Stile

Lesson Overview

2020

Science teachers are superheroes

You're on a valiant mission to instill in your students an understanding of the sheer power and importance of science. You're striving to shape inquisitive, thoughtful citizens who can critically evaluate the world around them and combat misinformation and "fake news". You are the heroes we need, and the heroes our students deserve.

But every hero needs a trusty sidekick.

Batman has Robin. You've got Stile.

Time is the mortal enemy of all teaching superheroes, and we're doing everything we can to save you from its evil clutches.

This Teacher Planning Companion was designed to save you time. It has been expertly crafted by our team of science teachers, all of whom understand the unique demands of day to day life in the classroom and the intricacies of planning. This guide will streamline your planning process, helping you integrate Stile's award-winning resources into your existing curriculum and units. It comes in two parts:

- The Lesson Overview book provides snapshots of every unit and lesson so you don't have to scroll through each one (who has time for that!?)
- The Curriculum Map book contains Stile's suggested Scope and Sequence and maps curriculum outcomes to each lesson.

But don't forget, your sidekick is always ready to drop everything to be by your side. If you ever need help with planning, aligning your scope and sequence with relevant Stile lessons, or setting up your Stile account, you can signal us from here: https://stileeducation.com/concierge

We're here, by your side, to ensure you have everything you need to help your students reach their full potential and graduate with the brightest possible future.

Byron Scaf (co-founder), and the whole Stile teaching team.


Strand
Description and code
Strand
Description and code
Earth & Space
Physics
Chemistry
Assessments
Lesson
Form
Approx. Timing
Marking
Lesson Summaries
Introduction: Invasive Species
Gather: Invasive Species
Process: Invasive Species
Project: Invasive Species

Curriculum Planning with Stile

The Teacher Planning Companion has been designed to help you easily build Stile into your existing curriculum. There are two books, the Lesson Overview and Curriculum Map.

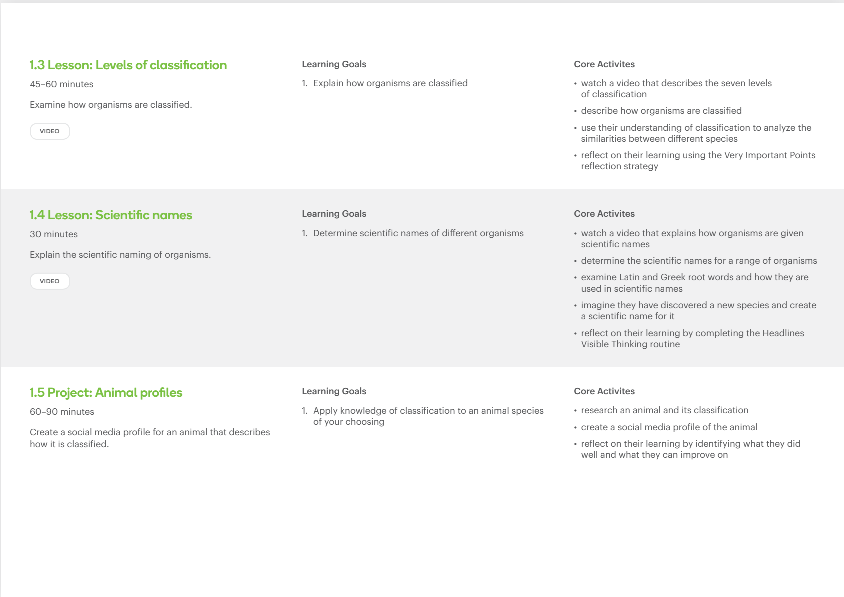
View curriculum mapping books for: AUS | VIC | NSW | WA | NZ

How it works

1 Find the unit you're looking for in this book

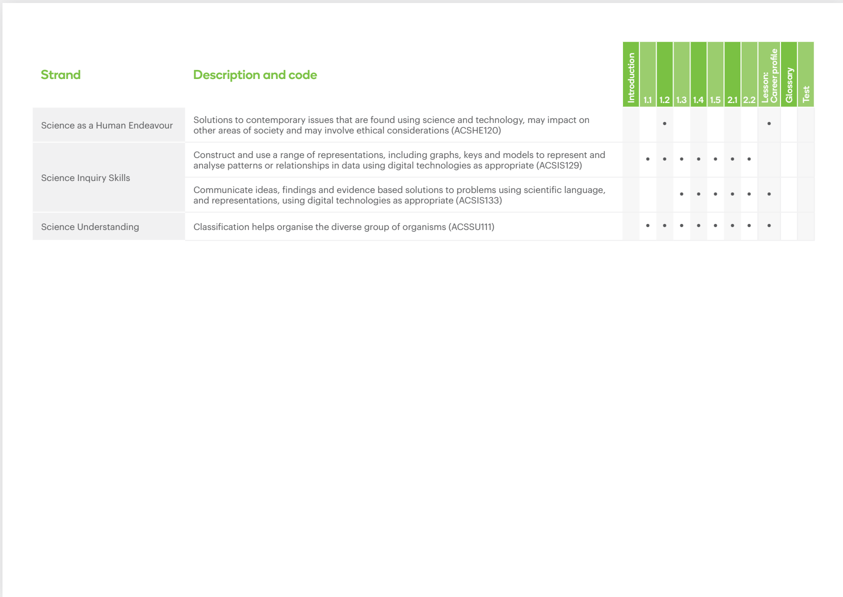
2 Grab your Curriculum Map book and find the corresponding unit

3 Use the books side by side to cross reference as you plan



1.3 Lesson: Levels of classification 45–60 minutes Examine how organisms are classified. VIDEO	**Learning Goals** 1. Explain how organisms are classified	**Core Activites** • watch a video that describes the seven levels of classification • describe how organisms are classified • use their understanding of classification to analyze the similarities between different species • reflect on their learning using the Very Important Points reflection strategy
1.4 Lesson: Scientific names 30 minutes Explain the scientific naming of organisms. VIDEO	**Learning Goals** 1. Determine scientific names of different organisms	**Core Activites** • watch a video that explains how organisms are given scientific names • determine the scientific names for a range of organisms • examine Latin and Greek root words and how they are used in scientific names • imagine they have discovered a new species and create a scientific name for it • reflect on their learning by completing the Headlines Visible Thinking routine
1.5 Project: Animal profiles 60–90 minutes Create a social media profile for an animal that describes how it is classified.	**Learning Goals** 1. Apply knowledge of classification to an animal species of your choosing	**Core Activites** • research an animal and its classification • create a social media profile of the animal • reflect on their learning by identifying what they did well and what they can improve on

This book
(Lesson Overview)



Strand	Description and code	Introduction	1.1	1.2	1.3	1.4	1.5	2.1	2.2	Lesson: Career profile	Glossary	Test
Science as a Human Endeavour	Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations (ACSHE120)			•						•		
Science Inquiry Skills	Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS129)		•	•	•	•	•	•	•			
	Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS133)				•	•	•	•	•	•		
Science Understanding	Classification helps organise the diverse group of organisms (ACSSU111)		•	•	•	•	•	•	•	•		

Curriculum Map

Key features

We've tagged some key features within lessons that we think are fun, interesting or might be helpful for you to know about during planning.

VIDEO

Videos featured in the activity to show on a projector or have students watch and listen individually with their headphones.

VR

Lead an expedition to the surface of the moon or plunge inside a plant cell. Our VRs allow students to view things on their mobile devices in an immersive 360º experience.

AR

Bring the outside world into the classroom with augmented reality. Use mobile devices to view 3D models of the real world.

INTERACTIVE

Fun interactive experiences help to reinforce and enhance the lessons, allowing students to explore key learning outcomes at their own pace.

SIMULATION

From climate change to chemical reactions, put your student in charge of a digital experiment. Simulations provide an intuitive understanding of complex systems.

MATERIALS REQUIRED

For practicals and other activities, your students may need to bring something in or you may need a lab tech to prepare equipment or chemicals etc. Check before teaching this lesson for what's required.

POSTER

We have created amazing artworks and posters for various lessons that you might like to print off beforehand to hang in your classroom.

Reading the Lesson Overview

The topic pages in this book are laid out as follows.

Key concepts covered in the unit

Unit name

Real world context used to engage students

Unit short links can be used to quickly access the unit in the Stile library

Lessons included within the unit at a glance demonstrate unit length and key concepts covered

Introduction to Science

What is science and how can it help us solve global problems?

Science is the best way we have of understanding how the world works. By helping us create new technologies, it has the power to change the way we live and solve some of our most pressing issues. This unit will build your students' investigation skills and get them excited about the wonderful world of science!

stileapp.com/go/intro-to-science

The big ideas covered in this unit are:

- The what, who, where and why of science
- How do we stay safe in a science lab?
- What skills does a scientist need?
- How do you plan and conduct your own investigation?

Unit structure

Introduction

1.1 Lesson: What is science?
1.2 Lesson: Why do we do science?
1.3 Lesson: Who does science?
1.4 Lesson: Where does science happen?
1.5 Summing up

2.1 Lesson: Lab safety
2.2 Practical activity: Exploring the lab
2.3 Lesson: Using a Bunsen burner
2.4 Practical activity: Using a Bunsen burner

3.1 Scientist skills: Observing & inferring
3.2 Scientist skills: Measuring
3.3 Practical activity: Measurement stations
3.4 Scientist skills: Using data
3.5 Practical activity: Conducting an investigation

Squiz

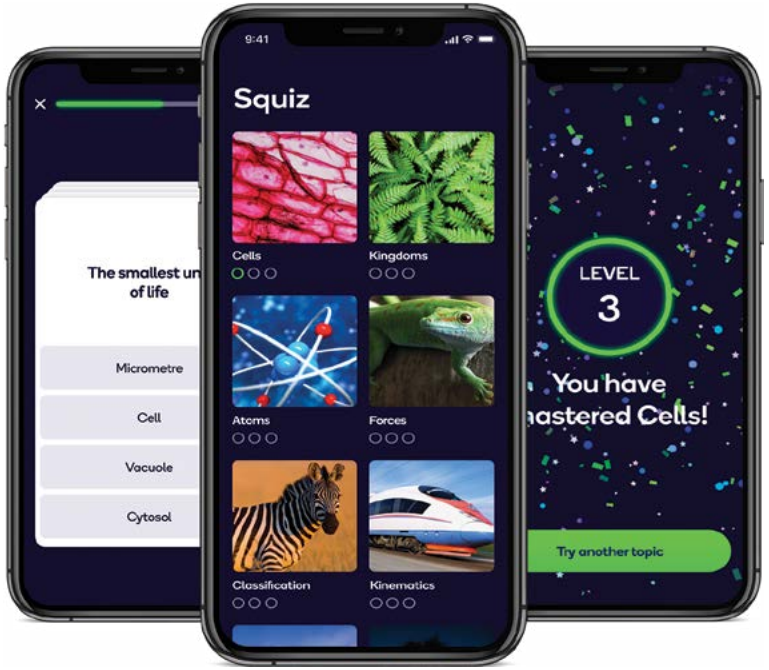
Learn, consolidate and revise outside of class.

Squiz is the perfect way for students to rapidly learn the key scientific terminology needed for every topic, at home or on the go. The idea is to free up valuable class time for tackling Stile's higher-order questions, or getting stuck into hands-on investigations, rather than simply learning the facts.

The true magic of Squiz is that it personalises learning for every student. As students answer questions, Squiz learns what they do and don't know, and teaches them what they don't know until they've mastered a topic.

Squiz complements Stile perfectly. For every unit presented in this book, you'll find a matching unit in Squiz.

Search for 'Squiz' in your phone's App Store to get started.



Contents

Introduction to Science

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- How do we stay safe in a science lab?
- What skills does a scientist need?
- How do you plan and conduct your own investigation?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
2.1 Quiz: Lab Safety	Multiple choice questions	5–10 minutes	Automatic
2.2 Quiz: Exploring the lab	Multiple choice questions	5–10 minutes	Automatic
2.3 Quiz: Using a Bunsen burner	Multiple choice questions	5–10 minutes	Automatic
3.1 Quiz: Scientist skills: Observing & inferring	Multiple choice questions	5–10 minutes	Automatic
3.2 Quiz: Scientist skills: Measuring	Multiple choice questions	5–10 minutes	Automatic
3.4 Quiz: Scientist skills: Using data	Multiple choice questions	5–10 minutes	Automatic
3.5 Quiz: Conducting an investigation	Multiple choice questions	5–10 minutes	Automatic
Test	Multiple choice and short answer questions	30–40 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Elicit students' current ideas about science and spark curiosity by observing bubbles.

Learning Goals

1. Discuss your current ideas about science
2. Use observation techniques

Core Activities

- Be introduced to the Stile characters, who will guide them through the unit
- Tune in and share prior knowledge about science through a brainstorming activity
- Create a mind map of what they already know about the phenomenon of bubbles
- Investigate bubbles using the *see, think, wonder visible thinking routine*
- Describe what they have learnt before in science, what they are looking forward to and what they are nervous about
- Reflect by writing down any questions or comments about this class for the teacher

1.1 Lesson: What is science?

30 minutes

Explain what science is and introduce the four main branches.

VIDEO

Learning Goals

1. Describe what science is
2. Name and describe the four main branches of science
3. Demonstrate understanding of what some different scientists do

Core Activities

- Watch a short video to explore what science is
- Describe the main branches of science and explore questions that might be asked in each one
- Explore what some different scientists do in their jobs
- Reflect on their observations and generate new questions using the *creative questions visible thinking routine*

1.2 Lesson: Why do we do science?

30 minutes

Examine the role that science and technology play in daily life and global issues.

VIDEO

Learning Goals

1. Determine how science and technology is present in our everyday lives
2. Describe some ways that science can help us solve global issues

Core Activities

- Explore how science and technology have improved our lives
- Watch a video about the evolution of the telephone and imagine how it might continue to evolve in the future
- Explore some of the global problems that science could help us solve
- Reflect on their learning using a variation of the *headlines visible thinking routine*

1.3 Lesson: Who does science?

30 minutes

Challenge ideas of who can do science.

VIDEO

Learning Goals

1. Discuss ideas about who does science
2. Identify recent examples of young people engaging in science and technology-based projects

Core Activities

- Evaluate scientist stereotypes in their drawings and discuss the origins of these stereotypes
- Watch one of three short videos featuring young people doing cool things in science and technology
- Brainstorm questions and problems they would like to solve in their daily lives
- Reflect on their learning by drawing themselves as scientists

1.4 Lesson: Where does science happen?

30 minutes

Explore the different places where scientific investigations can take place.

VIDEO | VR | MATERIALS REQUIRED

Learning Goals

1. Identify three different places where scientific investigations happen
2. Relate scientific questions to the places where they can be investigated

Core Activities

- Match scientific questions to the places that scientists would need to go to answer them
- Explore the Great Barrier Reef and International Space Station through virtual reality or 360° videos
- Carry out a simple activity of making and investigating slime (this activity can be done at home)
- Reflect on their learning using an *I used to think, but now I think visible thinking routine*

1.5 Summing up

20 minutes

Consolidate students' ideas about science and encourage them to reflect on their learning.

Learning Goals

Core Activities

- Return to their first brainstorming canvas ("What? Why? Who? Where?") From the Introduction and add their new knowledge and ideas
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

2.1 Lesson: Lab safety

90–120 minutes

Introduce safety hazards and rules for the laboratory.

VIDEO VR INTERACTIVE

Learning Goals

1. Identify common hazards found in a science lab
2. Describe the safety rules that you need to follow when you're in the lab

Core Activities

- Investigate a virtual reality scenario where they will identify unsafe situations and safety hazards
- Write a set of safety rules and share these with the class to create a class set of safety rules
- Draw a map of the locations of safety items in the classroom
- Apply their learning by thinking about the safety rules that were broken in the virtual reality scenario
- Create a poster, song or video to help remember the class safety rules
- Reflect on their learning using the *very important points reflection strategy*

2.2 Practical activity: Exploring the lab

100–120 minutes

Introduce lab equipment, its names and uses.

INTERACTIVE

Learning Goals

1. Recall the names and uses of common pieces of lab equipment
2. Identify the correct equipment to use in different scenarios

Core Activities

- Discover lab equipment by participating in a scavenger hunt
- Find the right equipment for common lab scenarios in an interactive simulation
- Practise remembering names and uses of lab equipment in matching activities, including Kahoot!
- Reflect on their learning by thinking of mnemonics to help remember the uses of lab equipment

2.3 Lesson: Using a Bunsen burner

45–60 minutes

Explain the method for setting up and using a Bunsen burner, including safety rules.

VIDEO SIMULATION

Learning Goals

1. Identify the parts of a Bunsen burner and state their functions
2. Explain the safety rules for using a Bunsen burner

Core Activities

- Watch a video and/or teacher demonstration explaining how to set up and use a Bunsen burner safely
- Use an interactive simulation to test their understanding of the sequence of steps
- Label the parts of a Bunsen burner and match them to their functions
- Order the steps for lighting a Bunsen burner safely
- Give reasons for following the safety rules
- Reflect on their learning using the *Very Important Points reflection strategy*

2.4 Practical activity: Using a Bunsen burner

90–120 minutes

Obtain a Bunsen burner licence and perform a short practical activity heating ice and water.

MATERIALS REQUIRED

Learning Goals

1. Demonstrate how to light a Bunsen burner safely
2. Use a Bunsen burner safely to melt ice and evaporate water

Core Activities

- Demonstrate that they can light and use a Bunsen burner safely
- Compare how long it takes to melt ice and evaporate the same amount of water

3.1 Scientist skills: Observing & inferring

45–60 minutes

Introduce the difference between observations and inferences.

MATERIALS REQUIRED

Learning Goals

1. Distinguish between observations and inferences
2. Use different senses to make observations
3. Outline how scientific theories change over time

Core Activities

- Practise recording observations
- Distinguish between observations and inferences in different scenarios
- Discuss how inferences change through an activity of interpreting footprints
- Practise making observations using touch, hearing and smell
- Explore how scientific theories change as new evidence is discovered
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

3.2 Scientist skills: Measuring

45–60 minutes

Distinguish between types of observations, and learn to use measuring equipment.

MATERIALS REQUIRED

Learning Goals

1. Classify observations as either qualitative or quantitative
2. Describe ways to improve the accuracy of your measurements

Core Activities

- Compare quantitative and qualitative measurements and apply the distinction
- Brainstorm ideas of when measurement is used in their daily lives
- Learn the importance of accurate measurement
- Perform a short activity to test their ability to make accurate measurements of liquids
- Describe the different types of measurement errors
- Reflect on their learning using the *very important points reflection strategy*

3.3 Practical activity: Measurement stations

45–60 minutes

Students practise taking measurements with a range of equipment.

MATERIALS REQUIRED

Learning Goals

1. Collect and record accurate measurements of length, time, mass, temperature and volume
2. Identify the appropriate unit for each measurement
3. Describe potential errors with measurements

Core Activities

- Practise measuring length, mass, time and volume
- Select the appropriate units for their measurements
- Recognize the importance of using a measuring cylinder rather than a beaker for measuring volume
- Reflect on their learning by analyzing the accuracy of their results and considering what they would do differently next time

3.4 Scientist skills: Using data

60 minutes

Apply the qualitative/quantitative distinction and analyze and communicate data.

MATERIALS REQUIRED

Learning Goals

1. Make observations and record data in tables
2. Calculate averages and draw graphs
3. Interpret graphs and explain what they mean

Core Activities

- Collect qualitative and quantitative data about gummy worms
- Record their data in tables
- Calculate the average mass and length for each gummy worm “species”
- Present their data in column graphs
- Analyze their findings
- Reflect on their learning using a variation of the *headlines visible thinking routine*

3.5 Practical activity: Conducting an investigation

45–60 minutes

Plan and conduct an investigation, and communicate the results.

MATERIALS REQUIRED

Learning Goals

1. Plan a fair scientific investigation
2. Produce a clear testable hypothesis
3. Describe possible ways to improve the accuracy of the results

Core Activities

- Plan an investigation to find out if sugar dissolves faster in hot or cold water
- Identify the variables and make a hypothesis
- Carry out the method and record their results using a table and column graph
- Reflect on their investigation and write a conclusion

Classification

Why do zebras have stripes?

It's a question that scientists have been asking for more than 100 years, but new research may finally have an answer. Explore classification through this real-world context, and help your students discover if the process of classification is black and white...

stileapp.com/go/classification

The big ideas covered in this unit are:

- What key features can be used to distinguish between one animal and another?
- Why do we need to classify organisms and give them scientific names?
- What are dichotomous keys and how do they work?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Examine a new theory of why zebras have stripes, and identify prior knowledge of living things.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read a magazine article and watch a video that explores a new theory about why zebras have stripes
- Compare the appearance of zebras and donkeys
- Complete diagnostic activities to see if they can identify living things and what all living things have in common

1.1 Lesson: Living or non-living?

45–60 minutes

Compare living and non-living things.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Describe the features that distinguish living things from non-living things

Core Activities

- Watch a video that explains the life processes that all living things have in common
- Identify living and non-living things in a short hands-on activity
- Reflect on their learning using the *headlines visible thinking routine*

1.2 Lesson: Why do we classify?

45–60 minutes

Introduce the concept of classification.

Learning Goals

1. Explain the importance of classification

Core Activities

- Brainstorm ways in which we classify objects in our daily lives
- Classify a variety of animals into groups based on their observable properties
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.3 Lesson: Levels of classification

45–60 minutes

Examine how organisms are classified.

VIDEO

Learning Goals

1. Explain how organisms are classified

Core Activities

- Watch a video that describes the seven levels of classification
- Describe how organisms are classified
- Use their understanding of classification to analyze the similarities between different species
- Reflect on their learning using the *very important points reflection strategy*

1.4 Lesson: Scientific names

30 minutes

Explain the scientific naming of organisms.

VIDEO

Learning Goals

1. Determine scientific names of different organisms

Core Activities

- Watch a video that explains how organisms are given scientific names
- Determine the scientific names for a range of organisms
- Examine Latin and Greek root words and how they are used in scientific names
- Imagine they have discovered a new species and create a scientific name for it
- Reflect on their learning by completing the *headlines visible thinking routine*

1.5 Project: Animal profiles

60–90 minutes

Create a social media profile for an animal that describes how it is classified.

Learning Goals

1. Apply knowledge of classification to an animal species of your choosing

Core Activities

- Research an animal and its classification
- Create a social media profile of the animal
- Reflect on their learning by identifying what they did well and what they can improve on

1.6 Extension: Biodiversity

45–60 minutes

Examine the importance of biodiversity and identify ways that it is threatened.

VIDEO

Learning Goals

1. Define biodiversity
2. Explain why biodiversity is important
3. Describe threats to biodiversity

Core Activities

- Explore the biodiversity of animals on Earth
- Watch a video about the importance of biodiversity
- Examine ways that biodiversity is threatened
- Reflect on their learning by completing a Plus, Minus, Interesting (PMI) chart

2.1 Lesson: Using dichotomous keys

30–45 minutes

Introduce dichotomous keys as a classification tool.

VIDEO

Learning Goals

1. Describe how dichotomous keys work
2. Use dichotomous keys to classify organisms and other objects

Core Activities

- Watch a short video about dichotomous keys in table format
- Use table and flow chart dichotomous keys to identify a range of characters and organisms
- Make a simple dichotomous key to sort pieces of lab equipment
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

2.2 Practical activity: Create a dichotomous key

45–60 minutes

Create a dichotomous key.

Learning Goals

1. Develop a dichotomous key for a particular group of objects

Core Activities

- Practise identifying distinguishing features of animals by completing a dichotomous key
- Identify distinguishing features of a given set of striped animals
- Construct a dichotomous key that allows each animal to be identified
- Reflect on their learning using the *headlines visible thinking routine*

3.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling zoologist Tim Caro.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read a profile about zoologist Tim Caro
- Brainstorm questions they would like to ask him
- Design an informative poster or video about protecting a species from extinction

Kingdoms

How do ferns survive with so little sunlight?

Ferns are among the most ancient members of the plant kingdom. They were here before the dinosaurs. So it's amazing that it's taken until now to make a new key discovery about how they live. Springboard off this recent scientific news article to help your students make their own discoveries about the six kingdoms of life.

stileapp.com/go/kingdom-lessons

The big ideas covered in this unit are:

- What are the six kingdoms of living things?
- How are the kingdoms similar and different?
- How has our understanding of kingdoms changed over time?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	25–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Introduce the topic through a news article about ferns.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read a short article about a recent discovery about how ferns adapted to living in dim light
- Brainstorm characteristics that they would like to acquire from other species

1.1 Lesson: The six kingdoms

20–30 minutes

Explain the differences between the six kingdoms of living things.

VIDEO

Learning Goals

1. Explain the differences between the six kingdoms of living things
2. Categorize living things into kingdoms based on distinguishing characteristics

Core Activities

- Watch a video describing the six kingdoms
- Compare the kingdoms in terms of their cells and how they obtain energy
- Complete a mind map summarizing the key differences between the kingdoms

1.2 Lesson: Classifying ferns and fungi

20–30 minutes

Distinguish between ferns and fungi and consider why the kingdoms do not cover all living things.

VIDEO

Learning Goals

1. Describe the identifying characteristics of fungi and ferns

Core Activities

- Watch videos about fungi and ferns, and compare their characteristics
- Attempt to classify bacteria as plants or animals

1.3 Practical activity: Creating kingdoms

20–30 minutes

Think creatively about classifying organisms.

MATERIALS REQUIRED

Learning Goals

1. Classify organisms into three new kingdoms and justify this grouping

Core Activities

- Classify 10 organisms into three kingdoms of their own making

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling molecular biologist Kevin Rowe.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read a profile about molecular biologist Kevin Rowe
- Consider locations where new species could be found

Food Chains and Food Webs

Why do cats have slit-shaped pupils?

The answer relates to the one thing that connects all living things: food! The pupils of cats and other predators help them judge the precise distance to their prey and give them superior night vision. This eye-opening discovery will be the first of many as your students explore food chains and food webs.

stileapp.com/go/foodweb-lessons

The big ideas covered in this unit are:

- What are food chains and food webs?
- What are decomposers and why are they important?
- How are food chains connected into food webs?
- What happens when an organism is removed from an ecosystem?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Introduce the topic and identify students' prior knowledge.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about a science news story that explains why predators and prey often have differently shaped pupils
- Complete diagnostic activities relating to the requirements of life, types of diet (herbivore, carnivore, omnivore) and predator–prey relationships

1.1 Lesson: Food chains

45–60 minutes

Explain how food chains allow energy to flow through ecosystems.

VIDEO

Learning Goals

1. Classify living things as producers or consumers
2. Develop food chains to show the flow of energy in an ecosystem
3. Explain why decomposers and detritivores are important in an ecosystem

Core Activities

- Brainstorm the energy needs of living things
- Watch a short video about energy flow in food chains
- Interpret and draw simple food chains
- Identify different roles in food chains, including producers, consumers, decomposers and detritivores
- Reflect on their learning using the *creative questions visible thinking routine*

1.2 Lesson: Food webs

45–60 minutes

Introduce food webs and the impact of removing an organism from an ecosystem.

VIDEO

Learning Goals

1. Construct food webs from food chains
2. Explain the relationships between organisms in a food web
3. Analyze the impact of removing organisms from an ecosystem

Core Activities

- Watch a video that compares food webs and food chains
- Construct a simple food web from food chains
- Identify the different roles that organisms can play within a food web
- Explore the impact of removing an organism from an ecosystem
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.3 Simulation: Feed the dingo

45–60 minutes

Examine an Australian desert food web.

SIMULATION

Learning Goals

1. Identify what is needed to maintain a food web

Core Activities

- Use an interactive to create and maintain an Australian desert ecosystem
- Identify the different roles organisms play within the ecosystem
- Create a food web to summarize their findings

1.4 Practical activity: Modelling a food web

45–60 minutes

Apply an understanding of food webs.

MATERIALS REQUIRED

Learning Goals

1. Construct a model food web
2. Analyze what happens when a link in the food web is broken

Core Activities

- Model a food web in a reef ecosystem
- Examine the impact when a link in the food web is broken

2.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling zoo researcher Marissa Parrott.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video profile of zoo researcher Marissa Parrott
- Consider the skills needed for this job and its value for society

Invasive Species

SOS: Save our species

When a cat is curled up on your lap, it doesn't seem like a vicious killer, but even the cuddliest of cats is a predator by natural instinct. Australia is in the grips of a feral cat epidemic, and it's driving native species to extinction. Students will claw their way through this unit to explore how invasive species disrupt ecosystems, and consider possible solutions to help restore the balance.

stileapp.com/go/invasive-species

The big ideas covered in this unit are:

- What is an invasive species?
- How do invasive species affect the ecosystems they invade?
- How can we solve the problem without causing more harm?
- What is biological control and does it work?

Unit structure

Introduction

1.1 Lesson: The impact of invasive species
1.2 Lesson: Controlling invasive species
1.3 Project: Research a case study

Lesson: Career profile

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Invasive Species	Case study written report	90–120 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students in the topic with a *Cosmos* article.

VIDEO

Learning Goals

1. Identify issues surrounding invasive species

Core Activities

- Read and respond to an article about invasive species

1.1 Lesson: The impact of invasive species

30–45 minutes

Examine how invasive species can alter a food web.

VIDEO

Learning Goals

1. Describe what invasive species are and the effects they can have on ecosystems

Core Activities

- Watch and respond to a video detailing the invasion of the Yellow Crazy Ants and other invasive species

1.2 Lesson: Controlling invasive species

30–45 minutes

Explore ways to reduce the numbers of invasive species.

VIDEO

Learning Goals

1. Define "biological control" and give examples
2. Propose some problems humans face when they try to eradicate invasive species

Core Activities

- Watch and respond to a video detailing how to kill snakes in Guam by airdropping poison mice
- Graph ant densities with a line graph comparing the treated site and untreated site, then analyze graph
- Watch and respond to a video outlining the use of biological control in managing rabbit populations
- Respond to a hypothetical scenario, attempt to manage out-of-control populations of feral cats and rabbits, consider the possible consequences and present their findings

1.3 Project: Research a case study

90–120 minutes

Explore one invasive case study in depth.

Learning Goals

1. Investigate a case study of an invasive species in depth

Core Activities

- Research one case study of an invasive species in depth
- Present their findings in a report

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling zoological researcher Tim Doherty.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read and respond to an article profiling zoological researcher Tim Doherty

Cells

Could a $300,000 hamburger hold the key to feeding our growing population?

Scientists have discovered a way to produce meat using cultured cells instead of livestock. This discovery is paving the way for more ethical and sustainable food production methods, and could change the way we eat meat forever. Students will chew their way through this unit to discover the fascinating world of cells, and their potential to help solve a range of global issues.

stileapp.com/go/cells

The big ideas covered in this unit are:

- What is cell theory?
- How do microscopes work?
- What are the main structures within cells and their functions?
- What are specialized cells?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: The building blocks of life	Multiple choice questions	5–10 minutes	Automatic
1.3 Quiz: Introduction to microscopes	Multiple choice questions	5–10 minutes	Automatic
2.1 Quiz: Parts of a cell	Multiple choice questions	5–10 minutes	Automatic
2.2 Quiz: Animal vs. plant cells	Multiple choice questions	5–10 minutes	Automatic
2.4 Quiz: Cells under the microscope	Multiple choice questions	5–10 minutes	Automatic
3.1 Quiz: Specialized cells	Multiple choice questions	5–10 minutes	Automatic
3.2 Project: Putting cells to work	Research task	100–120 minutes	Teacher reviewed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Use a $300,000 hamburger made from cells to identify students' prior understanding.

VIDEO INTERACTIVE

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Watch an introductory video in which the unit guide, Thomas King, introduces the issue of cultured meat
- Answer a series of questions to determine their prior knowledge of cells
- Explore an interactive diagram that describes various ways that a knowledge of cells can benefit society
- Reflect on their learning using the *creative questions visible thinking routine*

1.1 Lesson: The building blocks of life

30–45 minutes

Explain what cells are and explore how they are organized into tissues, organs and organ systems.

VIDEO

Learning Goals

1. Explain what cells are
2. Classify organisms as either unicellular or multicellular
3. State the levels of organization in multicellular organisms and describe how they are related to each other

Core Activities

- Use analogies to describe what cells are
- Identify some basic features of cells
- Classify organisms as unicellular or multicellular
- Summarize the relationship between some of the levels of biological organization
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

1.2 Extension: Sizes of cells

45–60 minutes

Explore the sizes of cells compared to familiar objects.

Learning Goals

1. Describe the sizes of cells compared to other small objects
2. Convert between units of measurement, including micrometres and nanometres

Core Activities

- Use an interactive diagram to compare the sizes of various small things
- Calculate the sizes of objects in millimetres, micrometres and nanometres
- Reflect on their learning using the *very important points reflection strategy*

1.3 Lesson: Introduction to microscopes

60–90 minutes

Introduce students to light microscopes and their use.

VIDEO | INTERACTIVE

Learning Goals

1. Distinguish between the main types of microscope
2. Identify the parts of a light microscope
3. Describe how to use and handle a microscope safely

Core Activities

- Compare different types of microscopes and decide which one is most appropriate for a given purpose
- Use a simulation to explore the parts of a compound light microscope and learn how to use it
- Label the parts of a microscope, uploading a picture of the specific microscope to be used in following classes
- Watch a video to learn about proper microscope handling
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

1.4 Practical activity: Using a microscope

45–60 minutes

Teach basic microscope skills.

INTERACTIVE | MATERIALS REQUIRED

Learning Goals

1. Describe how a specimen's orientation appears under the microscope
2. Draw and describe how some everyday objects appear under the microscope

Core Activities

- View a range of images of everyday objects magnified using electron microscopes
- Revise microscope safety and handling
- View the letter "e" under the microscope using the predict–observe–explain method
- Compare the differences between salt and sugar under a microscope
- Observe other specimens of their choosing under a microscope, using different magnifications
- Reflect on their learning using the *very important points reflection strategy*

1.5 Practical activity: Measuring with microscopes

45–60 minutes

Use a microscope's field of view to measure the size of a specimen.

MATERIALS REQUIRED

Learning Goals

1. Calculate the sizes of very small objects using a microscope

Core Activities

- Practise calculating the length of an object relative to a larger object
- Measure the field of view of their microscopes
- Calculate the sizes of specimens in millimetres and micrometres
- Draw specimens in proportion to the field of view
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

1.6 Extension: Cell theory

45–60 minutes

Introduce cell theory, and the importance of collaboration and technology for scientific progress.

VIDEO

Learning Goals

1. Summarize cell theory
2. Describe how the development of cell theory depended on technology and collaboration

Core Activities

- Learn about the idea of spontaneous generation as a failed scientific theory
- Watch a video that summarizes the development of cell theory and the scientists who contributed to it
- Summarize their understanding of cell theory by completing comic strip cloze activities
- Analyze the factors that influenced the development of cell theory
- Reflect on their learning using a variation of the *headlines visible thinking routine*

2.1 Lesson: Parts of a cell

90–120 minutes

Introduce the structures and functions of the main organelles.

VR | AR | INTERACTIVE

Learning Goals

1. Identify the main parts of a plant cell
2. Describe the functions of these parts

Core Activities

- Use an interactive to learn about the basic parts of a plant cell
- Colour and label a plant cell, then turn it into an augmented reality 3D model
- Take a 360° video or virtual reality journey through a plant cell
- Summarize the structure and function of cell organelles
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

2.2 Lesson: Animal vs. plant cells

30–45 minutes

Compare the different features and functions of plant and animal cells.

INTERACTIVE

Learning Goals

1. Describe the differences between plant cells and animal cells

Core Activities

- Consider the different abilities and needs of plants and animals
- Use an interactive to build a simple animal cell
- Compare and contrast plant and animal cells
- Use an interactive to try distinguishing animal and plant cells under the microscope
- Reflect on their learning using the *I used to think, but now I think visible thinking routine*

2.3 Practical activity: Make a cell model

100–120 minutes

Build a physical model of a plant or animal cell, or create an analogy to illustrate the functions of the parts of a cell.

MATERIALS REQUIRED | POSTER

Learning Goals

1. Distinguish between an animal and a plant cell
2. Construct a visual representation of parts of a cell and/or recall their function

Core Activities

- Design and build a physical model of a plant or animal cell
- Label each part of the cell and explain its function
- Alternative or extension activity: create an analogy to describe the function of a cell
- Reflect on their learning by identifying what they did well and what they can improve on

2.4 Lesson: Cells under the microscope

45–60 minutes

Introduce students to the rules of scientific drawing.

Learning Goals

1. Apply the rules of scientific drawing and identify when they have been broken

Core Activities

- Identify breaches of the rules of scientific drawing
- Practise drawing and labelling their observations of cells
- Compare a cell diagram with an electron micrograph of a cell
- Improve on their earlier drawing of a cell
- Reflect on their learning using the *very important points reflection strategy*

2.5 Practical activity: Observing plant and animal cells

100–120 minutes

Compare and contrast plant and animal cells using a microscope.

MATERIALS REQUIRED

Learning Goals

1. Use a microscope to observe and draw plant and animal cells
2. Describe similarities and differences between plant and animal cells

Core Activities

- Predict how the unique structures of plant cells might allow them to be identified under the microscope
- Observe and draw a plant cell and an animal cell using a microscope
- Describe some of the structural differences between plant and animal cells
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

3.1 Lesson: Specialized cells

30–45 minutes

Introduce the idea of cell specialization and explore common examples.

Learning Goals

1. Explain what specialized cells are using the words "structure" and "function"
2. Identify and describe some specialized cells in animals and plants

Core Activities

- Identify and describe a range of specialized animal and plant cells
- Research some specialized cells in humans
- Relate the structures of specialized cells to their functions
- Reflect on their learning using a variation of the *headlines visible thinking routine*

3.2 Project: Putting cells to work

100–120 minutes

Apply knowledge of specialized cells to a creative task.

Learning Goals

1. Explain one type of specialized cell, its appearance, structure, function and its role as part of a system

Core Activities

- Prepare a résumé for a specialized cell

3.3 Extension: Cell biology and Aboriginal art

45–60 minutes (plus the time needed to create a piece of art, which can be completed at home)

Examine patterns in nature and in Australian Aboriginal art.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Describe some common patterns in cells and tissues
2. Relate the patterns in tissues and those in Australian Aboriginal art

Core Activities

- Explore and identify patterns in cell biology and nature
- Compare patterns in nature with those found in works of Australian Aboriginal art
- Create new artistic representations of cells and tissues

3.4 Extension: Mythbusters – Cell division

45–60 minutes

Explain the role of cell division in growth and reproduction.

VIDEO

Learning Goals

1. Describe the basic process of cell division
2. Explain why cell division is important

Core Activities

- Participate in class polls that aim to target common misconceptions about cell division
- Describe cell division in simple terms
- Explore how cell division quickly increases the number of cells
- Discuss the role of mitosis in growth and repair
- Reflect on their learning using the *I used to think, but now I think visible thinking routine*

4.1 Lesson: Science and society

60 minutes (+ 1 week of student preparation)

Extend students' understanding of the potential social impact of cultured meat.

MATERIALS REQUIRED

Learning Goals

1. Describe some of the risks and benefits of cultured meat, as viewed from different perspectives

Core Activities

- Research the perspective of a stakeholder on the issue of cultured meat
- Participate in a Socratic seminar (student-led discussion forum) to explore issues around cultured meat
- Give and receive peer-peer feedback about their participation in the seminar

4.2 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Thomas King.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video in which Food Frontier Executive Director Thomas King discusses his work in relation to the food movement
- Reply to short answer questions in response to the video

Plant Cells

Deadly plants

The Bornean pitcher plant sets a cunning trap for its prey. But unlike most pitcher plants, it doesn't snack – it feasts! Their specialized cells make them true masters of ambush. Capture your students' attention with this unique take on the variety of life.

stileapp.com/go/plant-cells

The big ideas covered in this unit are:

- How are leaf cells organized to support photosynthesis?
- How are root cells specialized for gathering nutrients?
- How are carnivorous plants specially adapted for trapping prey?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	25–35 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

40–50 minutes

Examine how some plants are designed to catch more ants than others.

Learning Goals

1. Distinguish between plant cells and animal cells

Core Activities

- Read about the specific example of how pitcher plants trap prey
- Participate in a class brainstorm to identify ways in which plants are different to animals
- Complete an interactive about animal and plant organelles and identify their prior knowledge

1.1 Lesson: Leaf structure

90–120 minutes

Understand some key structures for photosynthesis and recognize some specialized plant cells.

VIDEO

Learning Goals

1. Identify the structural features of leaves that allow them to carry out photosynthesis
2. Describe how different types of epidermis cells are adapted to perform different functions
3. Explain how carnivorous plants are adapted to capture prey

Core Activities

- Watch a video about how sugar is made in leaf plants via photosynthesis
- Answer multiple choice, drag and drop terminology questions and summary tables in relation to the video
- Read then watch videos about the three types of epidermis cells: pavement, guard and root hair cells
- Complete labelling activities to identify the three types of epidermis cells
- Complete short answer questions in relation to epidermis cells (including a maths related question)

1.2 Lesson: Carnivorous plants

60–70 minutes

Explore the mechanisms certain carnivorous plants use to trap prey.

VIDEO

Learning Goals

1. Describe the trapping mechanisms carnivorous plants use to catch prey

Core Activities

- Read and watch a video introducing carnivorous plants and their trapping mechanisms
- Complete questions to show understanding of trapping mechanisms used by carnivorous plants
- Look at the specific example of Venus flytraps, firstly by comparing them to a bay leaf, then by applying the stages of trapping insects
- Revisit pitcher plants and hypothesize the function ridges play in defence through short answer questions with optional class discussion

1.3 Practical activity: Viewing leaf epidermis cells

100–120 minutes (double if both activities)

Design an experiment or utilize scientific skills to observe plants.

MATERIALS REQUIRED

Learning Goals

1. Make a dry impression of the epidermis cells on the underside of a leaf and observe its features under a compound light microscope
2. Draw scientific diagrams of an epidermis impression using standard conventions

Core Activities

- Make a dry impression of the epidermis cells on the underside of a leaf and observe its features under a compound light microscope
- Draw scientific diagrams of your epidermis impression using standard conventions
- Design an experiment to investigate what causes Venus flytraps to shut

Lesson: Career profile

30–45 minutes

Encourage students to think about careers in STEM by profiling artist Jessica Shepherd.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about a botanical artist, someone who studies plants by drawing detailed images of them
- Participate in a class brainstorm about ways that we depend on plants

Stem Cells

Could a new, functioning liver be grown in the lab?

There is a shortage of donated organs for transplant across the globe. Scientists are developing new technology to grow replacement organs using stem cells. Grow your students' interest in cells with this fascinating context.

stileapp.com/go/stem-cells

The big ideas covered in this unit are:

- What are stem cells?
- What are the potential uses of adult and embryonic stem cells?
- What are the ethical issues surrounding the medical use of stem cells?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: The story of a stem cell	Creative narrative story	45–60 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	15–20 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

20–30 minutes

Explore organ transplants and growing organs in a laboratory.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Be introduced to stem cells via the issue of organ donation (or lack thereof)
- Reflect on the ethical dilemma of waiting for an organ donor or accepting a lab-grown organ

1.1 Lesson: What are stem cells?

30–40 minutes

Introduce stem cells, discussing problems with their development and use.

VIDEO

Learning Goals

1. Explain what stem cells are and why they are special
2. Identify the functions and potential medical uses of adult and embryonic stem cells
3. Outline some of the ethical issues surrounding the medical use of stem cells

Core Activities

- Watch a video explaining what stem cells are
- Calculate the length of time life can be prolonged by using stem cell technology in one specific example
- Complete various short answer questions to reinforce the concept of stem cells
- Complete an interactive to consider which cell can change into other cell types

1.2 Lesson: Types of stem cells

30–45 minutes

Compare and contrast adult and embryonic stem cells, including ethical considerations.

VIDEO

Learning Goals

1. Distinguish between adult stem cells and embryonic stem cells
2. Identify arguments for and against the use of stem cells

Core Activities

- Watch a video introducing the different types of stem cells
- Use information from the video to compare adult stem cells and embryonic stem cells
- Reflect via a series of short answer questions on the controversy and ethical dilemmas around stem cell research

1.3 Project: The story of a stem cell

45–60 minutes

Apply students' understanding of stem cells' differentiation.

Learning Goals

1. Describe how a stem cell can change to become a specialized cell
2. Identify the role the new cell plays in helping the individual

Core Activities

- Write a creative narrative in the first person about the life journey of a stem cell using four prompt questions to help plan ideas

Lesson: Career profile

20–30 minutes

Encourage students to think about careers in STEM by profiling molecular biologist Rebecca Lim.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about a molecular biologist who is using stem cells to help save babies and pregnant mothers
- Use the internet to research another molecular biologist's work

Reproduction

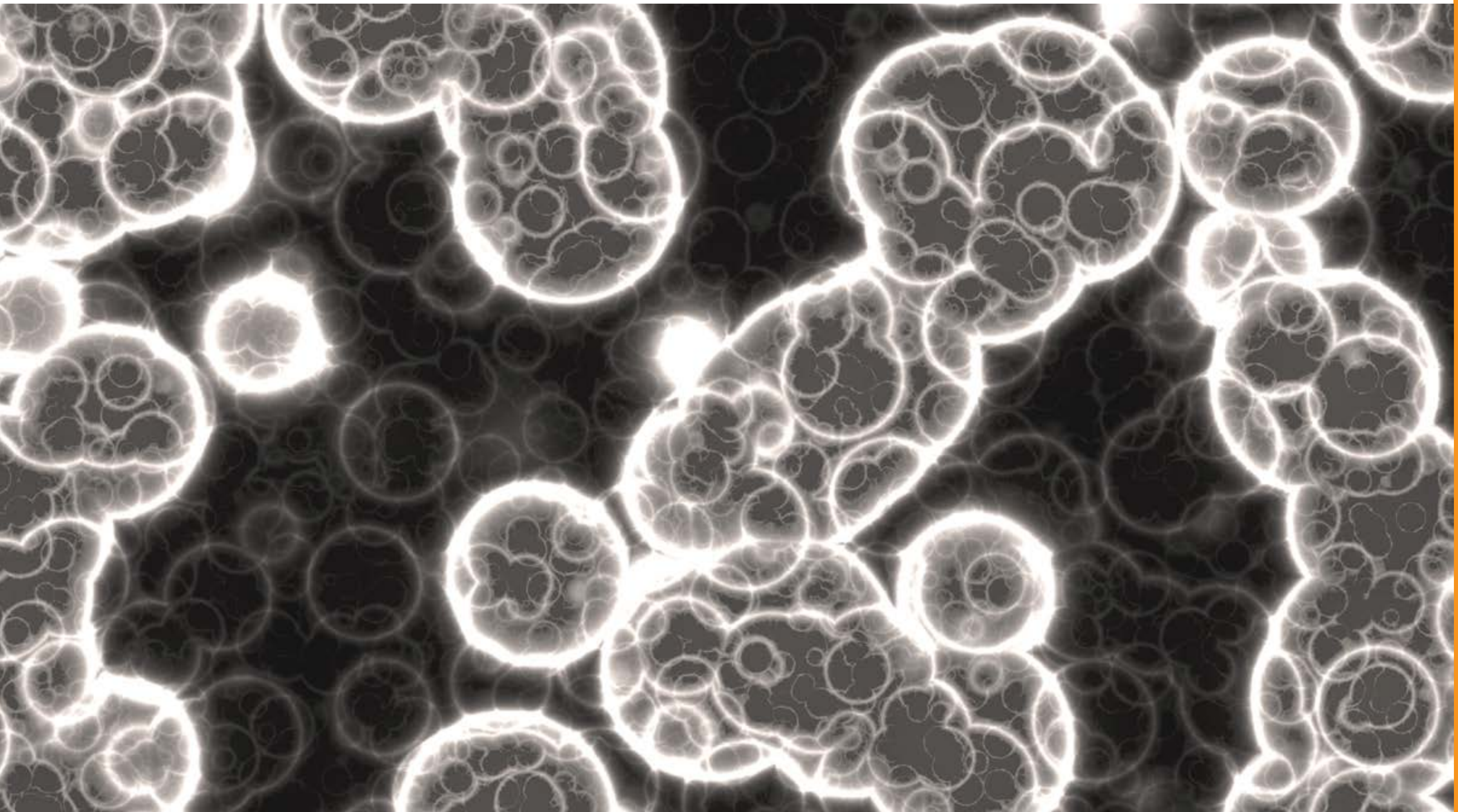
Which was the first species to have sex?

Organisms reproduce in all sorts of weird and wonderful ways. Scientists recently discovered which species was the first to have sexual intercourse, setting the pattern for many species up to the present. Explore the process of reproduction through this context and compare the reproduction habits of different organisms.

stileapp.com/go/reproduction

The big ideas covered in this unit are:

- What is the difference between sexual and asexual reproduction?
- What are some different types of asexual reproduction?
- Do parents always care for their offspring?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Imagine an asexual world	200- to 250-word essay	45–60 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Introduce some of the different ways animals can have sex.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about the first instance of sexual intercourse which occurred in now-extinct fish and watch an animation of this occurring
- Reflect on prior knowledge of sexual and asexual reproduction by participating in a class poll

1.1 Lesson: Sexual reproduction

45–60 minutes

Compare and contrast sexual and asexual reproduction.

VIDEO

Learning Goals

1. Distinguish between sexual and asexual reproduction
2. Identify the different types of asexual reproduction and describe how they differ from one another
3. Describe some of the advantages and disadvantages of reproducing sexually and asexually

Core Activities

- Watch a video and read a passage of text explaining sexual reproduction
- Write their own definition of sexual reproduction with an option for class discussion
- Participate in a class brainstorm to identify organisms that reproduce sexually
- Complete questions to reinforce understanding of gametes and fertilizations
- Watch a video explaining asexual reproduction
- Write their own definition of asexual reproduction
- Revise the three types of asexual reproduction in a drag-and-drop interactive

1.2 Lesson: Asexual reproduction

30–45 minutes

Provide a cross-curricula study of reproduction.

Learning Goals

1. Apply simple arithmetic to calculate various data points
2. Effectively assess and compare various organisms' life cycles

Core Activities

- Read fun facts about the dark fishing spider
- Complete simple math calculations regarding the dark fishing spider
- Complete a table that helps to compare different organisms' life cycles
- Think about advantages and disadvantages in relation to sexual and asexual reproduction

1.3 Project: Imagine an asexual world

45–60 minutes

Creatively apply knowledge of sexual and asexual reproduction.

Learning Goals

1. Formulate a stance on the importance of asexual versus sexual reproduction

Core Activities

- Write a 200- to 250-word essay in response to the question “If there were only asexual reproduction, how would this affect the world as we know it?”

Lesson: Career profile

15–20 minutes

Encourage students to think about careers in STEM by profiling Simona Kralj-Fišer.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people’s lives and generate career opportunities

Core Activities

- Read about what led one scientist to become a biologist specialising in the mating behaviour of nephilid spiders
- Think about what they enjoy doing and how science is involved in this

Healthy Eating

What if we still ate like cavemen?

Compared to Palaeolithic humans, most modern humans enjoy a vast range of foods. Adopters of the Paleo diet claim that the human digestive system hasn't evolved to keep up with our modern diet. But new research shows it's time to axe that theory.

stileapp.com/go/healthy-eating

The big ideas covered in this unit are:

- What did humans eat 20,000 years ago?
- What makes you feel hungry and full?
- What is a food pyramid?
- Why do we enjoy junk food so much?
- How has farming changed our diets?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Healthy eating campaign	Research ads, script and storyboard a healthy eating television ad (optional) produce their own ad	100–120 minutes (minimum)	Teacher reviewed
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students with the topic by examining the Paleo diet.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about issues to do with the Paleo diet
- Imagine what living 20,000 years ago would be like

1.1 Lesson: Why do we feel hunger?

45–60 minutes

Examine the reasons behind we feel full versus hungry, and the food pyramids.

VIDEO

Learning Goals

1. Describe the mechanisms responsible for making you feel hungry or full
2. Explain what typical food pyramids represent and describe how "Paleo" food pyramids are different
3. Explain why we enjoy eating junk foods so much

Core Activities

- Watch an ASAP science video explaining our desire to eat, the hunger regulation system, and the role of fat and sugar in this
- Complete multiple choice questions and a labelling interactive to reinforce concepts in the video
- Participate in a class brainstorm and discussion about the video's main message
- Read and explore a typical food pyramid and search the internet for examples of a Paleo food pyramid
- Compare and contrast the similarities and differences between a typical food pyramid and Paleo food pyramid

1.2 Lesson: Food pyramids

45–60 minutes

Encourage students to reflect on nutrition and diet.

Learning Goals

1. Reflect and compare your diet with a standard food pyramid
2. Understand the reason behind our craving for fatty and sugary foods
3. Explain the influence farming has on the appearance of some common fruit and vegetables

Core Activities

- List the food and drinks they have consumed in the previous week and categorize these into food groups
- Construct a food pyramid based on their food and drink record above
- Reflect on how their food pyramid compares to that of a typical food pyramid
- Hypothesize the role of taste buds in keeping us healthy
- Look at the role farming has had on the evolution of specific examples of food
- Make a calculation to compare the amount of sugarcane you would eat to sugar in a soft drink

1.3 Project: Healthy eating campaign

100–120 minutes minimum

Make an argument about healthy eating in a creative way.

Learning Goals

1. Reflect on what is considered healthy eating
2. Identify examples of advertisements that promote healthy eating and possible reasons for their success
3. Brainstorm, script, storyboard and produce an ad on healthy eating

Core Activities

- Research three YouTube ads that promote healthy eating
- Brainstorm ideas for their own ad
- Script and storyboard their healthy eating television ad
- (Optional) produce their own ad

Lesson: Career profile

15–20 minutes

Encourage students to think about careers in STEM by profiling dietician Therese O'Sullivan.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Therese O'Sullivan's work as a dietician and food researcher, and her findings about food groups
- Reflect on their breakfast based on Therese's recommendations

Body Systems

What does it take to be a cold-blooded killer?

Until recently, scientists thought that boa constrictors killed their prey through suffocation, but a new study suggests it’s another body system that fails. Students snake their way through this unit to uncover this exciting discovery, and compare the body systems of humans with those of other animals.

stileapp.com/go/body-systems

The big ideas covered in this unit are:

- What is the digestive system and how does it work?
- What is the respiratory system and how does it work?
- What is the circulatory system and how does it work?
- How do human body systems compare to systems in other species?
- What is thermoregulation?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: The digestive system	Multiple choice questions	10–15 minutes	Automatic
2.2 Quiz: The respiratory system	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: The circulatory system	Multiple choice questions	10–15 minutes	Automatic
4.1 Quiz: Systems in other species	Multiple choice questions	10–15 minutes	Automatic
5.1 Quiz: Thermoregulation	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	30–40 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30–45 minutes

Examine how boa constrictors kill their prey.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read and watch a video about how boa constrictors use the method of constriction to kill their prey
- Vote in various class polls about different things to do with body systems
- Complete a class brainstorm of all the different body systems that they have heard of

1.1 Lesson: The digestive system

90–120 minutes

Explore the digestive system and the mechanisms related to nutrient adsorption.

VIDEO

Learning Goals

1. Describe the pathway that food takes through the digestive tract and what happens on the way
2. Describe the difference between physical and chemical digestion
3. Explain the function of villi in the intestines for absorption of nutrients

Core Activities

- Complete a class brainstorm of all the parts of the digestive system that they have heard of
- Watch a video explaining the digestive system
- Read about the differences between physical and chemical digestion and the role of villi in absorption of nutrients
- Reinforce concepts in the reading and video by completing multiple choice and short answer questions
- Complete an interactive drag-and-drop of the human digestive system and physical versus chemical digestion
- Utilize information in the interactive, provided table and diagrams to infer answers to questions

1.2 Project: Vultures vs. koalas

45–60 minutes

Compare and contrast the digestive system of koalas, vultures and humans.

VIDEO

Learning Goals

1. Describe some differences and/or similarities in the digestion of food for koalas versus vultures versus humans

Core Activities

- Watch videos exploring the digestive system of vultures and then koalas
- Complete questions in response to the videos
- Analyze the bacteria within the digestive system of vultures, koalas and humans
- Extrapolate information from the graph of Clostridium to answer questions
- Compare the length of the digestive tracts of vultures, koalas and humans

2.1 Practical activity: Make a model lung

60–70 minutes

Use a 3D model of the lung to explore respiration.

MATERIALS REQUIRED

Learning Goals

1. Model the process of breathing and respiration

Core Activities

- Make a model lung from balloons and plastic bottles
- Simulate what happens during breathing and relate the model to the organs that make up the respiratory system
- Assess how well the model demonstrates human breathing

2.2 Lesson: The respiratory system

90–120 minutes

Introduce the mechanisms behind breathing and respiration.

VIDEO SIMULATION

Learning Goals

1. Describe the main components of the respiratory system and their functions
2. Identify the muscle movements that make us breathe
3. Explain how oxygen and carbon dioxide move from the air into the bloodstream

Core Activities

- Watch a video summarizing the respiratory system
- Complete multiple choice questions in relation to the video
- Complete an interactive drag-and-drop labelling the organs involved in the respiratory system and their main functions
- Complete a simulation of the breathing process and the pivotal role the skeletal system plays in this
- Watch a video explaining gas exchange and complete questions to reinforce concepts in the video
- Complete an interactive labelling activity on gas exchange
- Read, explore and hypothesize the shape of alveoli in relation to emphysema
- Create an advertising poster for an anti-smoking campaign

3.1 Lesson: The circulatory system

90–120 minutes

Examine the circulatory system, and how it works with other body systems.

VIDEO

Learning Goals

1. Identify the main functions of the circulatory system
2. Describe the roles of the blood, blood vessels and heart
3. Explain how the circulatory system interacts with other body systems

Core Activities

- Complete a class brainstorm and discussion regarding their prior knowledge of the circulatory system
- Read and answer questions about the role of the circulatory system
- Watch a video that explains more about blood and blood vessels and answer questions to reinforce these concepts
- Complete an interactive drag-and-drop to label major blood vessels
- Read and watch a video on how a heart pumps oxygenated and de-oxygenated blood around the body
- Complete interactive drag-and-drops to label a diagram of the heart, to infer oxygen levels at various parts of the body, and to analyze the relationship between the circulatory, digestive and respiratory systems

3.2 Investigation: Effect of exercise on heart rate

60–90 minutes

Investigate the effects of exercise on heart rate and blood circulation.

MATERIALS REQUIRED

Learning Goals

1. Make a conclusion about the effects of low- and high-intensity exercise on heart rate and blood circulation
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables

Core Activities

- Measure their resting heart rate, as well as heart rates after performing low-intensity and high-intensity exercise
- Construct a graph of change in heart rate for high-intensity exercise compared to resting heart rate
- Account for the relationship between high-intensity exercise and increasing heart rate
- Take part in a class poll to compare variation in resting heart rate
- Complete various calculations in relation to heart rate
- Summarize the discoveries made from this investigation

4.1 Lesson: Systems in other species

60–90 minutes

Explore body systems in species other than humans.

VIDEO

Learning Goals

1. Explain why some animals don't need body systems
2. Describe the respiratory and circulatory systems of sharks and grasshoppers and compare them with human systems
3. Explain how body systems work together in different ways in different species

Core Activities

- Watch a video and read about how sponges get oxygen and nutrients, and answer questions to consolidate information about sponges
- Read about sharks' respiratory system and answer questions to consolidate this information
- Complete an interactive to compare the shark circulatory system to a human's and think about how the human's system is more complex than the shark's
- Watch a video and read about how grasshoppers "breathe", and complete comparisons to determine how this is different to how humans breathe
- Complete a summary of differences and similarities in the respiratory and circulatory system of grasshoppers, sharks and humans

5.1 Lesson: Thermoregulation

90–120 minutes

Explore the concept of thermoregulation.

VIDEO

Learning Goals

1. Explain what thermoregulation is and why it is important
2. Describe the difference between endotherms and ectotherms
3. Identify general methods of thermoregulation common to different species

Core Activities

- Reflect on how they have manually thermoregulated the environment around their body
- Read about the balancing act between our metabolism and thermoregulation, and answer questions to consolidate this information
- Watch a video explaining thermoregulation in animals and complete a mind map to describe examples of thermoregulation in elephants and penguins
- Differentiate between structural and behavioural thermoregulation
- Learn about ectotherms versus endotherms via a reading, watching a video and answering questions
- Explore how evaporation, insulation and surface area are common thermoregulatory devices used by animals by looking at specific examples
- Apply their understanding of thermoregulation and utilize their creativity by designing an animal for a specific environment

6.1 Lesson: Science and society

45–60 minutes

Explore the career of Todd Gallo, a respiratory therapist, and the controversial issue of vaping.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Assess the pros and cons of vaping

Core Activities

- Watch a video about Todd Gallo, a respiratory therapist who started work in construction
- Reflect on what helped Todd to change careers, what careers are related to Todd's, and think about what career in medicine and nursing they would like
- Explore the issue of nicotine vaping by reading, taking part in a class poll, discussing in class and brainstorming
- Reflect on how they have or have not changed their stance since starting to look at this issue

The Nervous System

Could machines sniff out cancers better than dogs?

Dogs have an amazing sense of smell that can detect cancers and other diseases. Now this ability is inspiring scientists to develop electronic detectors that could save lives. By learning how these devices work, students are introduced to the organization and basic functions of the human nervous system.

stileapp.com/go/NervousSystem

The big ideas covered in this unit are:

- How does the sense of smell work?
- What is the nervous system and its main parts?
- What are neurons?
- What are the different types of sensory receptors?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Introduce the topic through the example of sniffer dogs.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm and discuss ways in which animals are used to detect smell

1.1 Lesson: Parts of the nervous system

45–60 minutes

Examine the nervous system and its components.

VIDEO

Learning Goals

1. Describe the signal pathway involved in smell
2. Distinguish between the central and peripheral nervous systems, and different types of receptors
3. Describe the main features of neurons

Core Activities

- Explain the connection between smell and memory
- Infer how having a cold affects sense of smell and taste
- Identify the receptors and typical response for a range of common stimuli
- Label a neuron

1.2 Lesson: Stimulus-response pathways

45–60 minutes

Explore the role of synapses.

VIDEO

Learning Goals

1. Construct stimulus-response flow charts for given examples
2. Explain synapses

Core Activities

- Consider the accuracy of sniffer dogs
- Complete stimulus-response flow charts for a range of examples
- Research and report on synapses and their involvement in the nervous system

1.3 Investigation: Taste and smell

45–60 minutes

Conduct an experiment on smell and taste.

MATERIALS REQUIRED

Learning Goals

1. Distinguish between the role of smell and taste when eating food

Core Activities

- Conduct a simple experiment
- Record and interpret the results
- Connect the results to what they know about smell and taste receptors

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Claire Guest.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Engage with the story of Claire Guest
- Brainstorm and discuss what special considerations would need to be taken into account when working with animals

The Endocrine System

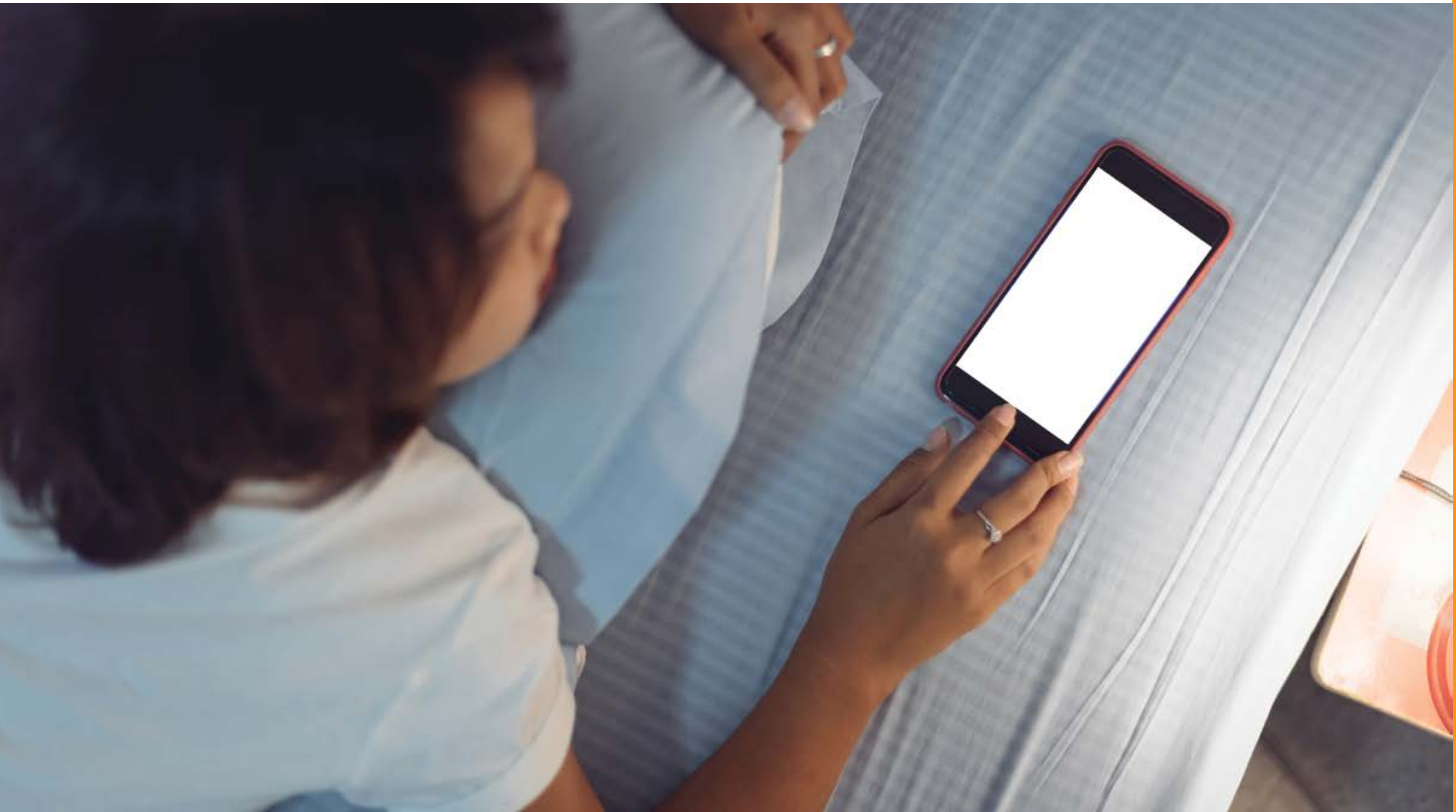
Will staring at your phone screen before bed affect your sleep?

New research stresses the importance of darkness for a good night's sleep. Light up your students' minds, as they explore the endocrine system through this relevant and real-world context.

stileapp.com/go/EndocrineSystem

The big ideas covered in this unit are:

- What are hormones and how do they work?
- Where are the main glands in the endocrine system?
- Why is homeostasis important?
- What are negative feedback loops?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Hormone disorders	Research project	60–90 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine melatonin release and its effect on sleep.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Use an interactive diagram to show the timing of melatonin release in adults and teenagers
- Consider their own sleep patterns and discuss how the school day could be shifted to better align with the sleep patterns of teenagers

1.1 Lesson: Hormones

45–60 minutes

Explain what hormones are.

VIDEO

Learning Goals

1. Explain what hormones are and what their role is in our bodies
2. Identify some of the main glands in the endocrine system and their targets
3. Explain what homeostasis is using control of blood glucose levels as an example

Core Activities

- Define a hormone
- Compare nerve signals with hormonal signals
- Explain the connection between the endocrine and circulatory system
- Label the major glands in the human body
- Understand the effects major hormones have within the human body
- Explain the role of hormone receptors in ensuring a hormone targets the correct area of the body

1.2 Lesson: Homeostasis

45–60 minutes

Explain homeostasis.

Learning Goals

1. Define homeostasis and explain why it is important

Core Activities

- Interpret a blood-glucose graph of a healthy person and a diabetic person
- Explain the role of insulin and glucagon in the body
- Complete a feedback flow chart of blood-glucose regulation
- Identify and explain negative and positive feedback loops

1.3 Project: Hormone disorders

60–90 minutes

Investigate a range of common hormone disorders.

Learning Goals

1. Investigate a common hormone disorder
2. Identify the hormones involved, symptoms and causes of common hormone disorders

Core Activities

- Research a chosen hormone disorder
- Identify the hormones involved, the symptoms and causes of their chosen disorder
- Creatively present their findings

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Satchin Panda.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Engage with the research Satchin Panda is conducting on sleep patterns
- Brainstorm where they would look to discover something new to humanity and justify their answer

The Immune System

How can we fight back against deadly diseases?

The recent Ebola outbreak in West Africa sparked fear around the world and spurred on the search for a vaccine. This search relied on an understanding of what causes diseases and how our bodies fight back. Arm your students with potentially life-saving knowledge about the immune system.

stileapp.com/go/immunesystem

The big ideas covered in this unit are:

- What are pathogens, what are their different types, and how do they cause infectious diseases?
- How do our bodies protect us from pathogens?
- When is fever helpful?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Engineering challenge: Stop the spread	Design, build and test a simple hand sanitizer device.	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine the 2014 Ebola outbreak.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm and discuss factors that could be responsible for the emergence or re-emergence of a disease

1.1 Lesson: Pathogens and the innate immune system

45–60 minutes

Explain pathogens and four ways the body fights infection.

VIDEO

Learning Goals

1. Describe the different types of pathogens that cause infectious diseases
2. Explain how skin, phagocytes, inflammation and fever help protect the body from infection
3. Compare how Ebola and malaria spread through a population

Core Activities

- Match pathogens with the infectious diseases they cause
- Explain how the skin protects the body from infection
- Explain the process of phagocytosis
- Compare, using a diagram, a normal blood vessel to an inflamed blood vessel and explain the differences
- Graph the rise in body temperature in the 12 hours following a viral infection and interpret the results

1.2 Lesson: The Ebola virus

45–60 minutes

Explain the Ebola virus and evaluate its impact.

VIDEO

Learning Goals

1. Explain how Ebola attacks the body
2. Evaluate the death toll from the latest Ebola outbreak
3. Evaluate the importance of the media coverage of Ebola

Core Activities

- Vote on which infectious disease (Ebola or malaria) should receive more media attention
- Calculate and interpret the death toll statistics for the 2014 Ebola outbreak
- Reconsider their initial vote and re-vote
- Explain the role journalists have in covering the outbreak of infectious diseases
- Consider the benefits and limitations of using social media as a source of information

1.3 Investigation: Microbe response to fever

60–90 minutes

Model the microbe response to fever.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Analyze trends in data to describe relationships between variables
3. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Plan, conduct and evaluate an experiment to investigate the microbe response to fever

Engineering challenge: Stop the spread

180–240 minutes

Design, build and test a simple hand sanitizer device.

MATERIALS REQUIRED

Learning Goals

1. Design and build a simple hand sanitizer
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design, build and test a simple hand sanitizer
- Evaluate their design and suggest improvements

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling an immunologist.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Examine the career of an immunologist and understand what they do on a daily basis
- Consider what aspects of the job they would enjoy the most and least

Vaccination

No jab, no play... What are the facts about vaccination?

Vaccination has proved to be highly effective in treating infectious diseases and preventing their spread. Despite this success, some people continue to doubt the value of vaccines. A recent study has shown that simply giving them the facts is unlikely to change their minds. Inject your students with the science behind this public health issue.

stileapp.com/go/Vaccination

The big ideas covered in this unit are:

- What are vaccines and how do they work?
- What are pathogens?
- What effect does vaccination have on the spread of infections?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Explore differing views of vaccination.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Consider how they would advise a concerned parent about vaccinating their child
- Brainstorm diseases they have heard of there being a vaccine for

1.1 Lesson: What are vaccines?

45–60 minutes

Explain what a vaccine is.

VIDEO

Learning Goals

1. Describe what a vaccine is and how it can prevent illness
2. Outline the effect of vaccinations on the spread of infection
3. Discuss factors that countries need to consider in setting up vaccination programs

Core Activities

- Explain the term "pathogen"
- Summarize how a vaccine works to protect the body from a pathogen
- Describe the body's typical pathogen immune response without the use of a vaccine
- Research and explain why some vaccines require a booster shot
- Use a diagram to contrast viruses and bacteria
- Research a chosen vaccine

1.2 Lesson: Vaccination around the world

45–60 minutes

Examine the global effects of vaccination.

VIDEO

Learning Goals

1. Evaluate factors that may affect a country's vaccination program
2. Explain herd immunity and link it to the vaccination debate
3. Explain how alternative vaccination methods may impact global vaccination rates

Core Activities

- Consider factors that may affect a country's vaccination program
- Calculate the percentage decrease vaccination has had on a number of diseases
- Research herd immunity and connect it to the vaccination debate
- Consider and explain what effect alternative vaccination methods could have on vaccination rates

1.3 Practical activity: Modelling the effect of vaccination

45–60 minutes

Model the effect of vaccination on the spread of disease.

MATERIALS REQUIRED

Learning Goals

1. Conduct an experiment to model the effect of vaccination on the spread of an infectious disease
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables

Core Activities

- Conduct an experiment to model the effect of vaccination on the spread of an infectious disease
- Collect and process the results
- Interpret the results to draw meaning and conclude their findings

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Danielle Stanisic.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Investigate the research of Danielle Stanisic
- Brainstorm and discuss what questions they would ask her about her research

Microbiomes

Can your microbiome keep you healthy?

It’s strange to think that each of us has an ecosystem of tiny organisms living inside our bodies. In fact, these microscopic guests outnumber our own cells by about ten-to-one and have a big impact on our day-to-day health. Zoom in with your students and discover the microscopic world that exists within us.

stileapp.com/go/microbiomes

The big ideas covered in this unit are:

- What are microbes?
- What is a microbiome and what does it do?
- What is symbiosis?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Prebiotics vs. probiotics	Written report	60–90 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explore how microbes living in the gut affect health.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Learn about scientific research into gut bacteria
- Estimate how long it takes for food to travel through the digestive system

1.1 Lesson: Microbes and the microbiome

45–60 minutes

Explain what microbiomes are.

VIDEO

Learning Goals

1. Describe what microbiomes are and give examples of different types
2. Explain how the gut microbiome plays an important role in our bodies

Core Activities

- Identify and label the main parts of the human digestive system
- Define the terms: microbe, microbiome and metabolic disease
- Calculate how many micrometres are in one metre to understand the size of a microbe
- Compare the size of common microbes
- State the six main roles of the microbiome

1.2 Lesson: Keeping the microbiome healthy

45–60 minutes

Explain symbiotic relationships using examples of gut microbes.

Learning Goals

1. Describe the different types of symbiotic relationships
2. Discuss what nutrients and conditions the microbes in the gut need to stay healthy

Core Activities

- Identify and classify examples of symbiotic relationships
- Research and brainstorm what nutrients and conditions the microbes in the human gut require to be healthy

1.3 Project: Prebiotics vs. probiotics

60–90 minutes

Explore the role of probiotics and prebiotics in gut health.

Learning Goals

1. Investigate probiotics and prebiotics

Core Activities

- Research probiotics and prebiotics
- Report on a given scenario

Lesson: Career profile

15–30 minutes

Encourage students to think about careers in STEM by profiling Dr Norman Swan.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Write a short newspaper piece describing the microbiome and its role in human health

Genetics

How can genes increase the risk of cancer?

In a book, small changes in the way the words are put together can change how the story unfolds – little changes can have big effects. The same applies to DNA. Unravel the mysteries of how DNA controls body development and function.

stileapp.com/go/genetics

The big ideas covered in this unit are:

- What are DNA and genes, and how do they help make you, you?
- What is the structure of DNA and why does the order of bases matter?
- How does mitosis allow our bodies to grow and repair themselves?
- How does meiosis produce sex cells for reproduction?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
2.2 Project: Cancer cells	Research and poster presentation	45–60 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Explore the BRCA2 gene and its link to breast cancer.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read an article about a genetic mutation that increases the risk of cancer
- Answer true/false questions that target common misconceptions
- Participate in a live poll about whether genetic mutations are always harmful

1.1 Lesson: DNA and genes

45–60 minutes

Introduce DNA and its role within the body.

VIDEO

Learning Goals

1. Explain how DNA relates to structure and function in an organism
2. Describe the structure of DNA and how the four bases fit together
3. Explain what genes are

Core Activities

- Watch a video that introduces DNA and its role in living things
- Examine the structure of the DNA molecule and how base pairs join together
- Watch a video about genes and consolidate their understanding of DNA as containing genetic information
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.2 Extension: The genetic code

30–45 minutes

Explain how DNA is used to build proteins.

VIDEO

Learning Goals

1. Define what codons are and give examples
2. Relate amino acids to codons in the genetic code

Core Activities

- Watch a video explaining how proteins are built out of amino acids
- Learn about codons and work out how many possible codons there are
- Use a codon wheel to see how the genetic code picks out particular amino acids for protein synthesis
- Reflect on their learning by completing the *headlines visible thinking routine*

1.3 Extension: Mutations

30–45 minutes

Consider how point mutations change DNA sequences.

VIDEO

Learning Goals

1. Identify the three types of point mutation
2. Use a codon wheel to analyze the effects of mutations

Core Activities

- Watch a short video introducing point mutations and frameshifts
- Analyze examples of point mutations using a codon wheel
- Reflect on the human impact of DNA mutations by considering the example of haemochromatosis from the perspective of someone who carries this mutation

1.4 Practical activity: Extracting DNA

45–60 minutes

Extract DNA from strawberries.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Investigate DNA through the extraction of DNA from strawberries

Core Activities

- Revise their understanding of the role of DNA
- Watch a short video explaining how to extract DNA from strawberries
- Extract DNA for themselves
- Answer some short discussion questions

2.1 Lesson: Mitosis

45–60 minutes

Explain and describe the stages of mitosis.

VIDEO

Learning Goals

1. Describe the importance of cell division for growth and repair
2. Identify the stages of mitosis

Core Activities

- Examine the role of mitosis and the cell cycle in increasing the number of cells in the body
- Learn how chromosomes are copied during interphase
- Watch a video describing the stages of mitosis
- Reflect on their learning using the *I used to think, but now I think visible thinking routine*

2.2 Project: Cancer cells

45–60 minutes

Explain how cell division is related to cancer.

VIDEO

Learning Goals

1. Investigate how mitosis is related to cancer

Core Activities

- Watch a video that explains what happens when cells divide out of control
- Design a WANTED poster summarizing information about one particular type of cancer cell

2.3 Lesson: Meiosis

60–75 minutes

Explain and describe the main stages of meiosis.

VIDEO

Learning Goals

1. Describe how sex cells are different from other cells in the body
2. Explain how sex cells are produced by meiosis

Core Activities

- Read about the role of sex cells (gametes) in fertilization and sexual reproduction
- Learn how the 46 human chromosomes are organized into homologous pairs and sex chromosomes
- Be introduced to meiosis and how it is different to mitosis
- Watch a video describing the stages of meiosis
- Complete a diagram depicting the stages of meiosis
- Optional extension: watch a video explaining why hybrid organisms, such as mules, can't reproduce
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

3.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Nancy Cohen.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video featuring a genetic counsellor explaining her job
- Reflect on whether or not they would personally undergo genetic testing to discover if their DNA puts them at higher risk of particular diseases

Simple Inheritance

Who's queen bee?

A queen bee looks and behaves very differently from her daughters and the worker bees that swarm around her hive. This is because of a complex interaction between her genes and the environment in which she was raised. Uncover the latest buzz about simple inheritance.

stileapp.com/go/SimpleInheritance

The big ideas covered in this unit are:

- Why do some traits skip a generation?
- What is the difference between your genotype and your phenotype?
- How do geneticists study inheritance patterns in humans?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Construct a family tree	Draw a pedigree chart	30–45 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explain how queen bees are different from worker bees.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Upload a photo and use it to decide which physical features they share with other family members
- Describe their traits and how they are related to the family members who share them

1.1 Lesson: Types of inheritance

45–60 minutes

Explain simple inheritance patterns.

VIDEO

Learning Goals

1. Use the distinction between dominant and recessive traits to explain why some traits skip a generation
2. Distinguish between genotype and phenotype
3. Use pedigrees to analyze simple inheritance patterns

Core Activities

- Watch a video explaining how Mendel's pea plant experiment helped us to explain genetics
- Read about dominant and recessive traits, what a phenotype is and how it is determined in part by an organism's genotype
- Be introduced to homozygous and heterozygous genotypes and distinguish between them

1.2 Lesson: Pedigrees

45–60 minutes

Explain how traits can be tracked using a pedigree.

VIDEO

Learning Goals

1. Understand the purpose of a pedigree and how it can be used to track genes within a family
2. Interpret a given pedigree
3. Predict the genetic outcomes possible from a cross between two known parents

Core Activities

- Read about how human genetics can be studied through the construction of a pedigree
- Learn how a pedigree is constructed
- Watch a video explaining how a pedigree is used
- Use inference to track the trait of albinism through a pedigree, identifying the genotypes of particular individuals
- Predict the chance an offspring of two known parents will possess a given trait

1.3 Project: Construct a family tree

30–45 minutes

Construct a family tree.

Learning Goals

1. Construct a family tree

Core Activities

- Construct a family tree of either their own family, or a fictional family given

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Emily Remnant.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about the career path of Emily Remnant
- Consider what animal they would study if they were to become a biologist and what this would involve

Evolution

What do Mexican short-tailed bats and military submarines have in common?

The answer is that both use "sonar jamming" to gain an advantage over rivals. But while humans used science and engineering to develop sonar technology, bats evolved theirs in their own bodies over millions of years. Hang around and explore how evolution has allowed this to happen.

stileapp.com/go/evolution

The big ideas covered in this unit are:

- What is genetic variation, and why is it important in evolution?
- What is natural selection?
- How do variation and natural selection lead to the emergence of new species?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explore how moths have evolved to jam bat radars.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Create a brainstorm of all existing knowledge linked to the topic of evolution

1.1 Lesson: Genetic variation and natural selection

45–60 minutes

Explain mutation and natural selection.

VIDEO SIMULATION

Learning Goals

1. Describe the source of genetic variation within a population
2. Explain how evolution depends on both genetic variation and natural selection
3. Explain how competition and adaptation over many generations bring about evolution and the origin of new species

Core Activities

- Watch a video explaining what evolution is
- Vote on a poll to identify true or false statements on evolution
- Learn about how DNA mutation introduces variation into a population
- Watch a video explaining natural selection

1.2 Lesson: Competition and adaptation

45–60 minutes

Explain the process of adaption and speciation.

VIDEO

Learning Goals

1. Describe how adaptations are caused by competition within a species
2. Explain speciation using the example of polar bears and brown bears

Core Activities

- Read about how competition within a species leads to adaptations
- Model natural selection through ladybirds
- Read about how natural selection can give rise to new species
- Extension: watch a video on how bats compete for food with each other using signal jamming

1.3 Practical activity: Modelling natural selection

45–60 minutes

Use a game format to model the processes of natural selection.

MATERIALS REQUIRED

Learning Goals

1. Investigate the process of natural selection and how it contributes to speciation.

Core Activities

- Play a game to model natural selection using coloured frogs and a dice
- Collect results noting the change in frog populations over five years
- Create a graph of the results collected
- Interpret the results to draw meaning, linking key concepts of natural selection and speciation

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling animal behaviour scientist Rachel Page.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video featuring scientist Rachel Page and her work studying frog-eating bats
- Consider if they would like to do a job like Rachel's
- Reflect on their responses to questions earlier in the unit and evaluate if their thoughts have changed

Human Evolution

How well do we really know our ancient relatives?

The story of our origin as a species grows increasingly complicated as we discover new human-like ancestors. A recent discovery of 1.8 million-year-old skulls has scientists stumped about how to fit them into our family tree. Dig in to unearth the true story of our ancestors.

stileapp.com/go/humanevolution

The big ideas covered in this unit are:

- What is evolution by natural selection?
- What does the human family tree look like?
- How have humans evolved over the past 6 million years?
- What might humans look like 100,000 years from now?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Debate: Are we still evolving?	Debate	60–90 mins	Optional
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explain that human ancestors may have looked different than humans today.

Learning Goals

1. Discuss how fossils can be used as evidence of human evolution
2. Explain what a human ancestor could have looked like

Core Activities

- Read about how scientists have discovered fossils of human ancestors and that these fossils show that humans have changed over time.
- Consider how a human ancestor may have looked different to today's humans

1.1 Lesson: Hominin species

45–60 minutes

Examine human ancestors to show how we have evolved over time.

VIDEO

Learning Goals

1. Explain what evolution is and the role that natural selection plays within it
2. Describe some of what is known about a range of hominin species
3. Describe the main trends in hominin height and brain size

Core Activities

- Watch a video explaining evolution and natural selection
- Consider how genetic traits can be advantageous to a species
- Compare hominin species, including where they lived, their average height and brain size to identify how hominins have changed over time

1.2 Lesson: Brain size in hominin species

45–60 minutes

Examine changes in brain size for species of hominin, exploring possible causes.

Learning Goals

1. Discuss what selective pressure may have resulted in an increasing brain size in hominin species
2. Explain why a tree, rather than a linear timeline, is used to map human evolution
3. Formulate an opinion on why Homo floresiensis do not fit within the trends of hominin evolution

Core Activities

- Calculate relative brain size between species of hominin
- Explain possible reasons for an increasing brain size across hominin evolution
- Explain why a tree is an appropriate representation of human evolution
- Consider and explain possible reasons for why homo floresiensis does not fit within the trend of increasing brain size and height

1.3 Debate: Are we still evolving?

60–90 mins

Debate whether the human species is still evolving.

Learning Goals

1. Examine the effect of modern medicine and technology on evolution
2. Identify modern selective pressures that may not have existed in previous times
3. Construct a debate on whether or not the human species is still evolving

Core Activities

- Brainstorm ideas surrounding the question of human evolution: are humans still evolving or not?
- Work as a group to collect ideas and construct a debate for their assigned stance

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling evolutionary biologist Jeremy Austin.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about how evolutionary biologist Jeremy Austin studies ancient DNA
- Consider what species they would study if they were to become an evolutionary biologist

Ecosystems

How can we prevent plastic from harming marine life?

With millions of tonnes of plastic ending up in our oceans every year, marine ecosystems are in trouble. Plastic waste is damaging habitats and turning up in the bodies of many species, including turtles and whales. We all need to work together to solve this problem. Students will dive into this unit to explore the importance of healthy ecosystems and discover ways they can minimize their plastic impact.

stileapp.com/go/ecosystems-unit

The big ideas covered in this unit are:

- What are ecosystems?
- How do organisms interact in ecosystems?
- What is biodiversity and why is it important?
- How is plastic pollution damaging ocean ecosystems?
- What can we do to help solve the problem of plastic pollution?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: What are plastics?	Multiple choice questions	10–15 minutes	Automatic
1.4 Quiz: The chemistry of plastics	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: What are ecosystems?	Multiple choice questions	10–15 minutes	Automatic
2.4 Quiz: Relationships in ecosystems	Multiple choice questions	10–15 minutes	Automatic
2.5 Quiz: Energy transfer	Multiple choice questions	10–15 minutes	Automatic
2.6 Quiz: The cycling of matter	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: Healthy ecosystems	Multiple choice questions	10–15 minutes	Automatic
3.2 Quiz: Human impacts	Multiple choice questions	10–15 minutes	Automatic
3.5 Project: Communicate the issue	Creative project	90–120 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Engage students in the topic through the context of the impact of plastic pollution.

VIDEO | VR | SIMULATION

Learning Goals

1. Explain how plastic pollution harms marine wildlife
2. Describe how plastic waste ends up in the oceans
3. Identify some solutions to the problem of plastic pollution

Core Activities

- Watch a short 360° video and brainstorm different kinds of marine organisms
- Watch a short video that illustrates the plastic pollution problem in our oceans and reflect on the video by completing the *see, think, wonder visible thinking routine*
- Connect the problem of plastic pollution to their own actions by tracing how plastic enters the ocean
- Use an interactive to explore how plastic is transported around the ocean
- Consider what they can do to help solve the problem of plastic pollution

What do you already know?

10–20 minutes

Identify students' prior knowledge relating to food chains, food webs and ecosystems.

Learning Goals

1. Demonstrate your existing knowledge of food chains, food webs and ecosystems.

Core Activities

- Complete diagnostic activities relating to food chains and food webs

1.1 Lesson: What are plastics?

45–60 minutes

Explain how plastics are made, why they are useful and how their use has changed over time.

VIDEO | INTERACTIVE | MATERIALS REQUIRED

Learning Goals

1. Describe how plastics are made
2. Identify properties that make plastics both useful and problematic
3. Describe how our use of plastics has changed over time

Core Activities

- Answer polls that test some of their prior knowledge about plastics
- Learn in simple terms what plastics are and how they are made
- Brainstorm properties of plastics and analyze how these properties make plastics both useful and problematic
- Watch a video about the history of our plastic use and consider how the problem of plastic pollution developed
- Reflect on their learning by completing a PMI chart about plastics

1.2 Practical activity: Properties of plastics

30–45 minutes

Sort different types of plastic by their recycling numbers and observe their properties.

MATERIALS REQUIRED

Learning Goals

1. Compare the properties of different types of plastic

Core Activities

- Sort plastics by identifying their recycling numbers
- Compare the observable properties of different types of plastic
- Reflect on their learning by completing the *headlines visible thinking routine*

1.3 Practical activity: Sorting plastics by density

45–60 minutes

Sort plastics by density in order to understand how they can be separated for recycling.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Explain how density differences can be used to separate plastics for recycling
2. Describe how to recycle each type of plastic in your local area

Core Activities

- Watch a video that shows how differences in density help separate plastics for recycling
- Test the densities of different types of plastic
- Research how to recycle different types of plastic in their local area
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.4 Extension: The chemistry of plastics

45–60 minutes

Explain how the chemical structure of plastics influences their properties and whether they can be recycled.

VIDEO | SIMULATION | MATERIALS REQUIRED

Learning Goals

1. Describe the basic chemical structure of plastics
2. Explain how the structure of a polymer determines its properties
3. Compare thermosoftening and thermosetting plastics

Core Activities

- Watch a short video demonstrating an amazing property of plastics
- Watch a video that introduces the basic structure of plastics as long polymer chains
- Use an interactive to explore different monomers and the type of plastic they make
- Examine how the arrangement of polymer chains can influence the properties of plastic
- Compare thermosoftening and thermosetting plastics
- Reflect on their learning by completing the *3–2–1 bridge visible thinking routine*

1.5 Lesson: My plastic impact

20–30 minutes

Encourage students to reflect on how much plastic waste they produce.

VIDEO | SIMULATION | POSTER

Learning Goals

1. Analyze the amount of plastic waste you produce

Core Activities

- Watch a video and consider the positive and negative impacts that plastic can have
- Analyze data from a global beach clean-up
- Use an interactive to calculate the amount of plastic waste they produce in a year
- Reflect on their learning by completing the *creative questions visible thinking routine*

1.6 Lesson: Reducing your plastic impact

approx. 20 minutes

Encourage students to identify ways to minimize their individual impact on the problem of plastic waste.

VIDEO | POSTER

Learning Goals

1. Describe the 6 Rs and apply them to the problem of plastic waste
2. Identify ways to reduce your individual plastic impact

Core Activities

- Learn about the 6 Rs of sustainability and apply them to the problem of plastic waste
- Consider which of the 6 Rs is most important for tackling the problem
- Make goals for how to reduce their plastic waste using the 6 Rs and consider how to overcome potential obstacles

1.7 Engineering challenge: Cleaning our oceans

approx. 180–240 minutes

Challenge students to design and test a device that removes plastic waste from the ocean.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Design and build a new product to remove floating plastic waste from the ocean
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design and construct a small-scale model of a device that removes plastic from the ocean
- Test how well their model performs in a simulated polluted ocean environment and identify improvements
- Watch two videos that showcase two different inventions that are helping remove plastic waste from the ocean
- Reflect on what went well and what they would do differently

2.1 Lesson: What are ecosystems?

approx. 60 minutes

Examine how living things depend on each other and non-living things for their survival.

VIDEO | INTERACTIVE | SIMULATION

Learning Goals

1. Define what an ecosystem is
2. Describe how biotic and abiotic factors interact in ecosystems

Core Activities

- Learn what ecosystems are and use an interactive to test whether they can identify them
- Explore the importance of biotic and abiotic factors
- Use a simulation to build a marine ecosystem
- Reflect on their learning by completing the *very important points reflection strategy*

2.2 Practical activity: Make an ecosystem model

approx. 45–60 minutes

Students make a terrarium as a model of an ecosystem.

MATERIALS REQUIRED

Learning Goals

1. Create a small-scale model of an ecosystem
2. Analyze the biotic and abiotic factors in the model
3. Compare the model with natural ecosystems

Core Activities

- Make a terrarium ecosystem
- Identify the biotic and abiotic factors in their terrarium
- Identify similarities and differences to natural ecosystems
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

2.3 Investigation: Abiotic factors and plant growth

approx. 120–180 minutes

Investigate the impact of an abiotic factor on plant growth.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Analyze and evaluate the results
3. Interpret the results in relation to the growth of plants in natural ecosystems

Core Activities

- Brainstorm abiotic factors that could affect plant growth
- Design and conduct an investigation into how one abiotic factor affects the growth of a plant species
- Analyze and communicate their results
- Reflect on their performance in the investigation using a rubric

2.4 Lesson: Relationships in ecosystems

approx. 45–60 minutes

Examine different types of relationship between organisms in ecosystems.

VIDEO INTERACTIVE POSTER

Learning Goals

1. Identify and describe predator-prey relationships
2. Explain why organisms compete for resources
3. Compare the three main types of symbiosis

Core Activities

- Brainstorm predator-prey relationships
- Watch a video about competition between organisms
- Compare the three main types of symbiotic relationship
- Analyze scientific data relating to the effect of microplastics on coral
- Reflect on their learning by completing the *I used to think, but now I think visible thinking routine*

2.5 Lesson: Energy transfer

approx. 45–60 minutes

Explore how energy is transferred through food chains and ecosystems.

VIDEO

Learning Goals

1. Describe how energy is transferred through a food chain
2. Explain why energy is lost in each step of a food chain

Core Activities

- Brainstorm ideas about the importance of food for living things
- Consider why food provides both matter and energy
- Compare the roles of photosynthesis and cellular respiration in food chains
- Analyze how energy is lost from food chains
- Reflect on their learning by completing the *I used to think, but now I think visible thinking routine*

2.6 Lesson: The cycling of matter

approx. 45–60 minutes

Explore how matter is cycled through food chains and ecosystems.

VIDEO

Learning Goals

1. Describe how matter cycles through an ecosystem

Core Activities

- Consider how matter enters and leaves food chains
- Examine how matter cycles through ecosystems through the example of the carbon cycle
- Optional: extend their learning by relating predator-prey graphs to the transfer of energy and matter through ecosystems
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

2.7 Investigation: Photosynthesis

approx. 90–120 minutes

Investigate how light conditions affect the rate of photosynthesis.

MATERIALS REQUIRED

Learning Goals

1. Explain changes in carbon dioxide levels caused by photosynthesis
2. Design a fair test to compare rates of photosynthesis in different light conditions

Core Activities

- Learn how an indicator can be used to detect changes in the amount of carbon dioxide dissolved in water
- Predict, observe and explain the colour changes caused by blowing into the water and by the photosynthesis of pondweed
- Design and conduct an investigation into how light conditions affect the rate of photosynthesis
- Analyze and communicate their results
- Reflect on their learning by completing the *very important points reflection strategy*

3.1 Lesson: Healthy ecosystems

approx. 45–60 minutes

Introduce biodiversity and the idea that ecosystems with high biodiversity are more resilient.

VIDEO

Learning Goals

1. Define biodiversity
2. Explain how high biodiversity protects ecosystems

Core Activities

- Consider the value of marine ecosystems to human society
- Compare marine ecosystems with high and low biodiversity
- Define the term biodiversity
- Consider why high biodiversity makes an ecosystem more resilient
- Reflect on their learning by completing the *I used to think, but now I think visible thinking routine*

3.2 Lesson: Human impacts

approx. 45–60 minutes

Investigate the impacts of some human activities on ecosystems.

VIDEO | INTERACTIVE | SIMULATION

Learning Goals

1. Describe the value of ecosystems for human society
2. Analyze the impact that human interaction has on ecosystems

Core Activities

- Use satellite photos to explore the impact of human activity in Manila and reflect using a *see, think, wonder visible thinking routine*
- Brainstorm human activities that have a negative impact on ecosystems
- Use a simulation to analyze the impact of either fishing, agricultural runoff or plastic pollution on a marine ecosystem
- Watch a video to find out how human actions can also help the environment recover, as they have with the Pasig River in Manila

3.3 Practical activity: Make plastic from milk

approx. 45–60 minutes over two sessions

Students make a biodegradable plastic out of casein and evaluate its properties.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Evaluate casein plastic by observing its properties

Core Activities

- Watch a video about Ooho's – an exciting alternative to plastic bottles
- Learn about how casein, a protein contained in milk, can be used to create plastic alternatives
- Make a solid object out of casein and evaluate its properties
- Consider how casein could be used to make everyday products
- Reflect on their learning by completing the *think, puzzle, explore visible thinking routine*

3.4 Lesson: Should we ban single-use plastics?

60 minutes (+ 1 week of student preparation)

Extend students' understanding of the potential social impact of single-use plastic.

Learning Goals

1. Describe some of the advantages and disadvantages of single-use plastics from a stakeholder perspective
2. Evaluate whether all single-use plastics should be banned, taking different perspectives into account

Core Activities

- Research the perspective of a stakeholder on the issue of single-use plastic
- Participate in a Socratic seminar to explore issues around single-use plastic
- Give and receive peer feedback about their participation in the seminar

3.5 Project: Communicate the issue

approx. 90–120 minutes

Create a campaign or product that communicates an idea about the problem of plastic pollution.

VIDEO

Learning Goals

1. Describe an idea related to plastic pollution in ecosystems, supported with scientific information
2. Develop a short, sharp message to communicate that idea
3. Create a campaign or product to share the message in your school or community

Core Activities

- Clarify an idea about the issue of plastic pollution
- Support the idea with scientific information about plastics and ecosystems
- Synthesise a strong, succinct message that communicates the idea
- Create a campaign or artefact to communicate the message
- Reflect on their learning by identifying what they did well and what they can improve on

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling entrepreneur Pete Ceglinski.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider the work of Pete Ceglinski
- Discuss what environmental issues are important to them

Author's Notes

The theme of this unit is the impact of plastic pollution on marine ecosystems. We chose this theme because plastic pollution is one of the biggest global issues that we, and future generations, are facing. Marine ecosystems are some of the worst affected by this problem. They also tend to be less understood than land ecosystems, despite being vital to the balance of life on Earth. By focusing on marine examples, we maintain a strong narrative while covering the curriculum and allowing students to generalize to more familiar land-based examples.

The first chapter of the unit is dedicated to exploring plastics as materials that have both useful and problematic properties. The remarkable explosion in our use of plastics over the past century provides essential context for understanding the problem of plastic pollution. We think it's important for students to appreciate the success story behind the development of plastics while learning about the negative consequences. This is also a great opportunity to revise and extend their understanding of chemistry through an exploration of the properties and molecular structure of plastics. We encourage students to reflect on their own use of plastics and how they can minimize their contribution to the problem of plastic waste.

Ultimately, we want students to recognize that this issue is one that we need to act on now. We want them to feel empowered to make a change, however big or small.

Mixtures

Can we 3D print new bones to replace broken ones?

Scientists are developing a new way of creating replacement bones for accident victims. By using 3D printing they can make sure the plastic scaffolds are precisely shaped for the individual patient. But they need to mix powdered bone into the plastic to encourage new bone to grow. So what's the right mixture? Break open this unit to find the answer, and discover the many other ways we use mixtures.

stileapp.com/go/mixtures

The big ideas covered in this unit are:

- What are mixtures?
- What are the differences between suspensions, colloids and solutions?
- How do we describe the parts of a solution and measure its concentration?
- How are mixtures important in our daily lives?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: What are mixtures?	Multiple choice questions	15–20 minutes	Automatic
2.1 Quiz: Suspensions & colloids	Multiple choice questions	15–20 minutes	Automatic
3.1 Quiz: Solutions	Multiple choice questions	15–20 minutes	Automatic
4.1 Quiz: Concentration	Multiple choice questions	15–20 minutes	Automatic
4.2 Project: Pollutants	Research and presentation	90–120 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Introduce students to the topic with an article about 3D printing bones.

Learning Goals

1. Recognize that 3D printing involves the use of mixtures

Core Activities

- Read a Cosmos article about 3D printing bones
- Practise creating mixtures of foods for zoo animals
- Identify mixture-related words in a story

1.1 Lesson: What are mixtures?

45–60 minutes

Distinguish between pure substances and mixtures.

VIDEO

Learning Goals

1. Define what mixtures are
2. Recognize that various combinations of solids, liquids and gases can be mixed together
3. Explain how the properties of a mixture depend on the proportions of its components
4. Identify common examples of mixtures in everyday life

Core Activities

- Watch and respond to a video explaining the science of mixtures in macaroni and cheese
- Practise classifying substances as pure or mixtures
- Identify components of mixtures as solids, liquids or gases
- Watch and respond to a video discussing the mixture of graphite and other substances that make up the lead inside of a pencil

2.1 Lesson: Suspensions & colloids

30–45 minutes

Explore suspensions, emulsions and colloids.

VIDEO SIMULATION

Learning Goals

1. Distinguish between suspensions and colloids
2. Explain why particle size is important in suspensions and colloids
3. Identify examples of suspensions and colloids in everyday life

Core Activities

- Watch a video about quicksand
- Read a short piece of information about suspensions and answer questions about a variety of suspensions
- Read and watch a video about emulsions, particularly homogenised milk
- Explore the effect of particle size in emulsions and suspensions
- Read about colloids and respond to questions on colloids

2.2 Practical activity: Making emulsions

90–120 minutes
* 60 minutes of this time is observing and recording, students could be working on another task at the same time

Create and investigate emulsions.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Identify the behaviour of different mixtures
3. Deduce whether a mixture is an emulsion or not

Core Activities

- Create five mixtures and shake them
- Observe their mixtures for 60 minutes and record their observations at several time intervals
- Analyze their results and attempt to classify the mixtures as emulsions or not

3.1 Lesson: Solutions

45–60 minutes

Explore solutions, solvents and solutes.

VIDEO

Learning Goals

1. Define what solutions are and how they differ from suspensions and colloids
2. Define the terms “solute”, “solvent”, “soluble” and “insoluble”
3. Identify examples of solutions in everyday life

Core Activities

- Watch a video and read a short piece of text explaining solutions
- Respond to questions on solutions
- Watch and respond to a video explaining solvents and solutes

3.2 Investigation: Dissolving & heat

90–120 minutes

Investigate the effect of temperature on dissolving time.

MATERIALS REQUIRED

Learning Goals

1. Determine the effect of temperature on the rate of dissolving sugar
2. Plan and conduct a scientific investigation that is a fair test
3. Identify the independent and dependent variables
4. Collect and record relevant data
5. Analyze trends in data to describe relationships between variables

Core Activities

- Make a prediction as to how temperature will affect the rate of dissolving sugar
- Design the procedure and conduct an investigation on how temperature will affect the rate of dissolving sugar
- Reflect on the experiment and suggest an improvement

4.1 Lesson: Concentration

45–60 minutes

Explain concentration in regard to mixtures.

VIDEO SIMULATION

Learning Goals

1. Compare the difference between dilute and concentrated solutions
2. Distinguish between saturated and unsaturated solutions and explain how they differ
3. Identify some everyday life examples where concentration is important

Core Activities

- Watch and respond to a video explaining concentration
- Order substances from dilute to concentrated
- Interact with a simulation on saturation and use it to answer questions
- Watch and respond to a video about the concentration of fats in milk
- Graph fat content in milk

4.2 Project: Pollutants

90–120 minutes

Research a pollutant and present the findings.

Learning Goals

1. Construct questions that can be investigated scientifically

Core Activities

- Research a pollutant
- Create a presentation of their findings to inform their classmates

5.1 Lesson: Career profile

20–30 minutes

Consider some of the applications of mixture chemistry.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch and respond to a video profiling a graduate development chemist, Madhuri Ranjan
- Read text, explore a chart and respond to questions about legal blood alcohol limits

Separation Techniques

Scientists on the front line

It's not often that scientists have to go to the front line of a war zone. But recently they were called in to the Syrian conflict to collect samples and help determine if the government was using poisonous gas as a chemical weapon. Rally the troops to find out how the scientists separated the samples into their components, and what they found when they did...

stileapp.com/go/separation-techniques

The big ideas covered in this unit are:

- How is a mixture different from a pure substance?
- What are the differences between homogeneous and heterogeneous mixtures?
- What are some methods for separating mixtures into their components?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students in the topic with a Cosmos article.

Learning Goals

1. Describe mixtures and pure substances

Core Activities

- Read an article about gas chromatography and sarin gas
- Identify some pure substances and mixtures in their everyday lives

1.1 Lesson: Types of mixtures

30–45 minutes

Explain the basic concepts of mixtures

VIDEO

Learning Goals

1. Explain the differences between pure substances and mixtures
2. Outline how homogeneous and heterogeneous mixtures differ from one another
3. Describe methods used to separate mixtures into their components

Core Activities

- Read and respond to text explaining pure substances and mixtures
- Classify particle drawing as either mixtures or pure substances
- Watch and respond to a video explaining the difference between heterogeneous and homogeneous mixtures
- Read and respond to text explaining solutions
- Create a mind map summarizing everything they have learnt in this lesson

1.2 Lesson: Separating mixtures

30–45 minutes

Explain some basic separation techniques.

VIDEO

Learning Goals

1. Explain how different separating techniques are used to separate mixtures depending on their physical properties

Core Activities

- Watch a video explaining how mixtures can be separated
- Read and respond to text explaining filtration, evaporation, simple distillation and flotation

1.3 Investigation: Chromatography

30–45 minutes

Experience paper chromatography.

MATERIALS REQUIRED

Learning Goals

1. Conduct an experiment to demonstrate the process of chromatography

Core Activities

- Perform paper chromatography

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling chemistry lecturer Martin Boland.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read and respond to an article profiling chemistry lecturer Martin Boland

States of Matter

How can we supply liquid water to colonies on Mars?

A human mission to Mars could be a reality in our lifetimes. It's a one-way trip and future human settlements will need liquid water to survive. Through this context, explore the states of matter that we interact with every day and how the particle model helps us explain how they behave.

stileapp.com/go/states-of-matter

The big ideas covered in this unit are:

- What are the three main states of matter and how are they different?
- How does the behaviour of particles in solids, liquids and gases help to explain their different properties?
- What happens to particles in matter when substances change state?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
2.3 Project: Life on Mars	Research project	25–30 minutes	Teacher Reviewed
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Engage students in the topic and identify their prior knowledge.

VIDEO INTERACTIVE

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read an article and watch a video that explores how astronauts will access water on Mars
- Identify ways in which they use water in their everyday life
- Complete diagnostic activities to determine their prior knowledge of states of matter
- Reflect on their learning by completing the *creative questions visible thinking routine*

1.1 Lesson: States of matter

45–60 minutes

Introduce the properties of solids, liquids and gases, and changes of state.

VIDEO

Learning Goals

1. Describe the properties of the three main states of matter
2. Identify how matter can change from one state to another

Core Activities

- Watch short videos to review states of matter and the properties of solids, liquids and gases
- Apply their understanding of the properties of states of matter to different scenarios
- Watch a video about the changes between states of matter
- Apply knowledge of changes of state to real-world examples
- Reflect on their learning by completing the *very important points reflection strategy*

1.2 Lesson: The particle model

45–60 minutes

Examine particle arrangement in solids, liquids and gases.

VIDEO INTERACTIVE

Learning Goals

1. Describe how particles are arranged in solids, liquids and gases
2. Use the particle model to explain the different properties of solids, liquids and gases

Core Activities

- Use an interactive to examine the arrangement of particles in solids, liquids and gases
- Learn about the particle model
- Apply the particle model to explain the properties of each state of matter
- Reflect on their learning by completing a *connect, extend, challenge visible thinking routine*

1.3 Practical activity: Evidence for the particle model

30–45 minutes

Demonstrate evidence for the particle model of matter.

VIDEO

MATERIALS REQUIRED

Learning Goals

1. Demonstrate evidence for the particle model of matter

Core Activities

- Perform three simple activities to demonstrate evidence for the particle model
- Explain how particles behaved in each activity

2.1 Lesson: Changing states

45–60 minutes

Explain changes of state using the particle model.

VIDEO

SIMULATION

Learning Goals

1. Use the particle model to explain how matter can change from one state to another

Core Activities

- Review how particles behave in solids, liquids and gases
- Use an interactive to explore how particles behave during changes of state
- Watch a short video about the processes happening during changes of state
- Apply their understanding of particle theory to different real-world scenarios
- Reflect on their learning by completing the *headlines visible thinking routine*

2.2 Practical activity: Observing changes of state

45–60 minutes

Demonstrate how water changes state from solid to liquid to gas.

MATERIALS REQUIRED

Learning Goals

1. Observe and explain the changes of state when water is heated

Core Activities

- Heat solid ice until it melts and then becomes water vapour
- Explain their observations of the two changes of state using the particle model

2.3 Project: Life on Mars

25–30 minutes

Consider the possibility of human settlement on Mars.

VIDEO VR

Learning Goals

1. Explain the implications for a move to Mars for you as well as human civilization

Core Activities

- Watch a video about living in a settlement on Mars
- Explore a 3D virtual reality tour of the Martian surface
- Create an application to be one of the first people to live on Mars

3.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling astronaut Scott Kelly.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read a brief story of how Scott Kelly became the commander of the International Space Station
- Watch a video showcasing Scott's time in space
- Evaluate whether or not they would want to spend a year in space
- Brainstorm as a class the challenges of living in the International Space Station and the skills needed to become an astronaut

Elements and Compounds

What happens if the world runs out of helium?

World supplies of helium were running low before the recent discovery of a large deposit in the East African Rift. The gas is rare on Earth because it's light enough to escape the atmosphere, but its unique properties also give it a wide range of important uses. Through this context, explore the incredible variety of elements and compounds that make the world the complex place it is.

stileapp.com/go/elements-and-compounds

The big ideas covered in this unit are:

- What are the differences between elements, compounds and mixtures?
- How are elements organized in the periodic table?
- How are elements and compounds represented by symbols?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Elements	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: The periodic table	Multiple choice questions	10–15 minutes	Automatic
2.2 Project: Build a periodic table	Build a class periodic table with properties	20–30 minutes	Optional
3.1 Quiz: Compounds	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	30–40 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

20–30 minutes

Engage students with helium and identify their prior knowledge.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about the uses of helium and learn about how rare it is
- Identify their prior knowledge of what an element is with an interactive activity and reflect on what makes something an element

1.1 Lesson: Elements

60–90 minutes

Introduce atoms and elements, and how these form molecules, lattices, metals and non-metals.

VIDEO

Learning Goals

1. Distinguish between atoms and elements
2. Describe how chemical bonds join atoms together to form molecules and lattices
3. Distinguish between metals and non-metals based on their typical properties

Core Activities

- Watch and respond to a video explaining what an element is
- Use an interactive to consolidate what a pure element is
- Watch and respond to a video clarifying the differences between atoms, molecules and lattices
- Make a visual summary of molecules versus lattices
- Complete an interactive and watch a video focusing on properties of metals
- Extrapolate from given information to infer the behaviour of certain metals at different temperatures

2.1 Lesson: The periodic table

60–90 minutes

Explore the organization and thinking of the modern periodic table.

VIDEO

Learning Goals

1. Distinguish between valid and invalid symbols for elements
2. Describe how Mendeleev organized the elements into a periodic table
3. Explain the layout of the modern periodic table

Core Activities

- Read and apply knowledge of how to write symbols for elements, chemical formulae and subscripts
- Participate in a class brainstorm and discussion about naming a newly discovered element
- Read and watch a video about atomic weight
- Complete an interactive to understand how Mendeleev may have organized the periodic table
- Read and watch a video to learn about the organization of the modern periodic table
- Complete an interactive to familiarize themselves with the modern periodic table
- Create visual presentations of the 10 most abundant elements in the Earth's crust

2.2 Project: Build a periodic table

20–30 minutes

Build a class periodic table with properties.

MATERIALS REQUIRED

Learning Goals

1. Demonstrate the properties of an element on the periodic table in a visual format

Core Activities

- Research information about a designated element found on the periodic table
- Create information cards to display basic information about that element

3.1 Lesson: Compounds

60–90 minutes

Explain compounds and compare them to mixtures.

VIDEO INTERACTIVE

Learning Goals

1. Explain what compounds are and how they differ from elements and mixtures
2. Identify the proportions of elements in a compound from its chemical formula
3. Show how the properties of compounds differ from the properties of the elements they contain

Core Activities

- Read and watch a video about how elements combine into compounds and mixtures and complete questions to consolidate this information
- Read about how elements always combine into compounds in fixed proportions and apply understanding of this via a series of questions
- Complete an interactive to build compounds
- Practise writing chemical formulae given the element name and number of particular atoms
- Read about compounds versus mixtures
- Complete an interactive drag-and-drop to compare elements, compounds and mixtures

3.2 Investigation: Burning magnesium

60–90 minutes

Measure the change in mass when magnesium burns in air and determine the products.

MATERIALS REQUIRED

Learning Goals

1. Formulate a valid conclusion with regards to changes in mass when magnesium is burnt
2. Determine which compound is produced

Core Activities

- Hypothesize about whether there will be a change in mass when magnesium is burnt in air
- Revise methodology for an experiment by reordering a series of steps that have been placed out of order
- Collect data and compare it to given information to determine a chemical formula
- Justify results and conclusions given data obtained

4.1 Lesson: Science and society

30–50 minutes

Explore the career of a flavour chemist and problems with plastics.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Construct an informed argument about adding flavours and chemicals to food
3. Reflect on the use of plastics in our everyday lives and how this contributes to pollution

Core Activities

- Learn about the work that a flavour chemist does
- Brainstorm the sorts of food that they would want to specialize in
- Reflect on what they have learned in the video and whether we should be adding chemicals to food
- Read and watch a video about the role of plastics in society
- Participate in a class poll regarding whether we need plastics, and reflect on the results

Physical and Chemical Change

Unwrapping the secrets of chocolate

Humans have been enjoying cocoa for millennia. Today, cocoa beans are turned into delicious, melt-in-your-mouth chocolate by a sequence of physical and chemical changes. Bite into this unit and get a taste of the chemistry of chocolate, as well as many other examples of changing matter.

stileapp.com/go/physical-and-chemical-change

The big ideas covered in this unit are:

- What are the differences between physical and chemical change?
- How can physical and chemical changes be explained at the particle level?
- What are the signs that a chemical change has taken place?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Examine the history of chocolate-making, and identify prior knowledge.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Watch a video describing some of the rich history of chocolate
- Design their own chocolate wrapper
- Test their observation skills by describing how chocolate appears to the senses
- Answer diagnostic questions relating to states of matter and other prior knowledge

1.1 Lesson: Changing matter

15–20 minutes

Introduce the contrast between physical and chemical change.

VIDEO

Learning Goals

1. Identify examples of physical and chemical change

Core Activities

- Brainstorm examples of matter changing from their everyday lives
- Watch a video that contrasts physical and chemical change
- Classify changes as physical or chemical
- Reflect on their learning using the *creative questions visible thinking routine*

1.2 Lesson: Physical change

45–60 minutes

Explore what occurs at the particle level during physical changes.

VIDEO

Learning Goals

1. Describe physical changes in terms of the arrangement of particles

Core Activities

- Read about the defining features of physical change and think of some examples
- Watch a video explaining physical change in terms of particles (atoms and molecules)
- Explore how particles behave during changes of state and mixing
- Reflect on their learning by completing the *very important points reflection strategy*

2.1 Lesson: Chemical change

45–60 minutes

Explore what occurs during chemical changes at the particle level.

VIDEO

Learning Goals

1. Identify signs of chemical change
2. Describe chemical changes in terms of the arrangement of particles

Core Activities

- Learn about the typical signs that a chemical change has taken place
- Watch a short video illustrating examples of chemical change
- Consider rusting and burning at the particle level
- Reflect on their learning by completing the *think, puzzle, explore visible thinking routine*

2.2 Investigation: Chemical change

45–60 minutes

Identify evidence of chemical change and investigate which substances are involved.

MATERIALS REQUIRED

Learning Goals

1. Identify signs of chemical change
2. Plan and conduct a scientific investigation that is a fair test
3. Analyze trends in data to describe relationships between variables

Core Activities

- Observe a chemical change and identify signs that a chemical change occurred
- Complete an open inquiry to investigate what caused one of the observed changes

3.1 Lesson: Physical vs. chemical change

45–60 minutes

Compare and contrast physical and chemical change.

Learning Goals

1. Distinguish between physical and chemical changes

Core Activities

- Summarize the differences between physical and chemical changes and apply the distinction in a range of scenarios
- Contrast the two types of change at the particle level
- Reflect on their learning by identifying new terms they have learnt during this unit and defining them

3.2 Practical activity: Identifying types of change

60–90 minutes

Observe and classify various examples of physical and chemical change.

MATERIALS REQUIRED

Learning Goals

1. Recognize evidence for physical and chemical change

Core Activities

- Perform six activities and explain whether each change they observe is physical or chemical

4.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling chocolate taster Orietta Gianjorio.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video detailing what a professional chocolate taster does
- Participate in a class poll regarding whether they would like to be a chocolate taster
- Participate in a class discussion proposing skills they think a professional food taster would require

Atoms

How can the building blocks of atoms help us see further?

Atoms, the building blocks of matter, are themselves made up of protons, neutrons and electrons. The electron microscope expanded our view of the microscopic world. Now a new scanner uses neutrons to help us look inside rocks, cameras and car engines like never before. Expand your students' horizons with this exploration of atomic structure.

stileapp.com/go/atoms

The big ideas covered in this unit are:

- What are atoms made of and how are their parts arranged?
- How can we demonstrate the electrical nature of atoms?
- What are ions and isotopes?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Examine neutron imaging.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read a magazine article that introduces the topic of neutron imaging
- Answer polls to draw out any misconceptions they may have about atoms

1.1 Lesson: The structure of atoms

30–45 minutes

Explore the structure of atoms.

VIDEO

Learning Goals

1. Describe the structure of atoms, and the particles they are made from
2. Compare and contrast the subatomic particles by their mass and electrical charge

Core Activities

- Complete a table to summarize the properties of subatomic particles
- Answer questions to consolidate and extend their understanding of the structure of atoms

1.2 Practical activity: Brownian motion

45–60 minutes

Model atomic structure using particles in a suspension.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Explain how the motion of pollen grains in water is evidence for the existence of atoms

Core Activities

- Carry out a short activity to observe Brownian motion
- Consider how their results provide evidence for the existence of atoms

2.1 Lesson: Protons and electrons

45–60 minutes

Explore the roles of protons and electrons.

INTERACTIVE

Learning Goals

1. Describe the relationship between the number of protons and atomic number
2. Analyze the relationship between protons and electrons in neutral atoms

Core Activities

- Use an atom builder interactive to explore the link between protons and atomic number
- Read about the relationship between protons and electrons in neutral atoms
- Explore net charge using the atom builder interactive

2.2 Lesson: Ions

30–45 minutes

Investigate ion formation.

INTERACTIVE

Learning Goals

1. Describe ions in terms of their protons, electrons and overall electrical charge
2. Describe the repulsion and attraction of charged particles

Core Activities

- Explore how positive and negative ions are made using an atom builder interactive
- Answer questions about positive and negative ions
- Investigate electrostatic attraction and repulsion using an interactive about balloons and static electricity
- Summarize how particles with like and unlike charges interact

2.3 Practical activity: The electrical atom

45–60 minutes

Use static electricity to give evidence of charged subatomic particles.

MATERIALS REQUIRED

Learning Goals

1. Analyze and evaluate evidence that atoms contain oppositely charged particles

Core Activities

- Demonstrate static electricity in three different ways
- Analyze their observations as evidence that atoms contain positively and negatively charged particles

3.1 Lesson: Neutrons and isotopes

45–60 minutes

Explain neutrons and isotopes of an element.

VIDEO INTERACTIVE

Learning Goals

1. Explain how the number of neutrons affects the mass number of an atom
2. Relate mass number to isotopes

Core Activities

- Learn that an atom's mass number is its total number of protons and neutrons
- Use an atom builder interactive to explore the mass number and stability of different carbon atoms
- Learn about isotopes and isotope notation and apply their knowledge to examples

3.2 Practical activity: Modelling atoms

100–120 minutes

Build a model atom, describing its parts and properties.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Construct a model of an atom and describe its parts and properties

Core Activities

- Design and build a physical model of an atom of one of the first 20 elements
- Label each part of the atom
- Make a poster describing the atom's parts and properties
- Reflect on their learning by identifying what they did well and what they can improve on

4.1 Lesson: Career profile

20–30 minutes

Encourage students to think about careers in STEM by profiling Dr Genoveva Burca.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Learn about the career of Genoveva Burca
- Record observations from viewing a video of a kaleidoscope
- Explain an alternative use of neutron-imaging machines

Chemical Reactions

An explosive new discovery

A team of scientists in the Czech Republic spent their Saturday afternoons investigating what really happens when sodium explodes in water. Their findings challenge the traditional explanation for this classic chemical reaction. Blow your students away with what they discovered, and explore a range of other chemical reactions in the world around us.

stileapp.com/go/ChemicalReactions-unit

The big ideas covered in this unit are:

- What is a chemical reaction?
- How do we represent chemical reactions?
- Why do chemical equations need to be balanced?
- What happens during an explosion?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explore what happens when sodium explodes in water.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Classify images as depicting either a chemical reaction of physical change

1.1 Lesson: Balancing chemical equations

45–60 minutes

Explain what a chemical reaction is.

VIDEO

Learning Goals

1. Describe what a chemical reaction is
2. Express chemical reactions with word, symbol and structural equations
3. Explain why chemical equations need to be balanced and how this is done

Core Activities

- Distinguish between reactants and products
- Write and balance basic chemical equations using words and symbols and structural diagrams

1.2 Lesson: Explosive chemical reactions

45–60 minutes

Examine the reaction between sodium and water.

VIDEO

Learning Goals

1. Explain what is occurring during the reaction between sodium and water
2. Investigate and explain uses for some common chemicals

Core Activities

- Balance the chemical equation for sodium and water
- Suggest the role hydrogen gas may play in the reaction
- Distinguish between correctly and incorrectly balanced equations
- Investigate a chemical reaction and its use in society

1.3 Investigation: Combustion of charcoal and steel wool

60–90 minutes

Observe and explain the combustion of charcoal and steel wool.

MATERIALS REQUIRED

Learning Goals

1. Observe and explain what happens during the combustion of two household products: charcoal (Part I) and steel wool (Part II)

Core Activities

- Conduct an experiment using charcoal and steel wool
- Record and analyze their observations and link them to their knowledge of chemical reactions
- Evaluate the method and suggest improvements

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Pavel Jungwirth.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Engage with the story of Pavel Jungwirth's career and research
- Consider and brainstorm what area of chemistry they would pursue a career in

Acids and Bases

Why are our oceans becoming more acidic?

Much of the carbon dioxide emitted by human activities is absorbed by the oceans. This makes the water more acidic, harming marine life around the world. Now scientists are reporting that the rate of ocean acidification is the worst it's been in the last 300 million years. Dive in and explore acids and bases through the context of this looming challenge for our environment.

stileapp.com/go/AcidsandBases

The big ideas covered in this unit are:

- What are acids and bases?
- How do we measure the strength of acids and bases?
- What causes ocean acidification and how is it affecting marine life?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

20–30 minutes

Explore ocean acidification.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read a magazine article introducing ocean acidification
- View a 360 degree image that illustrates the issue
- Answer a series of questions to determine their prior knowledge of acids and bases

1.1 Lesson: Acids and bases

20–30 minutes

Describe the main properties of acids and bases.

VIDEO

Learning Goals

1. Describe the main properties of acids and bases

Core Activities

- Read about the properties of acids, bases and neutral substances
- Complete questions to consolidate and apply their understanding

1.2 Lesson: Measuring acidity

45–60 minutes

Explain the pH scale.

VIDEO POSTER

Learning Goals

1. Describe acids and bases at the atomic level
2. Apply the pH scale to compare the strengths of acids and bases

Core Activities

- Explain acids and bases in terms of ions
- Watch a short video describing the pH scale and how it relates to the strength of acids and bases
- Complete questions and activities to consolidate and apply their understanding

1.3 Practical activity: Indicators

25–30 minutes

Test substances using litmus and universal indicator.

VIDEO | INTERACTIVE | MATERIALS REQUIRED

Learning Goals

1. Identify common liquids as either acidic, basic or neutral
2. Determine pH using universal indicator and a colour chart

Core Activities

- Predict the pH of some common substances
- Determine the colour litmus paper changes in the presence of acid, base and neutral solutions
- Test a range of materials to observe colour change and categorize the substances as acid, base or neutral
- Measure the pH of an acid, a base and a neutral solution using universal indicator and a colour chart
- Test a range of materials to observe colour change and order the substances on the pH scale

1.4 Practical activity: Natural pH indicators

90–120 minutes

Create a natural pH indicator and colour chart.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Construct a pH indicator and colour chart from a natural material

Core Activities

- Create their own pH indicator and colour chart from a naturally occurring substance

2.1 Lesson: Acid–base reactions

30–45 minutes

Describe neutralization reactions.

VIDEO

Learning Goals

1. Describe reactions of acids and bases
2. Describe reactions of acids with carbonates

Core Activities

- Watch a short video demonstration of an acid–base reaction with universal indicator
- Explore simple acid–base reactions
- Explore simple acid–carbonate reactions

2.2 Practical activity: Acid–base reactions – Making sherbet

25–30 minutes

Observe an acid–base reaction.

MATERIALS REQUIRED

Learning Goals

1. Recognize when an acid–carbonate reaction occurs

Core Activities

- Make sherbet – a mixture of an acid (citric acid) and a base (bicarbonate of soda)
- Observe the reaction of the acid and the base

2.3 Lesson: Ocean acidification

45–60 minutes

Explore how ocean acidification occurs.

VIDEO

Learning Goals

1. Describe the effect of increased atmospheric carbon dioxide on the ocean

Core Activities

- Watch a video about ocean acidification
- Read about how carbonic acid is formed
- Watch a video that illustrates the chemical processes causing ocean acidification
- Use data about ocean acidification to graph and discuss how ocean acidity will increase
- Examine how ocean acidification affects the availability of carbonate ions for organisms to make calcium carbonate structures

2.4 Practical activity: Modelling ocean acidification

25–30 minutes

Model how carbon dioxide can decrease the pH of water.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Investigate how carbon dioxide can cause water to become more acidic

Core Activities

- Blow into a solution of salt water and universal indicator
- Observe the change in pH
- Apply their observations to the phenomenon of ocean acidification

2.5 Practical activity: Effect of acids and bases on shells

45–60 minutes

Investigate the effect of acids and bases on shells.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Investigate the effect of changes in pH to eggshells
2. Explain how this models an effect of ocean acidification on seashells

Core Activities

- Soak eggs in vinegar, sodium bicarbonate and distilled water
- Observe the effect of vinegar (an acid) on the eggshell

3.1 Lesson: Career profile

20–30 minutes

Encourage students to think about careers in STEM by profiling Dr Sarah Cooley.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Draw a short cartoon that illustrates an aspect of ocean acidification

Reactions and Energy

Are bionic leaves better than the real thing?

Scientists have recently created a “bionic leaf” that manufactures fuel from sunlight ten times more efficiently than real leaves. This unit on the role of energy in chemical reactions will give your students plenty of fuel for thought.

stileapp.com/go/ReactionsandEnergy

The big ideas covered in this unit are:

- What are acids and bases?
- How do we measure the strength of acids and bases?
- What causes ocean acidification and how is it affecting marine life?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Combustion	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: Exothermic and endothermic reactions	Multiple choice questions	10–15 minutes	Automatic
2.3 Project: Design a hand warmer	Design a simple hand warmer	45–60 minutes	Teacher reviewed
3.1 Quiz: Photosynthesis and respiration	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students by examining the bionic leaf.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about the bionic leaf and how it mimics the processes in a real leaf
- Consider what is required for a fire to burn
- Participate in a number of polls to display prior knowledge

1.1 Lesson: Combustion

45–60 minutes

Explain combustion and its uses in society.

VIDEO

Learning Goals

1. Identify the basic form of combustion reactions
2. Describe the difference between complete combustion and incomplete combustion
3. Describe advantages and disadvantages of our use of combustion reactions for energy supply

Core Activities

- Write the general equation for combustion reactions
- Link the combustion reaction to rocket launches
- Diagrammatically represent the combustion of hydrogen and the combustion of carbon
- Diagrammatically represent common hydrocarbons
- Write the equation for the combustion of octane
- Investigate corrosion and consider if this is a combustion reaction
- Explore how society uses combustion reactions

1.2 Investigation: Putting out fires

60–90 minutes

Explore different ways in which fire can be extinguished.

MATERIALS REQUIRED

Learning Goals

1. Investigate the different ways a fire can be extinguished
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables
4. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Conduct a series of experiments to extinguish a candle flame
- Record and interpret the results in regard to the requirements of fire
- Reflect on the experimental method to suggest improvements

2.1 Lesson: Exothermic and endothermic reactions

45–60 minutes

Conduct a range of endothermic and exothermic reactions.

VIDEO | SIMULATION | MATERIALS REQUIRED

Learning Goals

1. Distinguish between exothermic and endothermic reactions
2. Identify the energy changes involved in breaking and making chemical bonds
3. Define activation energy

Core Activities

- Conduct a simple experiment to compare endothermic and exothermic reactions, collecting observations to draw conclusions
- Identify energy loss or gain in endothermic and exothermic reactions
- Identify the temperature change associated with endothermic and exothermic reactions
- Define activation energy
- Use a simulation to classify common reactions as endothermic or exothermic
- Create and interpret an energy level diagram for the combustion of methane

2.2 Extension: Heat of reaction

45–60 minutes

Calculate reaction heat and explain why it is useful.

Learning Goals

1. Explain heat of reaction and its importance in real-world contexts

Core Activities

- Interpret an energy graph for the combustion of methane
- Interpret energy graphs to classify reactions as endothermic or exothermic

2.3 Project: Design a hand warmer

45–60 minutes

Design a simple hand warmer.

Learning Goals

1. Design a hand warmer using your knowledge of exothermic reactions

Core Activities

- Design a hand warmer using the exothermic reaction between iron and oxygen
- Draw and explain their design
- Justify their design choices

3.1 Lesson: Photosynthesis and respiration

45–60 minutes

Describe the photosynthesis and respiration reactions.

VIDEO

Learning Goals

1. Describe the role of energy in photosynthesis and classify this reaction as exothermic or endothermic
2. Explain how respiration provides living things with a source of energy
3. Describe how photosynthesis and respiration have changed Earth's atmosphere

Core Activities

- Participate in a diagnostic poll to show and share prior knowledge
- Represent the reaction of photosynthesis and respiration using words, symbols and diagrams
- Consider and explain what a plant needs in order to photosynthesize and respire
- Classify photosynthesis and respiration as endothermic or exothermic using an energy graph
- Explain the relationship between photosynthesis and respiration

4.1 Lesson: Science and society

10–15 minutes

Encourage students to think about careers in STEM by profiling combustion engineer Vi Rapp.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Learn about Vi Rapp's career
- Consider Vi's research and evaluate if they would like a similar job

Chemical Bonds

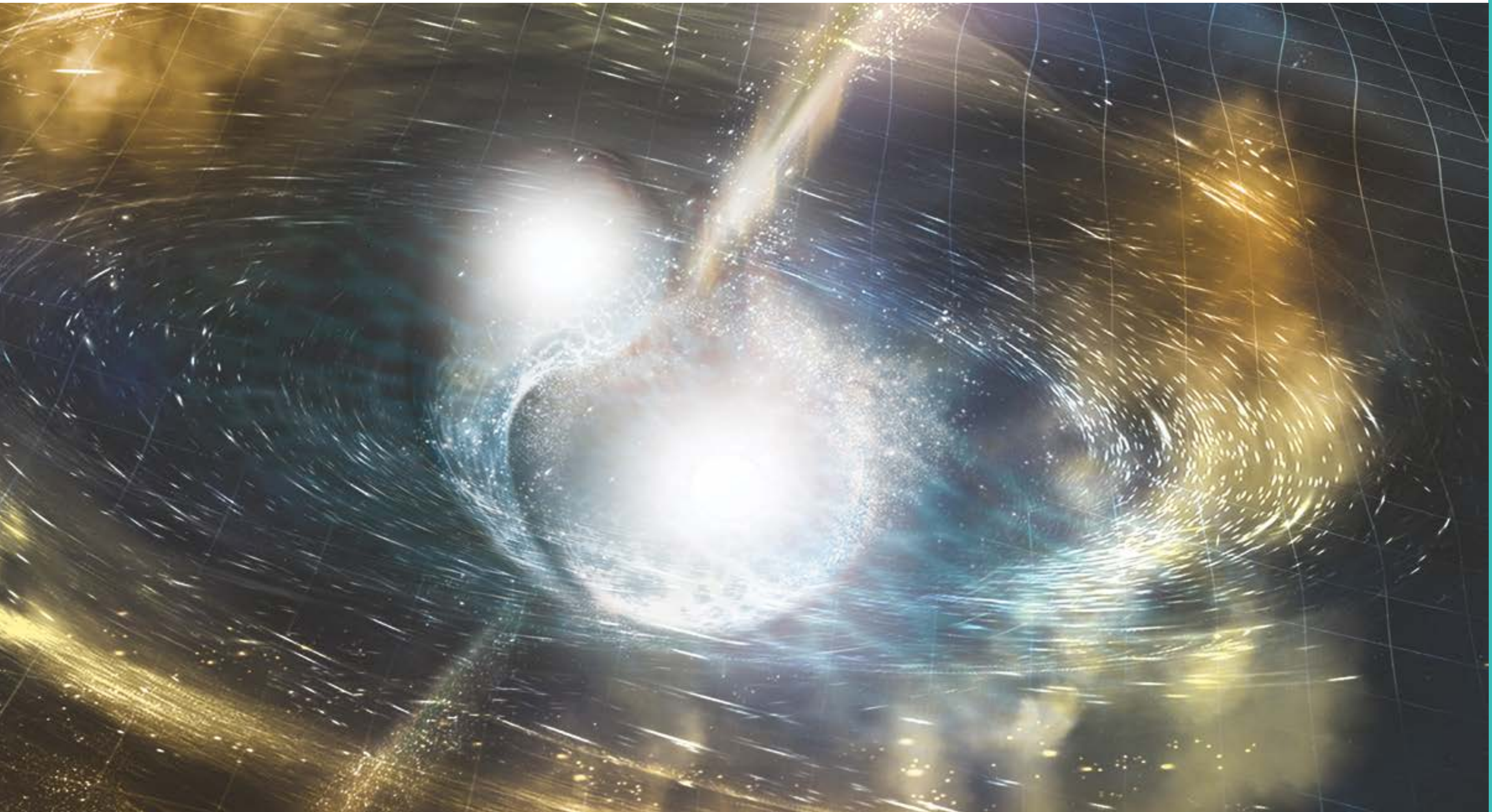
How do exploding stars create heavy metals?

Scientists recently detected the collision of two neutron stars, confirming theories about the origin of heavier chemical elements such as gold and platinum. Worth its weight in gold, this unit uses the periodic table to help students make sense of this important discovery.

stileapp.com/go/chemicalbonds

The big ideas covered in this unit are:

- How are electrons arranged in atoms of different elements?
- Why do chemical bonds form?
- What are the main differences between ionic and covalent bonds?
- How does the periodic table help us predict ionic compounds?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Electron configurations	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: Chemical bonds	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Explain where heavy metals come from.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Watch a video explaining the current theory of how heavy metals are created
- Define key atomic and periodic table terminology
- Calculate the number of subatomic particles in a variety of given isotopes
- Brainstorm what they know about chemical bonds

1.1 Lesson: Electron configurations

45–60 minutes

Explain electron configuration.

VIDEO

Learning Goals

1. Draw electron configurations for the first 20 elements
2. Explain how the electron configuration of an element relates to its position in the periodic table

Core Activities

- Explain the relationship between an atom's atomic number and the number of electrons it has
- Examine a periodic table and consider how elements are arranged within it
- Draw electron configurations for given atoms

2.1 Lesson: Chemical bonds

45–60 minutes

Introduce three types of chemical bonds, exploring ionic and covalent bonds.

VIDEO

Learning Goals

1. Describe the main differences between ionic and covalent bonds
2. Use the periodic table to predict the chemical formulae of ionic compounds

Core Activities

- Examine the three key types of chemical bonds
- Predict the formulae of various ionic compounds
- Draw atoms forming an ionic bond
- Explain the formation of an ionic compound
- Examine covalent bonding and draw an example of ammonia

2.2 Investigation: Flame colours

45–60 minutes

Determine the flame colours produced by different metal salts.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Investigate the various flame colours produced by metal salts
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables
4. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Conduct a series of flames tests and record the results
- Interpret the results and link the findings to what they know about electron configurations

3.1 Lesson: Science and society

10–15 minutes

Encourage students to think about careers in STEM by profiling Julia Abbott.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Interview a current or past science teacher about their science career path

Reaction Types

Are self-healing spacesuits science fiction or just science?

A super-fast chemical reaction between a new liquid plastic and oxygen could mend holes in spacesuits in mere seconds! Take your students on a journey out of this world to discover how different types of reactions can help us develop new materials.

stileapp.com/go/reactiontypes

The big ideas covered in this unit are:

- How and why do we classify reactions?
- How do precipitation reactions work?
- What are redox reactions and why are they important?
- How do surface area, concentration and temperature affect reaction rates?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Reaction types	Multiple choice questions	10–15 minutes	Automatic
1.2 Project: CFCs & the ozone layer	Research project	60–90 minutes	Teacher reviewed
2.1 Quiz: Precipitation reactions	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: Redox reactions	Multiple choice questions	10–15 minutes	Automatic
4.1 Quiz: Rates of reaction	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine how liquid plastic may be able to repair punctured astronaut suits.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Examine examples of rapid chemical reactions and make observations about them
- Group common chemical reactions together and justify their groupings

1.1 Lesson: Reaction types

45–60 minutes

Distinguish between composition and decomposition reactions.

VIDEO

Learning Goals

1. Explain the benefits of classifying reactions
2. Identify composition and decomposition reactions and give examples
3. Identify displacement reactions and give examples

Core Activities

- Explain the process by which nitrogen is removed from the air and converted into ammonia
- Identify general equations for composition and decomposition reactions
- Write balanced equations for chemical reactions
- Distinguish between single and double displacement reactions

1.2 Project: CFCs & the ozone layer

60–90 minutes

Research the ozone layer and the impact of CFCs.

Learning Goals

1. Describe the reactions taking place in the ozone layer
2. Investigate CFCs and their impact on the ozone layer

Core Activities

- Explain the importance of the ozone layer
- Explore CFCs and understand how they are produced
- Explain the reactions involved in producing CFCs and ozone
- Explain the environmental impact of CFCs

2.1 Lesson: Precipitation reactions

45–60 minutes

Explain precipitate reactions.

VIDEO

Learning Goals

1. Describe what precipitates are
2. Explain how precipitates are formed by chemical reactions
3. Apply solubility rules to predict when precipitates will form

Core Activities

- Identify the type of reaction a precipitate reaction is classified as
- Predict precipitates in a range of reactions using solubility rules
- Apply precipitate reaction concepts to a real-world problem

2.2 Practical activity: Precipitation reactions

60–90 minutes

Predict and test a range of precipitate reactions.

MATERIALS REQUIRED

Learning Goals

1. Investigate a range of precipitate reactions, predicting their outcomes using solubility rules

Core Activities

- Predict a range of precipitate reaction outcomes
- Conduct the reactions for their predictions
- Write balanced equations for each precipitation reaction
- Evaluate the experimental method and suggest improvements

3.1 Lesson: Redox reactions

45–60 minutes

Compare redox, oxidation and reduction reactions.

VIDEO

Learning Goals

1. Define oxidation and reduction in terms of the transfer of electrons
2. Identify which reactants are oxidized and reduced in common redox reactions
3. Explain how batteries and combustion involved redox reactions

Core Activities

- Identify which reactants are oxidized and reduced in a given chemical reaction and explain what is happening
- Write a balanced equation for the reduction of lead from lead oxide and carbon
- Explain how redox reactions can be used to produce electricity

4.1 Lesson: Rates of reaction

45–60 minutes

Explain how collision theory affects reaction rates.

SIMULATION

Learning Goals

1. Define reaction rate
2. State the main ideas of collision theory

Core Activities

- Classify reactions in terms of their rates
- Identify conditions that influence rates of reaction
- Explain how collision theory relates to rates of reaction

4.2 Lesson: Temperature and rates of reaction

45–60 minutes

Examine how temperature affects reaction rate.

VIDEO SIMULATION

Learning Goals

1. Use collision theory to explain how temperature affects the rate of reaction

Core Activities

- Predict the outcome of a chemical reaction inside glow sticks exposed to different temperatures
- Graph reaction rates at different temperatures and explain the results

4.3 Lesson: Surface area and rates of reaction

45–60 minutes

Examine how surface area affects reaction rate.

VIDEO SIMULATION

Learning Goals

1. Define surface area
2. Use collision theory to explain how surface area affects the rate of reaction

Core Activities

- Predict the outcome of a chemical reaction using effervescent drink tablets
- Justify their prediction using collision theory
- Use surface area and collision theory to explain the chemical reaction that occurs inside an airbag

4.4 Lesson: Concentration and rates of reaction

45–60 minutes

Examine how concentration affects reaction rate.

VIDEO SIMULATION

Learning Goals

1. Use collision theory to explain how concentration affects the rate of reaction

Core Activities

- Predict the outcome of a chemical reaction using bicarbonate soda and vinegar of different concentrations
- Justify their prediction using collision theory

5.1 Lesson: Science and society

45–60 minutes

Encourage students to think about careers in STEM by profiling forensic chemist Glen Jackson.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Discuss a variety of ways science is used in society
3. Evaluate the ethical considerations some of these uses have

Core Activities

- Identify ways in which chemistry can be used to benefit or harm society

Forces

Spiderman senses

How do you climb up a sheer glass wall? If you're a gecko, just walk. But for humans, scaling walls this way only happened in fiction, until recently. Elliot Hawkes, an engineering student in the US, did it in real life. Scale up your students' physics knowledge with this gravity-defying unit on forces.

stileapp.com/go/forces

The big ideas covered in this unit are:

- What do forces do?
- When are forces balanced and unbalanced?
- What are net forces?
- How do we measure forces?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.4 Investigation: Effect of forces	Scientific investigation	90–120 minutes	Peer and self assessed. Rubric provided
3.4 Engineering challenge: Parachutes	Design, construct and test a model parachute	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Engage students in the topic and identify students' prior knowledge of forces.

VIDEO

Learning Goals

1. Explain why geckos are able to climb walls and explain why humans cannot
2. Identify as many forces as you can and brainstorm words used to describe movement

Core Activities

- Read a magazine article about how engineer Elliot Hawkes applied his knowledge of forces to help him create "gecko pads"
- Complete diagnostic activities to test what they know about types of forces and what forces do
- Use a KW chart to record what they already know, and what they want to know about forces

1.1 Lesson: What are forces?

45–60 minutes

Introduce what forces are and what they do.

MATERIALS REQUIRED

Learning Goals

1. Define what forces are
2. Describe what forces do
3. Explain how forces are measured

Core Activities

- Identify a force as either a push, pull or twist
- Describe the effects of forces
- Use force arrows to represent forces
- Match forces to their effects
- Use a spring balance to measure forces in the classroom

1.2 Lesson: Types of forces

45–60 minutes

Examine common types of forces.

VIDEO

Learning Goals

1. Identify different types of forces in the world around you
2. Distinguish between contact and non-contact forces

Core Activities

- Identify common types of forces in a range of scenarios
- Examine the difference between contact and non-contact forces

1.3 Investigation: Friction and braking distance

90–120 minutes

Plan, conduct and communicate an investigation into the braking distances of vehicles.

SIMULATION

Learning Goals

1. Construct questions that can be investigated scientifically
2. Identify the independent and dependent variables
3. Collect and record relevant data
4. Analyze trends in data to describe relationships between variables
5. Evaluate the quality of the data collected

Core Activities

- Complete a guided inquiry into the effect of weather conditions on braking distance
- Complete an open inquiry into another variable that may affect braking distance

1.4 Investigation: Effect of forces

90–120 minutes

Plan, conduct and communicate an investigation into the effect of forces on moving objects.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables
4. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Complete a structured inquiry investigating the effect of forces on the motion of objects

2.1 Lesson: Balanced and unbalanced forces

45–60 minutes

Examine the difference between balanced and unbalanced forces.

VIDEO SIMULATION

Learning Goals

1. Identify when forces are balanced and unbalanced

Core Activities

- Complete a diagnostic activity to address the misconception that if an object is at rest, no forces act on the object
- Explore balanced and unbalanced forces through an interactive simulation
- Examine the physics of skydiving

2.2 Extension: Net force

45–60 minutes

Determine how net force is calculated.

SIMULATION

Learning Goals

1. Calculate the net force of balanced and unbalanced objects

Core Activities

- Examine how to calculate net force
- Use an interactive simulation to calculate net forces in a tug of war scenario

3.1 Lesson: Gravity

45–60 minutes

Examine the force of gravity and the strength of gravitational fields.

VIDEO

Learning Goals

1. Explain the concept of gravity and gravitational fields
2. Distinguish between mass and weight

Core Activities

- Examine how gravitational field strength changes according to the distance from an object
- Calculate the weight and mass of objects on different planets

3.2 Extension: Are astronauts weightless?

30–45 minutes

Examine why astronauts in space appear to be weightless.

VIDEO

Learning Goals

1. Explain why astronauts in orbit seem to be weightless

Core Activities

- Describe why the term “weightless” is an inaccurate description of astronauts in space
- Examine how water behaves in the International Space Station

3.3 Practical activity: The effect of gravity

45–60 minutes

Observe the effect of gravity on balls of differing mass.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Conduct an experiment to model the effect of gravity on objects of different mass

Core Activities

- Recreate Galileo Galilei’s famous experiment
- Observe the effect of gravity on balls of different mass

3.4 Engineering challenge: Parachutes

180–240 minutes

Guide students through the engineering of a model parachute.

MATERIALS REQUIRED

Learning Goals

1. Design, construct and test a model parachute
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design, build and test a parachute

4.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling engineer Elliot Hawkes.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider the invention of gecko pads and how they could be used
- Come up with an idea for an invention of their own

Levers and Gears

Shifting gears

A surprising number of the tools and machines we rely on every day – from door handles and cricket bats to clocks and bikes – can be explained in terms of a few simple ideas. The same principles allowed ancient civilizations to build enormous pyramids and the mysterious astronomical device known as the Antikythera Mechanism. Gear up to explore these basic principles with your students.

stileapp.com/go/levers-and-gears

The big ideas covered in this unit are:

- How do simple machines allow us to achieve a lot with little effort?
- What is "mechanical advantage" and how does it apply to levers, wheels and gears?
- How do gear systems work?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.4 Engineering challenge: Squashed tomatoes	Design, construct and test a food transport system	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10 minutes

Gauge students' prior knowledge of levers and gears.

Learning Goals

1. Identify any levers or gears you already know about

Core Activities

- Brainstorm known tools or utensils that involve levers or gears

1.1 Lesson: Levers and mechanical advantage

45–60 minutes

Explain how simple machines make tasks easier

VIDEO

Learning Goals

1. Describe how simple machines reduce the effort required to perform a task
2. Define "mechanical advantage" and explain how it applies to levers, wheels and gears
3. Explain how gear systems work

Core Activities

- Label a basic lever
- Explain how a lever works to reduce the amount of effort required
- Calculate mechanical advantage
- Classify levers
- Label diagrams of levers and classify them

1.2 Lesson: Wheels and gears

45–60 minutes

Explain how wheels and gears provide mechanical advantage.

VIDEO

Learning Goals

1. Classify wheels and gears as force multipliers or speed multipliers
2. Calculate gear ratios
3. Analyze an egg beater to decide what is involved in its operation

Core Activities

- Calculate the mechanical advantage of wheels and gears
- Classify wheels and gears as force multipliers or speed multipliers
- Calculate gear ratios for given examples
- Analyze an egg beater using a labelled diagram

1.3 Practical activity: Building a catapult

45–60 minutes

Construct and test a model catapult.

MATERIALS REQUIRED

Learning Goals

1. Construct and test a model catapult
2. Describe potential errors within the experimental design and suggest possible improvements
3. Test and evaluate the success of your design

Core Activities

- Construct and test a model catapult
- Identify the parts of a lever on their catapult and calculate the mechanical advantage
- Consider how to improve the design of the catapult

1.4 Engineering challenge: Squashed tomatoes

180–240 minutes

Simulate a real-life challenge affecting farmers in Nepal.

MATERIALS REQUIRED

Learning Goals

1. Design and construct a model food-transportation device
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design and build a model food-transportation device
- Evaluate the success of the design and suggest improvements

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling lab manager Jane Keeling.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people’s lives and generate career opportunities

Core Activities

- Imagine they have a job at Scienceworks – consider a common tool involving levers or gears and think of an activity to explain it

Inclined Planes

Old tools, new twists...

What do ramps, stairs, sloping roads, axes, knives, needles and screws have in common? They're all inclined planes, which are simple machines that make work easier. We've been using them for thousands of years but new high-tech versions are still being invented – like screws made out of silk for mending broken bones!

stileapp.com/go/inclined-planes

The big ideas covered in this unit are:

- What are the main types of inclined planes?
- How do inclined planes make work easier?
- What is "mechanical advantage" and how is it calculated?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students in the topic through the example of silk screws.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Examine the use of silk screws in medical procedures
- Use an interactive picture to consider where screws would be placed to support bone healing

1.1 Lesson: Types of inclined planes

45–60 minutes

Explain how inclined planes make work easier.

VIDEO

Learning Goals

1. Explain how inclined planes make work easier
2. Identify different types of simple machines that make use of inclined planes
3. Relate mechanical advantage to inclined planes

Core Activities

- Identify examples of inclined planes
- Identify load forces in given examples
- Explain the trade-off between effort and distance when using inclined planes
- Explain how the thread of a screw acts as an inclined place

1.2 Lesson: Inclined planes and mechanical advantage

45–60 minutes

Apply the formula for mechanical advantage to a range of inclined planes.

VIDEO

Learning Goals

1. Calculate the mechanical advantage in a variety of contexts
2. Compare different types of inclined planes to determine which is best

Core Activities

- Calculate the mechanical advantage for a variety of real-world examples
- Compare and contrast different types of inclined planes to determine which is ideal for different circumstances

1.3 Investigation: The mechanical advantage of ramps

60–90 minutes

Investigate the effect of friction on the mechanical advantage of ramps.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Analyze trends in data to describe relationships between variables

Core Activities

- Conduct an experiment to investigate the effect of friction on the mechanical advantage of ramps
- Analyze their results to determine the relationship between the angle of incline and the effort required
- Evaluate the method and suggest improvements

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling biomedical engineer Michelle Khine.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Reflect on Michelle's career path and evaluate their own skills in the areas of maths and science

Energy Transformation

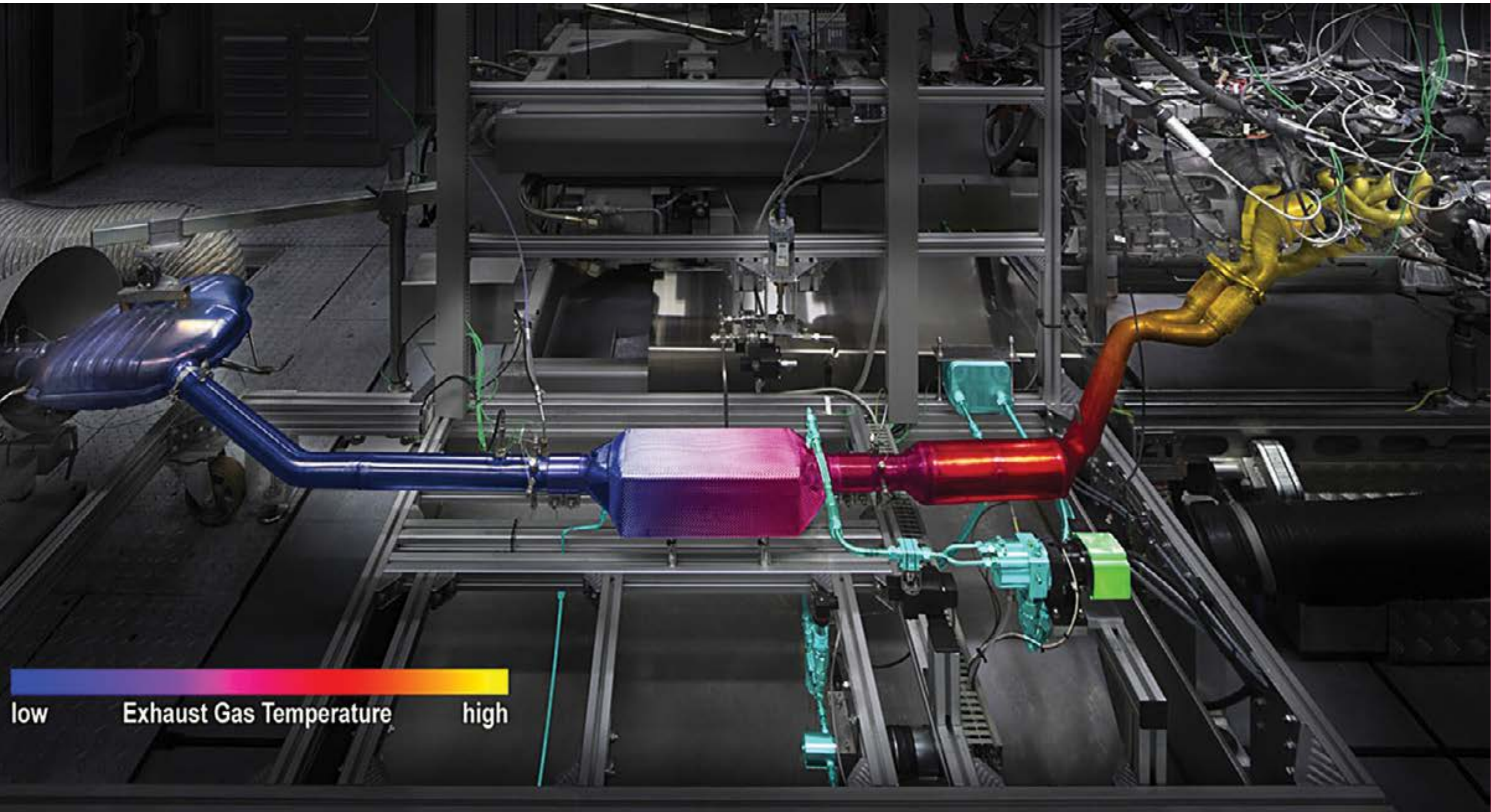
Could we use cars to create electricity?

Scientists are trying to turn waste heat into useful electricity, making machines such as cars more efficient than ever. Rev your students up for this exciting journey into energy transformation.

stileapp.com/go/energy_transformation

The big ideas covered in this unit are:

- What sorts of energy are there?
- What's the difference between energy transfer and energy transformation?
- What are Sankey diagrams?
- How can we improve the efficiency of machines?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students using the real-world context of energy research and assess prior knowledge.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about how energy conversion can be a wasteful process and what science is doing to reduce this waste
- Construct a mind map for what they already know about energy

1.1 Lesson: What is energy?

approx. 20 minutes

Introduce students to the concept of energy and identify common types of energy.

VIDEO

Learning Goals

1. State what energy is
2. Distinguish between the main types of energy

Core Activities

- Define energy
- Identify common types of energy
- Reflect on their learning with the *very important points reflection strategy*

1.2 Lesson: Energy transfer and energy transformation

45–60 minutes

Explore the difference between energy transfer and energy transformations and represent these changes using Sankey diagrams.

VIDEO

Learning Goals

1. Compare energy transfer and energy transformation
2. Use Sankey diagrams to represent energy transformations

Core Activities

- Identify energy transfer and energy transformation in simple everyday examples
- Learn what a Sankey diagram is and apply this knowledge to examples
- Reflect on their learning with the *connect, extend, challenge visible thinking routine*

1.3 Lesson: Energy efficiency

45–60 minutes

Examine the concept of energy efficiency.

Learning Goals

1. Distinguish between useful energy and waste energy
2. Calculate the energy efficiency of different processes

Core Activities

- Identify useful and wasted energy in a range of everyday examples
- Calculate energy efficiency and compare the efficiency of cars
- Watch videos to find out how waste energy can be turned into useful energy
- Reflect on their learning with the *think, puzzle, explore visible thinking routine*

1.4 Investigation: Bouncing balls

45–60 minutes

Compare the bounce efficiencies of various balls and identify the transformations that occur.

MATERIALS REQUIRED

Learning Goals

1. Determine the energy efficiency of a variety of bouncing balls

Core Activities

- Complete simple calculations to find out bounce efficiency of a variety of balls
- Fill out a Sankey diagram for a ball bounce

1.5 Extension: The law of conservsation of energy

10–15 minutes

Introduce students to the law of conservation of energy

VIDEO

Learning Goals

1. Describe the law of conservation of energy

Core Activities

- Read about the law of conservation of energy
- Watch a video of swinging pendulum and apply this to energy transfer
- Reflect on their learning with the *headlines visible thinking routine*

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling research scientist Corey Hewitt.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Corey Hewitt's invention of a new material to capture wasted heat as an energy source
- Brainstorm and discuss why it is important to change the way we use and waste energy

Heat

The secret ingredient

The best pizza chefs around the world know that cooking the perfect pizza requires a secret ingredient – heat! Scientists have confirmed that a wood-fired oven provides the optimal balance of heat to achieve a crispy dough and evenly cooked toppings. Through this context, explore what heat is and the different ways it is transferred. Your students will be hungry to find out more!

stileapp.com/go/heat

The big ideas covered in this unit are:

- How is heat energy relevant in our everyday lives?
- What are conduction, convection and radiation?
- How can heat be explained using the particle model?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
4.3 Engineering challenge: Build a solar oven	Design, build and test a solar oven	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10 minutes

Engage students in the topic by exploring a recent science news story.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read an article about the physics behind the perfect Italian pizza
- Design their own perfect pizza

What do you already know?

10–15 minutes

Identify students' prior knowledge of energy and temperature.

VIDEO

Learning Goals

1. Revise your existing knowledge of energy and temperature

Core Activities

- Identify types of energy, energy transfers and energy transformations
- Consider what they already know about temperature

1.1 Lesson: What is heat?

30–45 minutes

Examine what heat is and explore how the particle model relates to thermal energy.

VIDEO

Learning Goals

1. Define heat
2. Explain what thermal energy is using the particle model

Core Activities

- Examine what heat is and the direction of heat transfer
- Use the particle model of matter to relate thermal energy to the kinetic energy of particles
- Reflect on their learning using the *very important points reflection strategy*

2.1 Lesson: Conduction

45–60 minutes

Introduce conduction, explain why it occurs and compare conductors and insulators.

VIDEO

Learning Goals

1. Describe conduction at the particle level
2. Compare conductors and insulators

Core Activities

- Define conduction
- Watch a video that explains how conduction occurs at the particle level
- Compare thermal insulators and conductors
- Explain why solids make better conductors than liquids and gases
- Reflect on their learning by completing the *I used to think, but now I think visible thinking routine*

2.2 Investigation: Which material is the best insulator?

120–180 minutes

Conduct an open inquiry to investigate the best material for insulating a hot pizza.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables
4. Evaluate the quality of the data collected
5. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Form teams and assign roles
- Research materials that make good conductors
- Design a methodology for their investigation
- Summarize results and evaluate the experiment for errors
- Use a rubric to evaluate how well they went on the investigation

3.1 Lesson: Convection

45–60 minutes

Explain convection using the particle model.

VIDEO

Learning Goals

1. Describe how heat is transferred by convection
2. Explain convection at the particle level

Core Activities

- Use the predict–observe–explain routine to examine a demonstration of convection
- Apply the idea of convection to different real-world scenarios
- Read about convection at the particle level and apply this to the demonstration
- Identify the movement of particles and substances in different examples of convection currents
- Reflect on their learning with the *connect, extend, challenge visible thinking routine*

3.2 Practical activity: Modelling convection currents

45–60 minutes

Observe and explain the movement of convection currents.

MATERIALS REQUIRED

Learning Goals

1. Explain the movement of convection currents

Core Activities

- Explore how heat drives convection currents using the predict–observe–explain method
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

4.1 Lesson: Radiation

45–60 minutes

Introduce radiation and compare substances that reflect, transmit and absorb radiant heat.

VIDEO POSTER

Learning Goals

1. Describe how heat can be transferred by radiation
2. Compare how different materials reflect, absorb and transmit radiation

Core Activities

- Brainstorm examples of objects that emit heat
- Learn about radiation and compare it to the other types of heat transfer
- Watch a video that shows how infrared cameras detect heat
- Explore how different objects reflect, transmit and absorb radiation
- Reflect on their learning by completing the *very important points reflection strategy*

4.2 Investigation: Which colour absorbs the most radiation?

120–180 minutes

Conduct an open inquiry to investigate heat absorption by different coloured surfaces.

MATERIALS REQUIRED

Learning Goals

1. Plan and conduct a scientific investigation that is a fair test
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables
4. Evaluate the quality of the data collected
5. Describe potential errors within the experimental design and suggest possible improvements

Core Activities

- Form teams and assign roles
- Research materials that reflect, absorb and transmit radiation
- Design a methodology for their investigation
- Summarize results and evaluate them for errors and against expectations
- Complete a class brainstorm and discussion around any new questions they may now have, and what they would need to investigate further
- Use a rubric to evaluate how well they went on the investigation

4.3 Engineering challenge: Build a solar oven

180–240 minutes

Use the engineering process to design, build and test a solar oven.

VIDEO

MATERIALS REQUIRED

Learning Goals

1. Design, build and test a solar oven
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Watch a video explaining the value of solar ovens for solving real-world problems
- Design, build and test a solar oven

5.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling pizza chef Michele Scotti.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Michele Scotti's use of his engineering skills to make the perfect pizza
- Reflect via a class brainstorm and discussion about how science and cooking intersect

Magnetism

The most magical room on Earth

The world is fast becoming wireless. Now Disney Research Lab has invented a wireless charging room where devices can recharge automatically. It seems truly magical, but this ambitious project takes advantage of magnetism and its unique connection with electricity. Walk on into this unit to find out more about this mysterious force!

stileapp.com/go/magnetism

The big ideas covered in this unit are:

- How do magnets and magnetic fields work?
- What makes an object magnetized or not?
- What is electromagnetism and how can we make use of it?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	30–45 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10 minutes

Engage students in the topic by exploring Disney's development of a wirelessly powered room.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read a science news article about Disney's development of a wirelessly powered room
- Brainstorm uses for wireless electricity

What do you already know?

5–10 minutes

Identify students' prior knowledge of magnetism.

Learning Goals

1. Revise what you already know about magnetism and what you would like to find out going forward

Core Activities

- Create a mind map to display their current understanding of magnets and magnetism

1.1 Lesson: Magnets

45–60 minutes

Introduce the basic principles of magnets and magnetism.

VIDEO

MATERIALS REQUIRED

Learning Goals

1. Define magnetism
2. Distinguish between magnetic and non-magnetic materials
3. Explain the behaviour of magnets in terms of poles and magnetic fields

Core Activities

- Watch a short video about the power of neodymium magnets
- Brainstorm everyday objects that contain magnets
- Define magnetism and identify magnetic and non-magnetic objects
- Describe the poles of magnets and how they interact with each other
- Draw magnetic fields and explain their effects
- Reflect on their learning by completing the *very important points reflection strategy*

1.2 Practical activity: Mapping magnetic fields

45–60 minutes

Map magnetic fields and explain the interaction of magnets using the magnetic field model.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Map the magnetic fields of magnets with different shapes
2. Analyze how two magnetic fields interact to cause attraction or repulsion

Core Activities

- Describe how compass directions relate to magnetic field directions
- Map the magnetic fields of two magnets with different shapes, using iron filings and a compass
- Investigate how two magnetic fields interact during attraction and repulsion
- Apply their understanding to magnetic levitation
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.3 Extension: What causes magnetism?

45–60 minutes

Explain magnetism in terms of magnetic domains.

VIDEO | INTERACTIVE

Learning Goals

1. Explain why and how some materials can be magnetized
2. Compare temporary and permanent magnets

Core Activities

- Follow the predict–observe–explain method to examine a demonstration of magnetization
- Apply the model of magnetic domains to explain different scenarios
- Compare the features of temporary and permanent magnets, and brainstorm their uses
- Reflect on their learning by completing the *I used to think, but now I think visible thinking routine*

2.1 Lesson: Electromagnetism (Part 1)

30–45 minutes

Describe how electric currents produce magnetic fields.

VIDEO | INTERACTIVE

Learning Goals

1. Describe magnetic fields produced by electric currents
2. Explain the role of electromagnets in simple electronic devices

Core Activities

- Watch a short video about Oersted's discovery of electromagnetism
- Use an interactive of Oersted's original experiment and explain the significance of his observations
- Read about how electromagnets work
- Connect ideas between magnetic fields and the strength of electromagnets
- Apply their understanding of electromagnets to real-world scenarios
- Reflect on their learning by completing the *headlines visible thinking routine*

2.2 Investigation: Electromagnets

60–90 minutes

Plan and conduct a scientific investigation about the strength of electromagnets.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Build a simple electromagnet and investigate how to make it stronger
2. Plan and conduct a scientific investigation that is a fair test
3. Collect and record relevant data
4. Analyze trends in data to describe relationships between variables

Core Activities

- Build a simple electromagnet
- Investigate how to vary the strength of the electromagnet
- Analyze and communicate their results
- Reflect on their learning using a rubric

2.3 Practical activity: Make a simple electric motor

60–90 minutes

Examine the role of magnets in the operation of a simple motor.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Investigate how a simple motor uses an electromagnet to produce motion
2. Design and build a simple machine that uses the simple motor as a source of motion

Core Activities

- Build a simple electric motor and examine the roles of the electromagnet and the permanent magnet
- Research household appliances that use electric motors
- Modify their motor to create a simple moving machine
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

2.4 Lesson: Electromagnetism (Part 2)

45–60 minutes

Describe how changing magnetic fields induce electric currents and explore some applications.

VIDEO | INTERACTIVE | SIMULATION

Learning Goals

1. Analyze electric currents produced by magnetic fields
2. Describe how magnets generate electricity in different devices

Core Activities

- Use an interactive to investigate how moving a magnetic field produces an electric current in a wire
- Investigate how the electric current is affected by moving the magnet in different ways or changing the number of coils of wire
- Apply their understanding of electromagnetic induction to real-world scenarios
- Reflect on their learning by completing the *very important points reflection strategy*

3.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Disney Research scientist Alanson Sample.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video to see what Dr Alanson Sample's work with the Disney Research Lab involves
- Answer questions about the video

Light and Colour

Why is the sky blue?

Although science has answered this question, there are still lots of fascinating things to discover about light, one of the most familiar forms of energy. Take your students on a colourful journey to discover the properties of light and colour.

stileapp.com/go/lightandcolour

The big ideas covered in this unit are:

- What is light?
- What is the period and frequency of a light wave?
- Why do light waves reflect and refract?
- What causes everyday objects to have different colours?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Consider the colour of the sky.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm and discuss what question they would ask Sir Isaac Newton

1.1 Lesson: Light waves

45–60 minutes

Explain how light waves create colour.

VIDEO

Learning Goals

1. Describe what the period and frequency of waves are
2. Explain the relationship between frequency and colour, and how objects appear to have colour
3. Distinguish between reflection and refraction

Core Activities

- Distinguish between the frequency and period of waves
- Explain the visible spectrum of light
- Distinguish between refraction and reflection, giving examples of objects that do each

1.2 Lesson: Explaining colour

45–60 minutes

Apply knowledge of light to practical examples.

Learning Goals

1. Explain how the colour of leaves is influenced by the sun
2. Design an item of clothing suitable for both summer and winter

Core Activities

- Explain how the colour of leaves is influenced by the sun
- Design an item of clothing suitable for both summer and winter

1.3 Practical activity: Properties of bubbles

45–60 minutes

Examine the properties of bubbles.

MATERIALS REQUIRED

Learning Goals

1. Investigate the properties of bubbles
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables

Core Activities

- Create bubbles and observe the characteristics and properties of them
- Analyze the results and observations

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Bent Weber.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about the work Bent Weber does with electronics
- Consider and justify what combination of work and hobbies they would like to have

Lenses

Smartphones just got smarter

Through their ability to bend light, lenses have been helping transform our lives for centuries. Peer into the amazing world of lenses with your students and discover a new type of lens that means you can now use your smartphone as a microscope.

stileapp.com/go/lenses

The big ideas covered in this unit are:

- How do we see?
- What is refraction and how is it useful?
- What are the differences between convex and concave lenses?
- How have microscopes developed through history?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.3 Project: How have lenses changed the world?	Research presentation	120–180 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explain how a smartphone can be used as a microscope.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm and discuss ways in which technology uses light

1.1 Lesson: Refraction and lenses

45–60 minutes

Explain refraction, and convex and concave lenses.

VIDEO

Learning Goals

1. Describe what refraction is
2. Outline the main differences between convex and concave lenses
3. Outline how microscopes and telescopes vary and what each are typically used for

Core Activities

- Explain how we see objects
- Define refraction and reflection
- Explain how light changes when it passes through different mediums
- Distinguish between convex and concave lenses

1.2 Lesson: Telescopes and microscopes

45–60 minutes

Compare and contrast telescopes and microscopes.

VIDEO

Learning Goals

1. Distinguish between a telescope and a microscope
2. Identify and justify which viewing device would be suitable for a range of objects
3. Calculate size and magnification of a coin

Core Activities

- Explain the differences in lenses in a microscope and telescope
- Research the sizes of a variety of objects and justify the choice of viewing object
- Investigate real-world applications of simple lenses

1.3 Project: How lenses have changed the world

120–180 minutes

Research how lenses have changed the world.

Learning Goals

1. Investigate and create a presentation on how lenses have changed the world

Core Activities

- Research how lenses have changed the world
- Create an engaging visual presentation of their findings

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling physicist Steve Lee.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Steve Lee and consider some of his optical technology inventions
- Explain an app that could be developed to accompany one of his new inventions

Sound

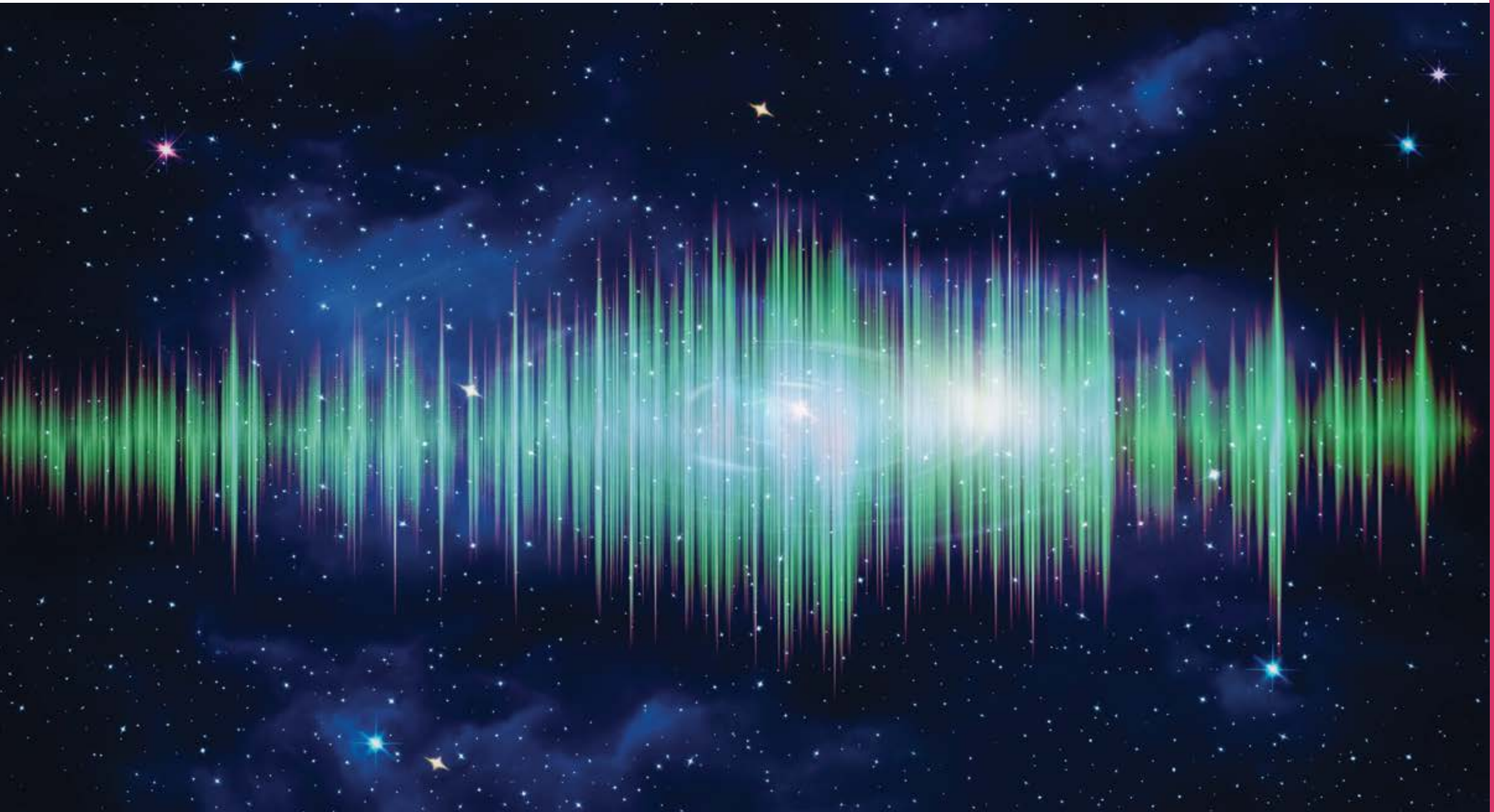
In space no one can hear you scream – or can they?

We think of space as a silent place – a vacuum through which sound waves cannot travel. But there are other types of waves that travel through space, and when converted into sound they make for an eerie listening experience. From silent screams to what music looks like – tune your students into the science of sound.

stileapp.com/go/sound

The big ideas covered in this unit are:

- What are waves, and what type of wave is sound?
- What properties do all waves share?
- Can we see sounds?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine if we can hear sounds in space.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Watch a video about sound in space
- Brainstorm the emotions they have felt when hearing certain sounds

1.1 Lesson: Sound waves

45–60 minutes

Explain sound waves and the speed of sound.

VIDEO

Learning Goals

1. Define what a wave is
2. Explain the difference between transverse and longitudinal waves
3. Explain what amplitude, wavelength and frequency are
4. Describe how sound can travel at different speeds

Core Activities

- Distinguish between waves that can travel through a medium or a vacuum
- Distinguish between transverse and longitudinal waves using a labelled diagram
- Graph sound waves
- Participate in polls on the types of sounds that would produce certain amplitudes and frequencies

1.2 Lesson: The speed of sound

45–60 minutes

Investigate wavelength and frequency.

VIDEO SIMULATION

Learning Goals

1. Explain the relationship between wavelength and frequency
2. Calculate the speed of sound and compare the speed sound travels through different mediums

Core Activities

- Use interactive simulations to explore the relationship between wavelength and frequency
- Graph wavelength and frequency from examples
- Calculate and compare the speed of sound through different mediums

1.3 Practical activity: Hearing range

45–60 minutes

Investigate the hearing range of humans and other animals.

VIDEO

Learning Goals

1. Investigate your hearing range
2. Compare your hearing range to that of your classmates
3. Compare human hearing range to other animals

Core Activities

- Work out their hearing range using a simple video
- Create a histogram for the lowest and highest frequencies heard in the class
- Consider the correlation between age and hearing range
- Graph the hearing range of six people of varying ages

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling musician Nigel Stanford.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about the experiments conducted by Nigel Stanford
- Explain the artistic possibilities in science

Radiation

In space, it's the stuff you can't see that can kill you

A vacuum that would make your eyes pop out and a temperature cold enough to freeze air are obvious dangers in space. But just as deadly is the invisible stream of cosmic radiation that could kill an astronaut even if they never went outside their spacecraft. Scientists are thinking about how we can protect astronauts from these rays as they travel to Mars, a trip that will take more than two years. You won't believe what they came up with.

stileapp.com/go/radiation

The big ideas covered in this unit are:

- What is radiation and what types are there?
- What are some of the ways we use radiation?
- Why is ionizing radiation dangerous?
- If radiation causes cancer how can it be used to treat cancer?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine the protection of astronauts from deadly cosmic radiation.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about how scientists are planning to protect astronauts against radiation
- Brainstorm and discuss existing knowledge on radiation

1.1 Lesson: What is radiation?

45–60 minutes

Explain radiation and its different types.

VIDEO

Learning Goals

1. Describe what radiation is and list the different types
2. Describe some ways radiation is used in everyday life
3. Discuss differences between ionizing and non-ionizing radiation

Core Activities

- Define radiation
- Consider types of radiation and their uses
- Distinguish between ionizing and non-ionizing radiation using examples
- Examine the electromagnetic radiation spectrum
- Classify radiation as alpha, beta or gamma

1.2 Lesson: Uses of radiation

45–60 minutes

Explore positive and negative applications of radiation.

VIDEO

Learning Goals

1. Explain galactic cosmic rays and why they are a concern for astronauts travelling to Mars
2. Consider how radiation can be used in a beneficial way

Core Activities

- Explain the concerns of galactic cosmic rays for astronauts
- Calculate the absorbed dose for patients receiving radiation therapy as a cancer treatment
- Explain the benefits and risks associated with radiotherapy

1.3 Investigation: Alpha, beta and gamma rays

45–60 minutes

Conduct a remote experiment to examine radiation.

Learning Goals

1. Compare the effectiveness of different types of material in blocking alpha, beta and gamma radiation
2. Identify a mystery source of radiation
3. Compare the effects of different types of radiation on living tissue

Core Activities

- Conduct an experiment to compare the effectiveness of different materials at blocking radiation
- Compare the effects of different radiation types on living tissue
- Graph and interpret their results

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Dr Peter Karamoskos.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Dr Peter Karamoskos' career
- Consider the risks associated with working with radiation

Electrical Circuits

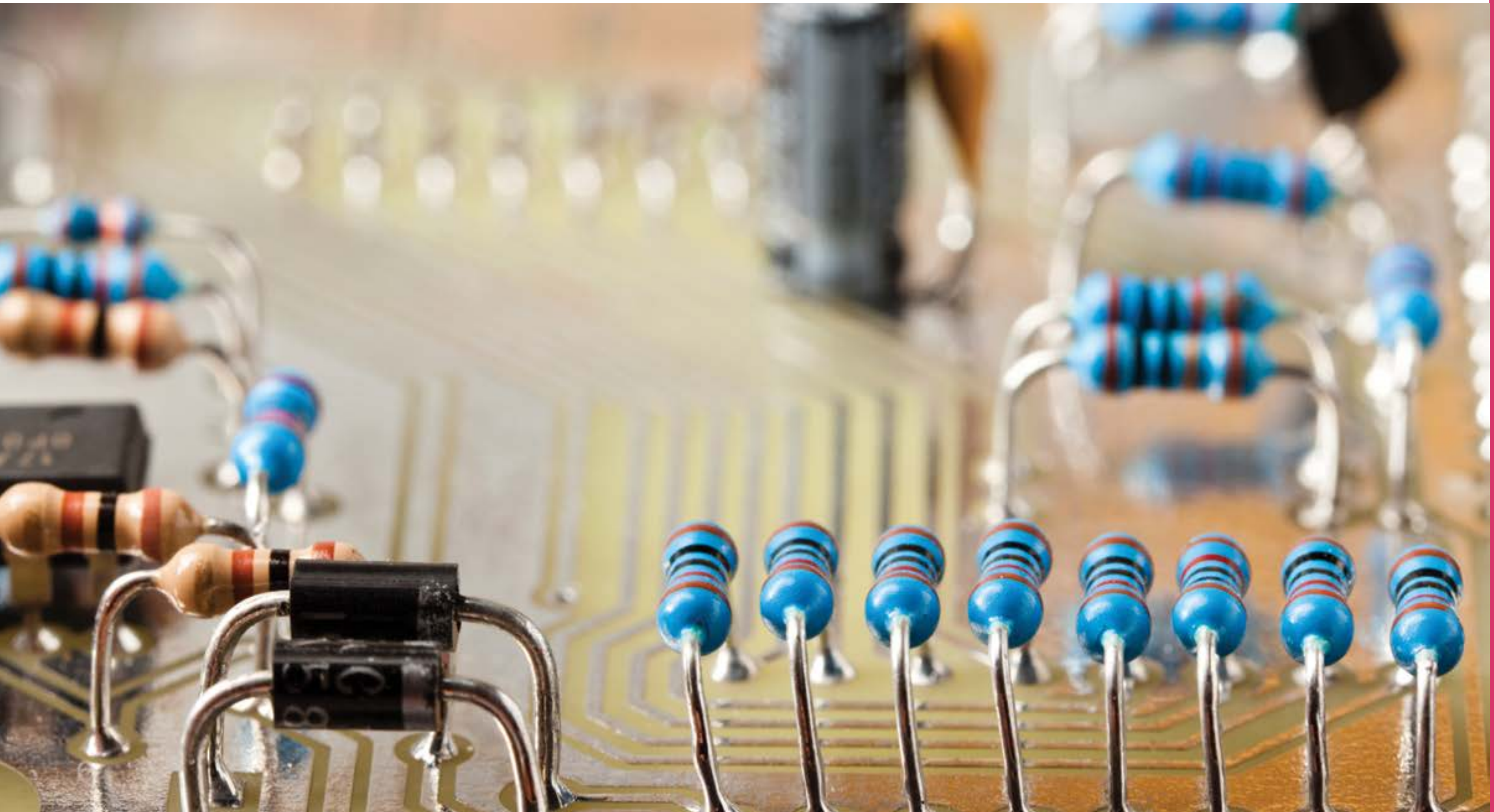
Electrical circuits on the catwalk?

Electrical circuits are everywhere in the modern world – hidden in the walls of our houses and packed inside our phones, computers and cars. Engineers are now working at knitting circuits into our clothes so we might one day wear devices that continuously monitor our health. Keep your students ahead of the trend as they explore electrical circuits through this context.

stileapp.com/go/electricity

The big ideas covered in this unit are:

- What is electrical current and how is it created?
- What are the necessary components of a circuit?
- What are voltage and resistance, and how are they related?
- What is Ohm's law?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine how electronics can be built into clothing.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about how scientists are working on building electronics into clothing
- Brainstorm ways in which we rely on electricity
- Consider how life would be different without electricity

1.1 Lesson: Current, voltage and resistance

45–60 minutes

Explain electrical current and how it is calculated.

VIDEO

Learning Goals

1. Explain what electrical current, voltage and resistance are
2. Use symbols to represent the arrangement of components in circuit diagrams

Core Activities

- Explain electrical current
- Define and distinguish between current, voltage and resistance
- Draw a basic circuit diagram

1.2 Lesson: Ohm's law

45–60 minutes

Explain Ohm's law.

Learning Goals

1. State Ohm's law and use it to calculate either current, voltage or resistance

Core Activities

- Graph current and voltage to understand the relationship between them
- Use Ohm's law to calculate current, voltage and resistance
- Draw a circuit diagram and use Ohm's law to calculate the total resistance
- Design a fun application of electrical technology

1.3 Investigation: Current and voltage in an electrical circuit

60–90 minutes

Investigate current and voltage around a simple circuit.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Construct an electrical circuit to examine current and voltage

Core Activities

- Construct a simple circuit to examine current and voltage
- Record and analyze their results

Lesson: Career profile

20–30 minutes

Encourage students to think about careers in STEM by profiling electrical engineers.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video on electrical engineering and research a project engineers are working on

Energy Conservation

Can we use ocean waves to produce electricity?

Roller coasters are thrilling, hurtling up and down at high speed. Each one of those dips and rises involves the transformation of energy. And the same sorts of transformation occur in rivers and in the rise and fall of ocean waves, which can be tapped to generate electricity. Students will be taken on a ride as they explore the transformation and conservation of energy in this unit.

stileapp.com/go/energyconservation

The big ideas covered in this unit are:

- What energy transformations do roller coasters undergo?
- How does the law of conservation of energy influence roller coaster design?
- How is the energy stored in dam water and ocean waves converted into electricity?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Examine methods of harnessing renewable energy.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Participate in a poll predicting the efficiency of common energy transformations

1.1 Lesson: The law of conservation of energy

45–60 minutes

Explain energy conservation using a rollercoaster.

VIDEO

Learning Goals

1. Explain the energy transformations that occur on a rollercoaster
2. Describe how the law of conservation of energy influences rollercoaster design
3. Explain the energy transformations in hydroelectric dams and for wave power

Core Activities

- Examine the motion of a roller-coaster to explain gravitational potential energy and identify the energy transformations taking place
- Identify points of energy transformation along a rollercoaster's path
- Calculate a rollercoaster's kinetic and gravitational potential energy
- Explain the law of conservation of energy

1.2 Lesson: Hydro power energy transformations

45–60 minutes

Explore the energy transformations occurring in the Three Gorges Dam.

VIDEO

Learning Goals

1. Identify and label the key energy transformations taking place in a hydroelectric dam
2. Describe the energy transformations involved in the "duck gen" electricity generator
3. Identify places energy is lost during transformations

Core Activities

- Label the main types of energy involved in hydroelectric power
- Identify the wasted energy forms in hydroelectric power
- Describe the energy transformations involved in wave energy
- Research the environmental impact of a chosen source of hydropower

1.3 Simulation: Energy changes in a skate park

45–60 minutes

Explore energy types and transformations using a skate park simulation.

VIDEO SIMULATION MATERIALS REQUIRED

Learning Goals

1. Explain the energy transformations and wasted energy types of a skater on a ramp
2. Calculate the skater's potential energy and energy loss

Core Activities

- Use a skate park simulation to investigate energy transformations
- Explain the movement of the skater in relation to potential energy and efficiency
- Calculate the skater's potential energy and efficiency

Lesson: Career profile

15–20 minutes

Encourage students to think about careers in STEM by profiling engineer Cengiz Shevket.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Explain if they would prefer to work in a science lab or the outdoors if they were to pursue a career in physics

Kinematics

Self-driving cars vs. drones... the battle is on!

Driverless devices are fast becoming the norm. Programming these devices to know whether they're on a collision course or not requires basic data about distances, times, velocities and accelerations. Students apply their knowledge of kinematics to help a food delivery company determine the most efficient method to deliver food to a music festival. Will it be a self-driving car or a drone?

stileapp.com/go/kinematicsunit

The big ideas covered in this unit are:

- How do scientists describe motion in terms of time, distance and speed?
- What is the difference between scalar and vector quantities?
- How do graphs help us understand velocity and acceleration?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.2 Quiz: Time, distance & speed	Multiple choice questions	10–15 minutes	Automatic
2.2 Quiz: Vectors & velocity	Multiple choice questions	10–15 minutes	Automatic
2.3 Project: Speeds of things	Research project	120–180 minutes	Teacher reviewed
3.1 Quiz: Acceleration	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–30 minutes

Examine self-driving car technology.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm prior knowledge of the concept of motion
- Read about self-driving cars
- Participate in a poll about the safety of self-driving cars and justify their answer

1.1 Simulation: Time, distance & speed

45–60 minutes

Explore the relationship between time, distance and speed.

SIMULATION

Learning Goals

1. Describe the relationship between time, distance and speed

Core Activities

- Use a van-driving simulation to explore time, distance and speed
- Interpret distance-time and speed-time graphs
- Draw a distance-time and speed-time graph of the van's movement

1.2 Lesson: Time, distance & speed

45–60 minutes

Graphically represent time, distance and speed.

SIMULATION

Learning Goals

1. Define speed and distinguish between instantaneous and average speed
2. Calculate average speeds
3. Construct distance-time and speed-time graphs to represent the motion of objects
4. Describe the relationship between speed-time and distance-time graphs

Core Activities

- Use a simulation to provide data to create a distance-time graph
- Interpret their distance-time graphs
- Apply the speed equation to calculate speed for given examples
- Convert between km/h and m/s

1.3 Lesson: Average speed

45–60 minutes

Distinguish between average and instantaneous speed.

Learning Goals

1. Explain the difference between instantaneous and average speed
2. Use the average speed equation

Core Activities

- Define instantaneous and average speed
- Apply the average speed equation to given examples

1.4 Lesson: Transposing equations

15–20 minutes

Explain how to transpose equations.

Learning Goals

1. Transpose equations to find different information

Core Activities

- Practice transposing the speed equation to find different information

1.5 Lesson: Graphing speed

45–60 minutes

Link the gradient of a graph to speed.

SIMULATION

Learning Goals

1. Construct a distance-time graph to establish the relationship between the slope of the graph and speed

Core Activities

- Interpret the motion of an object at different times from given distance-time graphs
- Determine the different information that can be gained from a distance-time or speed-time graph
- Interpret the motion of an object at different times from given speed-time graphs
- Match distance-time and speed-time graphs for the same object's motion

2.1 Simulation: Displacement & velocity

10–15 minutes

Introduce displacement and negative velocity.

SIMULATION

Learning Goals

1. Use the terms "displacement" and "velocity" appropriately

Core Activities

- Use a simulation to explore the concepts of displacement and negative velocity

2.2 Lesson: Vectors & velocity

45–60 minutes

Explore scalar and vector quantities.

Learning Goals

1. Distinguish between scalar and vector quantities
2. Distinguish between distance and displacement, and speed and velocity
3. Use positive and negative velocities to describe motion

Core Activities

- Distinguish between distance and displacement
- Define a vector quantity
- Calculate distance and displacement of objects
- Distinguish between speed and velocity
- Calculate average velocity from given examples
- Explain the difference between speed and velocity
- Distinguish between positive and negative velocities

2.3 Project: Speeds of things

120–180 minutes

Investigate a chosen topic relating to speed.

Learning Goals

1. Investigate a category of object and type of measurement
2. Present data in an accurate and meaningful way

Core Activities

- Independently research a chosen object and measurement type to investigate and present their findings on

3.1 Lesson: Acceleration

45–60 minutes

Explore acceleration and the units used to measure it.

VIDEO

Learning Goals

1. Explain what acceleration is and the units used to measure it
2. Calculate positive and negative accelerations
3. Explain the relationship between slopes of velocity-time graphs and acceleration

Core Activities

- Define acceleration and identify the units used to measure it
- Brainstorm everyday examples of objects accelerating
- Calculate an object's acceleration from given examples

3.2 Lesson: Acceleration & graphs

45–60 minutes

Investigate velocity-time graphs.

Learning Goals

1. Construct a velocity-time graph and interpret the slope
2. Interpret a positive and negative velocity-time graph

Core Activities

- Calculate the velocities of an accelerating object then create a velocity-time graph from this data
- Interpret the motion of an object from the shape of a velocity-time graph
- Interpret negative velocity-time graphs to describe an object's motion

3.3 Lesson: Acceleration & gravity

45–60 minutes

Explore acceleration relating to gravity.

VIDEO

Learning Goals

1. Explain what acceleration is and the units used to measure it
2. Calculate positive and negative accelerations
3. Explain the relationship between slopes of velocity-time graphs and acceleration

Core Activities

- Label parts of a velocity-time graph to explain the motion of a ball
- Calculate average acceleration of given examples
- Graph the motion of a tomato and a bungee jumper

3.4 Practical activity: Option 1 – ticker timer

45–60 minutes

Engage students with the tangible physical effects of motion.

MATERIALS REQUIRED

Learning Goals

1. Use a ticker timer to create motion graphs
2. Interpret the graphs to describe the object's motion

Core Activities

- Pull tape through a ticker timer then produce distance-time and speed-time graphs
- Put the graphs together and interpret them

3.5 Practical activity: Option 2 – rolling ball

45–60 minutes

Engage students tangible physical effects of motion.

MATERIALS REQUIRED

Learning Goals

1. Investigate motion of a rolling ball
2. Collect and record relevant data
3. Analyze trends in data to describe relationships between variables

Core Activities

- Observe a ball rolling down a slope and collect data from this
- Graph and interpret the data collected to describe motion

3.6 Practical activity: Option 3 – measuring motion using video

45–60 minutes

Engage students with tangible physical effects of motion.

MATERIALS REQUIRED

Learning Goals

1. Investigate the motion of a moving object to extract and interpret data

Core Activities

- Film an object moving over a small distance
- Extract data from the footage to create motion graphs

3.7 Practical activity: Option 4 – measuring motion using a data logger

45–60 minutes

Engage students with tangible physical effects of motion.

MATERIALS REQUIRED

Learning Goals

1. Use a motion detector and data logger to generate motion graphs
2. Interpret the motion graphs to describe the motion you created

Core Activities

- Generate and analyze motion graphs for a motion they have created

4.1 Lesson: Science and society

15–20 minutes

Encourage students to think about careers in STEM by profiling Zane Humphrey.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Consider and discuss the safety and regulation of self-driving cars

Core Activities

- Watch a video about Zane Humphrey's automated vehicle project
- Explain their stance on the safety of self-driving vehicles
- Participate in a poll on how governments should regulate the programming of cars in the event of collisions
- Justify their point of view on this regulation

Newton's Laws of Motion

How can we use Newton's Laws in car crash investigations?

The forces in car crashes can be intense. Vehicle collision investigators use Newton's three laws of motion to help understand what happened, revealing if any drivers were at fault. In this unit, students are presented with a fictional car crash, and attempt to solve the case using their knowledge of Newton's Laws.

stileapp.com/go/NewtonsLawsUnit

The big ideas covered in this unit are:

- What are Newton's three laws of motion?
- How do they apply, both on Earth and in space?
- How do free body diagrams help us understand the effects of forces?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.2 Quiz: The first law of motion	Multiple choice questions	10–15 minutes	Automatic
1.3 Quiz: Inertia on Earth	Multiple choice questions	10–15 minutes	Automatic
1.4 Quiz: Free-body diagrams	Multiple choice questions	10–15 minutes	Automatic
2.2 Quiz: The third law of motion	Multiple choice questions	10–15 minutes	Automatic
2.3 Quiz: Gravity and the third law	Multiple choice questions	10–15 minutes	Automatic
2.4 Quiz: Recoil, jets and collisions	Multiple choice questions	10–15 minutes	Automatic
3.1 Engineering challenge: Balloon cars	Design and build balloon-powered cars	90–120 minutes	Peer and self assessed
3.2 Quiz: The second law of motion	Multiple choice questions	10–15 minutes	Automatic
3.3 Quiz: Applying the second law	Multiple choice questions	10–15 minutes	Automatic
3.6 Project: Battling misconceptions	Develop a creative video	120–180 minutes	Optional
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine Dawn, the spacecraft orbiting Ceres collecting data.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Brainstorm their existing knowledge of motion and forces

What do you already know?

45–60 minutes

Review students existing knowledge of forces.

Learning Goals

1. Revise your prior knowledge of forces

Core Activities

- Complete a crossword using concepts and terms associated with forces
- Describe the effects of a force
- Differentiate between speed and velocity
- Identify different types of forces and provide examples of them
- Label an image with force direction arrows and identify each type of force involved

1.1 Practical activity: Demonstrating Newton's first law

45–60 minutes

Demonstrate inertia in practical examples.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Demonstrate inertia in a range of experiments
2. Explain the outcomes of your experiments in relation to the law of inertia

Core Activities

- Predict the outcome of practical demonstrations, then explain the outcomes using diagrams
- Conduct a simple demonstration to show the law of inertia

1.2 Lesson: The first law of motion

45–60 minutes

Explain inertia and Newton’s first law of motion.

VIDEO

Learning Goals

1. Explain what inertia is
2. State Newton’s first law and describe how it applies to stationary and moving objects

Core Activities

- Apply the concept of inertia to given examples
- Consider how the law of inertia relates to road safety
- Describe the behaviour of an object at rest or in motion according to the law of inertia

1.3 Lesson: Inertia on Earth

45–60 minutes

Explore and apply the law of inertia on Earth.

VIDEO

Learning Goals

1. Explain how net forces cause objects to change their velocities
2. Describe how gravity, friction and air resistance disguise some of the effects of inertia on Earth

Core Activities

- Consider and explain why moving objects come to a stop
- Identify the forces acting in a range of given examples
- Consider the effects of friction, air resistance and water resistance on objects moving on Earth

1.4 Lesson: Free-body diagrams

45–60 minutes

Introduce and interpret free-body diagrams.

Learning Goals

1. Construct and interpret free-body diagrams

Core Activities

- Draw and interpret free-body diagrams

2.1 Practical activity: Demonstrating Newton’s third law

45–60 minutes

Demonstrate Newton’s third law.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Demonstrate Newton’s third law in a variety of activities
2. Construct inferences about the law based on your observations

Core Activities

- Complete a series of activities demonstrating Newton’s third law
- Predict what will happen in each activity, before attempting to explain their observations

2.2 Lesson: The third law of motion

45–60 minutes

Explain Newton's third law of motion.

VIDEO

Learning Goals

1. State Newton's third law of motion
2. Explain how the third law of motion applies to forces acting between objects

Core Activities

- Apply Newton's third law to the NASA Gemini 9 space mission
- Label forces in given examples
- Draw and interpret force diagrams for given examples

2.3 Lesson: Gravity and the third law

45–60 minutes

Explain Newton's third law in the context of gravity.

VIDEO

Learning Goals

1. Explain how Newton's third law applies to gravity, illustrating that paired forces are always equal

Core Activities

- Identify and label the forces acting between the Earth and the moon
- Explain why forces have equal size, even if the objects involved have differing masses
- Use force diagrams to explain the forces acting on a skydiver during free fall, and once landed

2.4 Extension: Recoil, jets and collisions

45–60 minutes

Apply Newton's third law to forces pushing objects apart.

VIDEO

Learning Goals

1. Apply Newton's third law of motion to gun recoil, jet engines and collisions

Core Activities

- Examine a range of objects being pushed apart and apply Newton's third law
- Draw force diagrams to explain the motion of given examples

2.5 Investigation: Water rockets

90–120 minutes

Build and test water-powered rockets.

MATERIALS REQUIRED

Learning Goals

1. Investigate how varying the amount of water loaded into water rockets affects their launch distance
2. Explain how Newton's laws apply to the motion of rockets

Core Activities

- Construct a rocket from provided materials
- Attempt to find the optimal mix of water and air to maximize launch distance
- Identify variables within the experiment
- Write a hypothesis and collect results for the experiment
- Graph and interpret the results, linking the results to Newton's third law of motion

3.1 Engineering challenge: Balloon cars

90–120 minutes

Design and build balloon-powered cars.

MATERIALS REQUIRED

Learning Goals

1. Design and construct a balloon-powered car

Core Activities

- Design and construct a balloon-powered car
- Test the car along a 10-metre track, adding mass for each trial
- Evaluate how adding mass affected the distance travelled

3.2 Lesson: The second law of motion

45–60 minutes

Explain Newton's second law of motion.

VIDEO SIMULATION

Learning Goals

1. State the second law of motion and describe how an object's acceleration depends on its mass and the force applied

Core Activities

- Extract force, mass and acceleration values from simulated examples
- State Newton's second law of motion
- Interpret speed-time graphs to explain the motion of an object
- Use evidence to support Newton's second law of motion

3.3 Lesson: Applying the second law

45–60 minutes

Apply Newton's second law of motion.

Learning Goals

1. Use the second law to calculate force, mass and acceleration

Core Activities

- Use Newton's second law equation to calculate force, mass and acceleration
- Use free-body diagrams to identify net forces

3.4 Extension: Flying car simulation

45–60 minutes

Apply Newton's second law to a flying-car simulation.

SIMULATION

Learning Goals

1. Use an interactive simulation to investigate flying-car collisions in space
2. Calculate the final and initial velocities of cars to work out their accelerations
3. Use F=ma to calculate the forces acting on the cars in collisions

Core Activities

- Investigate a flying-car simulation to draw conclusions relating to Newton's second and third laws
- Use the simulation to calculate acceleration

3.5 Investigation: Jet-propelled can

60–90 minutes

Apply Newton's laws to a practical example.

MATERIALS REQUIRED

Learning Goals

1. Explain how Newton's laws apply to a spinning can propelled by a jet of water

Core Activities

- Conduct an experiment using water jets to spin a can
- Explore if increasing the number of holes increases the speed that the can rotates
- Link Newton's laws to their observations

3.6 Project: Battling misconceptions

120–180 minutes

Identify common misconceptions of Newton's laws.

VIDEO

Learning Goals

1. Identify common misconceptions of Newton's laws
2. Develop a creative video to communicate a correct law of motion

Core Activities

- Interview fellow students to identify common misconceptions of Newton's laws of motion
- Create a video correcting and explaining a law of motion

4.1 Lesson: Science and society

20–30 minutes

Encourage students to think about careers in STEM by profiling Detective sergeant Jenelle Mehegan.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Reflect on the importance of Newton's laws and how they relate to the real world

Core Activities

- Consider how Newton's laws are relevant in the real world
- Explain the importance of reconstructing vehicle collisions and the benefit to society
- Discuss and explain how Newton's laws apply to a road accident

Author’s Notes

In this unit we present Newton’s third law of motion before the second law. We decided on this ordering after careful consideration of the pedagogy and in consultation with Dr David Low, an expert in physics education. Research has shown that students struggle with applying Newton’s laws consistently to concrete examples. This is because the laws challenge some of our most deep-seated intuitions about forces and motion.

The third law describes pairs of forces between interacting objects, capturing the fundamental point that forces never occur in isolation. A proper understanding of the third law allows students to identify the types and sizes of the forces acting in a concrete situation. It also challenges the misconception that a force is a property of an object instead of an interaction between two objects.

The second law is quite different to the third. It relates the net force acting on an object to the object’s mass and acceleration: $F = ma$. This requires focusing on one object in isolation. “Equal and opposite” forces acting on the same object are balanced, and cancel each other out. In contrast, the forces in a third-law pair are always “equal and opposite” but do not cancel each other out because they act on different objects. Armed with an understanding of the third law, the second law becomes easier to apply and this leads to better learning outcomes.

For these reasons, we present the laws in the order 1–3–2. We believe this provides better scaffolding for students as they struggle to overcome their misconceptions.

Our Place in Space

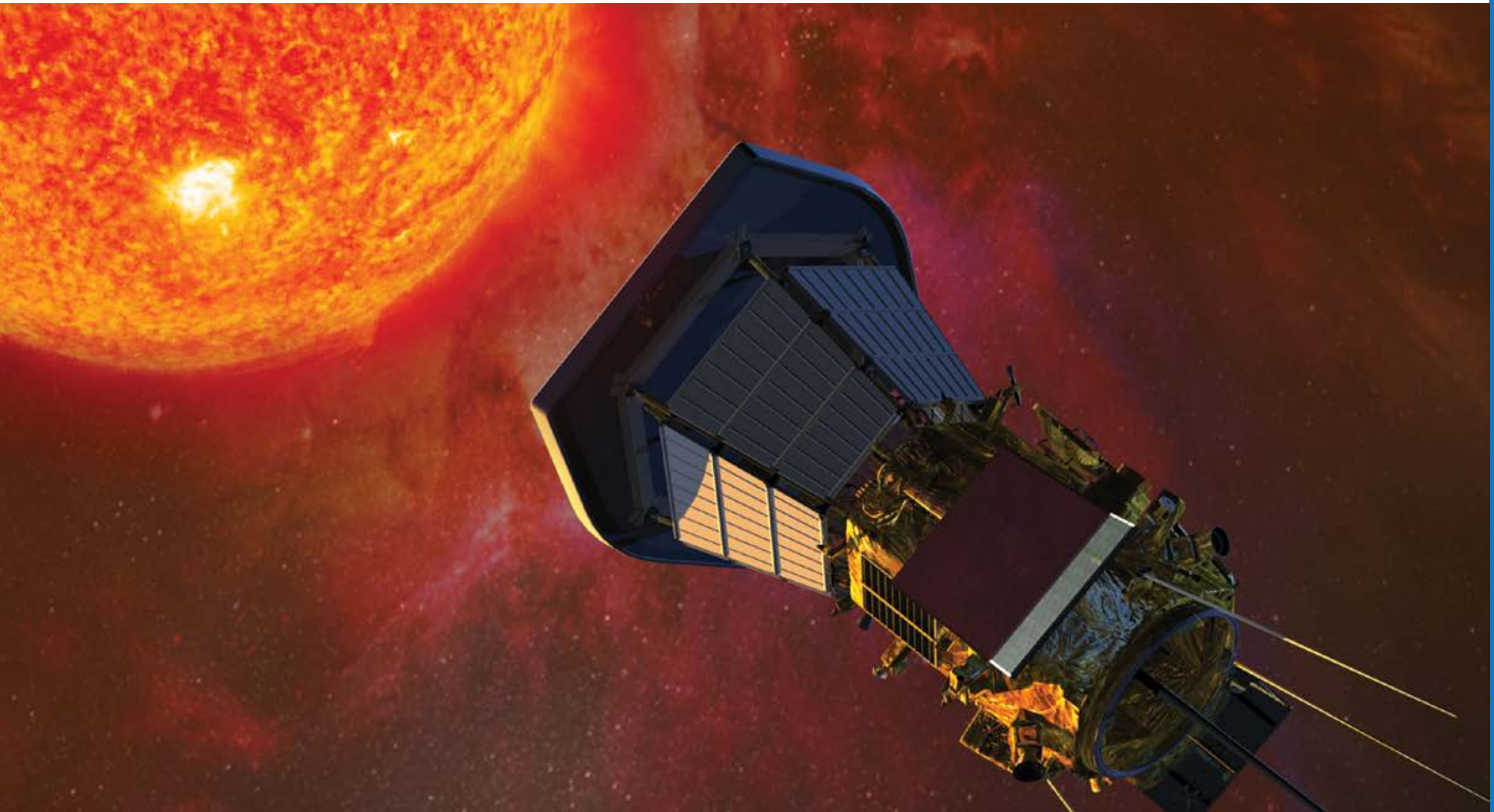
Journey to the Sun

In 2018, NASA launched the Parker Solar Probe on the first-ever mission to “touch” the Sun. The information it sends back could help solve many remaining puzzles about the object at the centre of our Solar System. Through this context, launch into an exploration of Earth’s place in space.

stileapp.com/go/our-place-in-space

The big ideas covered in this unit are:

- What makes up the Solar System?
- What causes day and night?
- Why do we have seasons?
- What causes eclipses and the phases of the Moon?



Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Project: Making a photo story	Photo stories	90–120 minutes	Peer and self assessed. Rubric provided
Engineering challenge: Heat shields	Design, build and test a model heat shield	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

20–30 minutes

Engage students with a news story about the Parker Solar Probe.

VIDEO

Learning Goals

1. Recognize that there is still much we don't know about the Sun

Core Activities

- Read a short science news article about NASA's launch of a probe that will travel to the Sun
- Watch a short video about the Parker Solar Probe
- Reflect on the video by recording what they already know and what they want to know about the Sun and the Parker Solar Probe

What do you already know?

20–30 minutes

Identify students' prior knowledge of the Solar System.

Learning Goals

1. Demonstrate your existing knowledge of the Solar System

Core Activities

- Brainstorm objects that make up the Solar System
- Complete diagnostic activities relating to day and night and the relationship of the Earth, Moon and Sun
- Use the *creative questions visible thinking routine* to record what they would like to know about the Solar System

Project: Making a photo story

90–120 minutes

Consider the way different cultures have explained outer-space phenomena.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Use technology to make photo stories
2. Investigate another culture's stories explaining phenomena in the universe

Core Activities

- Research a cultural story about a natural phenomenon related to the Earth, Moon or Sun
- Create a photo story to share their research
- Reflect on their learning by identifying what they did well and what they can improve on

Engineering challenge: Heat shields

180–240 minutes

Guide students through the engineering process for a model heat shield.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Design, construct and test a model heat shield
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design, build and test a heat shield

1.1 Lesson: The Solar System

45–60 minutes

Examine objects in the Solar System and consider its place in the Milky Way galaxy.

VIDEO | VR

Learning Goals

1. Describe the main objects that make up the Solar System
2. Outline how the Solar System is related to the Milky Way galaxy

Core Activities

- Watch a video about the planets in the Solar System and make their own mnemonic to remember the planets' order
- Examine the difference between moons, asteroids, meteors and meteorites
- Explore virtual reality or 360° images of stars in the night sky
- Consider the Solar System as part of the Milky Way galaxy
- Compare the Sun with the planets using a Venn diagram
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

1.2 Lesson: Orbits and years

45–60 minutes

Introduce orbits, gravity and satellites, and compare years on different planets.

VIDEO | VR | SIMULATION

Learning Goals

1. Describe what orbits and years are
2. Compare how long it takes different planets to orbit the Sun

Core Activities

- Consider gravity as the force that holds planets in orbit around the Sun
- Learn about natural and artificial satellites, and take a 360° or VR tour of the International Space Station
- Learn how the Earth's orbit is related to a year, and consider years on other planets
- Use an interactive to compare the time taken by different planets to orbit the Sun
- Calculate their age on different planets
- Reflect on their learning using the *very important points reflection strategy*

1.3 Practical activity: Modelling the Solar System

90–120 minutes

Examine models of the Solar System, and create a size model and a distance model of the Solar System.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Calculate the sizes and distances of planets to build scale models of the Solar System
2. Describe the limitations of models of the solar system

Core Activities

- Watch a video that explains why most models of the Solar System are inaccurate
- Compare the sizes of the planets and the Sun by creating a size model
- Compare the distances of the planets from the Sun by creating a distance model
- Reflect on their learning by using the *connect, extend, challenge visible thinking routine*

1.4 Lesson: Changing models of the Solar System

30–45 minutes

Explore how understanding of the Solar System has changed and evaluate the role of technology.

VIDEO | POSTER

Learning Goals

1. Compare heliocentric and geocentric models of the Solar System
2. Describe ways that scientific understanding changes over time

Core Activities

- Compare geocentric and heliocentric models of the Solar System
- Explore the importance of technology in helping to improve scientific models and understanding
- Identify how scientific understanding of the Solar System has changed
- Reflect on their learning using the *very important points reflection strategy*

2.1 Lesson: Day and night

30–40 minutes

Explain day and night in terms of the Earth's rotation.

VIDEO

Learning Goals

1. Explain what causes day and night

Core Activities

- Watch a video that shows what day and night look like from the International Space Station
- Examine how the Earth's rotation determines the length of one day
- Take part in a poll that targets misconceptions about the Moon
- Identify that the Moon does not cause night
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

2.2 Practical activity: Modelling day and night

20–30 minutes

Investigate how the rotation of the Earth results in day and night.

MATERIALS REQUIRED

Learning Goals

1. Use a model to explain how Earth's rotation causes day and night

Core Activities

- Create a model that shows how the Earth's rotation causes day and night
- Explain their observations
- Reflect on their learning by completing the *headlines visible thinking routine*

3.1 Lesson: Seasons

30–45 minutes

Explain that the Earth's tilt causes seasons.

VIDEO

Learning Goals

1. Explain why we have seasons

Core Activities

- Vote in a poll about what they think causes summer
- Watch a short video that debunks the misconception that Earth's elliptical orbit causes seasons
- Watch a short video that explains how seasons are caused by the Earth's tilt
- Analyze the position and orientation of the Earth during different seasons
- Optional extension: consider the tilt of other planets in the Solar System
- Reflect on their learning by completing the *headlines visible thinking routine*

3.2 Practical activity: Modelling sunlight intensity

45–60 minutes

Model sunlight and relate it to seasonal temperature changes.

MATERIALS REQUIRED

Learning Goals

1. Construct a model to explain direct and indirect sunlight
2. Explain how changes in sunlight intensity relate to the seasons

Core Activities

- Model direct and indirect sunlight
- Graph the relationship between the angle of a torch and the surface area of the light beam
- Analyze the results and relate them to how sunlight intensity influences the seasons
- Reflect by considering the reliability of their results and identifying possible improvements to the model
- Optional extension: use a mobile app to measure changing light intensity

3.3 Lesson: Daylight hours

45–60 minutes

Demonstrate changes in daylight hours and explain seasonal temperature change.

VIDEO

Learning Goals

1. Explain why daylight hours change with the seasons
2. Describe the effect of daylight hours on temperature

Core Activities

- Consider why daylight hours are longer in summer than in winter
- Watch a demonstration video that models the change in daylight hours through the year
- Relate the number of daylight hours to surface warming
- Reflect by considering the reliability of the model in the demonstration and identifying possible improvements
- Optional extension: graph the relationship between latitude and daylight hours during the northern hemisphere's summer

4.1 Lesson: The phases of the Moon

45–60 minutes

Explain the phases of the Moon.

VIDEO VR

Learning Goals

1. Distinguish between the phases of the moon
2. Explain why the Moon has phases

Core Activities

- Explore a 360° image of the Moon's surface
- Identify and name the phases of the Moon
- Consider the common misconception that the phases are caused by the Earth's shadow
- Watch a video explaining why the Moon has phases and consolidate their understanding by answering questions
- Examine why the Earth doesn't cast a shadow on the Moon every full moon
- Reflect on their learning by completing the *connect, extend, challenge visible thinking routine*

4.2 Practical activity: Modelling the phases of the Moon

45–60 minutes

Create a model that shows phases of the Moon.

MATERIALS REQUIRED

Learning Goals

1. Use scientific knowledge to draw conclusions supported by evidence
2. Evaluate the quality of the data collected
3. Describe potential errors within the experimental design and suggest possible improvements
4. Test and evaluate the success of your design

Core Activities

- Build a model that shows the phases of the Moon
- Record their results and name each phase
- Draw diagrams to show how a full moon and waning crescent moon are formed
- Reflect on their learning by discussing advantages, limitations and improvements to the model

4.3 Lesson: Eclipses

45–60 minutes

Explain the causes and distinguish between lunar and solar eclipses.

VIDEO

Learning Goals

1. Explain what causes solar and lunar eclipses

Core Activities

- Identify the circumstances in which each type of eclipse will occur
- Examine the similarities and differences between solar and lunar eclipses

4.4 Practical activity: Modelling eclipses

30–45 minutes

Model how lunar and solar eclipses occur.

MATERIALS REQUIRED

Learning Goals

1. Construct a model that shows how lunar and solar eclipses occur
2. Test and evaluate the success of your design

Core Activities

- Model a lunar eclipse and a solar eclipse
- Draw a diagram to show how each type of eclipse was created
- Reflect on their learning by identifying advantages, limitations and improvements to the model

5.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling astrophysicist Pauline Harris.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider the work of Pauline Harris
- Discuss what issues are important to them and their culture that they would like others to know about
- Explain why they think it is important for different cultures to share scientific knowledge

Tides

Can we use the power of tides to generate electricity?

We sure can. Tidal power has been slow to take off, but a new system just launched in the Bay of Fundy, on Canada's east coast, might just change all this... Surf's up!

stileapp.com/go/tides-lessons

The big ideas covered in this unit are:

- What causes tides?
- Why are there usually two high and low tides per day?
- How do tides relate to the phases of the Moon?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Engage students in the topic of tides.

Learning Goals

1. Identify what you already know about tides
2. Identify the time and height of the day's tides in your local area

Core Activities

- Learn about the Bay of Fundy in Canada
- Look up the times and heights of today's tides for their local area

1.1 Lesson: What causes tides?

45–60 minutes

Explain what tides are and how they relate to the phases of the Moon.

VIDEO

Learning Goals

1. Explain what causes tides and why there are two every day
2. Explain how tides relate to the phases of the Moon

Core Activities

- Identify factors that cause the Bay of Fundy to have such large tides
- State ways in which understanding tides is important
- Use an interactive diagram to explore the connection between the position of the Moon and the tide

1.2 Lesson: The effect of the Sun

45–60 minutes

Explain the effect of the Sun on tides.

Learning Goals

1. Illustrate the effect the Sun has on tides

Core Activities

- Use diagrams to show the relative strength and direction of the Sun's gravitational pull on the ocean
- Use an interactive diagram to explore the relationship between the position of the Sun, Moon and the tides
- Interpret tide graphs to determine water levels at given times

1.3 Practical activity: Modelling tides

20–30 minutes

Make a model of the tides.

MATERIALS REQUIRED

Learning Goals

1. Construct and interpret a simple model of the tides

Core Activities

- Construct a simple model of the tides
- Use the model to draw conclusions about the time of high or low tide in different locations

Lesson: Career profile

10–15 minutes

Encourage students to consider career opportunities by profiling research station manager Elizabeth Perkins.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider the career of Elizabeth Perkins
- Brainstorm and discuss their opinions of working on a remote island

Resources

How has our use of resources changed over time?

A new study has given us fresh clues about the workings of an ancient civilization. But it also highlights how all humans depend on the natural world around us for resources. Renew your students' passion for learning as you explore how even in our high-tech world we rely on natural resources in countless ways.

stileapp.com/go/resources

The big ideas covered in this unit are:

- What are resources?
- What makes a resource renewable or non-renewable?
- How do we generate electricity from fossil fuels and nuclear power?
- How can we use resources more sustainably?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: What are resources?	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: Renewability	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: Energy	Multiple choice questions	10–15 minutes	Automatic
3.2 Project: Energy at home	Simulation	45–60 minutes	Teacher reviewed
4.1 Quiz: Renewable energy	Multiple choice questions	10–15 minutes	Automatic
4.4 Engineering challenge: Wind power	Design, construct and test a model wind turbine	180–240 minutes	Peer and self assessed. Rubric provided
5.1 Quiz: Sustainability	Multiple choice questions	10–15 minutes	Automatic
5.2 Project: Sources of colour	Research project	90–120 minutes	Teacher reviewed
5.3 Engineering challenge: Beat the flood	Design, construct and test a model flood-proof home	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answers	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Introduce the topic of resources and examine students' prior knowledge.

Learning Goals

1. Identify what resources the ancient Mayans used
2. Identify resources that you have used today

Core Activities

- Identify resources in the context of food
- Participate in a poll to identify resources
- Attempt to explain their current understanding of what a resource is

1.1 Lesson: What are resources?

45–60 minutes

Explain what resources are and their uses.

VIDEO INTERACTIVE

Learning Goals

1. Define what natural resources are and explain their importance in our lives
2. Describe how the uses of a resource depend on its properties
3. List some important uses of animal and plant resources

Core Activities

- Identify synthetic resources made from natural ones
- Identify natural and synthetic resources from an interactive picture
- Label a diagram to show what can be made from different parts of an animal or plant
- Link properties of a resource to its use

2.1 Lesson: Renewability

45–60 minutes

Distinguish between renewable and non-renewable resources.

VIDEO

Learning Goals

1. Distinguish between renewable and non-renewable resources
2. Classify common resources as renewable or non-renewable
3. Explain why rocks, minerals, metals and soils are important resources

Core Activities

- Define the terms renewable and non-renewable resource
- Identify common renewable and non-renewable resources, justifying their choices
- Distinguish between rocks, minerals and metals and identify resources made from them

3.1 Lesson: Energy

45–60 minutes

Examine key energy resources and explain fossil fuel.

VIDEO

Learning Goals

1. List the world's main energy resources
2. Explain the importance of energy resources
3. Describe how fossil fuels are formed and used
4. Describe how fossil fuel and nuclear power plants work

Core Activities

- Create a timeline depicting when common energy resources came into use and their uses
- Distinguish between primary and secondary energy resources
- Interpret a graph to determine main energy resources used for different periods of time
- Identify energy resources required for a common activity they do at home
- Explain how fossil fuels are formed and used
- Label a diagram to show how a coal-fired power station works
- Interpret a diagram of a nuclear power station to determine how it works

3.2 Project: Energy at home

45–60 minutes

Simulate energy use in the home.

SIMULATION

Learning Goals

1. Use a simulation to understand the energy requirements in a house
2. Calculate the energy demands of certain household appliances
3. Propose ways energy could be saved

Core Activities

- Use a simulation to mimic energy use in a house
- Interpret the results of the simulation, identifying appliances which use large amounts of energy
- Calculate the energy requirement for the simulation house
- Calculate the amount of coal required to produce the required energy to power the simulation house
- Suggest and identify ways of saving energy or reducing the amount of energy required in the house
- Consider their own energy use and give themselves a score

4.1 Lesson: Renewable energy

45–60 minutes

Explain why renewable energy is an alternative to fossil fuels.

VIDEO

Learning Goals

1. Explain why renewable energy is a growing alternative to fossil fuel
2. Describe in simple terms how solar, wind and hydropower work
3. List the main advantages and disadvantages of renewable and non-renewable energy resources

Core Activities

- Examine common types of renewable energy and explain the energy is transformed into a useful form
- Brainstorm examples of renewable energy use
- Consider possible advantages and disadvantages of renewable energy sources

4.2 Practical activity: Power-station models

90–120 minutes

Make a model of a power station.

MATERIALS REQUIRED

Learning Goals

1. Construct a model of a power station and evaluate what factors would need to be taken into consideration if building a real version

Core Activities

- Make a model of an assigned power station

4.3 Practical activity: Steam turbine model

60–90 minutes

Make a model of a steam turbine.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Construct a model of a steam turbine
2. Evaluate how well your model represents a real power plant

Core Activities

- Make a model of a steam turbine and consider how well it reflects a real power station

4.4 Engineering challenge: Wind power

180–240 minutes

Simulate a real-world challenge that affects the developing world.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Design and construct a model wind turbine
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design, build and test a model wind turbine

5.1 Lesson: Sustainability

45–60 minutes

Explain sustainability and the sustainable use of resources.

VIDEO

Learning Goals

1. Explain what is meant by sustainability
2. Distinguish between sustainability and renewability
3. Identify examples of sustainable and unsustainable uses of resources

Core Activities

- Compare and contrast sustainable and unsustainable fishing practices
- Interpret graphs showing numbers of wild species and numbers of the same species being caught to draw conclusions and understand consequences of over-fishing
- Brainstorm materials they recycle at school or at home
- Compare the energy required to produce aluminium and recycle it
- Explain how the recycle of a material can make its use sustainable
- Identify harmful use of resources
- Explain the difference between renewability and sustainability

5.2 Project: Sources of colour

90–120 minutes

Investigate how a natural colour is obtained and used.

Learning Goals

1. Investigate a natural colour of your choice to discover how it is obtained and used

Core Activities

- Select a natural colour and investigate how it is obtained and used
- Present their findings in a creative way of their choosing

5.3 Engineering challenge: Beat the flood

180–240 minutes

Simulate a real-life challenge affecting communities in Bangladesh.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Design and construct a model flood-proof home
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Design, build and test a model flood-proof home

6.1 Lesson: Science and society

20–30 minutes

Examine the use of living resources and the ethical considerations around this.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Explain the importance of soil in creating healthy ecosystems
3. Consider how unhealthy soil can impact a community
4. Describe animal experimentation and consider the ethics around it

Core Activities

- Engage with and reflect upon the career of Afira and consider the role soil plays in creating healthy ecosystems
- Consider and discuss the issue of using and breeding animals as resources

The Water Cycle

Would you ever drink your own urine?

As NASA sets its sights on Mars, an efficient way to recycle water is required in order to make the almost two-and-a-half-year journey. Astronauts on the International Space Station have been testing a new system that filters their urine to produce drinking water. The new system could solve one of the problems of long-term space travel once and for all. Lift the lid on the water cycle with this space-age unit!

stileapp.com/go/WaterCycleUnit

The big ideas covered in this unit are:

- What is the water cycle?
- How do the three states of matter apply to the water cycle?
- How much of Earth's water is drinkable?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.3 Investigation: Modelling the water cycle	Build and test a solar still	60–90 minutes	Optional. Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Examine how astronauts purify and recycle water.

VIDEO

Learning Goals

1. Identify ways in which water appears in nature
2. Propose ways in which a lack of water would impact on your daily life

Core Activities

- Brainstorm and discuss ways that water appears in nature
- Explain how lack of water supply would affect daily life and how this could be combatted

1.1 Lesson: Processes in the water cycle

45–60 minutes

Examine the main processes within the water cycle.

VIDEO

Learning Goals

1. Describe the main processes involved in the water cycle

Core Activities

- Identify the changes of state water can undergo and where these occur within the water cycle
- Name and describe the main processes that make up the water cycle
- Label a diagram of the water cycle
- Identify the percentage of fresh and salt water on earth
- Estimate and then calculate the amount of drinkable water on Earth

1.2 Lesson: El Niño and La Niña

45–60 minutes

Explain El Nino and La Nina weather patterns.

VIDEO

Learning Goals

1. Explain the effects of El Nino and La Nina weather patterns
2. Explain the water cycle in a unique way

Core Activities

- Explain what type of weather is expected in various locations during an El Nino and La Nina event
- Creatively describe the process of the water cycle

1.3 Investigation: Modelling the water cycle

60–90 minutes

Build and test a solar still.

MATERIALS REQUIRED

Learning Goals

1. Construct and test a solar still
2. Explain how the solar still represents and simulates aspects of the water cycle
3. Test and evaluate the success of your design

Core Activities

- Build and test a solar still to simulate aspects of the water cycle

Lesson: Career profile

15–20 minutes

How human activity impacts the water quality of an area.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. State ways in which human activity can have a negative impact on water quality

Core Activities

- Watch a video featuring the work of environmental scientist Kylie Catterall
- Brainstorm and discuss ways in which human activity can negatively impact water quality

Active Earth

Feel the earth move!

The surface of Earth is changing all of the time. Sudden changes like the 2015 Nepal earthquake can kill thousands of people. Other changes take much longer than our lifetime, such as the rock cycle. But what causes these changes? And how does understanding our active planet help society? Dig into this unit to find out more!

stileapp.com/go/active-earth

The big ideas covered in this unit are:

- What lies below the surface of the Earth?
- How do rocks change over time and what can they tell us?
- Why do tectonic plates move and what happens when they do?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Structure of the Earth	Multiple choice questions	5–10 minutes	Automatic
2.1 Quiz: Rocks and minerals	Multiple choice questions	5–10 minutes	Automatic
2.3 Quiz: Types of rock	Multiple choice questions	5–10 minutes	Automatic
2.4 Quiz: The rock cycle	Multiple choice questions	5–10 minutes	Automatic
3.1 Quiz: Continental drift	Multiple choice questions	5–10 minutes	Automatic
3.2 Quiz: Plate tectonics	Multiple choice questions	5–10 minutes	Automatic
3.3 Quiz: Earthquakes and volcanoes	Multiple choice questions	5–10 minutes	Automatic
3.6 Engineering challenge: Earthquake-resistant buildings	Design, construct and test an earthquake-resistant building	180–240 minutes	Peer and self assessed. Rubric provided
Test	Multiple choice and short answer questions	40–50 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

45–60 minutes

Engage students using the real-world context of earthquake research and assess prior knowledge.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Watch a short video that introduces the context of natural disasters and the unit guide, Tamarah King
- Watch a 360° video showing damage from the 2015 Nepal earthquake
- Explore a world map of recent earthquakes and consider other examples of natural hazards
- Answer a series of questions to determine their prior knowledge of rocks and the structure of the Earth
- Reflect on what they would like to learn using the *creative questions visible thinking routine*

1.1 Lesson: Structure of the Earth

45–60 minutes

Introduce the main layers of the Earth.

VIDEO INTERACTIVE

Learning Goals

1. Identify and describe the layers of the Earth
2. Compare the pressure, temperature and composition of the Earth's layers

Core Activities

- Complete a diagnostic activity to uncover their current understanding of what lies beneath the Earth's surface
- Explore what lies beneath the Earth's surface through an interactive simulation
- Examine and graph temperature, pressure and composition of each of Earth's layers
- Reflect on their learning using the *I used to think, but now I think visible thinking routine*

1.2 Practical activity: Model of the Earth

45–60 minutes

Represent the layers of the Earth by building a simple 3D model.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Describe the scales of models using ratios
2. Describe some advantages and limitations of scale models and analogies

Core Activities

- Consider an analogy for the Earth's layers
- Calculate appropriate scales for a 3D model of the Earth
- Build a scale model of one hemisphere and label each layer
- Reflect on their learning by identifying limitations of their model and potential improvements they could make

2.1 Lesson: Rocks and minerals

30 minutes

Explain the difference between rocks and rock-like materials.

VIDEO INTERACTIVE

Learning Goals

1. Define what rocks are
2. Distinguish between rocks and rock-like materials

Core Activities

- Describe what rocks are in terms of their state (solid), composition (minerals) and formation (through geological processes)
- Apply this understanding to distinguish rocks from some rock-like materials
- Explore an interactive diagram that describes various ways that rocks and minerals are used in daily life
- Reflect on their learning using the *headlines visible thinking routine*

2.2 Practical activity: Making mineral paints

60–90 minutes

Investigate the use of mineral powders to make paints.

MATERIALS REQUIRED

Learning Goals

1. Describe the use of minerals to make paints
2. Analyze how paint quality varies depending on the ratio of the ingredients

Core Activities

- Use minerals to make tempera paints
- Investigate and discuss how different ratios of pigment to binder affect paint quality
- Reflect on their learning using the *think, puzzle, explore visible thinking routine*

2.3 Lesson: Types of rock

60–90 minutes

Introduce the three types of rock and how they form.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Describe how the three types of rock form

Core Activities

- Group rock samples by closely observing their features
- Watch a video to learn about igneous, sedimentary and metamorphic rocks
- Examine how the three types of rocks form
- Reflect by considering how they would change the way they grouped rocks at the start of the lesson

2.4 Lesson: The rock cycle

60–90 minutes

Examine the processes of the rock cycle.

VIDEO | VR | SIMULATION

Learning Goals

1. Describe the main processes involved in the rock cycle

Core Activities

- Observe virtual reality or 360° images of unique rock formations and complete a *see, think, wonder visible thinking routine*
- Explore the main processes that drive the rock cycle through an interactive diagram
- Create their own diagram summarizing the rock cycle
- Reflect on their learning using the *very important points reflection strategy*

2.5 Practical activity: Modelling the rock cycle

45–60 minutes

Model the processes involved in the rock cycle.

MATERIALS REQUIRED

Learning Goals

1. Model the processes involved in the rock cycle

Core Activities

- Model the processes of the rock cycle using lollies
- Identify which process each part of the activity represents
- Reflect on their learning by considering advantages and limitations of the model

2.6 Extension: Fossils and sediments

60–90 minutes

Explain how fossils are formed and what they tell us about the history of life on Earth.

VIDEO

Learning Goals

1. Classify fossils and explain how they form
2. Compare the ages of fossils using sedimentary rock layers and the geological time scale

Core Activities

- Develop their curiosity through a *see, think, wonder visible thinking routine* about the Guadalupe Mountains fossils
- Watch a short video explaining what fossils are and how they are formed
- Apply what they've learnt to the story behind the Guadalupe Mountains fossils
- Learn how to read a geological time scale
- Reflect on their learning using the *very important points reflection strategy*

2.7 Practical activity: Relative dating

45–60 minutes

Model the formation of sedimentary rock layers and use relative dating to date fossils.

MATERIALS REQUIRED

Learning Goals

1. Use relative dating to determine the relative ages of rock layers
2. Explain how folds and faults affect the relative dating of rock layers

Core Activities

- Create a simple model of a sedimentary rock sequence containing fossils
- Use relative dating to identify which layer is the oldest and which layer is the youngest
- Examine how folds and faults influence the relative dating of rock layers
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

3.1 Lesson: Continental drift

45–60 minutes

Examine the evidence for continental drift theory.

VIDEO | INTERACTIVE

Learning Goals

1. Describe the evidence for continental drift theory and its limitations

Core Activities

- Use an interactive to explore how the Earth's continents have changed over the last 600 million years
- Complete a *see, think, wonder visible thinking routine* in response to the interactive
- Watch a video that examines the evidence for continental drift theory as proposed by Alfred Wegener
- Consider how scientific theories change as new evidence becomes available
- Reflect on their learning using the *headlines visible thinking routine*

3.2 Lesson: Plate tectonics

60–90 minutes

Introduce the theory of plate tectonics and explore three types of plate boundary.

VIDEO | SIMULATION

Learning Goals

1. Describe what tectonic plates are
2. Identify the differences between convergent, divergent and transform boundaries

Core Activities

- Identify some of the major and minor tectonic plates on a world map
- Use an interactive to explore the differences between divergent, convergent and transform plate boundaries
- Examine major features produced at plate boundaries involving different combinations of continental and oceanic crust
- Optional extension: consider the forces that cause tectonic plates to move
- Reflect on their learning using the *very important points reflection strategy*

3.3 Lesson: Earthquakes and volcanoes

45–60 minutes

Explore the link between plate boundaries and the distribution of earthquakes and volcanoes.

VIDEO | INTERACTIVE

Learning Goals

1. Relate earthquakes and volcanoes to tectonic plate boundaries

Core Activities

- Watch a video explaining why the 2015 Nepal earthquake occurred
- Read about how earthquakes are described by scientists
- Use an interactive map to explore the connection between plate boundaries and the occurrence of earthquakes and volcanoes
- Watch a video about the Ring of Fire
- Reflect on their learning using the *connect, extend, challenge visible thinking routine*

3.4 Practical activity: Modelling a plate boundary

100–120 minutes (minimum)

Create a model of one type of plate boundary.

MATERIALS REQUIRED

Learning Goals

1. Research, design and create a model of a plate boundary

Core Activities

- Research one type of plate boundary
- Design a model to represent the plate boundary
- Use their design to create a model or poster that includes labels of key features and an explanation of the processes involved
- Reflect on their learning by identifying what they did well and what they can improve on

3.5 Extension: Hotspot volcanoes

60–90 minutes

Explore hotspot volcanoes’ formation and calculate the speed of a tectonic plate.

VIDEO

Learning Goals

1. Explain how some volcanoes are caused by hotspots
2. Calculate the speed of a tectonic plate using the ages of hotspot volcanoes

Core Activities

- Watch a video that explains how hotspot volcanoes form
- Create a graph of the ages of Hawaiian volcanoes against distance from the hotspot
- Calculate the gradient of the graph to determine how fast the Pacific plate is moving
- Learn how seamounts show that the Pacific plate changed direction millions of years ago
- Reflect on their learning using the *very important points reflection strategy*

3.6 Engineering challenge: Earthquake-resistant buildings

180–240 minutes

Use the engineering process to build an earthquake-resistant building.

VIDEO | MATERIALS REQUIRED

Learning Goals

1. Design and build an earthquake-resistant building
2. Justify your choices of materials and techniques
3. Test and evaluate the success of your design

Core Activities

- Watch a video about how earthquake-resistant buildings have been constructed out of cardboard
- Design and construct a small-scale model of an earthquake-resistant building
- Test how well their model performs in a simulated earthquake and identify improvements
- Reflect on what went well and what they would do differently

4.1 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling geologist Tamarah King.

VIDEO | POSTER

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Watch a video in which Tamarah King, an earthquake geologist, discovers her passion for geology
- Reflect on Tamarah's work and apply it to themselves
- Brainstorm the ways in which drones could be used for scientific research

4.2 Lesson: Science and society

30–45 minutes

Explore how earthquakes can be caused by human activities.

INTERACTIVE

Learning Goals

1. Analyze data relating to human activities that can cause earthquakes

Core Activities

- Read about human activities that can cause earthquakes and analyze data presented in a graph
- Explore an interactive map of human-induced earthquakes
- Research one type of human activity that can cause earthquakes
- Reflect on their learning using the *headlines visible thinking routine*

Author’s Notes

This unit covers both the rock cycle and plate tectonics. Although these topics have different curriculum descriptions and are sometimes taught in isolation, we believe that teaching them together leads to better learning outcomes.

One reason for our decision was to enhance student engagement. When the rock cycle is taught in isolation, students often find it boring and irrelevant. Following advice from our advisory board as well as feedback from a wide range of schools, we decided to build the unit around the real-world context of natural disasters. This places the rock cycle in the context of awe-inspiring natural events that impact human lives. Improvements in our scientific understanding of these phenomena is helping us make better predictions and preparations to reduce human suffering.

Another reason for combining the two topics was the close conceptual connection between them. An understanding of plate tectonics builds on a prior understanding of rock types and the rock cycle but it also provides an explanation of some of the driving forces behind the rock cycle. Teaching the two topics together forges stronger links between them and enhances learning outcomes. This also frees up teaching time to cover other topics in the crowded curriculum.

Minerals

An out-of-this-world discovery

The most abundant mineral on Earth makes up nearly 40% of its volume but didn't have a name until 2014. It's buried deep inside the mantle, so scientists couldn't get their hands on a sample, which is needed to officially name a mineral. Luckily, they found a sample in a meteorite that struck Australia in 1879. What is this mysterious mineral? And what exactly is a mineral? Dig in to find out!

stileapp.com/go/minerals-unit

The big ideas covered in this unit are:

- What is a mineral?
- What properties do geologists use to identify minerals in the field?
- What minerals make up granite?
- Why are some mineral crystals bigger than others?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
Test	Multiple choice and short answer questions	20–30 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

5–10 minutes

Engage students with the topic by introducing the rare mineral bridgmanite.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about bridgmanite as an example of a rare mineral and its elusiveness to scientists wanting to research it
- Locate and label the Earth layer in which bridgmanite can be found

1.1 Lesson: What are minerals?

60–90 minutes

Define minerals and their properties.

VIDEO

Learning Goals

1. Distinguish between minerals and non-minerals
2. Describe minerals in terms of their colour, hardness, lustre, streak and cleavage
3. Explain how crystal size depends on cooling rate

Core Activities

- Complete a class brainstorm of minerals, rocks or gemstones that they have heard of
- Watch a video that introduces what minerals are
- Utilize given information as well as their own research to classify given substances into minerals and non-minerals
- Read and apply understanding of the five properties of minerals (colour, hardness, lustre, streak, cleavage) via polls and questions

1.2 Lesson: Identifying minerals

20–30 minutes

Use common rock types to identify minerals.

Learning Goals

1. Use a mineral identification chart to identify mineral samples

Core Activities

- Complete an interactive drag-and-drop to finish building an identification chart for six minerals
- Make a detailed study of granite and basalt via a series of pictures and/or real rock samples, and questions
- Summarize all the ways in which we use minerals

1.3 Investigation: Effect of cooling rate on crystal growth

45–90 minutes (depending on how much your school lab tech has prepared)

Investigate how cooling rate affects the growth of epsomite crystals.

VIDEO

MATERIALS REQUIRED

Learning Goals

1. Determine the effect of cooling rate on crystal growth

Core Activities

- Watch a video of Mexico's Giant Crystal Cave
- Use a microscope to visualize crystal formation
- Construct their own results table to record data
- Make a judgment as to how cooling rate affects growth of crystals

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling geologist Stephanie Sykora.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about Stephanie Sykora's work as an exploration geologist
- Reflect on whether they would enjoy a dangerous job like Stephanie's

Earthquakes

Can humans cause earthquakes?

An earthquake can be a terrifying experience, causing the ground to shake so violently that cracks open up and buildings collapse. Scientists study them so they can predict future quakes and prevent loss of life and property. Shake up your students' learning as they discover that some quakes are actually caused by human activities.

stileapp.com/go/earthquakes

The big ideas covered in this unit are:

- What are earthquakes and why do they occur?
- What are the three types of seismic wave?
- How is the size of an earthquake measured?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.3 Project: Human activities and earthquakes	Research project	45–60 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

10–15 minutes

Explore things humans can do that cause earthquakes.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Read about earthquakes and the things humans do to cause them
- Brainstorm their prior knowledge of the topic

1.1 Lesson: What causes earthquakes?

45–60 minutes

Explain what causes earthquakes.

VIDEO

Learning Goals

1. Explain what causes earthquakes and the different sorts of fault associated with them
2. Describe how the magnitude scale measures earthquakes

Core Activities

- Explain the different types of fault
- Identify fault types and the direction of plate movement from images
- Identify places around the world where earthquakes are most common
- Use the Richter scale to compare the size of earthquakes

1.2 Lesson: Types of waves

45–60 minutes

Explain the three types of seismic wave.

VIDEO

Learning Goals

1. Distinguish between the three types of seismic wave
2. Explain the level of damage each wave type can cause

Core Activities

- Distinguish between and identify the key characteristics of each type of wave
- Design a simple experiment to record their own seismograph at home

1.3 Project: Human activities and earthquakes

45–60 minutes

Examine how humans can cause earthquakes.

Learning Goals

1. Explain the three main ways humans can cause earthquakes and evaluate the severity of each

Core Activities

- Explain the three ways human activity can cause earthquakes and evaluate the severity of each
- Review the 2007 Newcastle earthquake and consider whether human activity was the cause

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling Christian Klose.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Read about the career of Christian Klose
- Consider and justify what natural phenomenon they would study

The Universe

Discovered! Gravitational waves – science breakthrough of the century!

The recent detection of gravitational waves gives us a new way of observing the universe. But for centuries, telescopes have been gradually revealing the grand scale of the universe and the weird and wonderful things it contains. Venture on a journey through time and space all the way back to the Big Bang.

stileapp.com/go/universe

The big ideas covered in this unit are:

- What is the difference between stars, planets and moons?
- How do we measure distances in space?
- How are stars formed and destroyed?
- What is the Big Bang theory and what evidence supports it?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Our place in the universe	Multiple choice questions	10–15 minutes	Automatic
1.3 Quiz: Measuring distances in space	Multiple choice questions	10–15 minutes	Automatic
2.1 Quiz: The Sun	Multiple choice questions	10–15 minutes	Automatic
2.2 Quiz: The life cycle of stars	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: The Big Bang	Multiple choice questions	10–15 minutes	Automatic
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

30 minutes

Engage students in the topic and identify prior knowledge.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- State how understanding of the universe was changed by the discovery of gravitational waves
- Complete diagnostic activities relating to the planets within our Solar System, the importance of the Sun and the Big Bang theory

1.1 Lesson: Our place in the universe

45–60 minutes

Distinguish between stars, planets and moons.

VIDEO INTERACTIVE

Learning Goals

1. Describe the differences between stars, planets and moons
2. Identify our place in the universe

Core Activities

- Reflect on their prior knowledge of stars, planets and moons
- Complete a Venn diagram comparing stars, planets and moons
- Use an interactive to determine our place within the universe

1.2 Practical activity: Classifying galaxies

15–30 minutes

Classify galaxies by participating in a citizen-science research project.

Learning Goals

1. Classify galaxies based on their shape

Core Activities

- Participate in the citizen-science project Galaxy Zoo
- Reflect on the project and their participation

1.3 Lesson: Measuring distances in space

45–60 minutes

Explain how light-years are used to measure distances.

VIDEO VR

Learning Goals

1. Define a light-year and use it to describe distances in space

Core Activities

- Explain a light-year
- Use an interactive to explore different sizes and lengths in the observable universe
- Optional extension: examine how the distances of stars and galaxies are determined using parallax and standard candles

2.1 Lesson: The Sun

20–30 minutes

Explore the main features of stars.

VIDEO

Learning Goals

1. Describe the structure of the Sun
2. Explain how fusion and gravity provide opposing forces in the Sun

Core Activities

- Examine the structure of the Sun
- Describe how photons are released during nuclear fusion

2.2 Lesson: The life cycle of stars

45–60 minutes

Examine how stars form, change over time and eventually die.

VIDEO VR POSTER

Learning Goals

1. Describe how stars form
2. Describe what happens to small and large stars when they die

Core Activities

- Explore a 360° or virtual reality image of the night sky
- Examine the final stages of a star's life and compare how this differs for small stars and large stars

2.3 Extension: Neutron stars and black holes

20–30 minutes

Explore key features of neutron stars and black holes.

Learning Goals

1. Summarize the similarities and differences between neutron stars and black holes

Core Activities

- Examine the features of neutron stars and black holes
- Compare neutron stars and black holes using a Venn diagram

2.4 Extension: Observing stars

45–60 minutes

Examine the brightness of stars.

VIDEO SIMULATION

Learning Goals

1. Distinguish between the apparent and absolute magnitude of stars
2. Describe how different telescopes allow us to observe objects in different ways

Core Activities

- Compare apparent and absolute magnitudes of stars
- Explore how different telescopes detect different wavelengths of light
- Consider why stars and gas emit different types of radiation

3.1 Lesson: The Big Bang

45–60 minutes

Examine evidence that the universe is expanding.

VIDEO

Learning Goals

1. Describe the evidence that the universe is expanding
2. Explain the main ideas of the Big Bang theory

Core Activities

- Examine the Big Bang theory as an explanation for how the universe formed
- Consider some key events in the history of the observable universe

3.2 Practical activity: Model of universe expansion

25–30 minutes

Model the expanding universe.

MATERIALS REQUIRED

Learning Goals

1. Describe the expansion of the universe using a model

Core Activities

- Measure the distances between marks on a balloon as it is inflated
- Apply their observations to the expanding universe

4.1 Lesson: Science and society

20–30 minutes

Consider whether exploring the distant universe is valuable.

Learning Goals

1. Discuss the exploration of the universe from a financial point of view

Core Activities

- Participate in a poll where they evaluate reasons to investigate the universe
- Give reasons why spending on space exploration is justified
- Participate in a class discussion where they share their ideas

4.2 Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling professor of astrophysics Tamara Davis.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider the career path of Tamara Davis and if they would enjoy a similar job
- Brainstorm how new technology will improve our understanding of the universe in the future

Earth Systems

Climate change... is there even a debate?

Our planet is a beautiful, dynamic place, with complex interconnected systems in a delicate balance. To what extent are humans upsetting this balance? And how will this affect us and ecosystems around the world?

stileapp.com/go/earthsystems

The big ideas covered in this unit are:

- What are Earth's four systems and how do they interact?
- What determines Earth's main climate zones?
- How does the greenhouse effect keep Earth suitable for life?
- What is global warming and how are human activities contributing to it?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.1 Quiz: Four global systems	Multiple choice questions	10–15 minutes	Automatic
1.2 Quiz: Movement of matter	Multiple choice questions	10–15 minutes	Automatic
1.3 Quiz: Movement of energy	Multiple choice questions	10–15 minutes	Automatic
1.6 Quiz: Ecosystems	Multiple choice questions	10–15 minutes	Automatic
1.7 Quiz: The carbon cycle	Multiple choice questions	10–15 minutes	Automatic
1.8 Project: Explore another cycle	Research and report	60–90 minutes	Teacher reviewed
2.1 Quiz: The greenhouse effect	Multiple choice questions	10–15 minutes	Automatic
2.2 Quiz: Climate	Multiple choice questions	10–15 minutes	Automatic
2.3 Quiz: Ocean currents	Multiple choice questions	10–15 minutes	Automatic
2.4 Quiz: Earth's climate history	Multiple choice questions	10–15 minutes	Automatic
3.1 Quiz: Human activity and global warming	Multiple choice questions	10–15 minutes	Automatic
3.2 Quiz: Effects of global warming	Multiple choice questions	10–15 minutes	Automatic
3.3 Engineering challenge: Floating gardens	Design, construct and test a floating garden	90–120 minutes	Teacher reviewed
3.6 Quiz: Predicting the future	Multiple choice questions	10–15 minutes	Automatic
3.7 Project: Other questions	Research project	60–90 minutes	Teacher reviewed
Test	Multiple choice and short answers	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

20–30 minutes

Promote discussion of students' current knowledge of the topic.

VIDEO

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Participate in class discussions and brainstorms surrounding their current knowledge of the topic

1.1 Lesson: Four global systems

45–60 minutes

Introduce Earth's four main systems and their interactions.

VIDEO

Learning Goals

1. Name and describe Earth's four main systems

Core Activities

- Describe the Earth's four main spheres
- Explain how each sphere interacts with one and other

1.2 Lesson: Movement of matter

45–60 minutes

Explain how matter moves through Earth's systems.

VIDEO

Learning Goals

1. Describe how matter moves through Earth's non-living systems

Core Activities

- Identify how Earth gains and loses mass
- Identify and explain how matter moves around Earth

1.3 Lesson: Movement of energy

45–60 minutes

Explain how energy moves through Earth's systems.

Learning Goals

1. Describe how the Earth receives and emits energy
2. Describe how energy moves through Earth's non-living systems

Core Activities

- Identify the albedo for a variety of surfaces
- Explain which surfaces will reflect high and low radiation
- Explain how the Earth gains and loses heat
- Explain the movement of heat within Earth systems

1.4 Investigation: Albedo and colour

45–60 minutes

Demonstrate albedo using different coloured pieces of paper.

MATERIALS REQUIRED

Learning Goals

1. Describe the relationship between colour and albedo

Core Activities

- Conduct a simple experiment to model albedo
- Interpret the results to explain the relationship between colour and albedo
- Critically evaluate the scientific method

1.5 Investigation: Albedo and colour (open)

45–60 minutes

Demonstrate albedo using different coloured pieces of paper.

MATERIALS REQUIRED

Learning Goals

1. Describe the relationship between colour and albedo

Core Activities

- Conduct a simple experiment to model albedo
- Interpret the results to explain the relationship between colour and albedo
- Critically evaluate the scientific method

1.6 Lesson: Ecosystems

45–60 minutes

Examine how matter and energy flow through the biosphere.

VIDEO

Learning Goals

1. Explain how matter and energy flow through the biosphere and the impact that this can have on the other Earth systems

Core Activities

- Identify the role plants play within an ecosystem and know how they interact with the non-living Earth systems
- Draw a picture to show a chosen animal interacts with the non-living environment

1.7 Lesson: The carbon cycle

45–60 minutes

Examine the carbon cycle.

VIDEO

Learning Goals

1. Outline the main processes involved in the carbon cycle

Core Activities

- Construct diagrams to explain the carbon cycle and identify carbon pathways within the cycle
- Explain how photosynthesis and respiration cause a day-night cycle in atmospheric carbon concentration

1.8 Project: Explore another cycle

60–90 minutes

Research and report on the nitrogen or phosphorus cycle.

Learning Goals

1. Describe the nitrogen cycle or phosphorus cycle

Core Activities

- Conduct research on a selected cycle – the nitrogen or phosphorus
- Produce a report on their chosen cycle in a format of their choosing

2.1 Lesson: The greenhouse effect

45–60 minutes

Explore how the greenhouse effect warms Earth.

VIDEO

Learning Goals

1. Explain how the natural greenhouse effect increases Earth's average temperature

Core Activities

- Brainstorm prior knowledge about the greenhouse effect
- Identify greenhouses gases and the percentage of the atmosphere they make up
- Explain the role greenhouse gases play within the atmosphere
- Use a diagram to explain the greenhouse effect

2.2 Lesson: Climate

45–60 minutes

Introduce the four climate zones of Earth.

VIDEO

Learning Goals

1. Explain what climate is and why Earth has diverse climate zones

Core Activities

- Distinguish between climate and weather
- Explain how the difference in how the sun strikes the Earth means it is warmer at the equator and cooler at the poles
- Identify the four major climate zones
- Suggest factors that can influence variation in climate

2.3 Lesson: Ocean currents

45–60 minutes

Examine ocean currents and their effect on climate.

VIDEO

Learning Goals

1. Explain what the ocean conveyor belt is and what causes it

Core Activities

- Identify the oceans to make up the ocean conveyor belt
- Explain the formation of ocean waterfalls

2.4 Lesson: Earth's climate history

45–60 minutes

Explain key events in Earth's climate history.

VIDEO INTERACTIVE POSTER

Learning Goals

1. Describe some of the main events in the history of the Earth's climate and the evidence for them

Core Activities

- Explain how ice core samples can be used to determine greenhouse gas levels and temperatures on Earth thousands of years ago
- Interpret graphs depicting carbon dioxide and relative temperatures to identify trends over time
- Describe the way living things have influenced Earth's climate
- Research a chosen factor that has impacted the Earth's climate

2.5 Citizen science: Tracking CO2 levels

15–30 minutes

Demonstrate how carbon dioxide levels are measured and tracked.

Learning Goals

1. Explain how the stomatal index of plant leaves can be used to infer past atmospheric carbon dioxide levels

Core Activities

- Read about how the stomatal index of plant leaves can be used to interpret past atmospheric carbon dioxide levels
- Count the stomata of gingko trees online for the Smithsonian National Museum of Natural History

2.6 Simulation: Terraforming an exoplanet

30-45 minutes

Model interactions between the greenhouse effect, the water cycle and the biosphere.

SIMULATION

Learning Goals

1. Investigate interactions between the greenhouse effect, the water cycle and the biosphere

Core Activities

- Terraform a simulation planet to make it habitable for humans
- Reflect on the process of terraforming a planet with regard to the role of the water cycle and carbon dioxide levels

3.1 Lesson: Human activity and global warming

45–60 minutes

Explain the effect of human activity on atmospheric carbon dioxide levels.

VIDEO

Learning Goals

1. Describe recent trends in surface temperatures and atmospheric carbon dioxide
2. Explain how human activities are contributing to an enhanced greenhouse effect

Core Activities

- Identify key human activities that contribute to atmospheric carbon dioxide levels
- Interpret graphs depicting historical atmospheric carbon dioxide levels to identify a pattern

3.2 Lesson: Effects of global warming

45–60 minutes

Explore the effects of human-induced global warming.

VIDEO INTERACTIVE

Learning Goals

1. Describe the observed effects of human-induced global warming
2. Explain how positive and negative feedbacks affect the course of global warming

Core Activities

- Explore the symbiotic relationship between coral and algae, and the consequence of warming water temperatures on this relationship
- Explain how glaciers can be undercut by ocean currents and how this melts the ice
- Describe three effects of rising sea levels
- Explain the effect of positive and negative feedback within an Earth system
- Connect positive feedback to the albedo effect
- Use Global Carbon Atlas to examine possible future atmospheric carbon dioxide levels and the effects they will have

3.3 Engineering challenge: Floating gardens

90–120 minutes

Complete an engineering challenge to create a floating garden.

VIDEO MATERIALS REQUIRED

Learning Goals

1. Design a solution to a real-world problem caused by climate change

Core Activities

- Work in groups to design and construct a model floating garden

3.4 Investigation: Modelling sea level rise (guided)

60–90 minutes

Model how melting sea and land ice and thermal expansion affect sea levels.

MATERIALS REQUIRED

Learning Goals

1. Investigate sea level rise due to melting sea and land ice and thermal expansion

Core Activities

- Model the effects of melting sea ice and land ice and thermal expansion on sea levels

3.5 Investigation: Modelling sea level rise (open)

60–90 minutes

Model how melting sea and land ice and thermal expansion affect sea levels.

MATERIALS REQUIRED

Learning Goals

1. Investigate sea level rise due to melting sea and land ice and thermal expansion

Core Activities

- Model the effects of melting sea ice and land ice and thermal expansion on sea levels

3.6 Lesson: Predicting the future

45–60 minutes

Examine how technology predicts future global warming effects.

VIDEO INTERACTIVE

Learning Goals

1. Explain how computer models work, allowing us to envisage future effects to global warming

Core Activities

- Describe how Earth's climate is currently monitored and how this data is used to make projections
- Explain the uncertainty in climate change models
- Interpret and create graphs displaying climate change

3.7 Project: Other questions

60–90 minutes

Independently investigate a question related to climate change.

Learning Goals

1. Investigate a chosen question related to the issue of climate change

Core Activities

- Independently investigate a chosen question related to the issue of climate change and present their findings

4.1 Science and society

30–45 minutes

Encourage students to think about careers in STEM by profiling PhD student Willem Huiskamp.

VIDEO

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities
2. Explain how Willem Huiskamp's research is contributing to climate change knowledge
3. Discuss how climate change research contributes to society

Core Activities

- Consider the subjects involved in climate science and what their role is
- Brainstorm how climate research contributes to society
- Explain the role of the media in climate change and give their opinion on whether or not the media should give equal weight to both sides of the argument

Comets

What can comets tell us about the origin of life on Earth?

In November 2014, a spacecraft called Rosetta made history by landing a probe on a comet for the first time. The information gained from this extraordinary feat will not only tell us more about these astronomical visitors, it might also provide insights into the origin of life on Earth.

stileapp.com/go/comets

The big ideas covered in this unit are:

- What is a comet?
- How are comets different from planets, asteroids and meteors?
- Why is it important to study comets?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.3 Project: Create an advertising campaign for a comet	Creative presentation	60–90 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Examine the story of the Rosetta spacecraft landing a space probe on a comet.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Engage with the landing of space probe Rosetta on a comet and consider what was involved in this

1.1 Lesson: What is a comet?

30–45 minutes

Explain what comets are made of.

VIDEO

Learning Goals

1. Describe what comets are made of and identify their three main parts

Core Activities

- Identify and label what comets are comprised of
- Explain the role comets may have played in the formation of the Earth
- Calculate the speed of the Rosetta probe and when Halley's comet will next be visible from Earth

1.2 Lesson: Distinguishing between rocky bodies

30–45 minutes

Explain how a comet's orbit is unique.

VIDEO

Learning Goals

1. Distinguish between comets, planets, asteroids and meteors
2. Describe the differences between a comet's orbit and the Earth's orbit of the Sun

Core Activities

- Brainstorm the differences between comets, planets, meteors and asteroids
- Explain the findings of the Giotto comet exploration
- Describe the difference between a comet's orbit and the Earth's orbit of the Sun
- Justify the expense of comet research, or explain why they do not agree with it

1.3 Project: Create an advertising campaign for a comet

60–90 minutes

Explain the dangers of asteroids and comets.

VIDEO

Learning Goals

1. Describe the ways in which an asteroid or comet can be dangerous to people on Earth

Core Activities

- Design a campaign in response to a hypothetical situation of a comet on a collision course with Earth

Lesson: Career profile

10–15 minutes

Encourage students to think about careers in STEM by profiling astronomer Michael A'Hearn.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider Michael A'Hearn's career path and think about where in outer space they would travel if they had the chance

Mass Extinctions

Were the dinosaurs just unlucky?

Scientists are fairly sure that an asteroid strike sounded the final death knell for the dinosaurs, but a recent discovery indicates that a drop in biodiversity might have been an important factor as well. Travel back in time to find out how past mass extinctions can shed light on our present-day impact on ecosystems.

stileapp.com/go/massextinctions

The big ideas covered in this unit are:

- What are mass extinctions?
- What is the scientific evidence that an asteroid strike caused the extinction of the dinosaurs?
- Could low levels of biodiversity have been a factor in the demise of dinosaurs?

Unit structure

Assessments

Lesson	Form	Approx. Timing	Marking
1.3 Project: Protecting biodiversity	Research project	45–60 minutes	Teacher reviewed
Test	Multiple choice and short answer questions	45–60 minutes	Automatic and teacher reviewed

Lesson Summaries

Introduction

15–20 minutes

Engage students in the history of dinosaurs and their extinction.

Learning Goals

1. Prepare for the coming topic by establishing prior knowledge and promoting engagement using real-world context

Core Activities

- Consider what Earth would have been like 65 million years ago when dinosaurs were alive

1.1 Lesson: Mass extinction events

45–60 minutes

Explain mass extinction and how biodiversity can help a species survive.

VIDEO

Learning Goals

1. Describe what mass extinction events are and their possible causes
2. Describe the evidence for the theory that an asteroid strike caused the extinction of the dinosaurs
3. Explain how biodiversity can improve a species' chances of survival

Core Activities

- Interpret geological time scales to identify when particular events occurred
- Explain what a mass extinction event is and possible causes of them

1.2 Lesson: Causes of mass extinction events

45–60 minutes

Explore the K-Pg boundary extinction event.

VIDEO

Learning Goals

1. Explain the evidence supporting the K-Pg boundary extinction
2. Justify the events that are likely to have killed the dinosaurs

Core Activities

- Examine Walter Alvarez's thinking behind his proposed theory regarding the K-Pg boundary extinction
- Link the Chicxulub crater to the K-Pg boundary
- Consider the duration of some of the effects from the asteroid strike
- Explain how increased biodiversity may have improved the survival chances of some species

1.3 Project: Protecting biodiversity

45–60 minutes

Explore a local area and how it may have changed over time.

VIDEO

Learning Goals

1. Explain biodiversity with respect to a local area
2. Explain how a local area may have changed over time due to human impact
3. Identify some practical measures that could increase the biodiversity of a local area
4. Identify short-term and long-term benefits to humans from increasing an area's biodiversity

Core Activities

- Examine a local area to evaluate its biodiversity, how it has changed over time and suggest practical ways to increase its biodiversity

Lesson: Career profile

15–20 minutes

Encourage students to think about careers in STEM by profiling geneticist Rahul Rane.

Learning Goals

1. Recognize how scientific knowledge and STEM skills can affect people's lives and generate career opportunities

Core Activities

- Consider Rahul's job as a geneticist and how it informs climate change
- Explain what part of nature they would study and the role it plays in maintaining its ecosystem

Key Features Index

Simulations

Put your students in charge of a digital experiment to provide an understanding of complex systems.

Science Skills

Biology

Chemistry

Physics

Earth & Space

Practical activities

Allow students to develop experimental skills while applying knowledge.

Science Skills

Biology

Interactives

Fun interactive experiences help to reinforce and enhance the lessons.

Science Skills

Biology

Chemistry

Physics

Earth & Space

Engineering challenges

Students tackle real world problems requiring the application of key knowledge and skills.

Biology

Physics

Earth & Space

Virtual reality

Using mobile devices, VR provides an immersive 360˚ experience.

Science Skills

Biology

Chemistry

Earth & Space

Augmented reality

Using mobile devices, AR creates 3D models of the world.

Biology

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