Welcome to IntoScience and thank you for joining us on this journey of discovery. I hope you find this resource book useful and relevant to you and your students. I am confident that using IntoScience with your students will be extremely rewarding.

How students learn, and therefore how we teach is an ever-evolving process. The teaching of critical thinking skills and higher-order thinking are becoming more prevalent in today’s modern classroom. Skills such as these are invaluable to the scientific process and in developing scientific thinkers. Couple this with the exponential progression and access to technology, the classroom of today is a vastly different landscape even when compared to just the last five years.

Inquiry-based learning, and by that I mean the approach to learning which involves the investigation and exploration of problems or questions, is something every science teacher does through practical activities and experiments. Giving students problems, often with guidance, and letting them formulate questions, test hypotheses, record results and draw conclusions is the very essence of science and totally encapsulates inquiry-based learning. However, when it comes to teaching the theory side of science, the inquiry-based model is often lost. In many cases, this is due to not having the tools or resources to allow teaching and learning in an inquiry-based way.

This is exactly where IntoScience becomes an essential part of the teaching and learning process. From ‘doing’ mitosis to crashing cars when investigating friction, to playing basketball on the moon, IntoScience brings to life theories and concepts in a way in which no other resource can. It immerses students in a world of science, giving them the skills to grow as budding scientists. It brings scientific theories to life by questioning, doing, interacting and observing whilst staying true to the principles of science.

Having taught science for 11 years, I am very proud to be a part of the IntoScience team and to have the opportunity to truly enrich students’ lives. My aim as a teacher, and our aim at IntoScience is to inspire students to love science and to apply a scientific world view in their lives, which I am convinced is essential in today’s modern world. Seeing the way students respond to the program, how they love exploring and finding things out, and above all, how much they love learning science, is the most satisfying feeling you can have as a teacher.

I wish you well in your teaching of science and I am confident that IntoScience will help enrich your science teaching experience. Welcome to the future of education, and thank you for embarking on this incredible journey with us.

I hope you thoroughly enjoy it.

Dave Canavan MSc QTS

Dave completed his Biology Degree with Qualified Teacher Status in Manchester, where he taught High School science while completing his MSc in Behavioural Ecology. Dave then emigrated to Australia where he became the Head of Science in a government school which saw record numbers complete a science at Year 12 for that school. Dave then spent 5 years teaching science and eventually becoming the Principal of a British International School in Thailand where all students of varying ethnicities all achieved a grade C and above for their science IGCSE qualification during Dave’s time at the school. He now works to implement IntoScience in schools across Australia, the UK and the USA, changing one classroom at a time and bringing the teaching and learning of science into the future.
Students learn the differences between physical and chemical changes.

**Suggested time:** 30 minutes

**Summary of Key Learning Points**

Students:
- find out that physical changes do not involve the formation of any new substances
- discover that the formation of at least one new substance always accompanies a chemical change
- realise that there are many examples of physical and chemical changes in our everyday lives
- understand that many everyday situations, like digestion, involve physical and chemical changes working together to get the job done

**CHANGES ALL AROUND YOU**

*5 minutes*

The first page addresses the idea of a ‘new substance’. Make sure that students understand the term means a chemical species that was not there before the change occurred.

**Answers:** (Inquiry point 1)
- 12 apostles formed by erosion: No new substance formed
- Coral grows in the Great Barrier Reef: New substance formed

**PHYSICAL CHANGES**

*5 minutes*

Discuss the examples on this page with students. Get them to explain the reasons behind their choices. For example, if they say cooking an egg is a chemical change, see if they can identify the new substances being formed.

**Answers:** (Inquiry point 2)
- Crumpling paper; Shaping glass; Making a salad

**Explore this:** highlights the fact that any phase change is a physical change, as illustrated by the equation representing ice melting.

**CHEMICAL CHANGES**

*5 minutes*

Similarly to the last page, students identify the chemical changes amongst the examples.

**Answers:** (Inquiry point 3)
- Digesting food; Iron rusting; Rotting food

**WORKING TOGETHER**

*5 minutes*

This page explores digestion as an example of physical and chemical changes working together. Ask students if they can think of any other examples of situations where both physical and chemical changes are needed to get a job done - there should be plenty!

**Suggested answers:** (Inquiry point 4)
- **Physical change:** biting food into smaller pieces
- **Chemical change:** stomach acid and enzymes breaking down proteins
TRUE OR FALSE?
5 minutes
This is a difficult page with some high level concepts. Students might need a bit of extra help to understand the ideas presented here.

Answers: (Inquiry point 5)
False; False; True

PHYSICAL, CHEMICAL OR BOTH?
5 minutes
Students check their understanding by labelling six different examples as either physical change, chemical change or both. All labels correct = Inquiry point 6, triggered by selecting 'check' once all correct labels are in place. Writing an explanation for each = Inquiry point 7, triggered by submitting at least 15 characters of text in each text field.

Answers:
Bite, chew and swallow sandwich = Physical & chemical
(Biting food into smaller pieces is physical, but enzymes in saliva breaking down food is chemical)

Cordial mixed with water = Physical change
(No new substance formed)

Butter on toast = Physical change
(Melting is a phase change and therefore physical)

Petrol burning in a car = Physical & chemical
(Petrol being dispersed is physical, but being combusted is chemical as new substances form)

Acid rain on statue = Chemical change
(A chemical reaction happens so this is a chemical change)

Bread dough being kneaded then rising = Physical & chemical
(Being kneaded is a physical change, but when it rises a chemical reaction takes place)

Suggested completion levels

Basic - Inquiry point goal = 3
Students at this level will: define 'physical change' and identify one example; define 'chemical change' and identify one example.

Core - Inquiry point goal = 5
Students at this level will: describe the difference between a physical change and a chemical change using examples; identify physical and chemical changes occurring in everyday life.

Advanced - Inquiry point goal = 7
Students at this level will: explain how a physical change is different from a chemical change using examples from everyday life; understand that chemical changes always need another chemical change to reverse the process; describe the relationship between chemical bonding and physical and chemical changes.
Question 1
Define the terms
(a) Physical change
(b) Chemical change

Question 2
Label these changes as either physical changes (P) or chemical changes (C).
(a) Sweat evaporates from your skin. _____
(b) A car rusts. _____
(c) Charcoal burns in a furnace. _____
(d) Silver is melted to make jewellery. _____
(e) A cake is cut into pieces. _____
(f) A cake is baked in an oven. _____
(g) Fruit changes colour as it ripens. _____

Question 3
Circle all the words you would associate with physical changes.

- squash
- melt
- freeze
- rip
- burn
- rot
- condense
- tarnish
- rust
- boil
- corrode
- mix
PHYSICAL AND CHEMICAL CHANGES

Question 4
Label these statements as true (T) or false (F).

(a) Toasting marshmallows is a physical change. _____
(b) Chemical changes are easily reversed. _____
(c) Evaporation is a physical change. _____
(d) A new substance always forms in a physical change. _____
(e) All phase changes are physical changes. _____
(f) Grass growing is a physical change. _____
(g) Milk turning sour is a chemical change. _____
(h) Digestion in humans involves physical changes only. _____
(i) Freezing water to make ice cubes is a physical change. _____
(j) If a gas is produced, a chemical change must have occurred. _____
(k) Chopping wood into pieces is a chemical change. _____
(l) Fermenting grape juice to make wine is a chemical change. _____

Question 5
Read the following scenarios and decide which type of change is occurring. Provide reasons for your answer.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Physical change, chemical change or both?</th>
<th>Reasons for your answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A piece of copper left out in the air eventually turns green.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To make an omelette, eggs are whisked with milk then cooked over a flame.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocky road is made by mixing melted chocolate with lollies such as marshmallows.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heartburn is treated with antacid tablets, which often make you burp!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sherbet fizzes in your mouth when you eat it.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Question 1
Define the terms
(a) Physical change
A change in which no new substance is formed.
(b) Chemical change
A change in which at least one new substance is formed.

Question 2
Label these changes as either physical changes (P) or chemical changes (C).
(a) Sweat evaporates from your skin. ____P____
(b) A car rusts. ___C___
(c) Charcoal burns in a furnace. ___C___
(d) Silver is melted to make jewellery. ___P___
(e) A cake is cut into pieces. ___P___
(f) A cake is baked in an oven. ___C___
(g) Fruit changes colour as it ripens. ___C___

Question 3
Circle all the words you would associate with physical changes.

- squash
- melt
- freeze
- rip

- burn
- rot
- condense
- tanish

- rust
- boil
- corrode
- mix
PHYSICAL AND CHEMICAL CHANGES

Question 4
Label these statements as true (T) or false (F).
(a) Toasting marshmallows is a physical change. _____
(b) Chemical changes are easily reversed. _____
(c) Evaporation is a physical change. _____
(d) A new substance always forms in a physical change. _____
(e) All phase changes are physical changes. _____
(f) Grass growing is a physical change. _____
(g) Milk turning sour is a chemical change. _____
(h) Digestion in humans involves physical changes only. _____
(i) Freezing water to make ice cubes is a physical change. _____
(j) If a gas is produced, a chemical change must have occurred. _____
*note: evaporation also produces a gas and that is a physical change.
(k) Chopping wood into pieces is a chemical change. _____
(l) Fermenting grape juice to make wine is a chemical change. _____

Question 5
Read the following scenarios and decide which type of change is occurring. Provide reasons for your answer.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Physical change, chemical change or both?</th>
<th>Reasons for your answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A piece of copper left out in the air eventually turns green.</td>
<td>Chemical</td>
<td>The permanent colour change is a sign of chemical change.</td>
</tr>
<tr>
<td>To make an omelette, eggs are whisked with milk then cooked over a flame.</td>
<td>Both</td>
<td>Beating eggs is physical but cooking is chemical.</td>
</tr>
<tr>
<td>Rocky road is made by mixing melted chocolate with lollies such as marshmallows.</td>
<td>Physical</td>
<td>Only phase changes are occurring so this is physical.</td>
</tr>
<tr>
<td>Heartburn is treated with antacid tablets, which often make you burp!</td>
<td>Chemical</td>
<td>A chemical reaction must occur to neutralise excess stomach acid.</td>
</tr>
<tr>
<td>Sherbet fizzes in your mouth when you eat it.</td>
<td>Chemical</td>
<td>The fizziness is gas and is a sign of chemical change.</td>
</tr>
</tbody>
</table>
Students are introduced to the concept of energy and explore the major types of kinetic and potential energies.

**Suggested time:** 45 minutes

**Summary of Key Learning Points**

Students:
- explore the idea of 'energy'
- learn that all types of energy fall into one of two categories
- understand that kinetic energy is the energy of movement
- discover that potential energy is stored energy
- find out the different energies present in everyday objects

**ALL ABOUT ENERGY**

10 minutes

Brainstorm with students. Pose the questions, 'What is energy?', 'Which objects around you have energy?', 'What do we mean when we say we have no energy?' The point is of course that everything has energy, even a rock on the ground!

**Answers:** All of these objects have energy (Inquiry point 1)

Emphasise the significance of the Law of Conservation of Energy and talk students through the Science extra on 'What is work?'

**Answer to Science extra question:** $40 \times 25 = 1000 \text{ J}$ (Inquiry point 2)

**Class activity:** Estimate the energy consumption per minute of various activities, such as sitting (6 kJ/min), level walking (17 kJ/min), walking up steep hill (35 kJ/min), mowing the lawn (20 kJ/min) and cycling (30 kJ/min).

**KINETIC AND POTENTIAL ENERGY**

5 minutes

Explain the difference between potential and kinetic energy using the examples on this page. This might be a good time to introduce the idea of mechanical energy, which is energy due to an object's motion and position. Mechanical energy is the sum of the object's kinetic and potential energies, although chemical, nuclear and electromagnetic energies are not included in this total.

**Objects with more kinetic energy:**
Falling book; skier flying; open dam; apple falling

**Objects with more potential energy:**
Book on table; skier standing; closed dam; apple on tree (Inquiry point 3)

**Talking point:** Get students to start thinking about energy transformations and the Law of Conservation of Energy in the context of the objects on this page. For example, the book on the table has potential energy, but what happens to this potential energy as the book falls?

**KINETIC ENERGY**

10 minutes

Talk through the major types of kinetic energy with the students. It can be tricky for them to understand the difference between objects moving on a macroscopic level versus the movement of particles at an atomic level.

**Answers (in order):**
Moving objects
Electrical energy
Thermal energy
Radiation (Inquiry point 4)
Once they have completed all of them, students can select the pictures to revise the description of each type of energy.

**POTENTIAL ENERGY**

**10 minutes**

Explain the differences between the types of potential energy. It would also be good to discuss how the quantity of potential energy can be changed. For example, the same man would have more potential energy if he were higher above the surface of the Earth. The rubber band would have more potential energy if it were stretched further.

**Answers (in order):**

- Gravitational
- Elastic
- Nuclear
- Chemical
- Electrical (Inquiry point 5)

Once they have completed all of them, students can select the pictures to revise the description of each type of energy. The Science extra on 'Energy in fields' describes the relationship between an object’s position within a field and its potential energy.

**Talking point:** How could the potential energy of each object on this page be increased or decreased?

**DIFFERENT TYPES OF ENERGY**

**5 minutes**

The aim of this page is for students to identify the major types of energy present in three different situations.

**Answers:**

- Chocolate bar: chemical energy (Inquiry point 6)
- Bungee jumping: elastic, kinetic (Inquiry point 7)
- A camp fire: light, chemical heat (Inquiry point 8)

**Extra activity:** Have students make a list of 10 objects in the classroom and identify the major types of energy present in them.

**OBSERVING KINETIC AND POTENTIAL ENERGY**

**5 minutes**

Students explore kinetic and potential energy in the context of a roller coaster. This is also a nice introduction to energy transformations and it might be good to show a flow diagram for the energy changes taking place, noting that an electrical motor is used to take the cart to the top of the first hill.

**Answers:**

A heavier cart would have more gravitational potential energy at the highest point.

When the cart is at the top of the highest point, the potential energy is greatest.

As the cart goes downhill, it gains kinetic energy as it speeds up. (Inquiry point 9)
KINETIC AND POTENTIAL ENERGY

Suggested completion levels

Basic - Inquiry point goal = 3
Students at this level will: give a simple definition of kinetic energy and potential energy; identify one object with kinetic energy and one object with potential energy.

Core - Inquiry point goal = 6
Students at this level will: define kinetic energy and potential energy; describe the different types of kinetic energy and potential energy; identify the major types of energy present in everyday objects/situations.

Advanced - Inquiry point goal = 9
Students at this level will: define kinetic and potential energy; describe and give examples of the different types of kinetic and potential energies; identify the major types of energy present in everyday objects/situations; explain simple energy transformations, such as those occurring in a roller coaster.
Question 1
What is the difference between potential energy and kinetic energy?

Question 2
Complete this table:

<table>
<thead>
<tr>
<th>Type of energy</th>
<th>Kinetic or potential?</th>
<th>Description</th>
<th>Example of an object which has this energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravitational</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elastic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Question 3
Which types of energy do these objects have?

<table>
<thead>
<tr>
<th>Object</th>
<th>Type/s of energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A piece of wood</td>
<td></td>
</tr>
<tr>
<td>A hang glider</td>
<td></td>
</tr>
<tr>
<td>A chocolate bar</td>
<td></td>
</tr>
<tr>
<td>A sleeping baby</td>
<td></td>
</tr>
<tr>
<td>An iPad while in use</td>
<td></td>
</tr>
<tr>
<td>Lightning</td>
<td></td>
</tr>
</tbody>
</table>
KINETIC AND POTENTIAL ENERGY

Question 4

(a) What is energy?

(b) What are the SI units of energy?

Question 5

James Bond, 007, is in a tricky situation. In order to escape the bad guys, he is going to have to climb a tower, leap onto a nearby building roof, cross the roof, abseil down the other side, throw himself into a car (while firing shots at his chasers) then drive at high speed towards an over-water bridge that is opening to let a ship through. He gets there just in time to hurdle the gap and land safely on the other side. Identify as many types of energy at work here as you can.
Question 1
What is the difference between potential energy and kinetic energy?
Potential energy is stored energy, whereas kinetic energy is the energy of movement.

Question 2
Complete this table:

<table>
<thead>
<tr>
<th>Type of energy</th>
<th>Kinetic or potential?</th>
<th>Description</th>
<th>Example of an object which has this energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravitational</td>
<td>Potential</td>
<td>Energy of objects raised above ground</td>
<td>Aeroplane</td>
</tr>
<tr>
<td>Electrical</td>
<td>Kinetic</td>
<td>Energy of moving charges</td>
<td>Torch in operation</td>
</tr>
<tr>
<td>Light</td>
<td>Kinetic</td>
<td>Moving photons</td>
<td>Light globe switched on</td>
</tr>
<tr>
<td>Elastic</td>
<td>Potential</td>
<td>Energy of a stretched object</td>
<td>Stretched rubber band</td>
</tr>
<tr>
<td>Heat</td>
<td>Kinetic</td>
<td>Thermal energy moving particles</td>
<td>Fire</td>
</tr>
<tr>
<td>Chemical</td>
<td>Potential</td>
<td>Energy stored in chemical bonds</td>
<td>Battery</td>
</tr>
<tr>
<td>Nuclear</td>
<td>Potential</td>
<td>Energy stored in chemical bonds</td>
<td>Any atom, e.g. uranium</td>
</tr>
</tbody>
</table>

Question 3
Which types of energy do these objects have?

<table>
<thead>
<tr>
<th>Object</th>
<th>Type/s of energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A piece of wood</td>
<td>Chemical potential</td>
</tr>
<tr>
<td>A hang glider</td>
<td>Kinetic, gravitational potential</td>
</tr>
<tr>
<td>A chocolate bar</td>
<td>Chemical potential</td>
</tr>
<tr>
<td>A sleeping baby</td>
<td>Chemical, kinetic, heat</td>
</tr>
<tr>
<td>An iPad while in use</td>
<td>Chemical, light, electrical, heat</td>
</tr>
<tr>
<td>Lightning</td>
<td>Electrical, heat, light</td>
</tr>
</tbody>
</table>
KINETIC AND POTENTIAL ENERGY

Question 4

(a) What is energy?
The capacity to do work.

(b) What are the SI units of energy?
Joules (J)

Question 5

James Bond, 007, is in a tricky situation. In order to escape the bad guys, he is going to have to climb a tower, leap onto a nearby building roof, cross the roof, abseil down the other side, throw himself into a car (while firing shots at his chasers) then drive at high speed towards an over-water bridge that is opening to let a ship through. He gets there just in time to hurdle the gap and land safely on the other side. Identify as many types of energy at work here as you can.

Example answer:

James Bond himself has chemical, kinetic and heat (thermal) energy. Climbing a tower gives him gravitational potential energy. Abseiling down, his gravitational potential energy is converted to kinetic energy. Firing a gun uses chemical energy. It is converted to heat and kinetic energy of the bullet. Driving a car uses chemical energy of petrol. This converts to heat, sound and kinetic energy of the car. Jumping the bridge uses gravitational potential energy which is converted to kinetic energy as he descends on the other side of the gap.
USING THE DICHOTOMOUS KEY

Students are given a brief description of a dichotomous key followed by a drag and drop activity designed to increase their understanding of the layout and use of a dichotomous key.

**Suggested time:** 15 minutes

**Summary of Key Learning Points**

- Students:
  - learn about using dichotomous keys

**USING THE DICHOTOMOUS KEY**

5 minutes

This page has a key that students can use to classify organisms as either vertebrates or particular types of invertebrates. Use the key as a class and put photographs of different organisms up, using the key to classify them. Try a person, a mosquito and a red-back spider.

**A little history:** In 1689 the British naturalist and illustrator Richard Waller presented what is considered to be the first example of a dichotomous key. It was to his colleagues at a meeting of the Royal Society in London, and was an image-based key. The first text-based dichotomous keys didn’t appear until 1778, nearly 100 years later, when the French naturalist Jean Baptiste Lamarck published his three-volume work Flora Francaise. Lamarck is now generally cited as the developer of the dichotomous key.

**EXPLORE THIS: ARRANGE YOUR OWN**

10 minutes

Students must use reasoning skills to accurately arrange an image based dichotomous key. Matching the appropriate clues to the correct images of plants or animals results in a completed dichotomous key containing logical steps to help identify the species shown.

Guide students by suggesting what might be the first distinction you need to make - the highest level of separating species. In this case, it is Plant and Animal Kingdom. Students can work backwards from the image clues to arrange it correctly as shown here.

**Answers:** (Complete = Inquiry point 1, complete with no mistakes = Inquiry point 2)

1. Plant kingdom
   Animal kingdom

2. Has flowers
   Has no flowers

3. Gills present
   Gills absent

4. Feathers present
   Feathers absent

5. Walks on two legs
   Walks on four legs
**Extension activity:** Guess the playing card. This is a fun way to help students realise the importance of asking the right questions when constructing a dichotomous key. Using a pack of playing cards, select a card at random but don't show it to the class. Invite students to identify the card by asking a series of questions, and give them the correct response each time. For example: you have chosen the Queen of Diamonds.

The best possible questions would be:

1. red or black card (red)
2. hearts or not hearts (not hearts)
3. picture card or number card (picture card)
4. male or female (female: therefore it must be the Queen of Diamonds)

**Example 2** - The selected card is the eight of clubs.

The questions could be:

1. red or black (black)
2. clubs or not clubs (clubs)
3. picture card or number card (number card)
4. five or over, or under five (over five)
5. nine or over, or under nine (under nine)
6. six or over, or under six (over six)
7. eight or over, or under eight (it is the eight of clubs)

**Note:** you could follow this activity with the Create your own Dichotomous Key activity which involves the class constructing their own keys.

**Suggested completion levels**

**Basic - Inquiry point goal = 1**
Students at this level will: use a dichotomous key to classify at least two organisms.

**Core - Inquiry point goal = 2**
Students at this level will: use a dichotomous key to classify at least three organisms; construct a dichotomous key given the characteristics to use.

**Advanced - Inquiry point goal = 2**
Students at this level will: use a dichotomous key to classify a number of organisms; determine characteristics that can be used to distinguish between organisms and use these characteristics to construct a dichotomous key.
Question 1

Keys are vital tools in classification. Use the key below to identify these two dinosaurs.

<table>
<thead>
<tr>
<th></th>
<th>(a)</th>
<th></th>
<th></th>
<th>(b)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Over 6 m long</td>
<td></td>
<td>Under 6m long</td>
<td>go to 2</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Tail not pointy</td>
<td>Tail pointy</td>
<td></td>
<td>go to 5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Has horns</td>
<td>No horns</td>
<td></td>
<td>Triceratops</td>
<td>Euoplocephalus</td>
</tr>
<tr>
<td>3</td>
<td>Walks on 2 legs</td>
<td>Walks on 4 legs</td>
<td></td>
<td>Apatosaurus</td>
<td>Albertosaurus</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>Go to 6</td>
<td>Scelidosaurus</td>
</tr>
<tr>
<td>5</td>
<td>2 m long</td>
<td>3 m long</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Walks on 2 legs</td>
<td>Walks on 4 legs</td>
<td></td>
<td>Stenochosaurus</td>
<td>Psittacosaurus</td>
</tr>
</tbody>
</table>

(a)  

(b)  

---
Question 2

(a) Use the key below to find out which invertebrate group this creature belongs to.

(b) What characteristics would a creature belonging to the molluscs have?
Question 3

Create a dichotomous key to classify these 5 monsters.

Alex  Nick  Jay  Ding  Rob
Question 1

Keys are vital tools in classification. Use the key below to identify these two dinosaurs.

<table>
<thead>
<tr>
<th>Question</th>
<th>(a) Albertosaurus</th>
<th>(b) Triceratops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Over 6 m long</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Under 6m long</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tail not pointy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pointy tail</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Has horns</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No horns</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Walks on 2 legs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walks on 4 legs</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2 m long</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 m long</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Walks on 2 legs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Walks on 4 legs</td>
<td></td>
</tr>
</tbody>
</table>

(a) Albertosaurus

(b) Triceratops
Question 2

(a) Use the key below to find out which invertebrate group this creature belongs to.

(b) What characteristics would a creature belonging to the molluscs have?

No legs, hard shell, soft body.
Question 3

Create a dichotomous key to classify these 5 monsters.

Answer:

- **Has more than four teeth**
  - **Is green**
    - **Doesn’t have a tail**: **ALEX**
  - **Is not green**
    - **Has a tail**: **NICK**

- **Has less than four teeth**
  - **Has one eye**: **DING**
  - **Has multiple eyes**: **ROB**
Students explore how weathering and erosion slowly change the face of the Earth.

**Suggested time:** 20 minutes

**Summary of Key Learning Points**

Students:
- learn the difference between weathering and erosion
- discover the two major types of weathering
- find out about the different agents of erosion
- understand that spectacular landforms are the result of millions of years of weathering and erosion

**WEATHERING AND EROSION**

2 minutes

The first page clarifies what is meant by the terms ‘weathering’ and ‘erosion’, as these related processes are often viewed as the same thing.

**Answers:** (Inquiry point 1 of 6)

Weathering: The breaking down of rocks into smaller pieces.

Erosion: The transportation of pieces of rock to other areas.

**WEATHERING**

8 minutes

Here students explore physical (mechanical) and chemical weathering.

**Physical weathering page**

In physical weathering, no chemical reactions take place when the rocks break down.

**Answers:**

(In order) heated; contract; cooled. (Inquiry point 2 of 6)

(Suggested answer) When the water freezes, it will expand and cause the rock to crack.

**Chemical weathering page**

Chemical weathering largely occurs when water reacts with rocks, particularly acidic water.

(Answer) At 25 degrees Celsius, the acidic region of the pH scale is below pH 7.

(Answer) Carbon dioxide (Inquiry point 3 of 6)

Carbon dioxide is the gas in the atmosphere that causes all rainwater to be slightly acidic. Make sure students understand the difference between naturally acidic rainwater and acid rain.

Biological weathering science extra
WEATHERING & EROSION

(Answers) Seeking water, tree roots spread through cracks in a rock; Lichen (a mix of algae and fungi) excrete chemicals onto a rock which break it down; and Piddocks (a type of mollusc) use their shells to burrow holes into rocks. (Inquiry point 4 of 6)

Extension activity could be to have students also determine which are physical and which are chemical:

Seeking water, tree roots spread through cracks in a rock. (physical)

Hot water causes a rock to expand and crack. (physical)

Lichen excrete chemicals onto a rock, which break it down. (chemical)

Piddocks use their shells to burrow holes into rocks. (physical)

Maybe show the students photos of lichen and piddocks!

**EROSION**

5 minutes

On this page, students learn about different agents of erosion then select them from the list.

Answers:

Wind; gravity; water; ice (Inquiry point 5 of 6)

**WEATHERING AND EROSION**

5 minutes

Weathering and erosion constantly change the face of the Earth. Here, students choose which process has created the effect observed.

Answers (in order):

Mechanical weathering and erosion; Wind erosion; Mechanical weathering; Chemical weathering (Inquiry point 6 of 6)

It is worth pointing out to students that neither weathering nor erosion could happen if the rocks weren't at the Earth's surface. They get there by uplift (see Science extra), driven by tectonic processes.

**Suggested completion levels**

**Basic - Inquiry point goal = 3**

Students at this level will: define weathering and erosion; identify the two types of weathering; describe at least two agents of erosion.

**Core - Inquiry point goal = 4-5**

Students at this level will: explain the processes of weathering and erosion; describe the two types of weathering, with examples; identify at least three agents of erosion; define uplift.

**Advanced - Inquiry point goal = 6**

Students at this level will: explain the processes weathering and erosion; describe the two types of weathering and explain how biological weathering can be either type; identify at least four agents of erosion and explain their effect on the landscape; evaluate the effect of uplift on rock forming processes.
Question 1

Complete the sentences using these words:

temperature, smaller, weathered, chemical, weathering, erosion, physical, more

(a) __________________________ breaks rocks down into ______________________ pieces.
(b) __________________________ transports __________________________ material.
(c) Mechanical or ______________________ weathering is mostly caused by ______________________ changes.
(d) ________________________ weathering will happen ______________________ quickly in polluted areas.

Question 2

After rocks are weathered and eroded, deposition occurs. This is when the sediment comes to rest, for example on the bottom of a stream or river. Label the following as examples of weathering (W), erosion (E) or deposition (D).

(a) A mudslide after a storm. ______
(b) Water in a rock freezes and cracks the rock. ______
(c) Waves cause sand to accumulate on the shoreline. ______
(d) A glacier scrapes past rocks as it moves down a mountain. ______
(e) Layers of sediment build up on the ocean floor. ______
(f) Wind blows sand away. ______
(g) Rain washes soil away. ______
(h) Fine sediment travels along a river. ______

Question 3

Explain these statements.

(a) Biological weathering can be either physical or chemical.

__________________________________________________________

(b) Weathering and erosion are very slow processes.

__________________________________________________________
WEATHERING & EROSION

(c) A statue made of granite will last longer in a polluted city than one made of marble.

Question 4

Answer the questions then use the indicated letter to answer the final question.

(a) Which sort of rocks are formed at the Earth's surface and so are weathered early in their life?
V __ __ __ __ __ __ __ (1st letter)

(b) Which process breaks rocks down into smaller pieces?
W __ __ __ __ __ __ __ __ __ (3rd letter)

(c) Which sort of weathering involves living things?
B __ __ __ __ __ __ __ __ __ (4th letter)

(d) What is another name for physical?
M __ __ __ __ __ __ __ __ __ (last letter)

(e) Which agent of erosion is made of frozen water?
I __ (last letter)

(f) Which force present all over the world pulls rocks downwards?
G __ __ __ __ __ __ (last letter)

What sort of landform can be created from a glacier moving slowly down a mountain?

__ __ __ __ __ __
Question 5

Complete these mind maps.

Weathering
- Defined as:
  - Caused by non-chemical factors
  - Caused by chemical reactions

Erosion
- Defined as:
  - Agents of erosion include
WEATHERING & EROSION

Question 1

Complete the sentences using these words:

- temperature, smaller, weathered, chemical, weathering, erosion, physical, more

(a) _weathering______________ breaks rocks down into _smaller____________ pieces.

(b) _erosion_______________ transports _weathered______________ material.

(c) Mechanical or _physical______ weathering is mostly caused by _temperature____________ changes.

(d) _chemical_______________ weathering will happen _more___________ quickly in polluted areas.

Question 2

After rocks are weathered and eroded, deposition occurs. This is when the sediment comes to rest, for example on the bottom of a stream or river. Label the following as examples of weathering (W), erosion (E) or deposition (D).

(a) A mudslide after a storm. _E____

(b) Water in a rock freezes and cracks the rock. _W____

(c) Waves cause sand to accumulate on the shoreline. _D____

(d) A glacier scrapes past rocks as it moves down a mountain. _W____

(e) Layers of sediment build up on the ocean floor. _D____

(f) Wind blows sand away. _E____

(g) Rain washes soil away. _E____

(h) Fine sediment travels along a river. _E____

Question 3

Explain these statements.

(a) Biological weathering can be either physical or chemical.

Biological weathering comes in a variety of forms and can break down rocks due to a number of processes. Some examples of physical weathering includes the growth and expansion of roots between rocks. Chemical weathering can include when lichen release acidic substances.

(b) Weathering and erosion are very slow processes.

It takes many years for natural processes to break a giant boulder, or a part of a mountain down into fine sediment. Weathering and erosion is very powerful due to the accumulation of very small changes over very long periods of time.
(c) A statue made of granite will last longer in a polluted city than one made of marble.

Marble is known to weather very rapidly, especially in the presence of acidic substances. Rain water is naturally acidic, and when pollution is present acid rain may occur. This speeds up the weathering processes even more.

Question 4

Answer the questions then use the indicated letter to answer the final question.

(a) Which sort of rocks are formed at the Earth's surface and so are weathered early in their life?

V O L C A N I C (1st letter)

(b) Which process breaks rocks down into smaller pieces?

W E A T H E R I N G (3rd letter)

(c) Which sort of weathering involves living things?

B I O L O G I C A L (4th letter)

(d) What is another name for physical?

M E C H A N I C A L (last letter)

(e) Which agent of erosion is made of frozen water?

I C E (last letter)

(f) Which force present all over the world pulls rocks downwards?

G R A V I T Y (last letter)

What sort of landform can be created from a glacier moving slowly down a mountain?

VALLEY
Question 5

Complete these mind maps.
Every student learns differently, which is of course also true of teachers! That’s why the team here at 3P Learning offer a range of training options for schools - from a simple PDF guide, to videos and webinars, all of which are designed to help you get the most out of your IntoScience experience.

www.3plearning.com/training/au

Brought to you by the team behind the award winning teacher resource, Mathletics.