

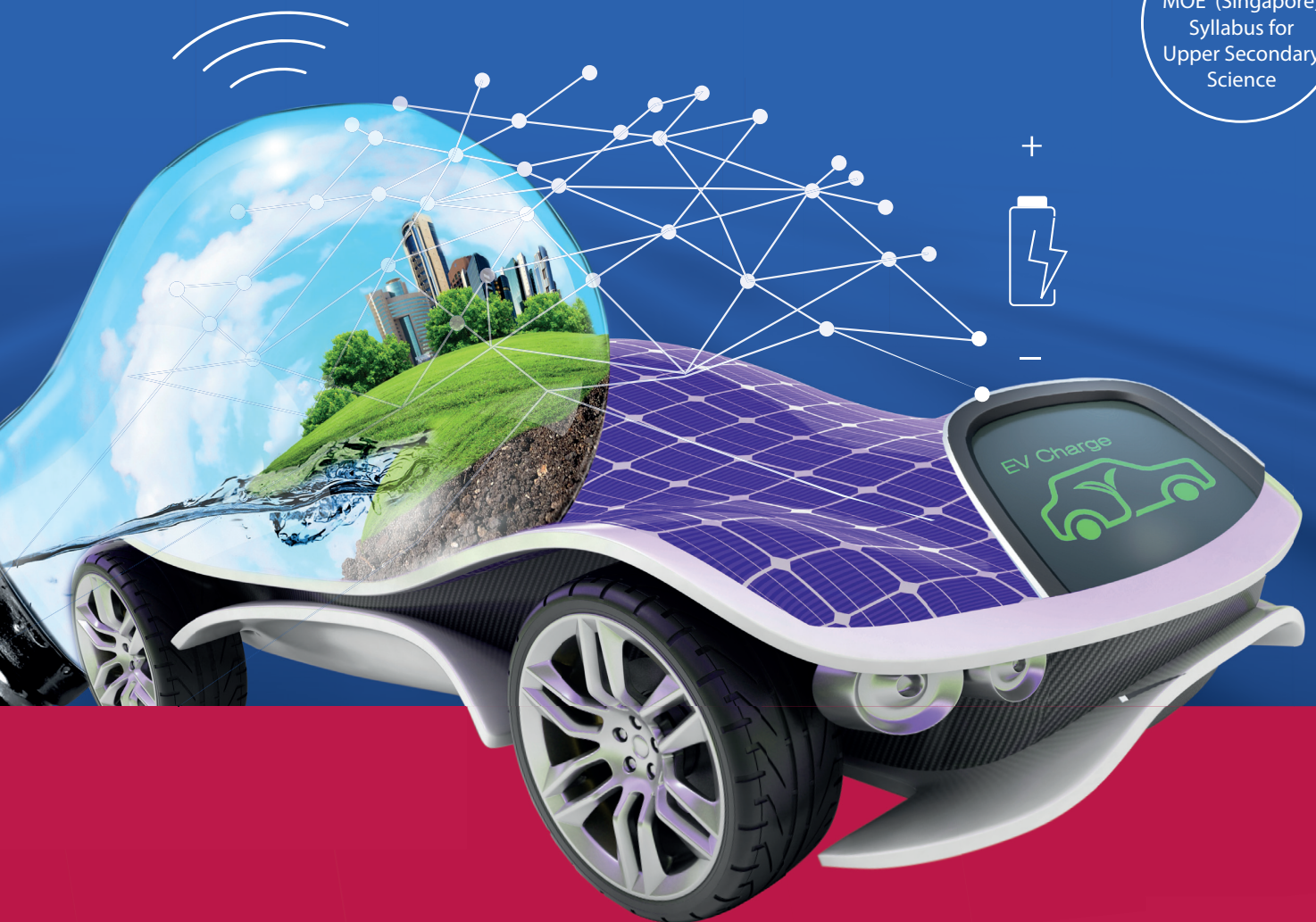
UPPER SECONDARY SCIENCE

MATTERS & DISCOVER SERIES

Physics, Chemistry and Biology

Brochure

Based on 2023
MOE (Singapore)
Syllabus for
Upper Secondary
Science



Marshall Cavendish Education Matters and Discover series Physics, Chemistry and Biology

The new edition of the Marshall Cavendish Education (MCE) Matters and Discover series for Physics, Chemistry and Biology is aligned to the latest GCE 'O' Level syllabuses, and the GCE 'O' Level Science and N(A) Level Science syllabuses respectively released by Ministry of Education (MOE), Singapore for use in 2023.

The latest series reflects the curriculum shifts in the new science curriculum framework such as the emphasis on Science for Life and Society, Practices of Science, VEA (Values, Ethics and Attitudes) and Disciplinary Ideas. It seeks to nurture future-ready learners who understand the relevance of science to the world around them and encourages them to be inspired, to inquire and to innovate.

Building on the strengths of the previous edition, this latest edition of the Matters and Discover series continues to adopt a visual approach and offer rich resources to make teaching and learning easy and simple. It is now designed for hybrid learning and supports the development of self-directed digital learners.

Why Choose the MCE Matters and Discover Series



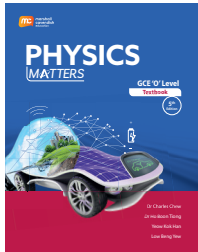
A hybrid research-based educational solution with a comprehensive range of resources that empowers science teacher professionals to nurture future-ready students.

- Hybrid solution for onsite and offsite learning experiences at the same time
- Research-based solution that provides an effective teaching and learning pathway
- User-friendly and comprehensive resources that empower science teacher professionals to nurture future-ready students

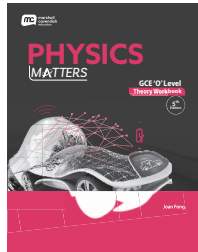
Matters series

Physics

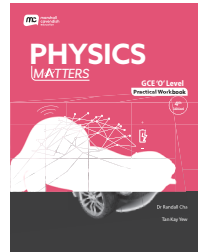
Student



Textbook
9789814987974

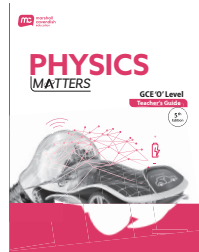


Theory Workbook
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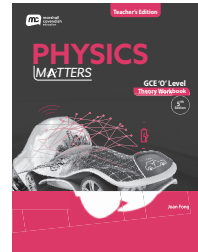


Practical Workbook
9789814987998

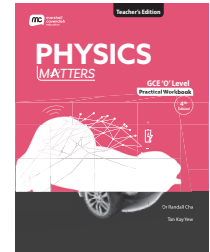
Teacher



Teacher's Guide
9789815056532



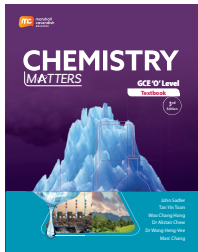
Theory Workbook (Teacher's Edition)
9789815056471



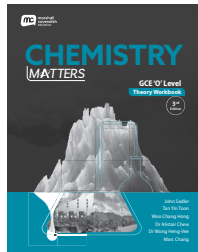
Practical Workbook (Teacher's Edition)
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Chemistry

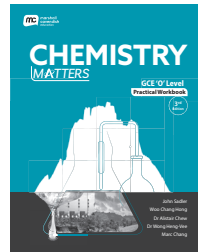
Student



Textbook
9789814988056

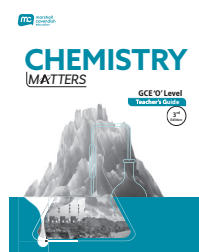


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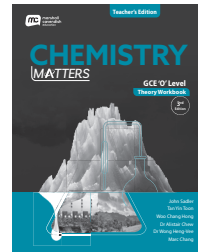


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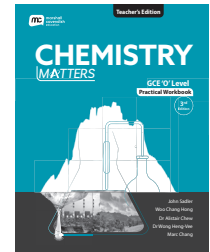
Teacher



Teacher's Guide
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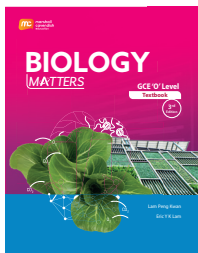
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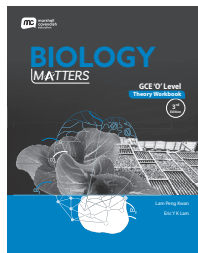
Practical Workbook (Teacher's Edition)
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Biology

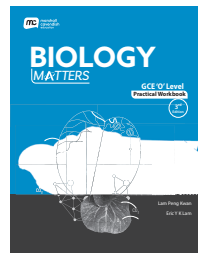
Student



Textbook
9789814987882

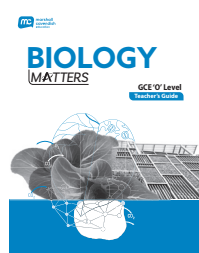


Theory Workbook
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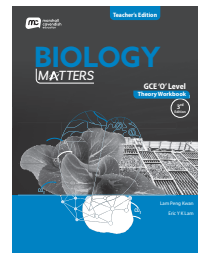


Practical Workbook
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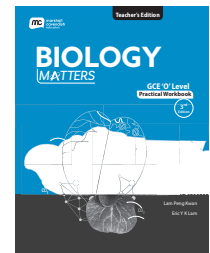
Teacher



Teacher's Guide
9789815072549



Theory Workbook (Teacher's Edition)
9789815072488



Practical Workbook (Teacher's Edition)
9789815072495

Digital Resources

Student

- Annotatable Enhanced eBooks
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Teacher

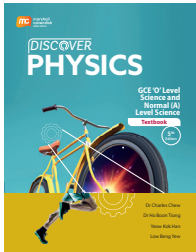
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Product Architecture

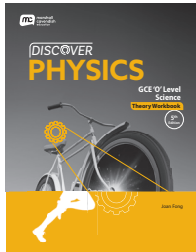
Discover series

Physics

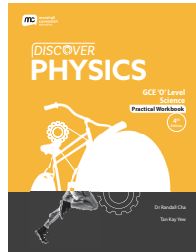
Student



Textbook
9789814988001

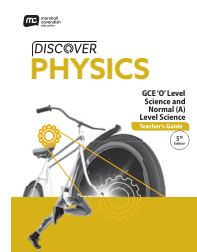


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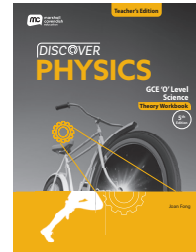


Practical Workbook
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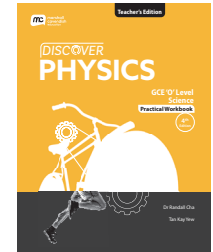
Teacher



Teacher's Guide
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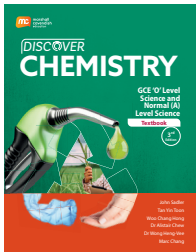
Theory Workbook (Teacher's Edition)
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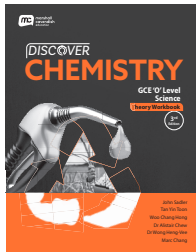
Practical Workbook (Teacher's Edition)
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Chemistry

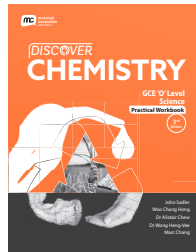
Student



Textbook
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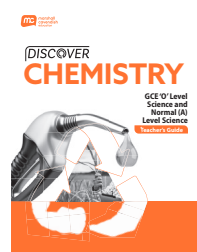


Theory Workbook
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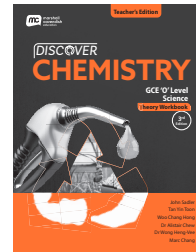


Practical Workbook
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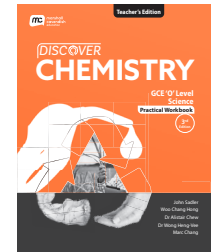
Teacher



Teacher's Guide
9789815072273



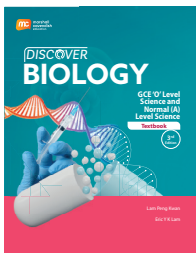
Theory Workbook (Teacher's Edition)
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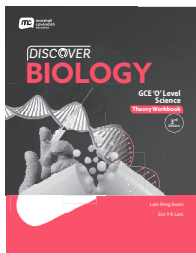
Practical Workbook (Teacher's Edition)
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Biology

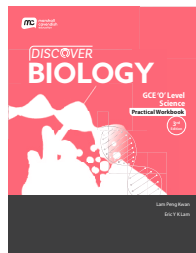
Student



Textbook
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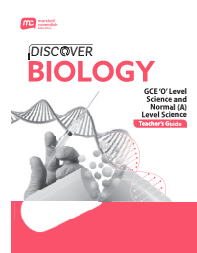


Theory Workbook
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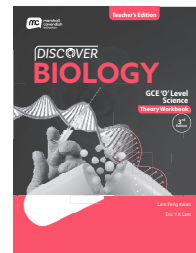


Practical Workbook
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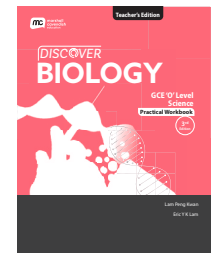
Teacher



Teacher's Guide
9789815072556



Theory Workbook (Teacher's Edition)
9789815072501



Practical Workbook (Teacher's Edition)
9789815072518

Digital Resources

Student

- Annotatable Enhanced eBooks
 - Textbook (tagged with quizzes, videos, animations, simulations)
 - Theory Workbook
 - Practical Workbook (tagged with experiment videos)

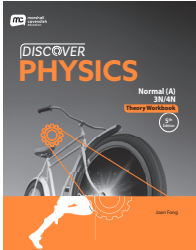
Teacher

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- Image Bank

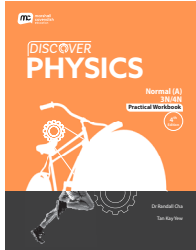
Discover series

Physics

Student

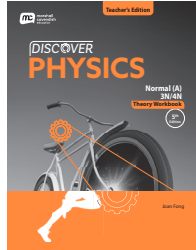


Theory Workbook
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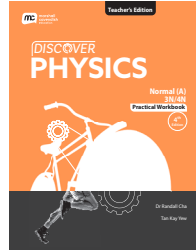


Practical Workbook
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Teacher



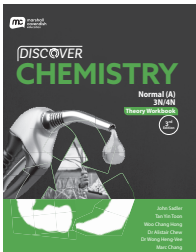
Theory Workbook (Teacher's Edition)
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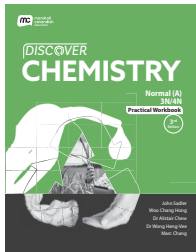
Practical Workbook (Teacher's Edition)
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Chemistry

Student

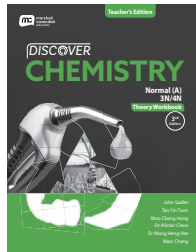


Theory Workbook
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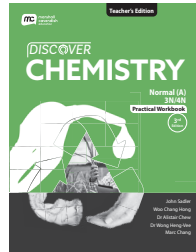


Practical Workbook
9789814988124

Teacher



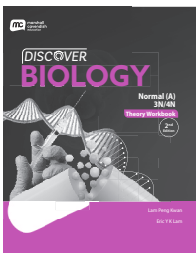
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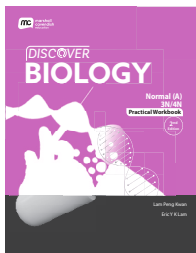
Practical Workbook (Teacher's Edition)
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Biology

Student

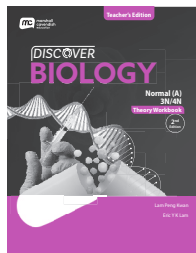


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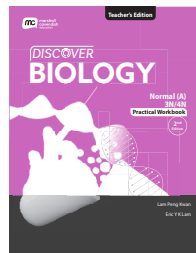


Practical Workbook
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Teacher



Theory Workbook (Teacher's Edition)
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Practical Workbook (Teacher's Edition)
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Digital Resources

Student

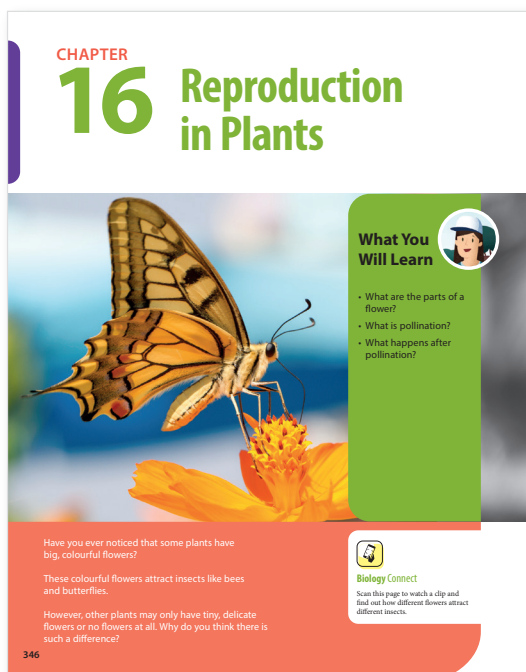
- Annotatable Enhanced eBooks
 - Textbook (tagged with quizzes, videos, animations, simulations)
 - Theory Workbook
 - Practical Workbook (tagged with experiment videos)

Teacher

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- Image Bank

Hybrid Solution for Onsite and Offsite Learning Experiences at the Same Time

Teaching and learning are no longer restricted to the classroom today, and many schools have incorporated home-based learning (HBL) as part of their school curriculum. In addition, some lessons are conducted in class with some students attending remotely from home. Therefore, the Matters and Discover series are designed to offer teachers and students the flexibility of using the resources seamlessly onsite and offsite at the same time.

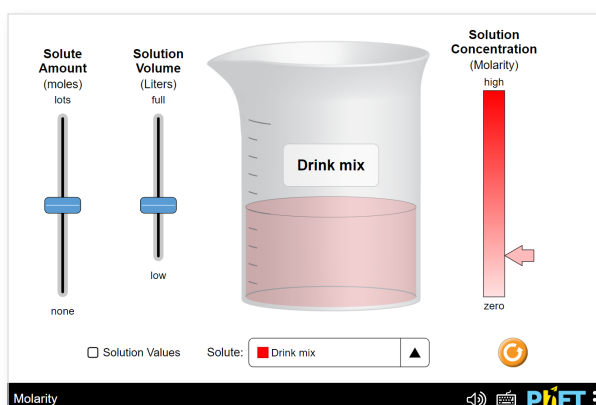


Biology Matters Textbook

Connect

Connect helps to capture students' interest and make science come alive by using digital resources* such as videos, animations, simulations or articles, in school or at home. It also provides opportunities for self-directed learning whereby students can access the resources on their Personal Learning Devices (PLDs).

*Accessible on smartphones or PLDs by scanning the page using the MCEduHub app, which has a marker recognition function.



Simulation

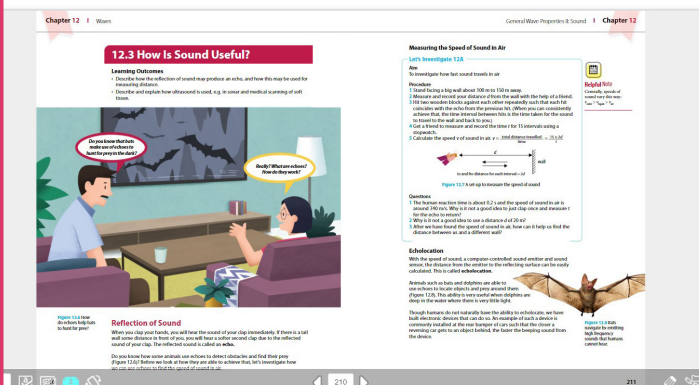
Annotatable Enhanced eBooks

The enhanced eBooks of the textbooks and workbooks are annotatable and tagged with digital resources* such as videos, animations, simulations and quizzes to support hybrid teaching and learning.

Teachers can conveniently launch the eBook for in-class or online teaching as all its resources are tagged and accessible with a click.

Students can make annotations as they learn on the go and carry out self-assessment using the auto-markable quizzes.

*Downloadable in the MCEduHub app for offline use.



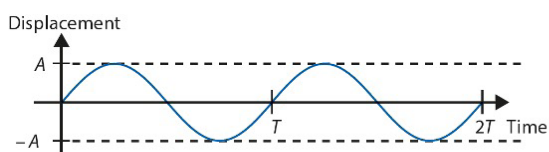
Annotatable eBook

Application of Key Ideas

Textbook
Page 208

Worked Example 12B

For a particular tuning fork, the displacement–time graph on the screen is as shown.



Draw a new displacement–time graph to show the sound from the tuning fork with its amplitude doubled and its frequency halved.

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Lesson-by-lesson PowerPoint Slides

Offer a convenient hybrid solution for teachers to carry out engaging lessons both in class and online to achieve the desired learning outcomes. The PowerPoint slides facilitate learning using the series' pedagogical framework.

Interactive Kahoot! quizzes, critical thinking questions and links to relevant videos, animations and simulations are arranged in an easy-to-deliver lesson flow to teach key concepts and carry out assessment.

Skills-based and Experiment Videos

Support hybrid learning as teachers can play the videos during online lessons when they are unable to conduct practical lessons in the laboratory.

Students may also use these videos as a tool for self-directed learning or revision.

Available in *Practical Workbook (eBook)*



Research-based Solution That Provides an Effective Teaching and Learning Pathway

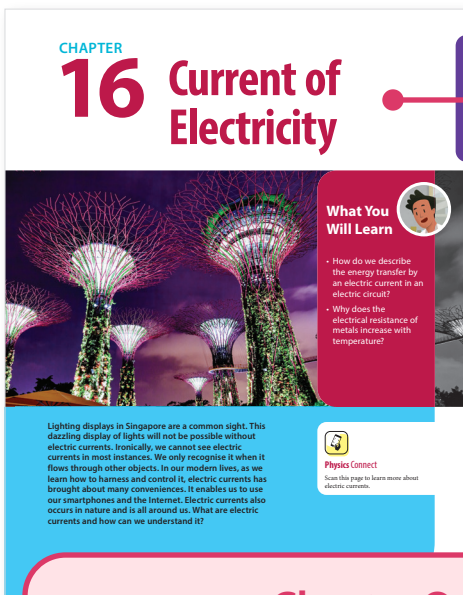
The series is underpinned by the 3Cs with 1E Pedagogical Approach of Capturing Interest, Constructing Understanding, Consolidating Learning and Enrichment. This approach is guided by findings of Mind, Brain and Education Science (MBE Science) as well as the established 3Cs Inquiry Framework by local researchers, Dr Poon et al.

Our series uses a multi-modal and multi-sensory approach to support effective learning for diverse student profiles. To help students better visualise abstract concepts, the content is represented using rich infographics in the Textbooks, and videos, animations and simulations in the eBooks.

3Cs with 1E Pedagogical Approach

Capture Interest with the Big Ideas of the Topic

Physics Matters Textbook



Chapter Opener

Includes engaging visuals and trigger questions to pique interest in the topic and promote inquiry-based learning

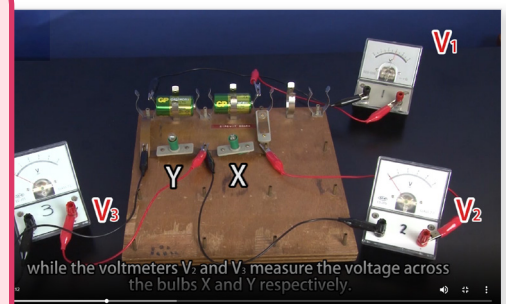
Concept Cartoons

Provide purposeful visuals which present relatable scenarios to trigger discussion of concepts, challenge students' ideas, and clarify misconceptions.

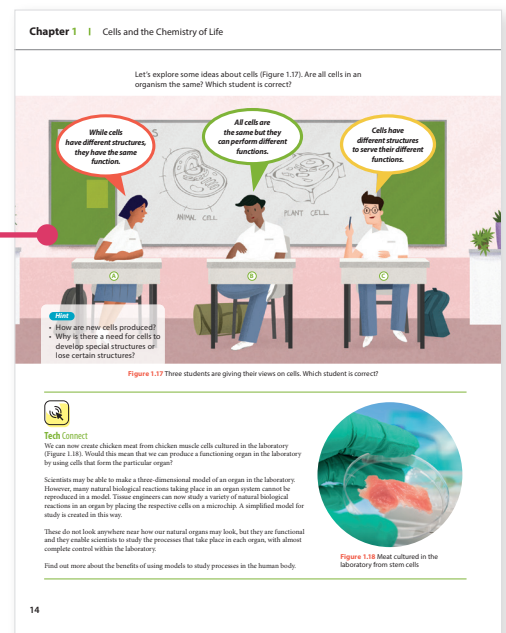
Connect

Provides access to videos, animations, simulations and articles via the MCEduHub App for an engaging chapter introduction or for reinforcing concepts within the main chapter.

Video



Discover Biology Textbook



Construct Understanding of the Key Concepts

Chemistry in a Sustainable World | Chapter 22

① Within the layer, the chlorine atoms from the CFCs react with ozone to form oxygen and chlorine oxide. Chlorine oxide continues to break up another ozone molecule. The chlorine atom is released and continues to attack another ozone molecule in a chain reaction.

② UV radiation from the sun breaks up the CFC molecules in the stratosphere into chlorine atoms.

③ Holes in the ozone layer start to form. The holes allow harmful UV radiation to reach the Earth's surface.

Figure 22.13 How CFCs destroy the ozone layer

In 1985, it was noticed that a hole had opened in the ozone layer above Antarctica. This hole has changed in size over the years and has also covered parts of Australia, New Zealand, Argentina and South Africa (Figure 22.14). It may have contributed to increases in skin cancer rates in these countries since.

In 1987, the Montreal Protocol was signed by 46 countries. It restricts the production and release of CFCs into the atmosphere. The Protocol has since been adopted by nearly every country including Singapore which only allows the use of ozone-friendly refrigerant gases. The ozone layer is expected to fully heal sometime around 2075.

Let's Practise 22.3

- 1 Write the chemical formula of ozone.
- 2 State the importance of the ozone layer.
- 3 List **two** undesirable effects that humans might experience when the ozone layer is depleted.
- 4 Name a substance that depletes the ozone layer.

Figure 22.14 The expansion of the ozone hole, represented by the dark blue regions

Helpful Note
Reactions that require sunlight to occur typically utilise the ultraviolet radiation it contains to overcome the activation energy barrier.

Link
[Theory Workbook Worksheet 22C](#)

415

Infographics and Stepwise Presentations

Enable students to visualise abstract concepts by breaking them down into bite-sized pieces of information that are easy to understand.

Helpful Note

Highlights misconceptions, tips, and additional information to support students' learning.

Chemistry Matters Textbook

Biology Matters Textbook

Let's Investigate

Features experiment-based or hands-on activities to introduce experimental skills and support conceptual development.

Nutrition and Transport in Flowering Plants | Chapter 12

12.4 How Can We Study the Movement of Substances in Plants?

Learning Outcome

- Define the term *translocation* as the transport of food (mainly sucrose) in the phloem tissue and illustrate the process through translocation studies.

Animals have a circulatory system that moves blood around their bodies in order to transport substances. Plants also have a way of moving water and dissolved substances around their bodies. With animals, we can measure pulses, but plants have no heartbeat. How then can we study the movement of water and food substances in plants?

How Can We Study the Path Water Takes Through a Plant?

Let's Investigate 12.10

Aim
To investigate the path of water through a plant

Procedure

- 1 Take a celery plant and wash it with water to remove the soil. A celery stem may be used for this experiment
- 2 Allow the plant to stand with its stem immersed in methylene blue (or dilute red ink) solution (Figure 12.43).
- 3 After a few hours, you can see that the blue dye has risen up the stem. Cut thin transverse sections of the stem.
- 4 Place the sections on a glass slide. Examine the sections under a light microscope.
- 5 Sketch the transverse section of the leaf to show the distribution of the blue colour (methylene blue) in the main vein or the vascular bundle.

Observation and Conclusion

- 1 Which tissue has been stained blue?
- 2 What conclusion can you draw from your investigation?

Figure 12.43 Experimental set-up to study the path of water through a plant

Disciplinary Idea Systems
The plant's transport system ensures that its leaves receive sufficient raw materials for photosynthesis and that the entire plant subsequently receives the products of photosynthesis for growth.

Link
[Practical Workbook Experiment 12G](#)

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Worked Example 11B

Which statement about M, a Group 1 element, is true?
A It reacts with oxygen to form an acidic oxide.
B It will react with cold water.
C Its chloride is insoluble in water.
D The formula of its nitrate is $M(NO_3)_2$.

Thought Process
 All Group 1 elements, or the alkali metals, react with cold water to form hydrogen and an alkali. The oxides of these metals are basic and their chlorides are soluble in water. The valency of each Group 1 element is 1. The formula of its nitrate is MNO_3 .

Answer
B

Group 17 Elements — Halogens

The elements in Group 17 of the periodic table are called the **halogens**. The elements in the group are fluorine (F), chlorine (Cl), bromine (Br), iodine (I), astatine (At) and tennessine (Ts) (Figure 11.11). They exist as diatomic molecules and are non-metals. This means that there are two halogen atoms per molecule (i.e. F_2 , Cl_2 , Br_2 , I_2 , At_2 and Ts_2).

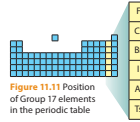


Figure 11.11 Position of Group 17 elements in the periodic table

Physical Properties of Halogens

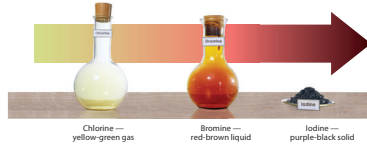
The halogens:
 • have low melting and boiling points; and
 • are coloured.

Table 11.5 shows the physical properties of chlorine, bromine and iodine.

Table 11.5 Physical properties of some halogens

Halogen	Melting Point / °C	Boiling Point / °C	Appearance at r.t.p.
chlorine	-101	-34	yellow-green gas
bromine	-7	59	red-brown liquid
iodine	114	184	purple-black solid

From Table 11.5, we can see that going down the group,
 • the melting and boiling points of the halogens increase; and
 • the colours become darker (colour **intensities** increase).



Astatine is below iodine in Group 17. Based on Figure 11.12, we can deduce that astatine will be darker than iodine. In fact, astatine is black.

Worked Example

Guides students through the thought process of answering a question and promotes self-directed learning.



Word Alert

intensity: strength of something that can be measured

Word Alert

Provides language support by supplying brief and simple definitions of words that students may find challenging.

Experiment

Provides students with opportunities to hone their practical skills, includes questions that require students to analyse, evaluate and make conclusions, and reinforces concepts by linking theory to the practical.

Name: _____ () Class: _____ Date: _____

Experiment 4B

Effect of Balanced and Unbalanced Forces

WOTD Conducting experiments and testing solutions, analysing and interpreting data, constructing explanations and designing solutions

VEA Curiosity, objectivity, resilience

Skills

You will:

- outline an experimental procedure to investigate the question/problem;
- set up apparatus correctly by following written instructions or diagrams;
- use common laboratory apparatus and techniques to collect data and make observations;
- present all information in an appropriate form;
- manipulate measurements effectively for analysis;
- analyse and interpret data or observations appropriately;
- draw conclusion(s) from the interpretation of experimental data or observations and underlying principles; and
- make predictions based on their data and conclusions.

A vector toy is an object that uses gravity to slide along a table without falling over the edge of the table. We have learnt that to make an object move, an unbalanced force must be applied on it. This can be done by tying a mass to the front of the toy using a string. The mass is hung over the edge of the table to drag the toy towards the edge.

In this experiment we will investigate why the vector toy (a wooden block) slides and stops at the edge of the table without falling over the edge of the table.

Aim

To explain how a vector toy slides on a table and stops at the edge of the table without falling over

Materials

- electronic balance
- metre rule
- paper clips
- small wooden block or any object of a small mass that can slide easily on a table
- string (70 cm)

Procedure and Observations

1. Tie the string to the wooden block or object if possible.
2. Tie the other end of the string to a paper clip.
3. Place the wooden block about 30 cm from the edge of the table.
4. Hang the paper clip over the edge of the table.
5. Ensure there is an angle θ between the string and the tabletop (Figure 4.2). The string must not be horizontal.

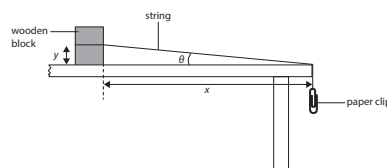


Figure 4.2

Consolidate Learning of the Key Concepts

Metallic Properties of Elements Across a Period

Metals are grouped on the left-hand side of each period. Non-metals are grouped on the right-hand side. Due to the change from metal to non-metal across a period, there is also a change in the properties of the elements (Table 14.3).

Table 14.3 Properties of elements across Period 3

Group	1	2	13	14	15	16	17	18
Symbol	Na	Mg	Al	Si	P	S	Cl	Ar
Name	sodium	magnesium	aluminium	silicon	phosphorus	sulfur	chlorine	argon
Properties	metallic			metalloid	non-metallic			
Nature of Oxides	basic		amphoteric		acidic			

There is a decrease in metallic properties and an increase in non-metallic properties across a period.

An atom displays more metallic properties when it is more likely to lose electrons than to gain electrons. As we move across a period, the atom becomes less likely to lose electrons. This is because it requires more energy to lose electrons (there are more protons in the nucleus).

Metallic Properties of Elements Down a Group

Going down a group, there is an increase in metallic properties and a decrease in non-metallic properties.

This is because the size of the atom increases going down a group. Hence, the outermost electrons of the element will be further away from the attractive force of the nucleus. An element further down a group will thus lose its outermost electrons more easily (Figure 14.4).

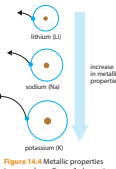


Figure 14.4 Metallic properties increase down Group 1 elements.



Link

Recall from Chapter 3: Atoms can gain or lose electrons to attain the electronic configuration of a noble gas. The ions they form is dependent on the energy required.



Disciplinary Idea

Regular patterns can be observed in the chemical and physical properties of elements across a period, and down a group. This is due to the electronic configurations of atoms.

Let's Practise 14.1

1 Using only the elements shown in the simplified periodic table in Figure 14.5, answer the following questions.

- Deduce the electronic configuration of chlorine. Explain your answer.
- Give the symbol(s) of:
 - two elements in the same group;
 - two elements in the same period;
 - two elements that combine together to form an acid;
 - the element whose atoms contain the greatest number of electrons; and
 - the element that forms an ion with a charge of +1.

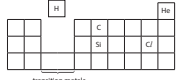


Figure 14.5

Let's Practise

Includes a set of formative questions to check students' understanding of the section(s).

Let's Review

Section A: Multiple-choice Questions
Examine Figure 6.45 and answer questions 1–3.

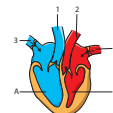


Figure 6.45

- Which blood vessels carry oxygenated blood?
A 1 and 2 B 2 and 3
C 2 and 4 D 3 and 4
- Which of the blood vessels supplies oxygenated blood to the heart muscles?
A 1 B 2
C 3 D 4
- Which of the following is **not** involved in bringing blood from A to B?
A 1 and 2 B 2 and 4
C 2 and 3 D 3 and 4

Figure 6.46 shows the pressure changes in the left side of the heart. With reference to the graph, answer questions 4–5.

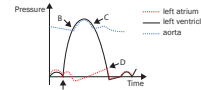


Figure 6.46

- At which point does the bicuspid valve begin to close?
- At which point does the bicuspid valve begin to open?

Section B: Structured Questions

1 Figure 6.47 shows some tissue cells and a blood vessel.

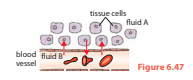


Figure 6.47

- Name the fluid A and B.
- Name **one** chemical substance that passes from fluid:
(i) A to B (ii) B to A
- What type of blood vessel is shown in the diagram? Give **two** reasons to support your answer.

2 The blood of three people, X, Y and Z, was tested with plasma from blood of different groups to determine their blood groups. Table 6.3 shows the test results.

Blood of Person	X	Y	Z
Plasma from Blood of Group A	clumps	clumps	no clumping
Plasma from Blood of Group B	no clumping	clumps	no clumping

- To which blood group does each person belong?
- What causes the red blood cells of person X to clump together when his blood is mixed with plasma from group A?
- What blood group(s) must a donor belong to if he is to donate blood to person Z?
- A donor has blood group A. To which blood groups can his blood be given safely?

Section C: Free-response Questions

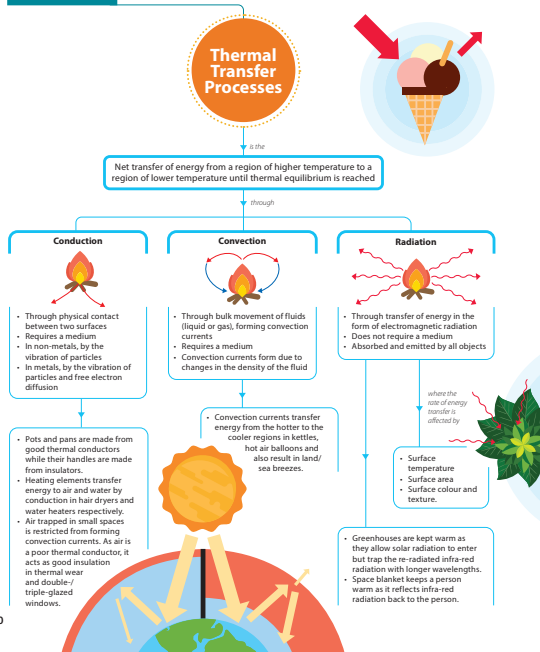
- The number of white blood cells increases in a patient's bloodstream shortly after surgery. Suggest and explain **one** possible cause of this increase.
- Describe the cardiac cycle in terms of what happens during systole and diastole.

Let's Review

Helps students review their understanding of concepts through end-of-chapter exam-style questions (multiple-choice questions, structured and free-response questions).

Includes data-based questions and synoptic questions (question testing connections between concepts) where applicable.

Let's Map It

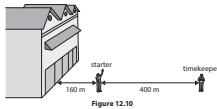


Let's Map It

Summarises the relationships between key concepts in the chapter through a visual concept map.

Worksheet 12B Usefulness of Sound

1. Figure 12.10 shows a starter standing between a building and a timekeeper. When the starter fires his gun to start a 400 m race, the timekeeper at the end of the track hears two sounds that are one second apart.



Calculate the speed of sound in air.

Let the speed of sound for that day be v .
Let the time taken by the sound to travel from the starter to the timekeeper be t_1 .
Let the time taken by the reflected sound to travel from the building to the timekeeper be t_2 .

$$v = \frac{400 \text{ m}}{t_1}$$

$$v = \frac{(160 + 160) + 400 \text{ m}}{t_2}$$

Given that $t_2 - t_1 = 1 \text{ s}$,

$$\frac{720 \text{ m}}{v} - \frac{400 \text{ m}}{v} = 1 \text{ s}$$

$$v = \frac{720 \text{ m} - 400 \text{ m}}{1 \text{ s}}$$

$$v = 320 \text{ m/s} - 400 \text{ m/s}$$

$$= 320 \text{ m/s}$$

2. (a) What is the range of frequencies that a human ear can hear?
The range is from 20 Hz to 20 000 Hz on average. However, this range varies from person to person.
- (b) What are frequencies above the range in (a) called?
Ultrasonic frequencies.
3. (a) A bat emits squeaks of pitch 100 kHz, which is in the ultrasound region. By giving out 160 squeaks per second, the bat can locate objects around it through a process called echolocation.
Using the example of a bat, explain what the term echolocation means.
The bat's squeaks bounce off objects in the dark. These echoes are picked up by the bat's large ears, allowing it to know the locations of the objects in its surroundings.
- (b) Like a bat, a fishing boat can use sound waves to detect the presence of a shoal of fish (Figure 12.11). Discuss the process of echolocation in this case.
The fishermen on the boat send beams of sound waves to locate the fish.
They can also gauge the number of fish and the depth at which the fish are.
This allows them to decide whether they should cast their nets.



Figure 12.11

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Physics Matters Theory Workbook (Teacher's Edition)

Section Worksheets

Formative worksheets that include structured questions provide practice for students to apply their knowledge and skills in various contexts, including real-life scenarios.

Biology Matters Theory Workbook (Teacher's Edition)

Let's Assess

State whether each of the following statements is true or false in Table 14.2. Then, correct the false statement(s). Revise the relevant Textbook section(s) if you are unsure of the concepts.

Table 14.2

Statement	True / False	Correct Statement	Textbook Section(s) to Revise
1. A DNA molecule may carry many genes along its length.	True		14.1
2. In humans, DNA is a double helix comprising of two, parallel strands of amino acids.	False	In humans, DNA is a double helix comprising of two, parallel strands of nucleotides.	14.1
3. A nucleotide is made up of a sulfate group, a sugar called deoxyribose, and a nitrogen-containing base.	False	A nucleotide is made up of a phosphate group, a sugar called deoxyribose, and a nitrogen-containing base.	14.1
4. The four nitrogen-containing bases in DNA are adenine, thymine, cytosine and guanine.	True		14.1
5. The rule of complementary base pairing states that adenine always bonds with thymine while cytosine always bonds with guanine.	True		14.1
6. A gene is a sequence of nucleotides that controls the formation of a single polypeptide.	True		14.2
7. Genetic engineering is a technique used to transfer genes from one organism to another.	True		14.3
8. A restriction enzyme is used to cut the gene of interest from a strand of DNA.	True		14.3

Let's Reflect

How can the concepts you learnt in this chapter be applied in daily life? What would you like to learn more about?

Molecular Genetics | Chapter 14 | 143

Let's Assess

Allows students to evaluate their understanding using a friendly 'True or False' format and can be used to help correct misconceptions. Guides students to revisit Textbook sections for revision of concepts and can also be used as a trigger for class discussions and assessment of learning.

Let's Reflect

Allows for self-reflection and encourages students to think beyond the Textbook and Theory Workbook. Helps students identify and address knowledge gaps as part of being self-directed learners.

Name: _____ () Class: _____ Date: _____

Revision Worksheet 4

Section A Multiple-choice Questions

Choose the correct answer and write **A, B, C or D** in the brackets provided.

1. Figure 1 shows a fetus undergoing medical procedure in a clinic. Which medical procedure is the fetus undergoing?
A Images of the fetus are being taken by an ultrasound scanner.
B Images of the fetus are being taken by an X-ray machine.
C The fetus is being treated with infra-red light.
D The fetus is getting warmth from microwaves.



Figure 1

(A)

2. Figure 2 show a light ray entering a glass block.

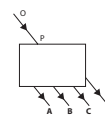


Figure 2

Which path, A, B, C or D, is the most likely path along which the ray will emerge?

(B)

3. Figure 3 shows a wave with a float M with a displacement y . Figures 4 and 5 show the displacement-distance graph and displacement-time graph of the wave respectively.

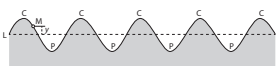


Figure 3

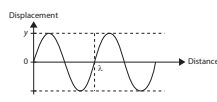


Figure 4

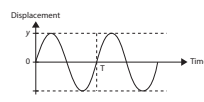


Figure 5

Based on Figure 3, which of the following correctly describes Figure 4 or 5?

- A Figure 4 shows how the displacement of the float M varies with time.
B Figure 4 shows the profile of the wave at a particular instant in time.
C Figure 5 shows the profile of the wave at a particular instant in time.
D Figure 5 shows how the shape of the wave varies with distance.

(B)

Revision Worksheet 4 | 117

Physics Matters Theory Workbook (Teacher's Edition)

Enrichment with Exciting Real-world Applications

Activities are included across selected chapters in the Textbook, each tagged with a link to the Problem-based Learning: Application worksheet in the Theory Workbook and the Problem-based Learning: STEM Project in the Practical Workbook, allowing seamless integration.

Chapter 5 | Structure and Properties of Materials

Link
Theory Workbook
Worksheet 5E
Let's Assess
Let's Reflect
Revision Worksheet 1
Problem-based Learning: Application
Practical Workbook
Problem-based Learning: STEM Project

Let's Practise 5.5

- 1 Solids X and Y both contain copper, but X is more malleable than Y. Which solid is likely to be pure copper? Explain your answer.
- 2 Mottoballs are made of naphthalene, a covalent molecule. Naphthalene and potassium chloride are both white solids, but one melts at 770 °C and the other loses its solid structure at 80 °C. State which of the two substances is naphthalene and explain your answer.
- 3 P and Q are both black solids. They are either manganese(IV) oxide or graphite. At room temperature, solid P conducts electricity but solid Q is an insulator. The insulator conducts electricity when melted. From the information provided, deduce the type of bonding in each solid and hence determine the identities of P and Q.

Problem-based Learning Activity

To make food taste, look and smell good, ingredients such as chilli, beetroot and pandan leaves are often used to add spice, colour and fragrance. The blue pigment in butterfly pea flowers is widely used to make rice dishes, desserts and beverages (Figure 5.33). The blue pigment can be extracted, or removed from the flowers, using the following steps:

- Remove the green sepals, or the leaf-like parts enclosing the flower.
- Chop up the petals finely and soak the fine petals in hot water to extract the blue pigment.
- Filter the mixture and evaporate the blue filtrate gently over a water bath. The blue pigment will be left in the evaporating dish.



Figure 5.33 Butterfly pea flower extract changes from blue to purple when an acid, such as lemon juice, is added.

Turmeric is used in many Asian dishes. It contains the active ingredient, curcumin, which is thought to provide many health benefits (Figure 5.36). Imagine you are a food scientist tasked to research ways to extract curcumin from turmeric.



Figure 5.36 Turmeric contains curcumin, which is scientifically proven to help fight inflammation and reduce the risk of heart diseases and cancer.

Consider the following questions when conducting your research to develop an extract method for curcumin from turmeric.

- Is curcumin a solid, liquid or gas at room temperature?
- Based on its physical properties and chemical formula, suggest the type of bonding found in curcumin.
- What are some solvents that curcumin can dissolve in?
- How can you prepare the turmeric root for the extraction to be done efficiently?
- How can you check the purity of the curcumin you have obtained?
- How can you purify the extracted curcumin?
- What apparatus and materials are needed for the extraction and the purification of the curcumin?

Chemistry Matters Textbook

Problem-based Learning Activity (in the Textbook)

Includes a problem-based scenario and critical thinking questions to develop 21st century competencies through collaboration and research. Hones problem-solving skills by encouraging students to develop solutions to a real-life problem.

Chemistry Matters Theory Workbook

Name: _____ () Class: _____ Date: _____

Problem-based Learning: Application

WOTD Designing investigations, evaluating and defending ideas with evidence, constructing explanations and designing solutions

VEA Curiosity, creativity, objectivity, resilience

Imagine you are a food scientist tasked to research ways to extract curcumin from turmeric. You will need to determine the steps required to perform the extraction from a sample of turmeric root.

Link
Theory Workbook
Problem-based Learning Activity

Flow Map

This thinking map helps you to arrange steps, stages or events. Use it to come up with the steps and considerations required to perform the extraction of curcumin. You may do a search on the internet to get more information. Part of the map has been done for you.

```

    graph TD
      A[How should the turmeric root be prepared?] --> B[What solvent should be used?]
      B --> C[What are the apparatus and materials required?]
      C --> D[How should the apparatus be set up?]
      D --> E[What are the steps needed for the extraction?]
      E --> F[How can the purity of the sample be tested?]
      F --> G[How can the sample be purified?]
      G --> H[ ]
      H --> I[ ]
  
```

Figure 5.3

Matter — Structures and Properties | Chapter 5 33

Problem-based Learning: Application (in the Theory Workbook)

Provides opportunities for students to use tools, such as mind maps, flowcharts, and tables, as part of the problem-solving process to help structure their thoughts.

Name: _____ () Class: _____ Date: _____

CHAPTER 05 Structure and Properties of Materials

Problem-based Learning: STEM Project

Extracting Curcumin From Turmeric

WOTD Designing investigations, conducting experiments and testing solutions, analysing and interpreting data, communicating, evaluating and defending ideas with evidence, using and developing models

VEA Curiosity, creativity, objectivity, resilience, healthy scepticism

Problem Identification

In recent years, people have become more health conscious, watching what they eat. Some people have even adapted the practice of clean eating, which is to minimise the consumption of processed foods. It is important that efficient methods are developed to extract food chemicals from their natural sources. We have explored how to extract curcumin from the turmeric root in the Theory Workbook. Let us now test the method using two solvents in the laboratory. After the extraction, we will test the purity of our samples and compare the effectiveness of the solvents.

Model Design

Aim
To analyse the effectiveness of two solvents in extracting curcumin from turmeric root.

Guidelines
You should perform the extraction of curcumin from turmeric root using two solvents. Then, compare the effectiveness of the solvents and test the purity of the samples that you have obtained using your selected method.

Questions to Consider
Consider the following questions related to Science, Technology, Engineering and Mathematics (STEM) concepts when carrying out this activity.

- What are the conditions that affect the rate curcumin dissolves into the solvent?
- What are the variables that you should keep constant?
- How do you separate the mixture of solvent and curcumin?
- How can you determine if the sample of curcumin obtained is pure?
- How can you improve the purity of the sample of curcumin obtained?
- How can your extraction method be applied industrially?
- What should you measure to evaluate the effectiveness of the solvents?

Matter — Structures and Properties | Chapter 5 31

Chemistry Matters Practical Workbook

Problem-based Learning: STEM Project (in the Practical Workbook)

Builds on ideas discussed and developed in the Textbook and Theory Workbook activities to allow students to transform their ideas into practical solutions. Encourages students to use creative and inventive thinking and STEM concepts to design, plan, and carry out a STEM project to find solutions to a real-life problem.

User-friendly and Comprehensive Resources That Empower Science Teacher Professionals to Nurture Future-ready Students

This series is aligned with MOE Singapore's "SkillsFuture for Educators" roadmap to empower teachers to lead, care, and inspire. To support teachers in fulfilling these roles, the Matters and Discover series come with a full suite of resources.

12.3 How is Sound Useful?

Textbook Page 211

Echolocation

- With the speed of sound, a sound emitter and sound sensor, the distance from the emitter to the reflecting surface can be easily calculated. This is called echolocation.
- Some animals use echoes to detect obstacles and find their prey.

How can we determine the minimum distance between the source of the sound and the reflecting surface?



Bats navigate by emitting high frequency sounds that humans cannot hear.

Which of the following statements about regions X and Y is/are correct?

18



0 Answers

- ▲ Region X is a compression.
- ◆ Region Y is a rarefaction.
- Region X is a rarefaction.
- Region Y is a compression.

Kahoot Quiz launched from PowerPoint Slides

Lesson-by-lesson PowerPoint Slides (Editable)

Provides ready-made lesson-by-lesson slides that follow the 3Cs with 1E Pedagogical Approach to foster inquiry.

The PowerPoint slides use e-pedagogy to create a participatory, connected, and reflective classroom. For example, Kahoot! quizzes are included in the slides to maximise student engagement and provide formative assessment.

Lesson Plans (Editable)

The lesson plans are designed based on the 3Cs with 1E Pedagogical Approach and cater to the needs of diverse student profiles through differentiated instruction. They include suggested teaching ideas for engaging lessons, critical thinking questions for inquiry-based learning and suggestions to remediate possible misconceptions.

They can be used in conjunction with the lesson-by-lesson PowerPoint slides which allow teachers to deliver effective hybrid lessons effortlessly.

Lessons 12.1–12.2 (3 periods)

12.1 What is Sound?
12.2 How Do We Relate Loudness to Amplitude and Pitch to Frequency

Learning Outcomes

- Show an understanding that sound can be produced by vibrating sources and a medium is required for the transmission of sound.
- Describe the longitudinal nature of sound waves in terms of the processes of compression and rarefaction.
- Relate loudness of a sound wave to its amplitude and pitch to its frequency.

Students' Prior Knowledge

- Students have learnt the terms related to waves (amplitude, frequency, wavelength and period) and the wave equation in Chapter 11.

Potential Learning Difficulties

- Many students struggle to represent sound accurately.
- Many students confuse the effects of changing the amplitude and frequency of a sound wave on the pitch and volume of the sound.

Common Misconceptions

No.	Misconception	Correct Explanation
1	Sound is generated by human action such as a person using a hammer to hit a nail into the wood.	Sound is caused by vibrations.
2	Sound can travel through empty space.	Sound needs a medium for transmission.
3	Waves transfer matter and waves do not have energy.	Waves transfer energy without transferring matter.

Lesson 12.1A (single period)

Activate Prior Knowledge (5 minutes)	Resources
<ul style="list-style-type: none"> • Ask students to do the pre-lesson quiz on PPT slide 4 before the lesson. • Look at students' responses in the pre-lesson quiz to check students' understanding and for any potential misconceptions. • Go through the answers of the quiz on PPT slide 4 (answers are shown in the teaching notes of PPT slide 4). • Highlight that sound needs a medium to travel. • Highlight the learning outcomes on Textbook p. 206 and/or PPT slide 8. 	Core Material(s) <ul style="list-style-type: none"> • Textbook p. 206 Digital Resource(s) <ul style="list-style-type: none"> • Chapter 12 Lesson 1 PPT slides 1–3 • Textbook eBook p. 206
Capture Interest (10 minutes)	Resources
<ul style="list-style-type: none"> • Launch the digital resource in Physics Connect on Textbook p. 205 and/or PPT slide 8. <ul style="list-style-type: none"> – Let students form their own ideas after watching the clip. • Ask: Why does the pitch of the sound become higher when the length of the ruler that hangs out decreases? 	Core Material(s) <ul style="list-style-type: none"> • Textbook p. 205 Digital Resource(s) <ul style="list-style-type: none"> • Chapter 12 Lesson 1 PPT slide 8



Annotable Enhanced eBooks

The enhanced eBooks are packed with digital resources* such as videos, simulations, animations, and quizzes to provide a one-stop platform for teaching and learning. The auto-marking function for fixed answer questions is available to help teachers save time on marking.

*Downloadable in the MCEduHub App for offline use.

Physics-C17 D.C. Circuits(MCQ)

PSC_PHY 1 min 42 sec

MCQ

Question 1

The following shows a $4.0\ \Omega$ resistor and an $8.0\ \Omega$ resistor connected to a $6.0\ \text{V}$ battery.

What is the current in the battery?

0.50 A

Questions

MCQ

1	2	3
4	5	6
7	8	9
10	11	12
13	14	15

Online Question Bank (Editable)

Over 500 new questions per subject in MCQ, structured and free-response format are provided for teachers to create their own worksheets quickly for formative or summative assessment. Context-based questions and data-based questions are included to let students apply their knowledge to real-life contexts and novel situations.

The questions are levelled by difficulty, so teachers can customise worksheets easily to meet their students' needs. Questions with fixed answers can also be auto-marked to help teachers save time.

Context-based Videos with a Sustainability Focus

These context-based videos relate the subject content to real-life industrial applications and help students understand and appreciate the need to practise sustainability in their lives for a better future. The learning experiences provide opportunities for students to connect the dots and understand the relevance of what they are learning to life and society, to become responsible global citizens. Accompanying lesson plans and e-worksheets are provided.



Physics Matters / Discover Physics – Table of Contents

O Level Physics	O Level Science Physics	N(A) Level Science Physics
Measurements	Measurements	Measurements
C01 Physical Quantities, Units and Measurements	C01 Physical Quantities, Units and Measurements	C01 Physical Quantities, Units and Measurements
Newtonian Mechanics	Newtonian Mechanics	Newtonian Mechanics
C02 Kinematics	C02 Kinematics	C02 Kinematics
C03 Dynamics I: Mass and Weight	C03 Force and Pressure	C03 Force and Pressure
C04 Dynamics II: Forces	C04 Dynamics	C04 Dynamics
C05 Turning Effects of Forces	C05 Turning Effects of Forces	
C06 Pressure		
C07 Energy	C06 Energy	C06 Energy
Thermal Physics	Thermal Physics	Thermal Physics
C08 Kinetic Particle Model of Matter	C07 Kinetic Particle Model of Matter	C07 Kinetic Particle Model of Matter
C09 Thermal Processes	C08 Thermal Processes	C08 Thermal Processes
C10 Thermal Properties of Matter		
Waves	Waves	Waves
C11 General Wave Properties I: Introduction	C09 General Wave Properties I: Introduction	C09 General Wave Properties I: Introduction
C12 General Wave Properties II: Sound	C10 General Wave Properties II: Sound	
C13 Electromagnetic Waves	C11 Electromagnetic Waves	C11 Electromagnetic Waves
C14 Light	C12 Light	
Electricity and Magnetism	Electricity and Magnetism	Electricity and Magnetism
C15 Static Electricity	C13 Electric Charge and Current of Electricity	C13 Electric Charge and Current of Electricity
C16 Current of Electricity		
C17 D.C. Circuits	C14 D.C. Circuits	C14 D.C. Circuits
C18 Practical Electricity	C15 Practical Electricity	C15 Practical Electricity
C19 Magnetism	C16 Magnetism and Electromagnetism	
C20 Electromagnetism		
C21 Electromagnetic Induction		
Radioactivity	Radioactivity	Radioactivity
C22 Radioactivity	C17 Radioactivity	C17 Radioactivity

Note: Chapters 5, 10, 12 and 16 are not in the GCE 'N' Level Science (Physics) syllabus.

Chemistry Matters / Discover Chemistry – Table of Contents

O Level Chemistry	O Level Science Chemistry	N(A) Level Science Chemistry
Matter – Structures and Properties	Matter – Structures and Properties	Matter – Structures and Properties
C01 Experimental Chemistry	C01 Experimental Chemistry	C01 Experimental Chemistry
C02 Kinetic Particle Theory	C02 Kinetic Particle Theory	C02 Kinetic Particle Theory
C03 Atomic Structure	C03 Atomic Structure	C03 Atomic Structure
C04 Chemical Bonding	C04 Chemical Bonding	C04 Chemical Bonding
C05 Structure and Properties of Materials	C05 Structure and Properties of Materials	C05 Structure and Properties of Materials
Chemical Reactions	Chemical Reactions	Chemical Reactions
C06 Chemical Formulae and Equations	C06 Chemical Formulae and Equations	C06 Chemical Formulae and Equations
C07 Mole Concept and Stoichiometry	C07 Mole Concept and Stoichiometry	C07 Mole Concept and Stoichiometry
C08 Acids and Bases	C08 Acids and Bases	C08 Acids and Bases
C09 Salts		
C10 Ammonia		
C11 Qualitative Analysis	C9 Qualitative Analysis	C9 Qualitative Analysis
C12 Oxidation and Reduction	C10 Oxidation and Reduction	
C13 Electrochemistry		
C14 The Periodic Table	C11 The Periodic Table	C11 The Periodic Table
C15 The Reactivity Series	C12 The Reactivity Series	C12 The Reactivity Series
C16 Chemical Energetics	C13 Chemical Energetics	
C17 Rate of Reactions	C14 Rate of Reactions	
Chemistry in a Sustainable World	Chemistry in a Sustainable World	Chemistry in a Sustainable World
C18 Fuels and Crude Oil	C15 Fuels and Crude Oil	C15 Fuels and Crude Oil
C19 Hydrocarbons	C16 Hydrocarbons	C16 Hydrocarbons
C20 Alcohols, Carboxylic Acids and Esters	C17 Alcohols, Carboxylic Acids	
C21 Polymers	C18 Polymers	C18 Polymers
C22 Maintaining Air Quality	C19 Maintaining Air Quality	C19 Maintaining Air Quality

Note: Chapters 10, 13, 14 and 17 are not in the GCE 'N' Level Science (Chemistry) syllabus.

Biology Matters / Discover Biology – Table of Contents

O Level Biology	O Level Science Biology	N(A) Level Science Biology
Cells and the Chemistry of Life	Cells and the Chemistry of Life	Cells and the Chemistry of Life
C01 Cell Structure and Organisation	C01 Cell Structure and Organisation	C01 Cell Structure and Organisation
C02 Movement of Substances	C02 Movement of Substances	C02 Movement of Substances
C03 Biological Molecules	C03 Biological Molecules	C03 Biological Molecules
C04 Enzymes	C04 Enzymes	C04 Enzymes
The Human Body – Maintaining Life	The Human Body – Maintaining Life	The Human Body – Maintaining Life
C05 Nutrition in Humans	C05 Nutrition in Humans	C05 Nutrition in Humans
C06 Transport in Humans	C06 Transport in Humans	C06 Transport in Humans
C07 Respiration in Humans	C07 Respiration in Humans	C07 Respiration in Humans
C08 Excretion in Humans		
C09 Homeostasis and Hormonal Control		
C10 The Nervous System and the Eye		
C11 Infectious Diseases in Humans	C8 Infectious Diseases in Humans	C8 Infectious Diseases in Humans
Living Together – Plants, Animals and Ecosystems	Living Together – Plants, Animals and Ecosystems	Living Together – Plants, Animals and Ecosystems
C12 Nutrition and Transport in Flowering Plants	C9 Nutrition and Transport in Flowering Plants	C9 Nutrition and Transport in Flowering Plants
C13 Organisms and Their Environment	C10 Organisms and Their Environment	
Continuity of Life	Continuity of Life	
C14 Molecular Genetics	C11 Molecular Genetics	
C15 Modes of Reproduction		
C16 Reproduction in Plants		
C17 Reproduction in Humans	C12 Reproduction in Humans	
C18 Inheritance	C13 Inheritance	

Note: Chapters 10 – 13 are not in the GCE 'N' Level Science (Biology) syllabus.

Complementary Materials

Available in print and eBooks

Revision Guide

The **Physics, Chemistry and Biology Matters for GCE 'O' Level Revision Guide**, and the **Discover Physics, Chemistry and Biology for GCE 'O' Level Science and Normal (A) Level Revision Guides** are aligned to the latest GCE 'O' Level syllabuses, and the latest 'O' Level Science and N(A) Level Science syllabuses respectively by the Ministry of Education, Singapore. The series are designed to prepare students to excel in the examinations by providing comprehensive notes for quick yet thorough revision. The books correct common errors and clarify misconceptions, with supporting explanations. Trial examination papers are included to consolidate student's learning.



Multiple-choice Questions (MCQs)

The **Physics, Chemistry and Biology Matters GCE 'O' Level Multiple-choice Questions (MCQs)**, and the **Discover Physics, Chemistry and Biology GCE 'O' Level Science and Normal (A) Level Science Multiple-choice Questions (MCQs)** are written in line with the latest GCE 'O' Level syllabuses, and the latest 'O' Level Science and N(A) Level Science syllabuses respectively by the Ministry of Education, Singapore. The series are designed to provide ample practice on a wide variety of multiple-choice question types from basic to intermediate to advanced levels, to achieve excellence in the examinations. Questions for topical and thematic practice are provided to enable students to apply their conceptual understanding within and across topics for holistic understanding.



Structured and Free-response Questions

The **Physics, Chemistry and Biology Matters for GCE 'O' Level Structured and Free-response Questions**, and the **Discover Physics, Chemistry and Biology for GCE 'O' Level Science and Normal (A) Level Science Structured and Free-response Questions** are written in line with the latest GCE 'O' Level syllabuses, and the latest 'O' Level Science and N(A) Level Science syllabuses respectively by the Ministry of Education, Singapore. The series are designed to provide ample practice on structured and free-response questions, from basic to intermediate to advanced levels, to achieve excellence in the examinations.



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