible changes due to **positive feedback cycles** that intensify the initial warming effects. The significance of global temperature rise lies in its potential to disrupt ecosystems, weather patterns, and cause **sea level rise**, highlighting the urgent need to address anthropogenic climate forcing to mitigate these impacts.

Data source



1. The image below shows a visual representative of the last 200 years of global temperature change, using the average from 1961-2010 as a measuring stick. Blue is colder, the darkest over 0.7°C colder, and the red is warmer; again the darker colors showing an extreme of over 0.7°C warmer. In a small group, discuss the implications of the data presented as a means to raise awareness of climate change. Record your thoughts below:



2. Two sets of data that change in proportion to each other, either negatively or positively, show correlation. However, this does not necessarily imply causation, where changes in one factor causes changes in another. Suggest how scientists might show causation between global temperature rise and anthropogenic-only climate forcing:

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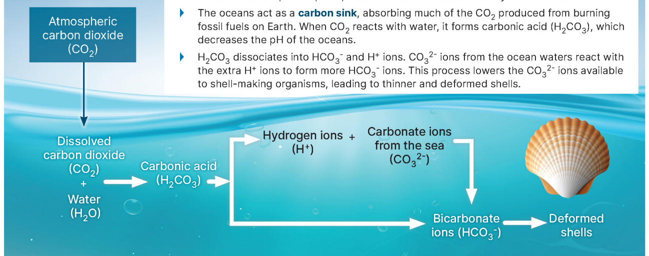
GC

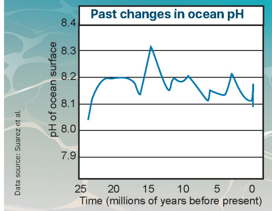
193 Ocean Acidification

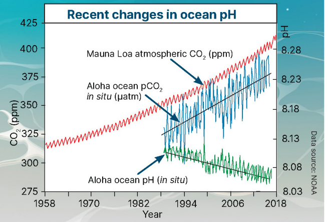
Key Idea: Ocean acidification is occurring because higher CO_2 concentrations are lowering the pH of the water.

More **CO_2** in the atmosphere is resulting in increased quantities of it dissolving in the ocean surface waters. This lowers the pH of the water through the formation of carbonic acid and H^+ ions and is known as **ocean acidification**. The ocean pH is the lowest than it has been in nearly 25 million years, becoming 30% more acidic in the past 200 years (although it is still above pH 7) . Changes in ocean pH reduce the calcification rate of many species, including coral reefs and shelled molluscs. This limits their ability to form and maintain skeletal structures such as shells.

- The pH of the oceans has fluctuated throughout geological history but has usually remained at around pH 8.1 - 8.2. Recent studies have measured current ocean pH at around 8.1. A drop in 0.1 pH represents a 25% increase in acidity of the water.
- The oceans act as a **carbon sink**, absorbing much of the CO_2 produced from burning fossil fuels on Earth. When CO_2 reacts with water, it forms carbonic acid (H_2CO_3), which decreases the pH of the oceans.
- H_2CO_3 dissociates into HCO_3^- and H^+ ions. CO_3^{2-} ions from the ocean waters react with the extra H^+ ions to form more HCO_3^- ions. This process lowers the CO_3^{2-} ions available to shell-making organisms, leading to thinner and deformed shells.







The link between ocean temperature and CO_2 absorption

- Since pre-industrial times, the oceans have absorbed up to 30% of total **anthropogenic** CO_2 **emissions**, reducing the impacts of **climate change** but resulting in their increased acidification.
- Warming oceans hold less CO_2 and become net CO_2 emitters rather than net carbon sinks that the cold oceans are - the warmer surface water can 'hold' less dissolved CO_2, so the excess gas is released into the air above.
- Additionally, the increasing temperature reduces the mixing of ocean waters, so acidified water remains trapped under a warmer band of water, reducing nutrient and oxygen mixing.

1. Data indicates the oceans were less alkaline (more acidic) than they are today, such as 25 mya. Why is the current acidification so concerning?

GC

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116 Did You Get It?

1. Describe some issues that can arise by applying chemical pesticides to crop plants and soils:

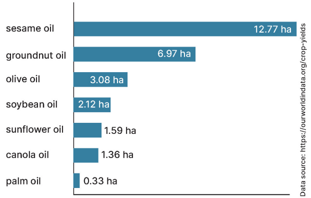
2. What actions taken by individuals would have the greatest impact on reducing in-home water consumption?

3. Describe some ways in which a city could develop in sustainability:

4. Examine the graph on the right:

   (a) What oil crop uses the most land area to produce one metric ton?

   (b) What oil crop uses the least land area to produce one metric ton and suggest what might be the reason for this?



Land area required to grow 1 metric ton

5. Suggest what has taken place to affect the landscape shown in the photo (right). What are some of the environmental consequences of this land use:

Assessment tasks conclude each chapter

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Summative Assessment
Ch 1: The Earth's Systems

Student name: ______________________ **Class:** ________ 20

1. Earthquakes normally occur along plate boundaries. Measuring the depth of these earthquakes can give an idea of the shape of the boundary and how the plate are interacting. The data below, left shows earthquake depths for the Tonga Trench in the Pacific Ocean and along the coast of Chile.

   (a) Plot a scatter graph of the data on the grid provided: 3

Tonga trench	
Longitude (°W)	Depth (km)
176.2	270
175.8	115
175.7	260
175.4	250
176.0	160
173.9	60
174.9	50
179.2	650
173.8	50
177.0	350
178.8	580
177.4	420
178.0	520
177.7	560
177.7	465
179.2	670
175.1	40
176.0	220

   (b) Add a line of best fit through the data points: 1

   (c) What type of plate boundary appears to be present at the locations plotted? 1

   (d) Draw a diagram in the space below to show the how the layers of the Earth are moving at the Tonga Trench: 2

2. The diagram below shows the layers of the Earth. Add labels to the layers including their name and whether they are solid or liquid to complete the diagram. 2

Additional assessment tasks can be downloaded by teacher as "unseen" tests

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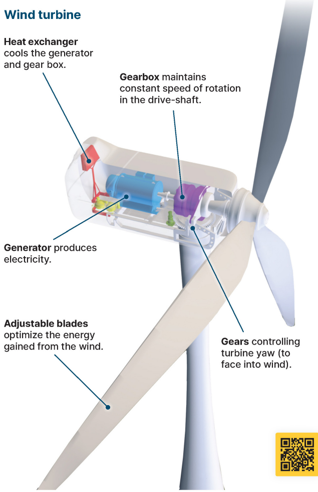
126 Wind Power

Key Idea: Wind power provides a relatively simple and scalable way to produce electricity.

Wind power has been used for centuries to provide the mechanical energy to pump water or run milling machinery. Today, it is mainly used to produce electricity. Wind power is becoming increasingly reliable and cost effective as the technology develops and turbines are able to operate in a range of conditions and wind speeds. In fact **wind energy** is one of the cheapest types of energy to build, maintain, and use. Globally, wind power is steadily increasing in generation capacity, but wind is a variable energy provider. There can be problems matching output to demand, such as during seasonal demands and low (or extremely high) winds. This means systems for managing and distributing electricity will be required as well as backup or base load electricity supplies, e.g. hydro or geothermal power.

Wind turbine



Wind farms often cover large areas of land but turbines can be designed to operate at sea and, on a smaller scale, along highway edges. The scalability of **wind turbines** makes them simple to install in many locations, with turbine sizes ranging from a few metres to over 200 metres in diameter.

At the end of 2022, the power output from wind turbines was around 7% of global electricity production. Global installed capacity was more than 800 GW. Electricity generation from wind is rising every year.

1. A typical wind turbine produces around 2.3 MW. The average house uses 30 kWh of energy per day (a kilowatt hour is the equivalent of 1000 joules of energy per second (1kW) running for 1 hour). Calculate the following:

   (a) The minimum number of wind turbines required to power a town of 20,000 households:

   ____

   ____

   (b) Wind turbines cost around $1.3 million per MW of energy production to build. What will the be the cost of (a) above?

   ____

   (c) The cost of building, running, and maintaining wind turbines over their 20 year lifetimes is about $50 per MWh. What could the 20,000 households using the wind turbines above expect to pay in dollars per year for the use of electricity provided by the wind turbines?

   ____

   ____

   (d) Why can households actually expect to have to pay a lot more than this? ______________________

   ____

GR

ISBN: 978-1-99-101409-2

QR codes

Two types of QR codes:

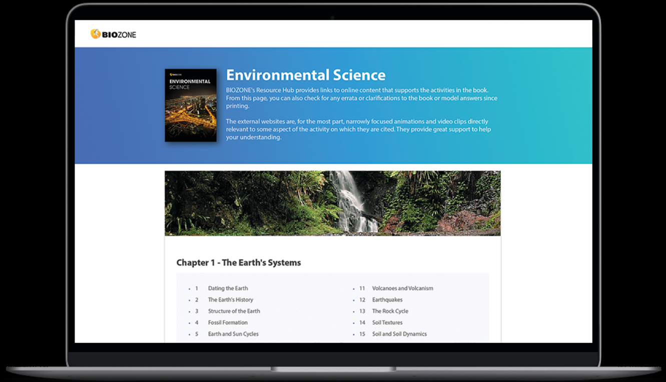
- Yellow link to 3D models
- Blue link to live data sets

  good for easily accessing up-to-date information that changes rapidly

Teacher resources

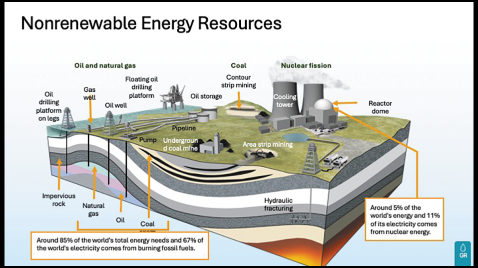
Teacher's Edition
with answers
Print & digital

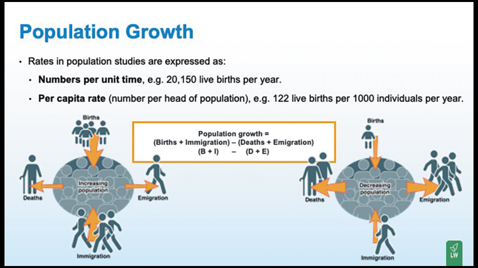
Classroom Guide
features / delivery

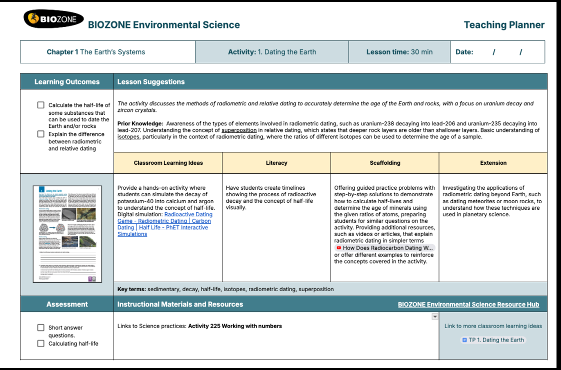


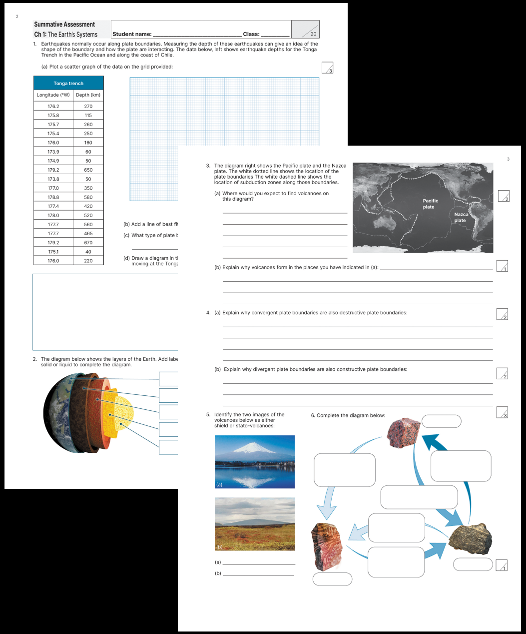
Resource Hub
engagement / extension
Print & digital users

Teacher resources









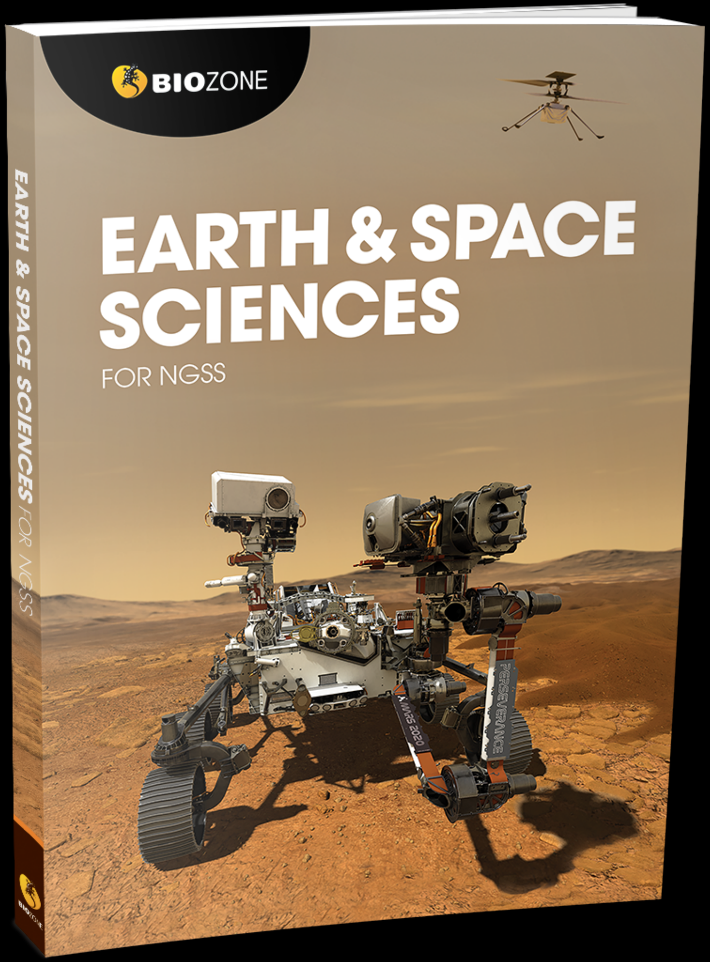
Presentation Slides
Digital platform

Teacher Planner
Teacher notes
Pacing Guide
Differentiation

Additional assessments

BIOZONE

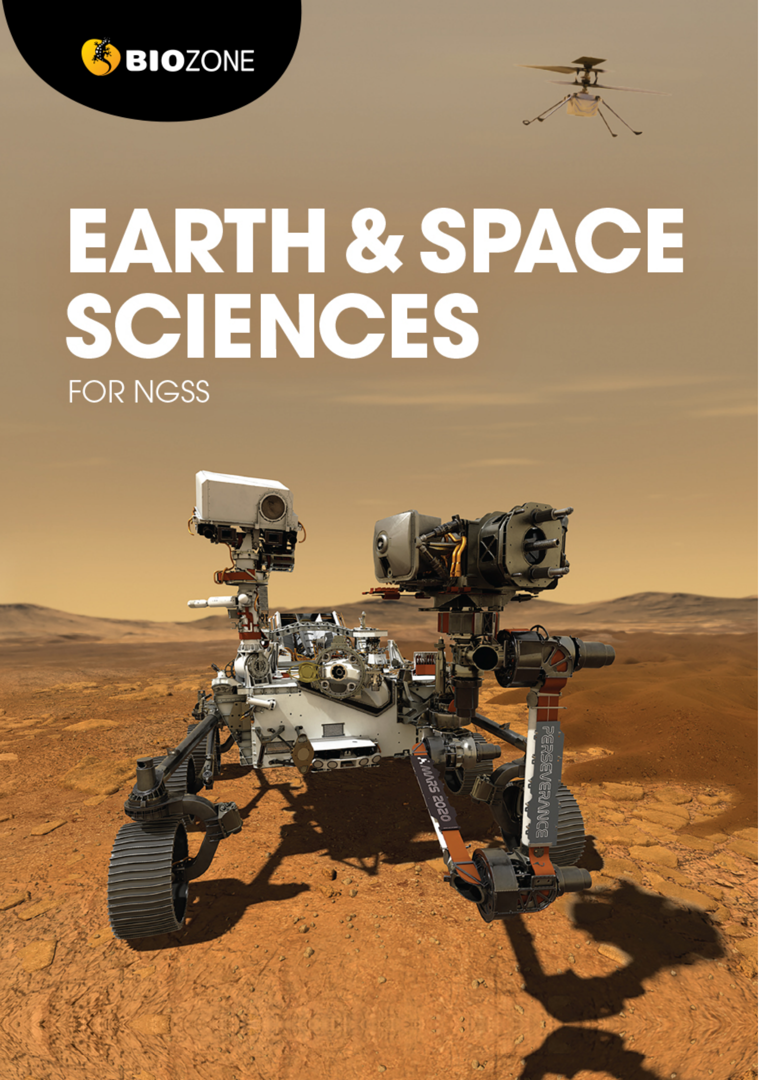
Earth and Space Sciences



Curriculum specific features

- **Three dimensions**
  form the cornerstone of the title.
- Scaffolded delivery of content using the **5Es Instructional Model**.
- Strongly based in **inquiry.**
  - Students engage with **phenomena** to ask and answer questions.
- **Assessments** inbuilt.
- **Common Core State Standards** inbuilt.
- **Teacher Toolkit**

STRUCTURE



EARTH & SPACE SCIENCES FOR NGSS

Chapter structure

CHAPTER INTRODUCTION

- Identifies the activities relating to the guiding questions.

ANCHORING PHENOMENON

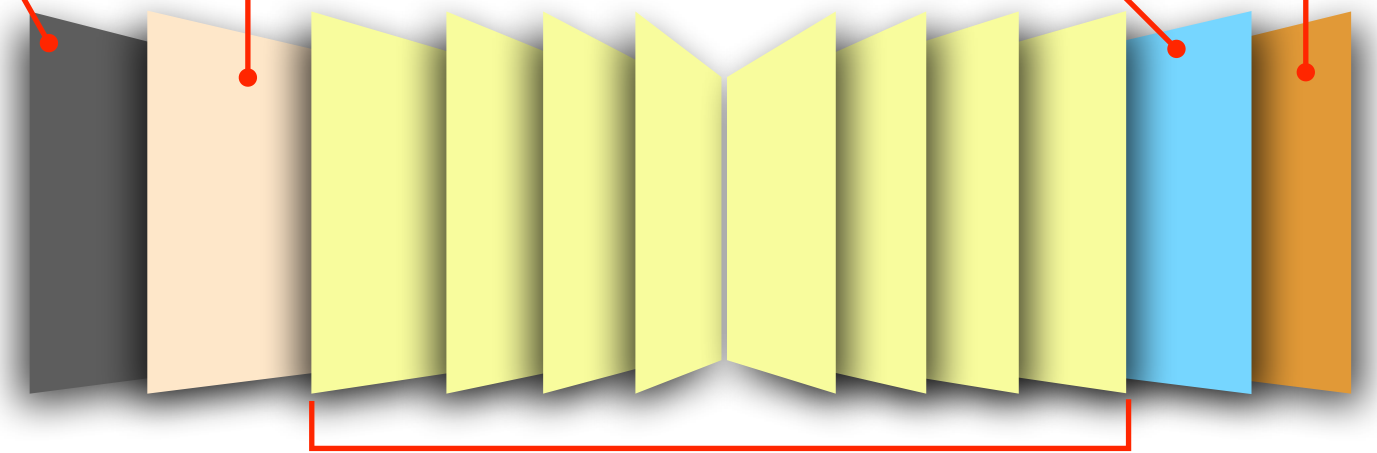
- The first activity is an anchoring phenomenon.
- It introduces a phenomenon that is used as an anchor for the rest of the activities in the chapter.

ANCHORING PHENOMENON REVISITED

- Once the have completed the activities in the chapter, students should be able to explain various aspects of the anchoring phenomenon more fully.

SUMMATIVE ASSESSMENT

- This can be used as a formal assessment of the performance expectations addressed in the chapter.

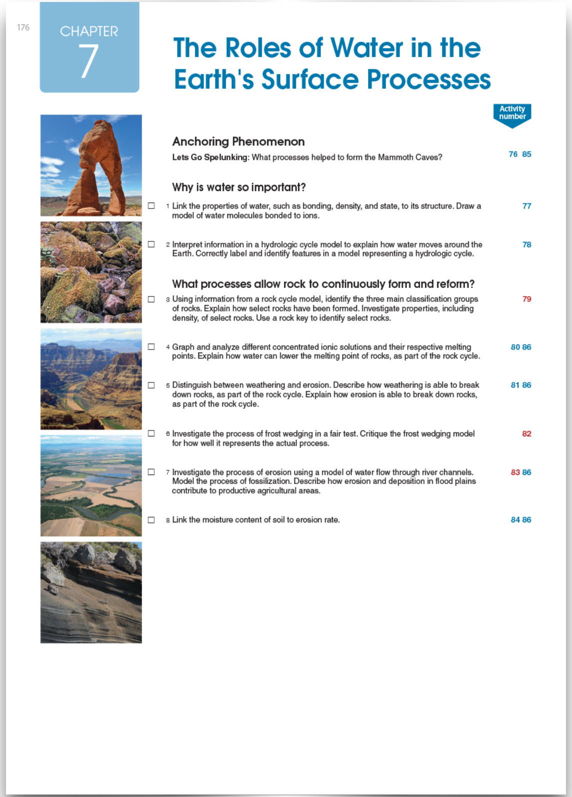


ACTIVITY PAGES

- Scaffolded delivery of content using the 5Es instructional model
- Questions within activities are designed for students to demonstrate understanding

Chapter Introductions

Student Introduction



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CHAPTER 7

The Roles of Water in the Earth's Surface Processes

Activity number

Anchoring Phenomenon

Lets Go Spelunking: What processes helped to form the Mammoth Caves? 76 85

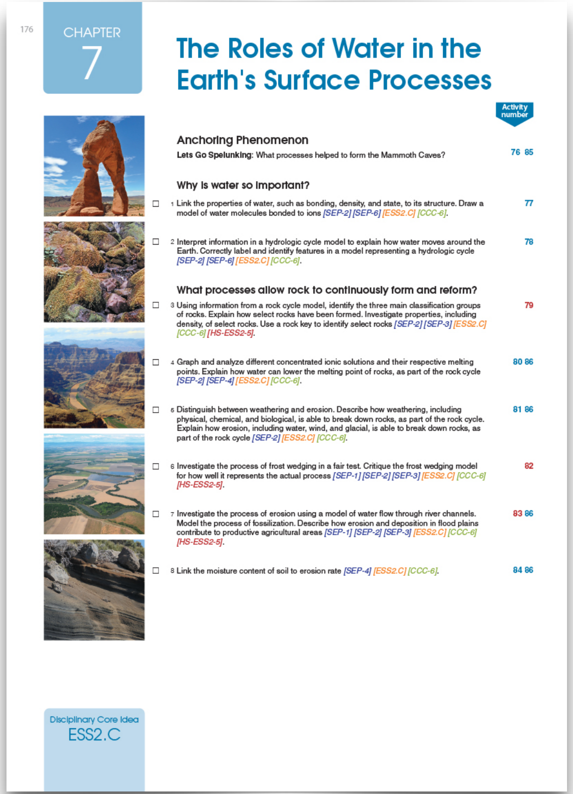
Why is water so important?

- ☐ 1 Link the properties of water, such as bonding, density, and state, to its structure. Draw a model of water molecules bonded to ions. 77
- ☐ 2 Interpret information in a hydrologic cycle model to explain how water moves around the Earth. Correctly label and identify features in a model representing a hydrologic cycle. 78

What processes allow rock to continuously form and reform?

- ☐ 3 Using information from a rock cycle model, identify the three main classification groups of rocks. Explain how select rocks have been formed. Investigate properties, including density, of select rocks. Use a rock key to identify select rocks. 79
- ☐ 4 Graph and analyze different concentrated ionic solutions and their respective melting points. Explain how water can lower the melting point of rocks, as part of the rock cycle. 80 86
- ☐ 5 Distinguish between weathering and erosion. Describe how weathering is able to break down rocks, as part of the rock cycle. Explain how erosion is able to break down rocks, as part of the rock cycle. 81 86
- ☐ 6 Investigate the process of frost wedging in a fair test. Critique the frost wedging model for how well it represents the actual process. 82
- ☐ 7 Investigate the process of erosion using a model of water flow through river channels. Model the process of fossilization. Describe how erosion and deposition in flood plains contribute to productive agricultural areas. 83 86
- ☐ 8 Link the moisture content of soil to erosion rate. 84 86

Teacher Introduction



176

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- ☐ 4 Graph and analyze different concentrated ionic solutions and their respective melting points. Explain how water can lower the melting point of rocks, as part of the rock cycle [SEP-2] [SEP-4] [ESS2.C] [CCC-6]. 80 86
- ☐ 5 Distinguish between weathering and erosion. Describe how weathering, including physical, chemical, and biological, is able to break down rocks, as part of the rock cycle. Explain how erosion, including water, wind, and glacial, is able to break down rocks, as part of the rock cycle [SEP-2] [ESS2.C] [CCC-6]. 81 86
- ☐ 6 Investigate the process of frost wedging in a fair test. Critique the frost wedging model for how well it represents the actual process [SEP-1] [SEP-2] [SEP-3] [ESS2.C] [CCC-6] [HS-ESS2-5]. 82
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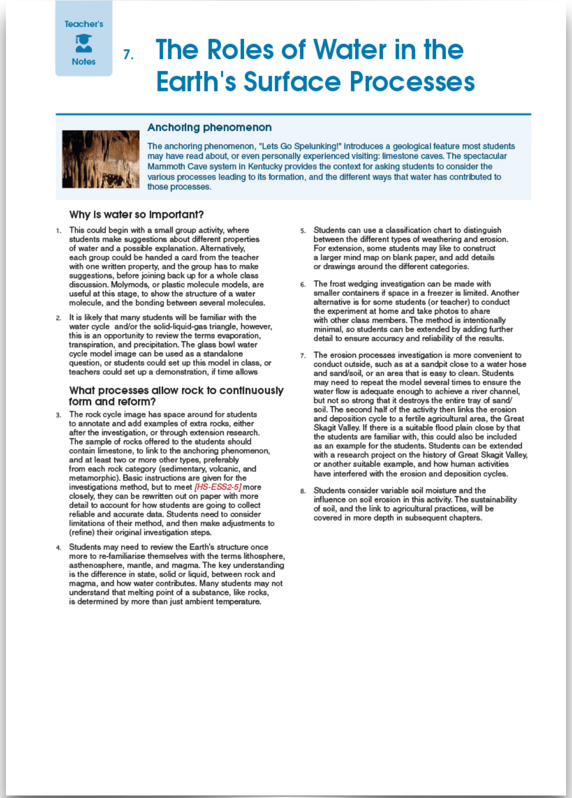
- ☐ 8 Link the moisture content of soil to erosion rate [SEP-4] [ESS2.C] [CCC-6]. 84 86

Disciplinary Core Idea ESS2.C

Teacher Notes



Teacher's Notes

7. The Roles of Water in the Earth's Surface Processes

Anchoring phenomenon

The anchoring phenomenon, "Lets Go Spelunking!" introduces a geological feature most students may have read about, or even personally experienced visiting: limestone caves. The spectacular Mammoth Cave system in Kentucky provides the context for asking students to consider the various processes leading to its formation, and the different ways that water has contributed to those processes.

Why is water so important?

1. This could begin with a small group activity, where students make suggestions about different properties of water and a possible explanation. Alternatively, each group could be handed a card from the teacher with one written property, and the group has to make suggestions, before joining back up for a whole class discussion. Molymods, or plastic molecule models, are useful at this stage, to show the structure of a water molecule, and the bonding between several molecules.
2. It is likely that many students will be familiar with the water cycle and/or the solid-liquid-gas triangle, however, this is an opportunity to review the terms evaporation, transpiration, and precipitation. The glass bowl water cycle model image can be used as a standalone question, or students could set up this model in class, or teachers could set up a demonstration, if time allows

What processes allow rock to continuously form and reform?

3. The rock cycle image has space around for students to annotate and add examples of extra rocks, either after the investigation, or through extension research. The sample of rocks offered to the students should contain limestone, to link to the anchoring phenomenon, and at least two or more other types, preferably from each rock category (sedimentary, volcanic, and metamorphic). Basic instructions are given for the investigations method, but to meet [HS-ESS2-5] more closely, they can be rewritten out on paper with more detail to account for how students are going to collect reliable and accurate data. Students need to consider limitations of their method, and then make adjustments to (refine) their original investigation steps.
4. Students may need to review the Earth's structure once more to re-familiarise themselves with the terms lithosphere, asthenosphere, mantle, and magma. The key understanding is the difference in state, solid or liquid, between rock and magma, and how water contributes. Many students may not understand that melting point of a substance, like rocks, is determined by more than just ambient temperature.
5. Students can use a classification chart to distinguish between the different types of weathering and erosion. For extension, some students may like to construct a larger mind map on blank paper, and add details or drawings around the different categories.
6. The frost wedging investigation can be made with smaller containers if space in a freezer is limited. Another alternative is for some students (or teacher) to conduct the experiment at home and take photos to share with other class members. The method is intentionally minimal, so students can be extended by adding further detail to ensure accuracy and reliability of the results.
7. The erosion processes investigation is more convenient to conduct outside, such as at a sandpit close to a water hose and sand/soil, or an area that is easy to clean. Students may need to repeat the model several times to ensure the water flow is adequate enough to achieve a river channel, but not so strong that it destroys the entire tray of sand/soil. The second half of the activity then links the erosion and deposition cycle to a fertile agricultural area, the Great Skagit Valley. If there is a suitable flood plain close by that the students are familiar with, this could also be included as an example for the students. Students can be extended with a research project on the history of Great Skagit Valley, or another suitable example, and how human activities have interfered with the erosion and deposition cycles.
8. Students consider variable soil moisture and the influence on soil erosion in this activity. The sustainability of soil, and the link to agricultural practices, will be covered in more depth in subsequent chapters.

Anchoring Phenomena

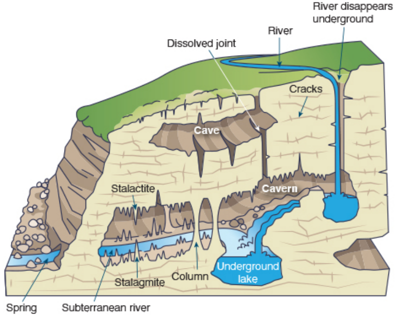
- Begin every chapter
- Familiar to students,
  but cannot be fully explained
- Encompass chapter content

- **Two purposes**:
  - Engage students
  - Teachers identify misconceptions and knowledge gaps

76 Lets Go Spelunking!

Key Question: What processes helped to form the Mammoth Caves?

- At Mammoth Cave National Park in Kentucky there is an underground limestone cave system, with around 640 km mapped out, and over 1000 km yet to be discovered by spelunkers, a term for cave explorers.
- The cave system started to form around 10 million years ago. It sits within the large Green River drainage basin, so was exposed to river water, along with slightly acidic rainwater, and ground water seeping through the rock.
- The cave system contains huge caverns, underground lakes, and sinkholes in which streams suddenly disappear into caves containing underground lakes.
- Mammoth Caves have stalactites, mineral formations that hang from the cave's ceilings, and stalagmites extending from the ground upwards.
- The oldest rocks that form the deep cave structure were laid down around 320 million years ago, on the site of a huge inland sea. On top of that are three other layers, or formations, that are successively younger.



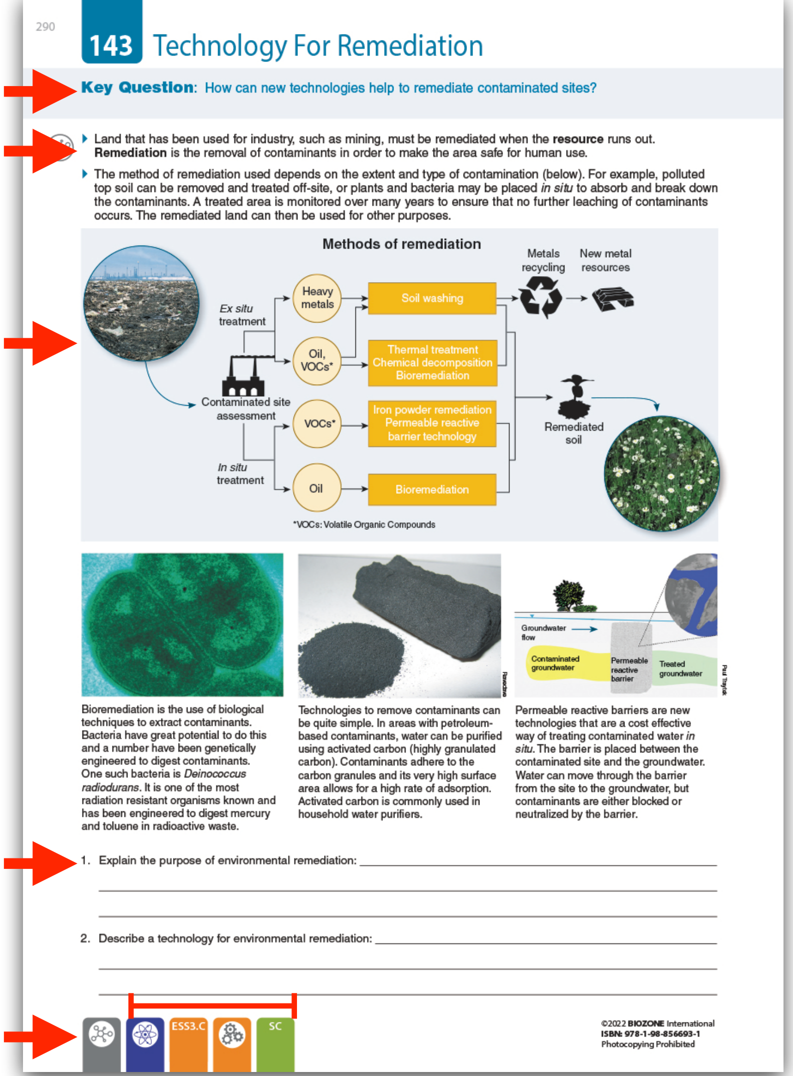
1. In groups, discuss what type of rock you think the big open caverns, containing the stalactites and stalagmites, in Mammoth Caves are made from, and how might you know that? Record a summary of your group's ideas below:

2. How do you think the Mammoth Caves might have formed? Use the space below to develop a flow chart of the processes you think might be involved in forming Mammoth Caves (you may not decide to use all four steps):

ISBN: 978-1-98-856693-1

Activity design

- Key Question.
- Introductory information
- Scaffolded information
- Question
- Tab system
    - Resource Hub content
    - Three dimensions identified



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143 Technology For Remediation

Key Question: How can new technologies help to remediate contaminated sites?

- Land that has been used for industry, such as mining, must be remediated when the **resource** runs out. **Remediation** is the removal of contaminants in order to make the area safe for human use.
- The method of remediation used depends on the extent and type of contamination (below). For example, polluted top soil can be removed and treated off-site, or plants and bacteria may be placed *in situ* to absorb and break down the contaminants. A treated area is monitored over many years to ensure that no further leaching of contaminants occurs. The remediated land can then be used for other purposes.

Bioremediation is the use of biological techniques to extract contaminants. Bacteria have great potential to do this and a number have been genetically engineered to digest contaminants. One such bacteria is *Deinococcus radiodurans*. It is one of the most radiation resistant organisms known and has been engineered to digest mercury and toluene in radioactive waste.

Technologies to remove contaminants can be quite simple. In areas with petroleum-based contaminants, water can be purified using activated carbon (highly granulated carbon). Contaminants adhere to the carbon granules and its very high surface area allows for a high rate of adsorption. Activated carbon is commonly used in household water purifiers.

Permeable reactive barriers are new technologies that are a cost effective way of treating contaminated water *in situ*. The barrier is placed between the contaminated site and the groundwater. Water can move through the barrier from the site to the groundwater, but contaminants are either blocked or neutralized by the barrier.

1. Explain the purpose of environmental remediation: ______

2. Describe a technology for environmental remediation: ______

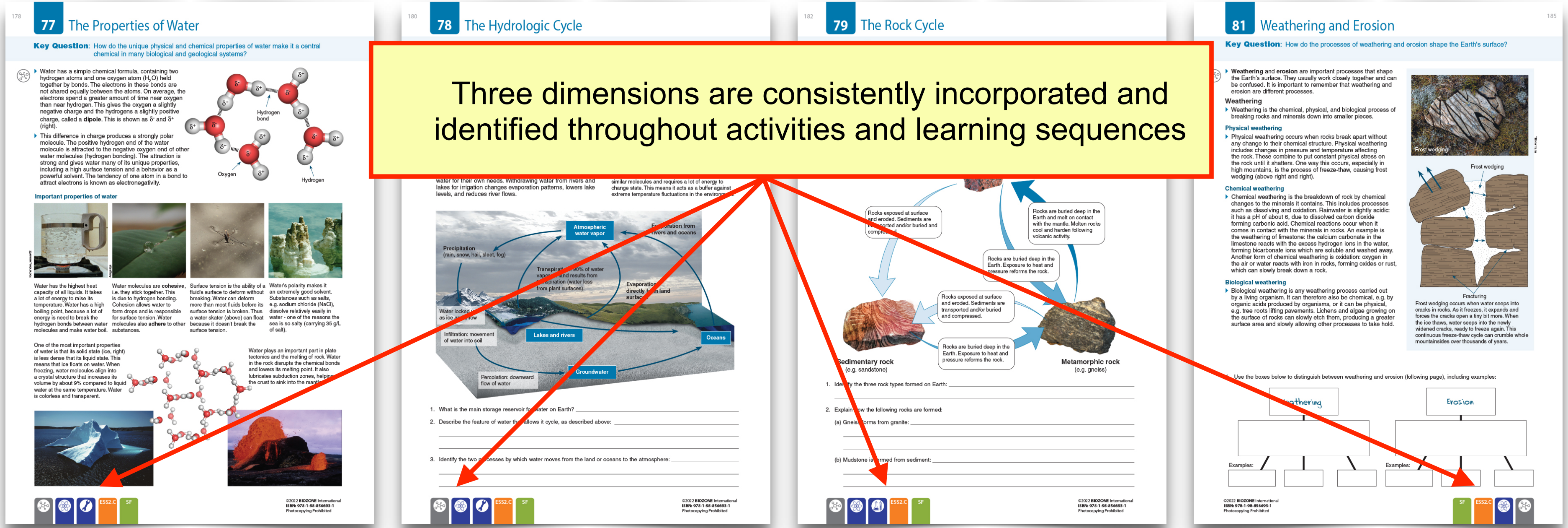
ESS3.C SC

ISBN: 978-1-98-856693-1

Learning Sequence

Develop deeper understanding

- **Related learning sequence**
  - **5Es Instructional model** scaffolds delivery of material
  - Develop a deeper understanding with progression through a learning sequence



Three dimensions are consistently incorporated and identified throughout activities and learning sequences

Anchoring Phenomenon Revisited

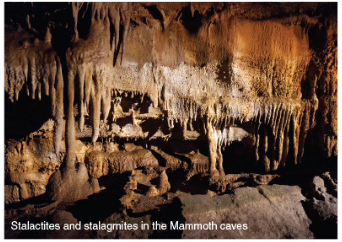
- Revisited at end of chapter
- Students should be able to fully explain Anchoring Phenomenon
- Formative assessment
- Identify material to revisit before progressing

192

85 Review Your Understanding

Key Question: What processes helped to form the Mammoth Caves?

In this chapter you have seen how water plays a role in developing the Earth's surface features, like the vast Mammoth Cave system encountered in the anchoring phenomenon. You should now be able to better describe the process involved in the cave system formation, and the interaction between **water** and rocks.


Stalactites and stalagmites in the Mammoth caves

1. (a) What type of rock is the caverns of the Mammoth Caves formed from?

   (b) How could we test to distinguish this rock type from igneous rocks, such as basalt or granite?

   (c) What is the type of weathering that formed the Mammoth Caves?

2. At the start of the chapter, you developed a flow chart of how you thought the Mammoth Cave system may have formed. You will now refine this flow chart by creating a simple annotated diagram below, using the correct scientific vocabulary, as well any rock cycle processes and the type of weathering leading to the Mammoth Cave formation.

ESS2.C SF

ISBN: 978-1-98-856693-1

Practical Investigations

- Practical Investigations are clearly identified in green boxes.
    - Investigative phenomena
    - Promote collaboration
    - Enhance communication
    - Develop laboratory skills
- Investigations use equipment commonly found in high school laboratories and classrooms.
    - No special kits are required.
- Equipment list is provided.

Appendix 2: Equipment List

1: Science Practices

INVESTIGATION 1.1
Investigating surface area and dissolving time

Per student/pair
Limestone ($CaCO_3$) chips
1 mol/L HCl
3 x 200 mL beakers
Timer
Electronic balance
Mortar and pestle

2: The Universe and its Stars

INVESTIGATION 2.1
Modeling expansion

Per student/pair
Rubber bands
Thumb tacks

INVESTIGATION 2.2
Measuring the size of the Sun

Per student/pair
Aluminum foil
Push pin
Card (to make a frame for the foil)
Ruler

3: Earth and the Solar System

INVESTIGATION 3.1
Elliptical orbits

Per pair/group
String (15 cm)
Two thumbtacks
Pencil
Corkboard or card

INVESTIGATION 3.2
Modeling orbits 1

Per pair
1 bowl
4–5 balls of various sizes
4–5 clothes pegs
Sheet of material to cover bowl

INVESTIGATION 3.3
Modeling orbits 2

Per student/pair
Computer

INVESTIGATION 3.4
Parallax

Per group of four
Protractor (a 180° is easiest to use)
Corkboard or thick card
Tape
Push pins
Plastic straw
Measuring tape

4: The History of Planet Earth

INVESTIGATION 4.1
Modeling half-lives

Per pair/group
M&M's®
Lidded container

5: Earth Materials and Systems

INVESTIGATION 5.1
Modeling ice sheet melting

Per pair/group
2 x Florence or Erlenmeyer flasks
Black paint
Aluminum foil
Ice cubes
2 x thermometers
60W tungsten lamp (optional)
Timer

6: Plate Tectonics

INVESTIGATION 6.1
Continental drift

Per student/pair
Scissors
Tape or paste

INVESTIGATION 6.2
Modeling drift over time

Per student/pair
Scissors
Tape or paste

7: The Roles of Water in the Earth's Surface Processes

INVESTIGATION 7.1
Determining properties of rocks

Per pair/group
Samples of sedimentary, igneous, and metamorphic rock
Graduated cylinder
Electronic balance

INVESTIGATION 7.2
Investigating frost wedging

Plaster of paris
3 x balloons
Graduated cylinder
3 x Disposable containers
Freezer

INVESTIGATION 7.3
Modeling the process of erosion

Per group
1 x plastic tray (at least A3 in size) with a water inlet and outlet
Hose and connectors
Substrate (gravel, silt, sand, clay)
Large rocks
Vegetation

8: Weather, Climate, and Biogeography

INVESTIGATION 8.1
Measuring energy

Per student/pair
Torch
Clamp stand
Protractor
Grid paper

INVESTIGATION 8.2
Modeling carbon cycle changes

Per student/pair
Computer
Spreadsheet application e.g. Excel

9: Natural Resources

INVESTIGATION 9.1
Investigating soil types 1

Per student/pair
Samples of sand, silt, and clay.
Measuring cylinders
Stirring rods

INVESTIGATION 9.2
Investigating soil types 2

Per student/pair
Three different soil samples.
Measuring cylinders
Stirring rods

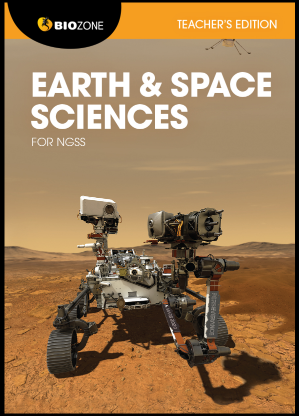
12: Global Climate Change

INVESTIGATION 12.1
Investigating how dry ice affects pH

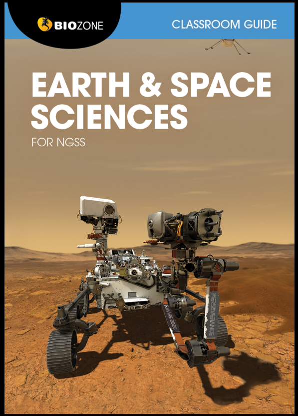
Per pair/group
250 mL conical flasks
Universal indicator
Dry ice
1 Mol/L NaOH

TEACHER SUPPORT MATERIALS

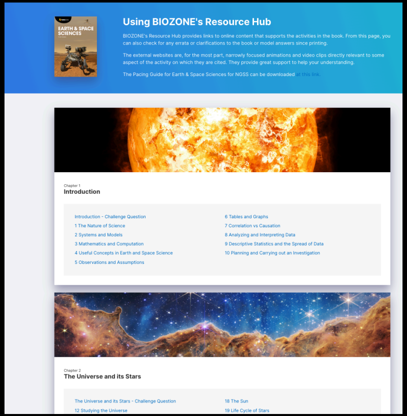
TEACHER TOOLKIT



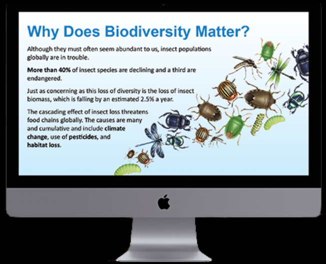
Teacher's Edition



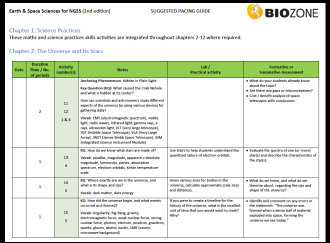
Classroom Guide



Resource Hub



Presentation slides



Pacing Guide

Test Bank + Question Library

Teacher's Edition

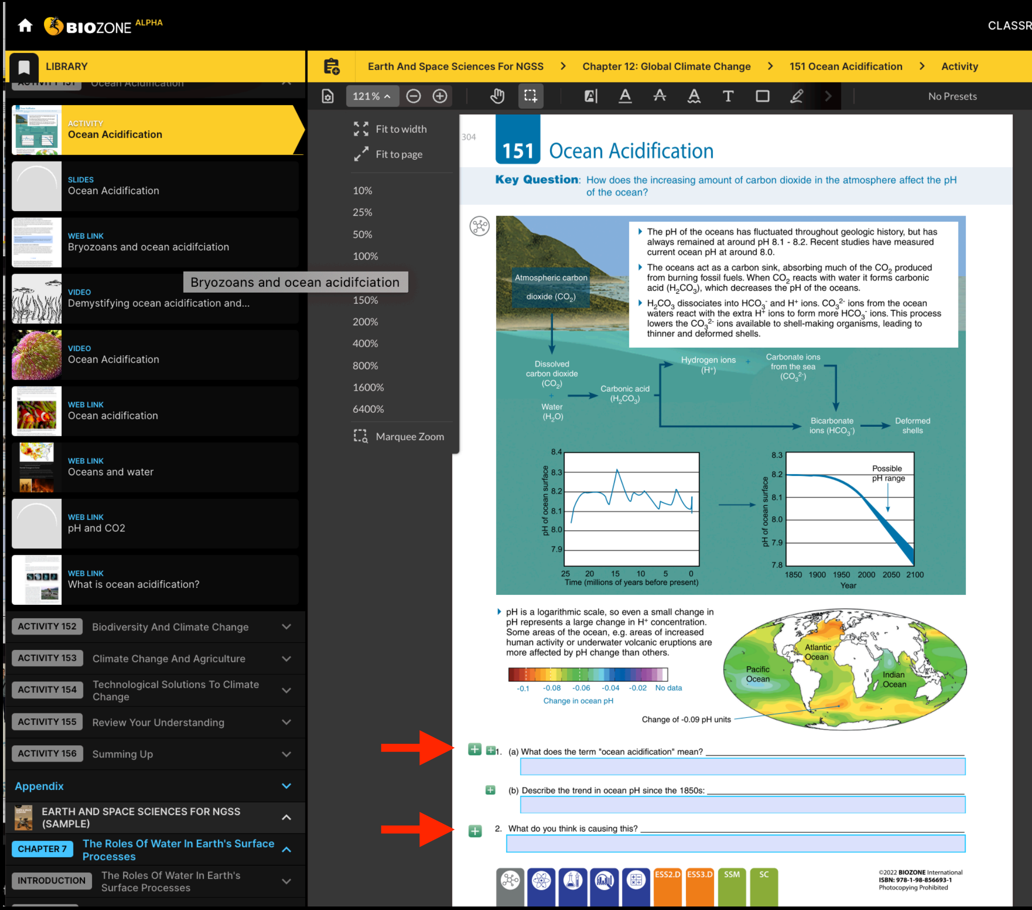
Replica of the Student Edition with:

- Print and digital
- Classroom Guide in place
- Model answers in place

BIOZONE WORLD: Teacher's version

Introduce, unpack, review answers

- Has answers in place.
- Has additional resources inbuilt
- Project on a shared screen.
- Introduce the topic.
- Wrap up a session.
- Review answers by toggling show/hide buttons



Classroom Guide

- Pedagogical tools and features explained
- Teacher toolkit resources
- Suggestions for using the resources including:
  - Collaborative learning in the classroom
  - Differentiated instruction
  - Practicals
  - Assessments

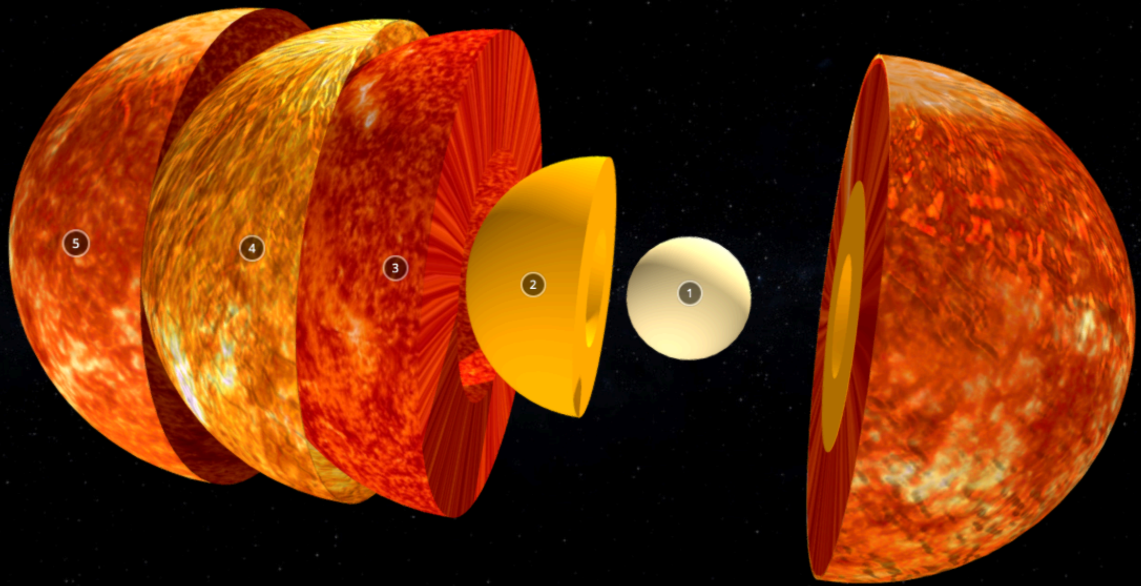
Resource Hub

Curated materials

- Curated materials support the content of the worktext.
- FREE resource for teachers and students
- Print and digital users

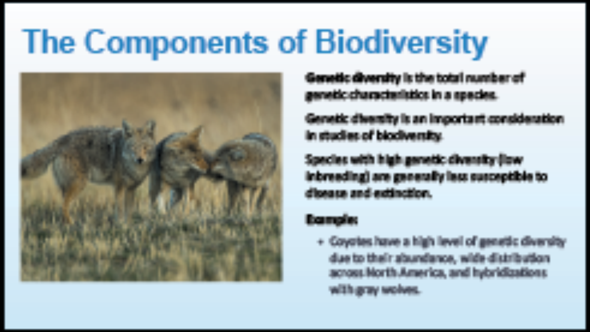
  - Articles
  - Videos
  - Simulations
  - Animations
  - Games
  - Spreadsheets
  - 3D Models
  - And more…

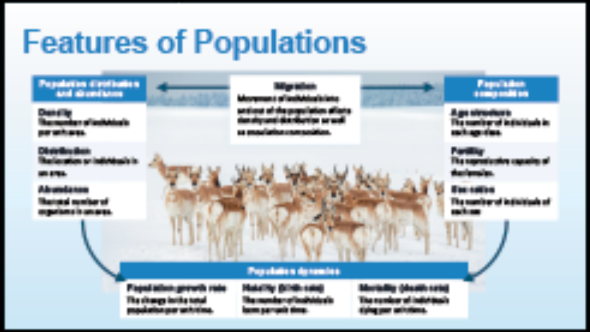
- Resources to engage all students
- Resources to extend Gifted & Talented students

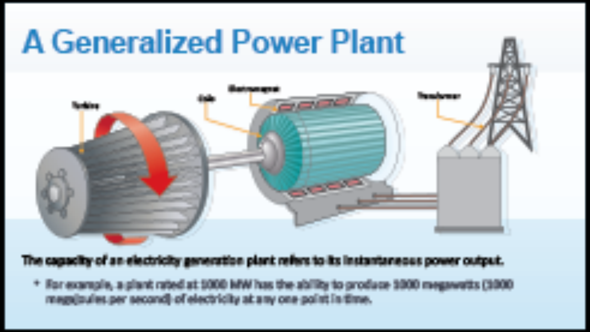


Presentation Slides

- Presentation style slides.
- Inbuilt into BIOZONE WORLD
  Pop up automatically with an activity.
- Present to your students using a projector or interactive whiteboard.

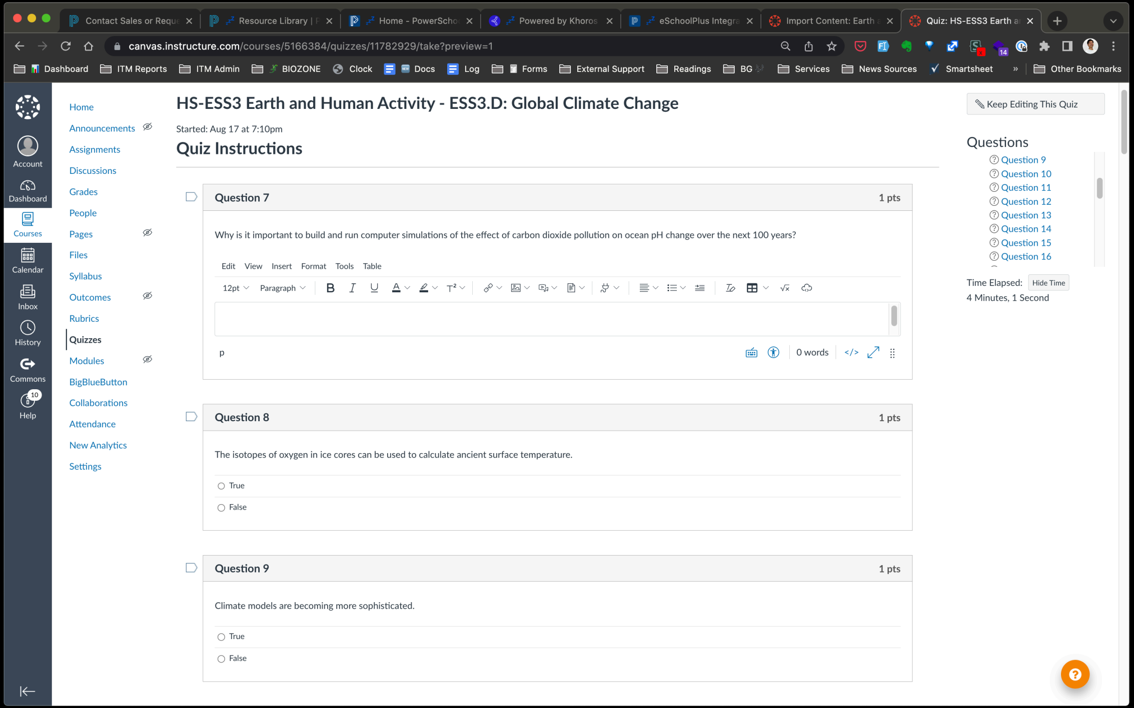






Test Bank content

- Additional questions test DCI knowledge.
- Formatted to ingest directly into your own test software or LMS.



- Range of question types, including:
  - Multiple choice
  - Multiple response
  - True/False
  - Modified true/false
  - Numeric
  - Matching

Question Library

- Embedded questions from the worktext are provided digitally as a **question library**.

- Question library allows you to:
  - Deliver the same questions from the print version to students via an online service.
  - Customize questions to suit reading ability.

NOTE: Question Library is only available to schools/districts committing to multi-year adoptions

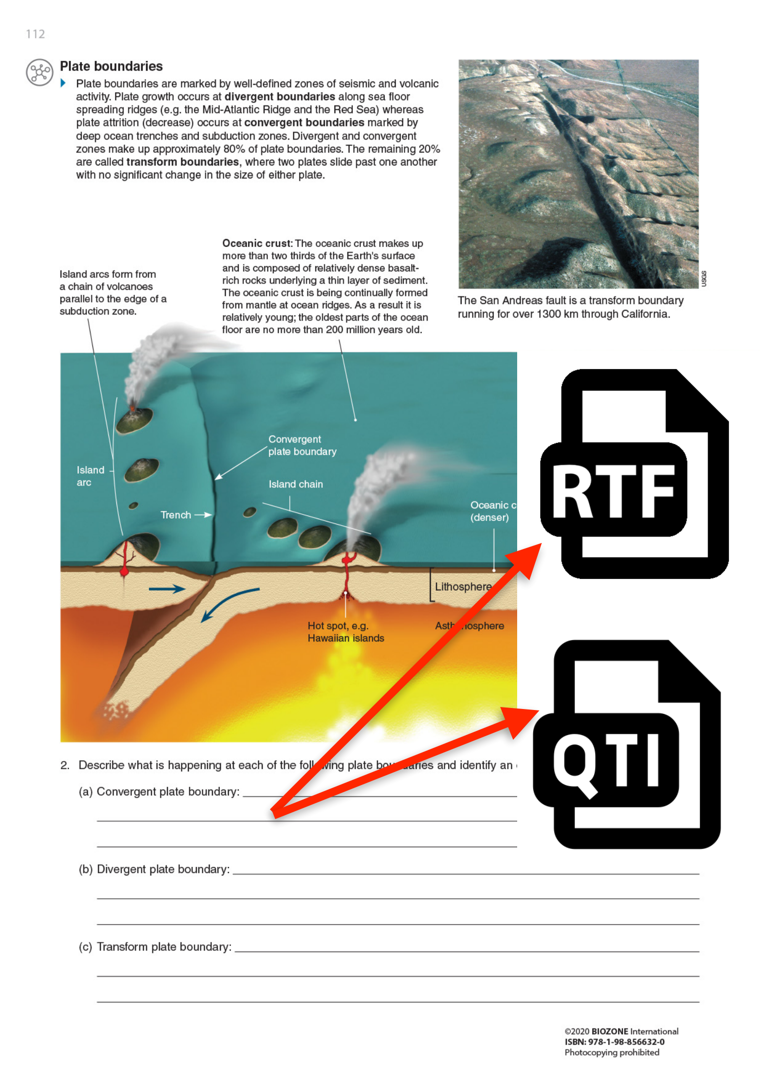

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Plate boundaries

Plate boundaries are marked by well-defined zones of seismic and volcanic activity. Plate growth occurs at **divergent boundaries** along sea floor spreading ridges (e.g. the Mid-Atlantic Ridge and the Red Sea) whereas plate attrition (decrease) occurs at **convergent boundaries** marked by deep ocean trenches and subduction zones. Divergent and convergent zones make up approximately 80% of plate boundaries. The remaining 20% are called **transform boundaries**, where two plates slide past one another with no significant change in the size of either plate.

The San Andreas fault is a transform boundary running for over 1300 km through California.

2. Describe what is happening at each of the foll ing plate bo aries and identify an

(a) Convergent plate boundary: ______

(b) Divergent plate boundary: ______

(c) Transform plate boundary: ______

Pacing Guide

- Suggested delivery /timing
- Highlights vocabulary
- Highlights investigations
- Highlights assessment

Chapter 1: Science Practices

These maths and science practices skills activities are integrated throughout chapters 2-12 where required.

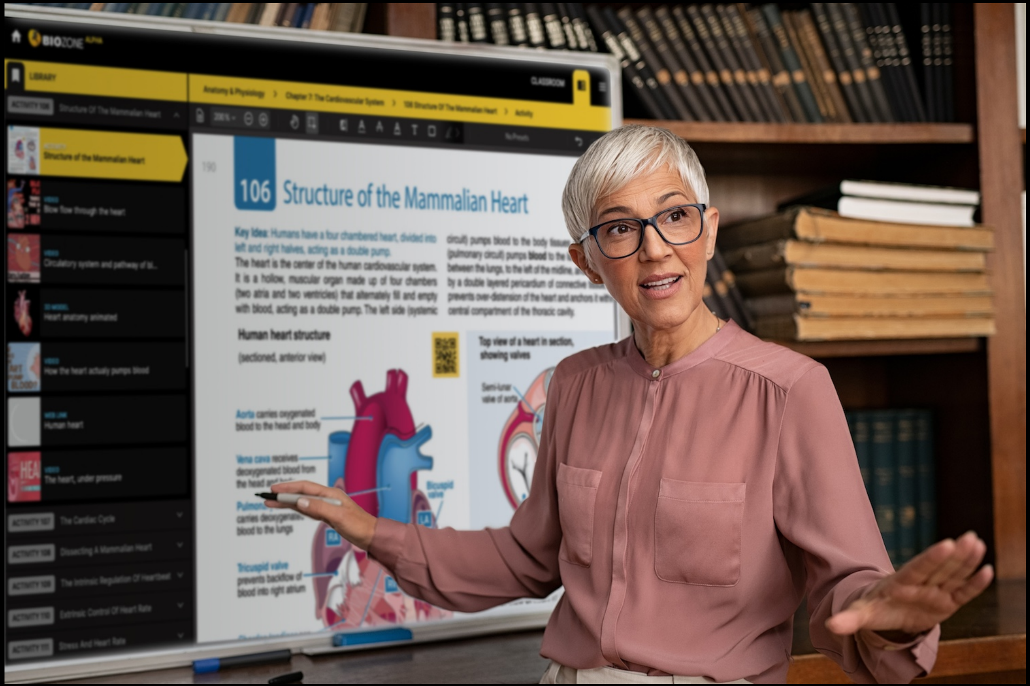
Chapter 2: The Universe and Its Stars

Date	Duration Time / No. of periods	Activity number(s)	Notes	Lab / Practical activity	Formative or Summative Assessment
	2	11 12 1 & 4	**Anchoring Phenomenon**: Hidden in Plain Sight. **Key Question (KQ)**: What caused the Crab Nebula and what is hidden at its center? How can scientists and astronomers study different aspects of the universe by using various devices for gathering data? **Vocab**: EMS (electromagnetic spectrum), visible light, radio waves, infrared light, gamma rays, x-rays, ultraviolet light, VLT (very large telescope), HST (Hubble Space Telescope), VLA (Very Large Array), JWST (James Webb Space Telescope), ISIM (Integrated Science Instrument Module)		• What do your students already know about the topic? • Are there any gaps or misconceptions? • Cost / Benefit analysis of space telescopes with conclusions.
	1	13 4	**KQ**: How do we know what stars are made of? **Vocab**: parallax, magnitude, apparent v absolute magnitude, luminosity, parsec, absorption spectrum, electron orbitals, Kelvin temperature scale	Use stairs to help students understand the quantized nature of electron orbitals.	• Evaluate the spectra of one (or more) star(s) and describe the characteristics of the star(s).
	1	14 5	**KQ**: Where exactly are we in the universe, and what is its shape and size? **Vocab**: dark matter, dark energy	Given various sizes for bodies in the universe, calculate approximate scale sizes and distances.	• What do we know, and what do we theorize about, regarding the size and shape of the universe?
	1	15 5	**KQ**: How did the universe begin, and what events occurred as it formed? **Vocab**: singularity, Big Bang, gravity, electromagnetic force, weak nuclear force, strong nuclear force, photon, electron, positron, gravitron, quarks, gluons, atomic nuclei, CMB (cosmic microwave background)	If you were to create a timeline for the history of the universe, what is the smallest unit of time that you would want to mark? Why?	• Identify and comment on any errors in the statement: "The universe was formed when a dense ball of material exploded into space, forming the universe we see today."


A single place of integration
BIOZONE WORLD

Streamline classroom-based

Collaborative Learning



Teacher
introduces Activity

↓

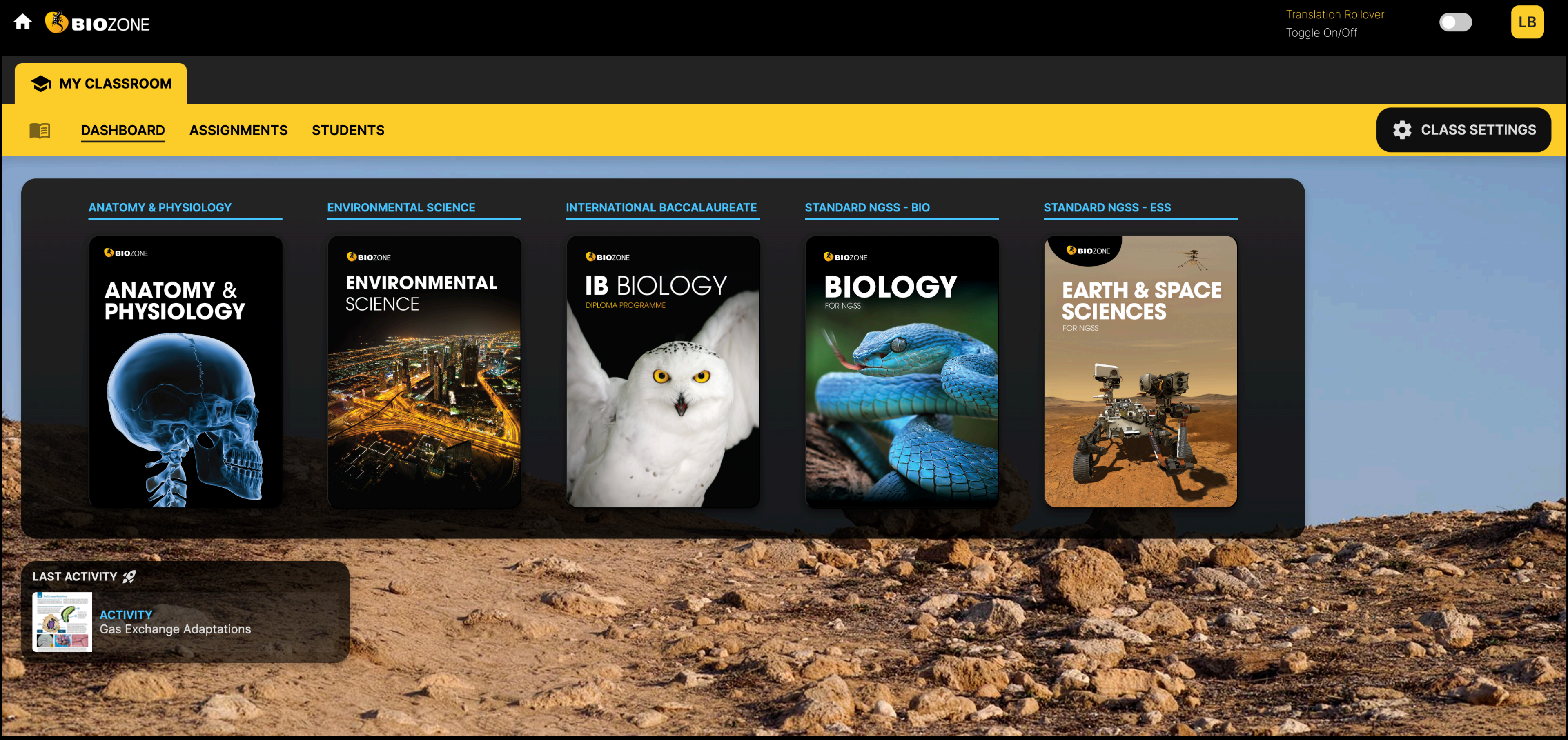
Brief class discussion
to "unpack" the Activity's
infographic or **data**

Breakout into small student groups

Student Group A	**Student Group B**	**Student Group C**
Discuss, then create consensus answers	Discuss, then create consensus answers	Discuss, then create consensus answers

↓

Students **quickly report back** via
teacher-led discussion then
Self-grade and **improve answers**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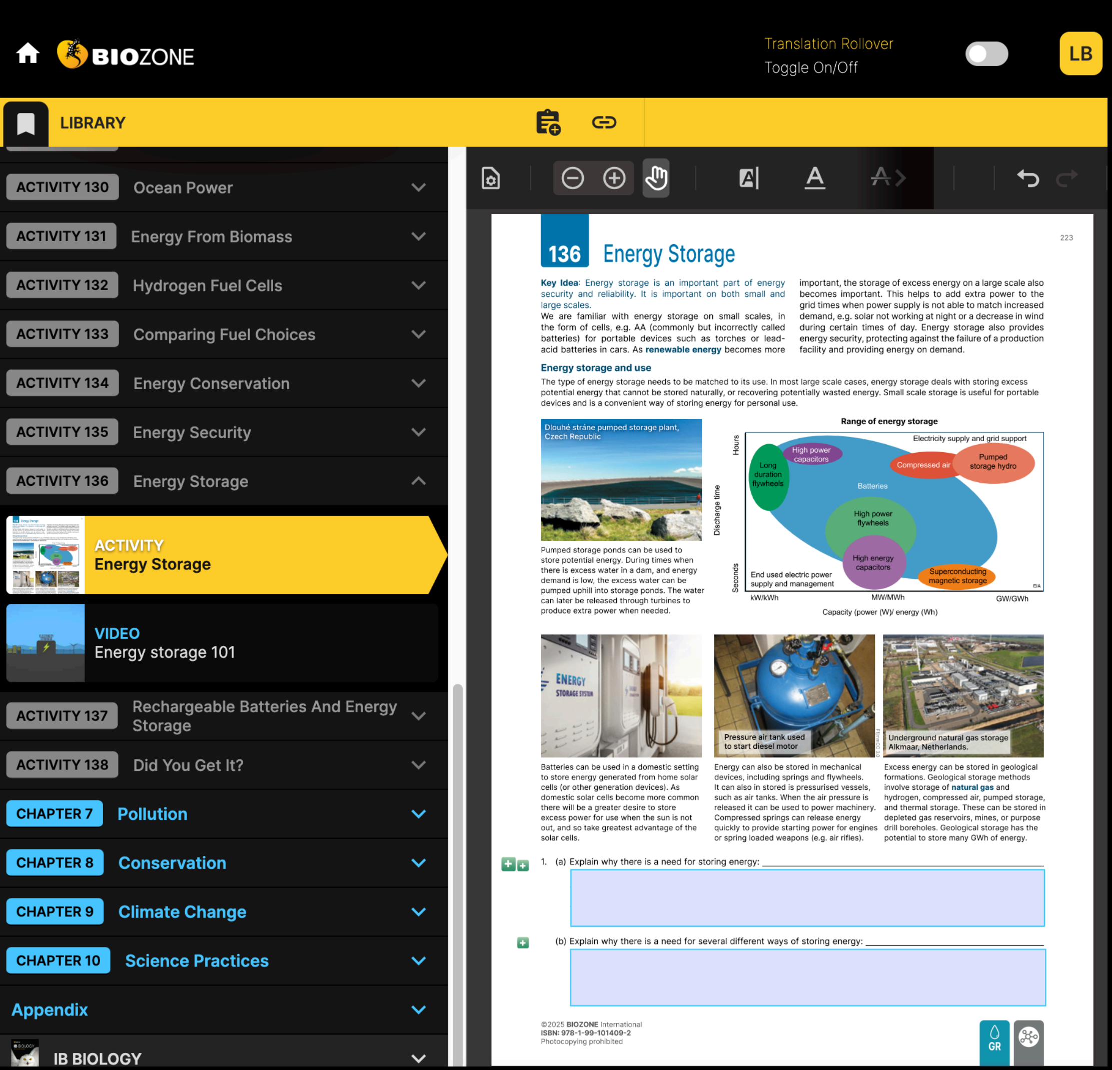
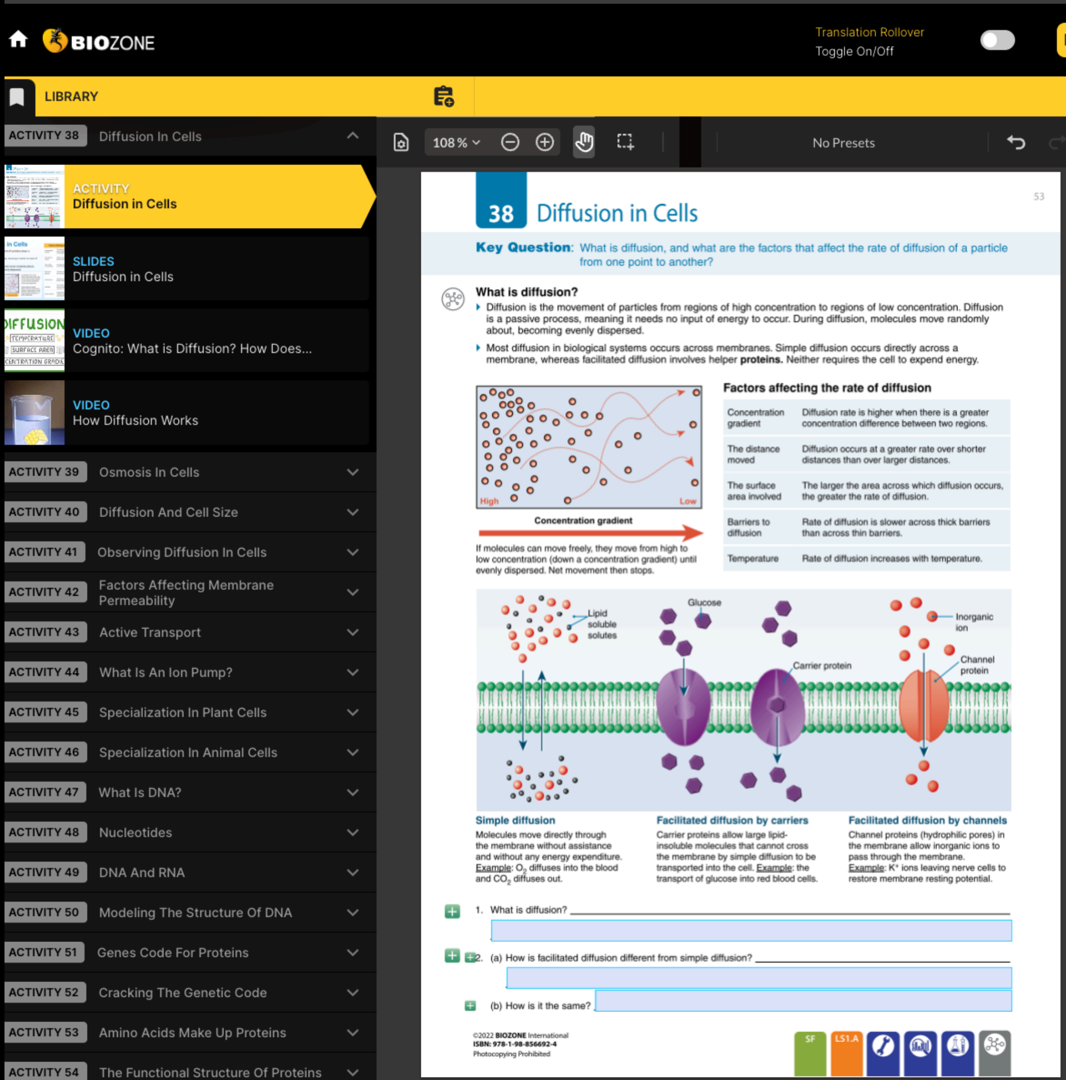
BIOZONE BIOLOGY FOR NGSS
BIOZONE EARTH & SPACE SCIENCES FOR NGSS
LAST ACTIVITY
ACTIVITY
Gas Exchange Adaptations

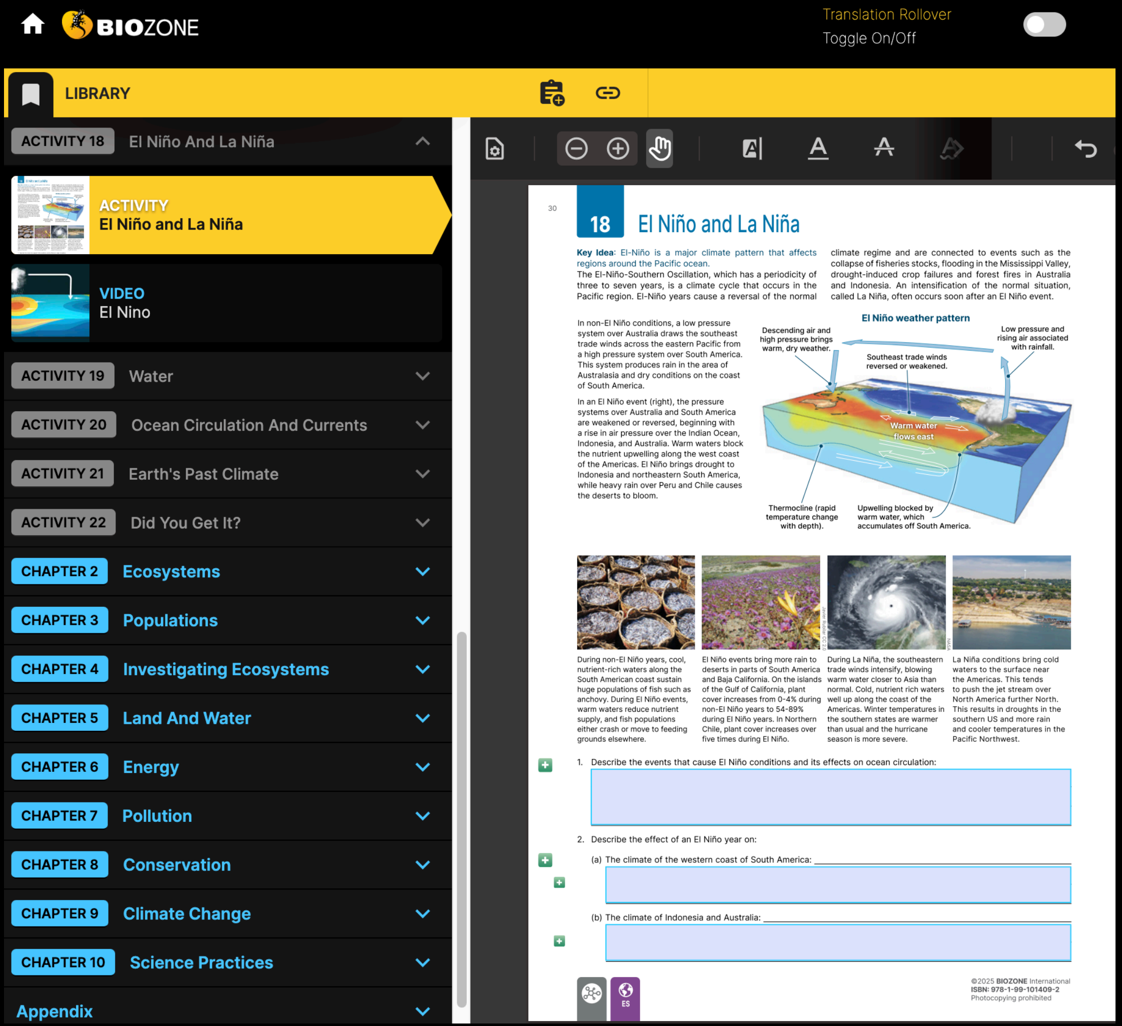


- Replicas of the printed books allow students to view content and answer questions online.
- Student view and teacher view.
- Direct access to:
  - Presentation slides
  - 3D models
  - Curated Videos
  - Websites

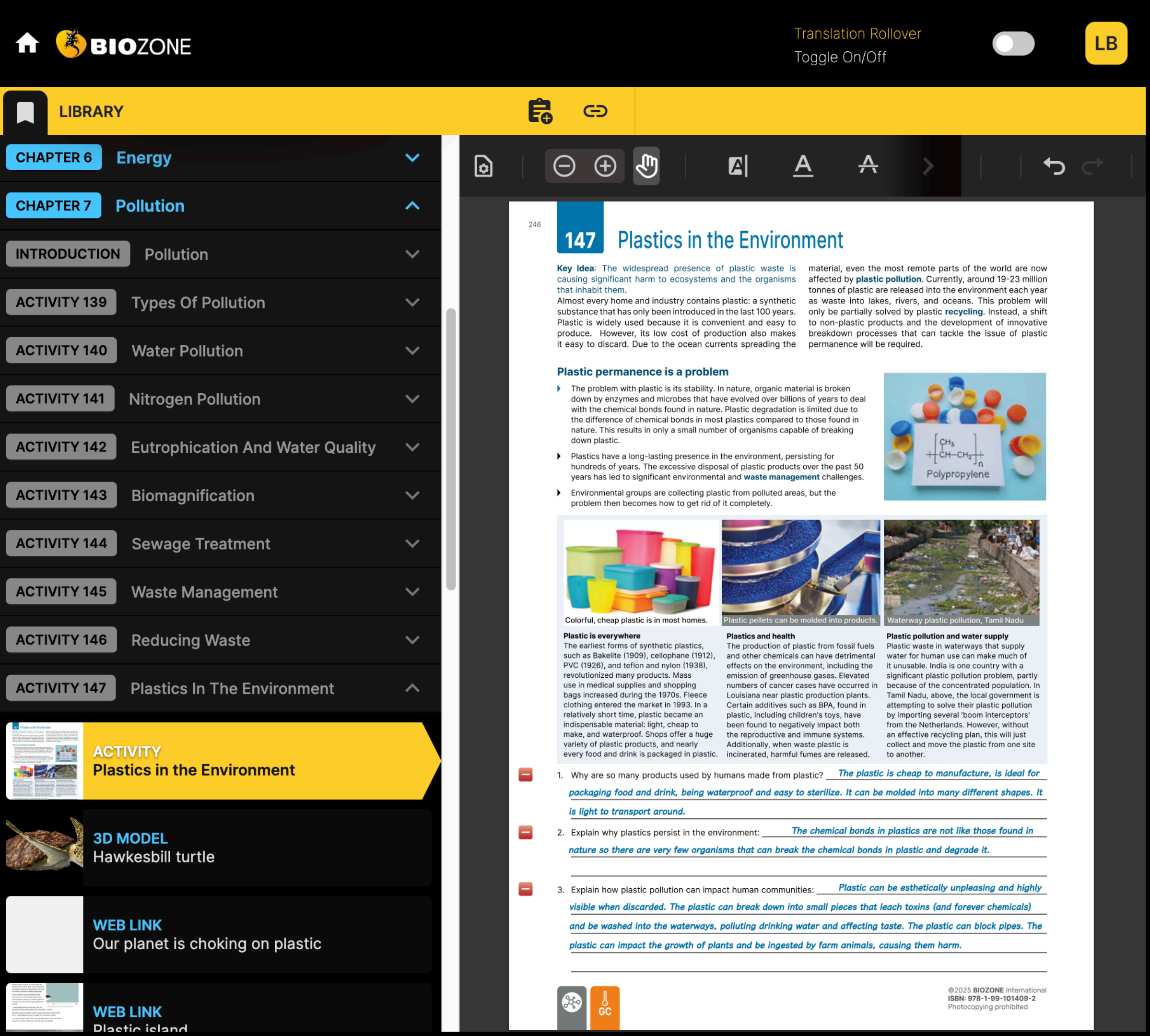
Digital platform

- Activity content and order are the same as the print resources.
  - Seamless transition between print and digital.
- Rostering capability.
- LMS integration.
- Digital resources inbuilt.





- **Students can**:
  - Input answers into the platform for review and grading.
  - Add notes, draw on the page and highlight text passages.
- **Teachers can**:
  - View and show answers
  - Assign activities
  - Grade and return work
  - Force hand in



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147 Plastics in the Environment

Key Idea: The widespread presence of plastic waste is causing significant harm to ecosystems and the organisms that inhabit them.

Almost every home and industry contains plastic: a synthetic substance that has only been introduced in the last 100 years. Plastic is widely used because it is convenient and easy to produce. However, its low cost of production also makes it easy to discard. Due to the ocean currents spreading the material, even the most remote parts of the world are now affected by **plastic pollution**. Currently, around 19-23 million tonnes of plastic are released into the environment each year as waste into lakes, rivers, and oceans. This problem will only be partially solved by plastic **recycling**. Instead, a shift to non-plastic products and the development of innovative breakdown processes that can tackle the issue of plastic permanence will be required.

Plastic permanence is a problem

- The problem with plastic is its stability. In nature, organic material is broken down by enzymes and microbes that have evolved over billions of years to deal with the chemical bonds found in nature. Plastic degradation is limited due to the difference of chemical bonds in most plastics compared to those found in nature. This results in only a small number of organisms capable of breaking down plastic.
- Plastics have a long-lasting presence in the environment, persisting for hundreds of years. The excessive disposal of plastic products over the past 50 years has led to significant environmental and **waste management** challenges.
- Environmental groups are collecting plastic from polluted areas, but the problem then becomes how to get rid of it completely.

Colorful, cheap plastic is in most homes.

Plastic pellets can be molded into products.

Waterway plastic pollution, Tamil Nadu

Plastic is everywhere
The earliest forms of synthetic plastics, such as Bakelite (1909), cellophane (1912), PVC (1926), and teflon and nylon (1938), revolutionized many products. Mass use in medical supplies and shopping bags increased during the 1970s. Fleece clothing entered the market in 1993. In a relatively short time, plastic became an indispensable material: light, cheap to make, and waterproof. Shops offer a huge variety of plastic products, and nearly every food and drink is packaged in plastic.

Plastics and health
The production of plastic from fossil fuels and other chemicals can have detrimental effects on the environment, including the emission of greenhouse gases. Elevated numbers of cancer cases have occurred in Louisiana near plastic production plants. Certain additives such as BPA, found in plastic, including children's toys, have been found to negatively impact both the reproductive and immune systems. Additionally, when waste plastic is incinerated, harmful fumes are released.

Plastic pollution and water supply
Plastic waste in waterways that supply water for human use can make much of it unusable. India is one country with a significant plastic pollution problem, partly because of the concentrated population. In Tamil Nadu, above, the local government is attempting to solve their plastic pollution by importing several 'boom interceptors' from the Netherlands. However, without an effective recycling plan, this will just collect and move the plastic from one site to another.

1. Why are so many products used by humans made from plastic? *The plastic is cheap to manufacture, is ideal for packaging food and drink, being waterproof and easy to sterilize. It can be molded into many different shapes. It is light to transport around.*

2. Explain why plastics persist in the environment: *The chemical bonds in plastics are not like those found in nature so there are very few organisms that can break the chemical bonds in plastic and degrade it.*

3. Explain how plastic pollution can impact human communities: *Plastic can be esthetically unpleasing and highly visible when discarded. The plastic can break down into small pieces that leach toxins (and forever chemicals) and be washed into the waterways, polluting drinking water and affecting taste. The plastic can block pipes. The plastic can impact the growth of plants and be ingested by farm animals, causing them harm.*

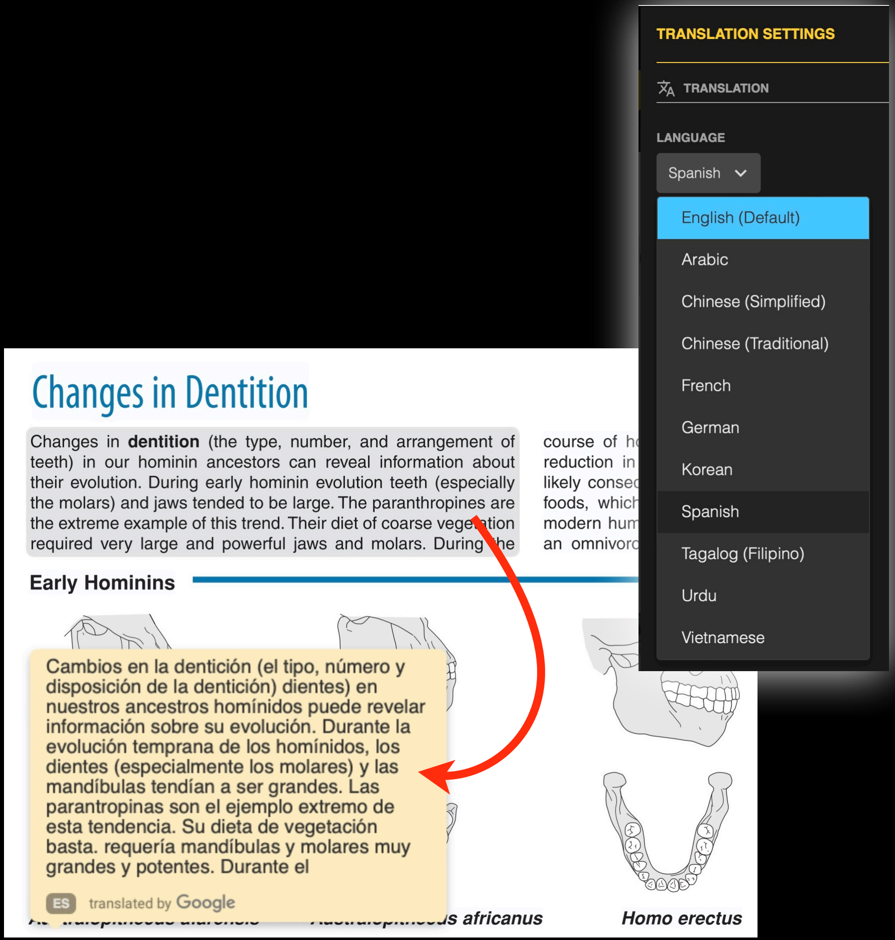
ISBN: 978-1-99-101409-2

- Perfect for introducing or reviewing content with students via shared screen.
- Teacher can **display model answers** when they want.
- Simply click the buttons on the teacher view to reveal the answers.
- Students can refine their own answers based on the model answers.

Translation feature

- **Translation for 150 languages:** Realtime translation - highlight the English text to display text translation in the selected language.

- Once activated, pointing the mouse at a text block in the book page will show the translated version on a nearby pop-up panel.

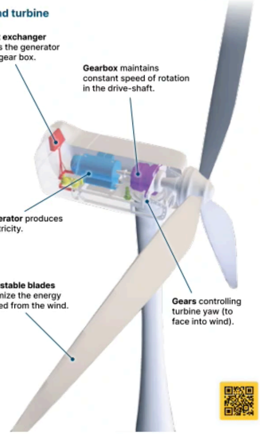


126 Wind Power

Key Idea: Wind power provides a relatively simple and scalable way to produce electricity.

Wind power has been used for centuries to provide the mechanical energy to pump water or run milling machinery. Today, it is mainly used to produce electricity. Wind power is becoming increasingly reliable and cost effective as the technology develops and turbines are able to operate in a range of conditions and wind speeds. In fact **wind energy** is one of the cheapest types of energy to build, maintain, and use. Globally, wind power is steadily increasing in generation capacity, but wind is a variable energy provider. There can be problems matching output to demand, such as during seasonal demands and low (or extremely high) winds. This means systems for managing and distributing electricity will be required as well as backup or base load electricity supplies, e.g. hydro or geothermal power.

Wind turbine



Wind farms often cover large areas of land but turbines can be designed to operate at sea and, on a smaller scale, along highway edges. The scalability of **wind turbines** makes them simple to install in many locations, with turbine sizes ranging from a few metres to over 200 metres in diameter.

At the end of 2022, the power output from wind turbines was around 7% of global electricity production. Global installed capacity was more than 800 GW. Electricity generation from wind is rising every year.

1. A typical wind turbine produces around 2.3 MW. The average house uses 30 kWh of energy per day (a kilowatt hour is the equivalent of 1000 joules of energy per second (1kW) running for 1 hour). Calculate the following:

   (a) The minimum number of wind turbines required to power a town of 20,000 households:

   (b) Wind turbines cost around $1.3 million per MW of energy production to build. What will the be the cost of (a) above?

   (c) The cost of building, running, and maintaining wind turbines over their 20 year lifetimes is about $50 per MWh. What could the 20,000 households using the wind turbines above expect to pay in dollars per year for the use of electricity provided by the wind turbines?

   (d) Why can households actually expect to have to pay a lot more than this? ______

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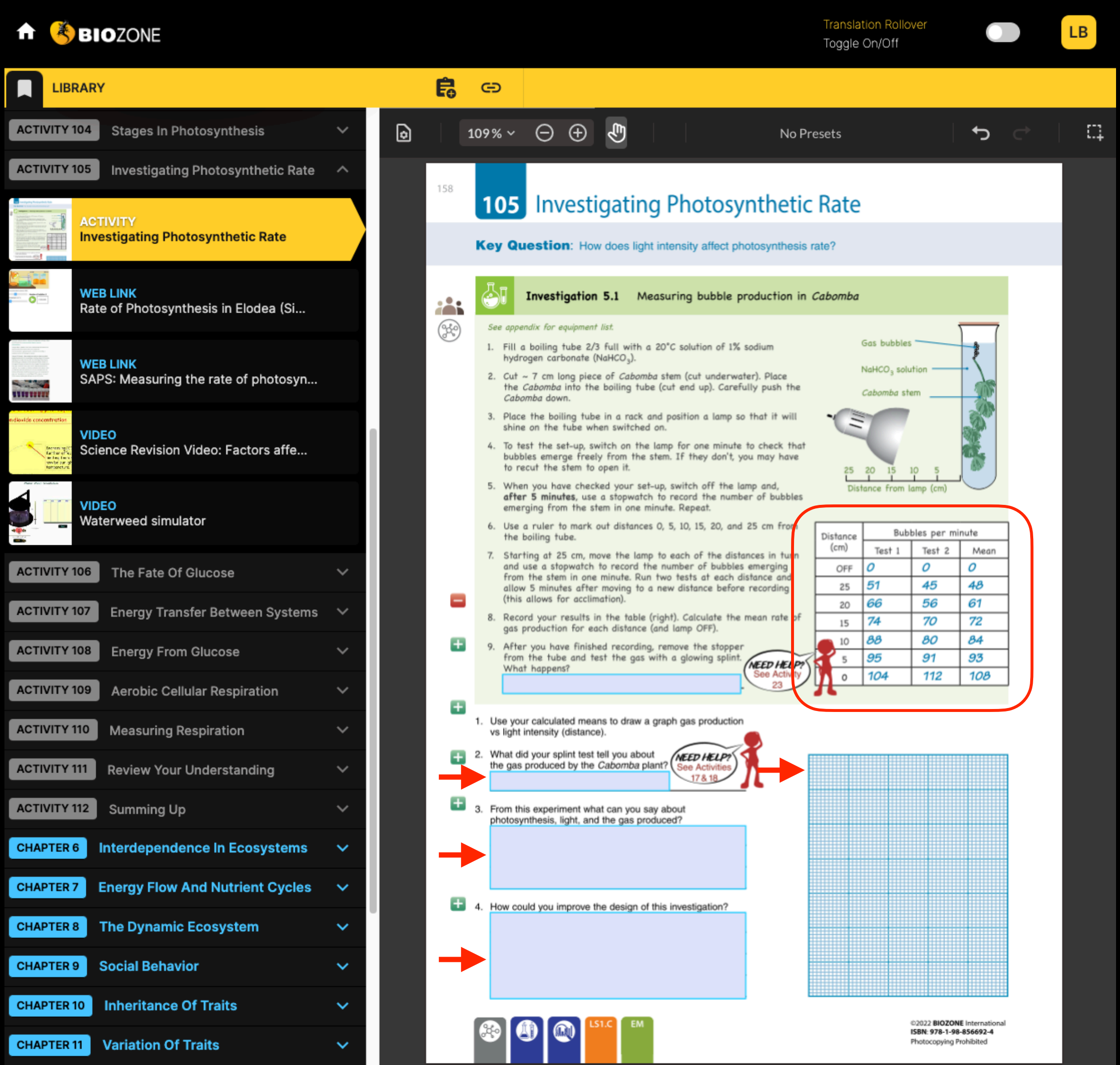
Practical Investigations

- Short on time?
- Student results can't be used?
- Share the model answer data.
- Students still do the graphing and analysis of results.



STUDENT Access

Digital interactive replica of the book:

- Students can view the book, add **annotations** and **markup**.
- Students can enter **answers online** and **submit** them to their teacher.
- Access embedded resources: **3D models**, **presentation slides**, curated OER **videos**, **weblinks**.

TEACHER Access

All the functions the student has plus:

- Teacher has access to **model answers** & can show/hide via display buttons.
- Teacher can **assign activities** to students.
- Force hand in.
- Teacher can **view**, **comment,** and **grade** student responses to questions.

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