Supporting Materials for Updated Science (S1-3) Curriculum

Part I

Sample Class Practice Worksheets / Assessment Items

[Version 1.0]

Example 1

Curriculum Link Unit 4: Scientific Practice II (2024)
       [Unit 1: Introducing Science (2017)]

Major Content Area 4.1 Scientific investigation

A group of students noticed that bacteria growing on an agar plate did not grow near a mold colony on the same plate. They recorded in their science journal: "The mold might release a substance that prevents bacterial growth." This statement is best classified as:

A a hypothesis
B an observation
C a conclusion
D a fact

Note:
This question assesses students' ability to identify a hypothesis - a testable statement which can be investigated through scientific inquiry.

Correct Answer: A

Example 2

Curriculum Link   Unit 5: Earth and Space (2024)
         [Unit 2: Water (2017)]

Major Content Area 5.1 The Earth

Which impurities from water can be removed by the water purification methods list below? Put a ✓ in the appropriate boxes.

Impurity	Sedimentation	Filtration	Distillation
Leaves			
Pebbles			
Microorganisms			

Note:
This question assesses students' knowledge of various water purification methods.

Correct answer:

Leaves: Filtration, Distillation

Pebbles: Sedimentation, Filtration, Distillation

Microorganisms: Distillation

Example 3

Curriculum Link   Unit 1: Scientific Practices I (2024)
                             [N/A (2017)]

Major Content Area   1.2 Scientific observation and data

During an experiment, the primary reason for repeating measurements is to:

A   find out the accuracy of the measurement
B   check that the equipment is working
C   list all the results in a table
D   find out the precision of the measurement

Note:
This question assesses students' understanding of the importance of repeating measurements, i.e. to find out the differences between data from repeated measurement, so as to find out the precision of the measurement.

Correct Answer: D

Example 4

Curriculum Link   Unit 7: Matter and Energy (2024)
                             [Unit 6: Matter as Particles (2017)]

Major Content Area   7.1 Particle Theory; 7.2 Density

As a liquid changes into a gas, which characteristics or properties change and which remain the same? In each row of the table below, put a ✓ in the appropriate boxes.

Characteristics or Property	Change	Remain the Same
Mass		
Volume		
Density		
Size of molecules		
Speed of molecules		

Note:
This question assesses students' understanding of state changes in matter, particularly the relationship between molecular motion and property changes during the liquid-to-gas transition.

Correct answer:

Change: Volume, Density, Speed of molecules
Remain the same: Mass, Size of molecules

Example 5

Curriculum Link   Unit 2: Looking at Living Things (2024)
                            [Unit 3: Looking at Living Things (2017)]

Major Content Area   2.1 Grouping of living things

A group of students classified some animals into two categories as shown in the table below:

Group 1	Group 2
rabbit	lion
cow	frog
elephant	eagle
sheep	dog
giraffe	cheetah

Which of the following was used to classify these animals?

A   Organs used in breathing
B   Food source
C   Method of reproduction
D   Pattern of movement

Note:
This question assesses students' ability to classify animals based on their characteristics trains them to identify the basis for classification (such as food source) and eliminate interference from other irrelevant characteristics.

Correct answer: B
Group 1: Herbivores
Group 2: Carnivores

Example 6

Curriculum Link   Unit 4: Scientific Practices II (2024)
                                   [Unit 1: Introducing Science (2017)]

Major Content Area   4.1 Scientific Investigation

Two students conducted an experiment by leaving two open bottles, one filled full with sugar syrup and the other with olive oil, near a window exposed to sunlight. After several days, they noticed that the bottles were no longer full. What conclusion can be drawn from this observation?

A   Olive oil evaporates faster than sugar syrup.
B   Direct sunlight is necessary for evaporation.
C   Both sugar syrup and olive oil evaporate.
D   Whatever liquids containing water will evaporate

Note:
This question assesses students' ability to interpret observations and draw conclusions based on evidence.

Correct Answer: C

Example 7

Curriculum Link   Unit 7: Matter and Energy (2024)
                                   [Unit 5: Energy (2017)]

Major Content Area   7.4 Energy Transformation

The diagram shows a sequence of energy changes:

Chemical energy → Thermal energy + Light energy

This sequence of energy changes best explains which of the following events?

A   An electric fan is on.
B   A candle burns.
C   Gasoline powers a car.
D   A refrigerator operates.

Note:
This question accesses students' understanding of the energy conversion process. Students need to identify the main forms of energy and their transformation paths in different events.

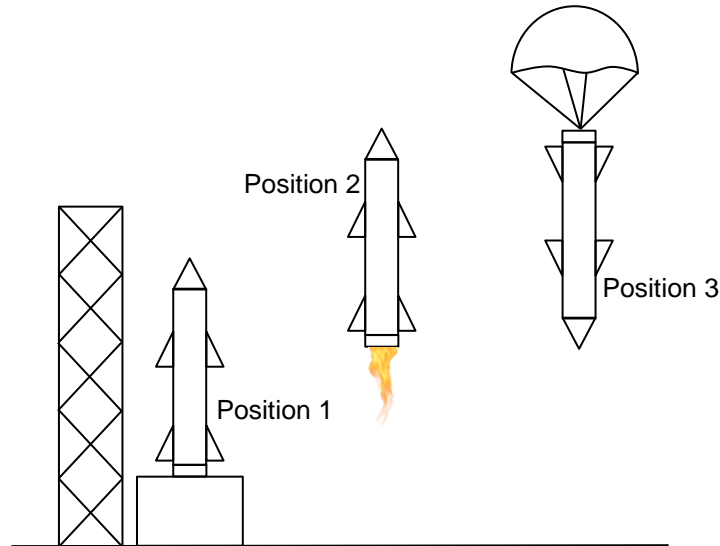**Correct Answer:** B

Example 8

Curriculum Link　　　Unit 9: Force and Motion (2024)
　　　　　　　　　　　　[Unit 11: Force and Motion (2017)]

Major Content Area　　9.1 Characteristics of force and motion

The diagram shows a toy rocket launched into the air and then returning to the ground.

In which of the three positions does gravity act on the rocket?

■　　　Position 1
■　　　Position 2
■　　　Position 3

Note:
This question assesses students' understanding of gravity, emphasising that gravity is always present during the entire motion (including stationary, ascent, and descent).

Example 9

Curriculum Link   Unit 12: Light and Sound (2024)
[Unit 10: Sensing the Environment (2017)]
[Unit 14: Light, Colours and Beyond (2017)]

Major Content Area   12.1 Light; 12.3 Sound

On a stormy day, two students were observing lightning and thunder from their classroom window. They noticed that they saw the lightning first and heard the thunder a few seconds later.

Explain why they saw the lightning before they heard the thunder.

Note:
This question accesses students' understanding of the difference between the speed of light and the speed of sound and helps them build their ability to provide scientific explanations for observed phenomena. It emphasizes the importance of logical reasoning based on the patterns of nature.

Correct answer:
The student can explain that the speed of light is faster than the speed of sound.
(Not accept (1) that only mentions distance (such as: "Thunder travels farther"); (2) that describes thunder as an "echo" or that thunder occurs after lightning, but does not mention the difference in speed of light and the speed of sound.)

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Example 10

Curriculum Link   Unit 4: Scientific Practices II (2024)
                             Unit 7: Matter and Energy (2024)
                             [Unit 5: Energy (2017)]

Major Content Area   4.2 Scientific Reasoning; 7.4 Energy Transformation

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The table below shows the results of an experiment conducted by students to investigate how the length of a spring changes when masses of different weight are hung from it:

Mass (g)	Length of Spring (cm)
No weight is hung	5
10	8
20	11
30	14
40	16
50	17
60	17
70	17

Describe how the length of the spring changed as weights of different masses were hung from it.

Note:
This question accesses students' ability to analyze trends in data, specifically identifying nonlinear patterns and explaining the scientific logic of experimental phenomena, such as what happens when a spring reaches its elastic limit.

Correct answer:
Students can identify trends in the data, such as the length of a spring increasing as the mass of the suspended weight increases, but maintained constant above 50 grams.

Example 11

Curriculum Link   Unit 1: Scientific Practices I (2024)
                                      Unit 4: Scientific Practices II (2024)
                                      [Unit 1: Introducing Science (2017)]

Major Content Area   1.2 Scientific observation and data ; 4.1 Scientific investigation

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A student conducted an experiment to determine the boiling point of liquid X. The student used two different setups respectively for conducting the same experiment:

Setup 1	Using Bunsen burner for heating
Setup 2	Using hot plate for heating

The student placed 200 mL of liquid X into beakers with same volume and size and recorded the temperature of the liquid every 3 minutes for 15 minutes.

(a) List one variable that the students kept constant in the experiment.

(b) Suggest one method to test the precision of the experiment.

(c) Explain why using two different setups makes the experiment more reliable.

Note:
This question accesses students' understanding of control variables and the precision of test measurements, and also tests students' knowledge of different methods to improve the reliability of experiments.

Correct answer:
(a) Use the same volume of liquid X or use the beakers with same volume and size
(b) Repeat the experiment several times
(c) Conducting the same experiment with different devices can ensure that the experimental results will not be affected by different heating devices (that is, to eliminate one possible confounding factor), thus making the experimental result more reliable.

Example 12

Curriculum Link   Unit 5: Earth and Space (2024)
[N/A (2017)]

Major Content Area   5.3 Space Exploration

The table below shows some information about Venus and Mercury:

Planet	Average Surface Temperature (°C)	Atmospheric Composition	Mean Distance from the Sun (millions of km)	Time to Revolve Around the Sun (Number of Days)
Venus	470	Mostly Carbon Dioxide	108	225
Mercury	300	Trace amounts of gases	58	88

Which of the following best explains why the surface temperature of Venus is higher than that of Mercury?

A.   There is less absorption of sunlight on Mercury because of the lack of atmospheric gases.
B.   The high percentage of carbon dioxide in the atmosphere of Venus causes a greenhouse effect.
C.   The longer time for Venus to revolve around the Sun allows it to absorb more heat from the Sun.
D.   The Sun's rays are less direct on Mercury because it is closer to the Sun.

Note:

This question evaluates students' ability to analyze tabular data and integrate atmospheric science knowledge to explain phenomena. It emphasizes the role of the greenhouse effect in planetary surface temperatures, which is significant for understanding climate change and atmospheric systems.

Correct answer: B
The high percentage of carbon dioxide in the atmosphere of Venus causes a greenhouse effect.

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Further Examples

[Version 1.0]

Exercise 1

Curriculum Link (2017)	Curriculum Link (2024)
Unit 1 Introducing Science	Unit 1 Scientific Practices I

1. Errors can be minimised by using apparatus with a suitable scale. Measurements made by apparatus with a smaller *division of scale* (刻度間距) could give a smaller reading error.

   For measuring the volume of a liquid which is expected to be around 20 cm^3, which of the following apparatuses (A, B, C or D) should be used to obtain the most accurate result?

A	B	C	D
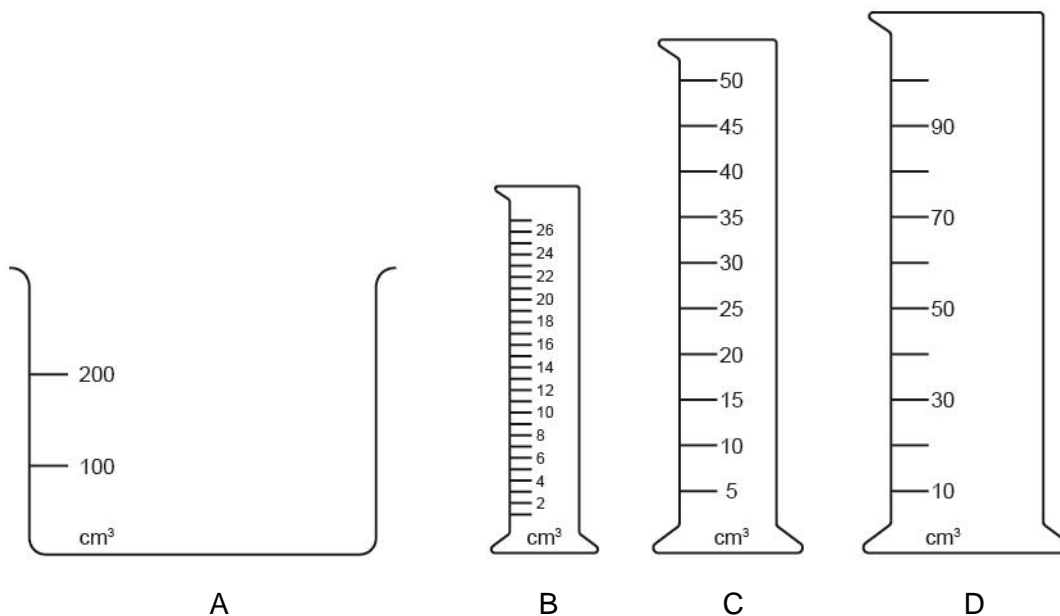
2. The following shows a measurement conducted using a balance.
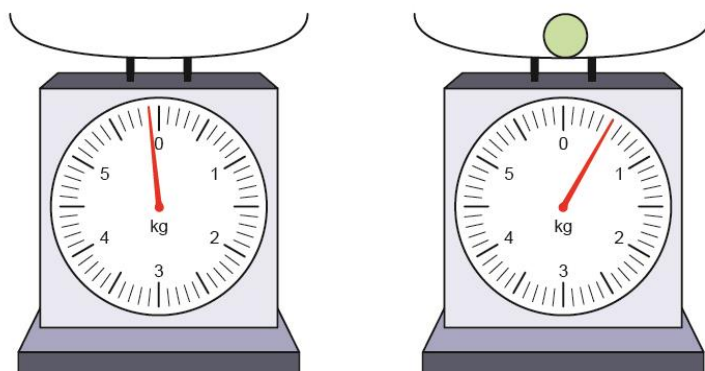
   Find the mass of the object (in kg).

Exercise 2

Curriculum Link (2017)	Curriculum Link (2024)
Unit 1 Introducing Science	Unit 1 Scientific Practices I

1. All measurements involve some inaccuracy known as error. Reading error is one type of error.

   The diagram below shows a ruler :
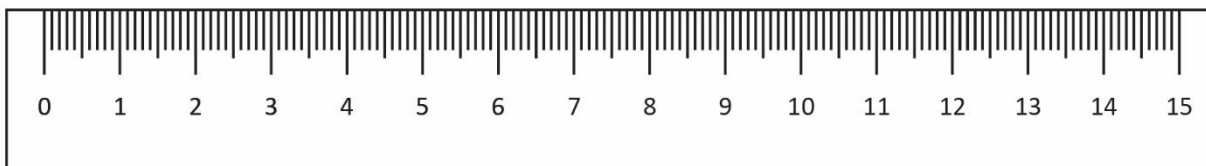
   The limit of reading of the ruler is _____ cm

   The reading error of the ruler is _____ cm

2. A student placed on an electronic balance an object known to be 22 g in mass, and the reading recorded on the balance is 20 g. The student was told the electronic balance has not been set to zero before his use.
   When the student takes the object away from the balance, what reading (gram) would the electronic balance show?

   A. -22
   B. -2
   C. -20
   D. 2

3. A student is planning to conduct an experiment to measure some masses to one decimal place with the use of a balance.
   Before the experiment, a student placed a block known to be exactly 40 grams on the balance, and three measurements were taken. It was concluded that the balance is "precise but not accurate".
   Which of the following is most probably the student's measurement results?

   A. 36.1, 36.0, 36.1
   B. 40.1, 40.0, 40.0
   C. 40.6, 39.4, 40.1
   D. 34.6, 36.2, 38.8

Exercise 3

Curriculum Link (2017)	Curriculum Link (2024)
Unit 1 Introducing Science	Unit 4 Scientific Practices II

A student placed two lit candles in different containers that were filled with air as shown in the diagram below.

Container A   Container B
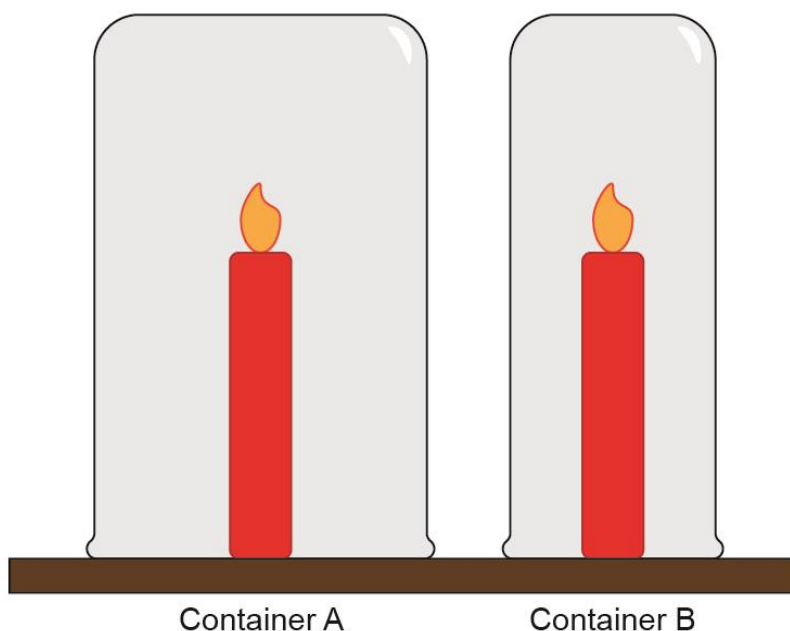
Based on the experiment, which of the following correctly describes the aim of the experiment and the variables that the student needs to keep constant to ensure a fair test?

	Aim	**Variables to be kept constant**
A	To find out how the amount of air affects how long the candle remains lit.	Size of the candle Size of the container
B	To find out if oxygen is needed for burning.	Material of the container Time taken for the flame to go off
C	To find out if oxygen is needed for burning.	Size of the candle Size of the container
D	To find out how the amount of air affects how long the candle remains lit.	Size of the candle Type of candle

Exercise 4

Curriculum Link (2017)	Curriculum Link (2024)
Unit 7 Living Things and Air	Unit 6 Living Things and Environment

A student thinks that soil with high salt content would retard the growth of plants.   He designed 4 experiment sets to prove his claim.

Experiment Set	1	2	3	4
Experimental conditions	With water and chemical fertilisers only	With water only	With water, chemical fertilisers and salt only	With chemical fertilisers and salt only

Which experiment sets should the student use to prove his claim?

A.   (1) and (3)
B.   (3) and (4)
C.   (2) and (4)
D.   (1) and (4)

Exercise 5

Curriculum Link (2017)	Curriculum Link (2024)
Unit 11 Force and Motion	Unit 9 Force and Motion

A student gave the box a push from the starting position as shown in the diagram below. It slid and came to a stop. He measured the distance moved by the box. He repeated the experiment twice, pushing the box with the same force each time.
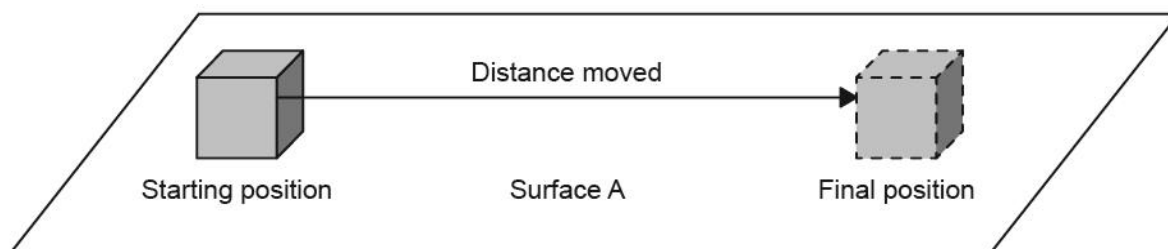
The experiment was repeated on surfaces B, C and D, and the results are recorded in the table below.

Surface	Distance moved (cm)			
	1st trial	2nd trial	3rd trial	Average
A	3.7	4.1	4.5	4.1
B	9.2	7.8	7.6	8.2
C	16.8	14.5	16.2	15.8
D	10.5	11.7	13.5	11.9

Based on the results above, which surface (A, B, C or D) will cause the most wear and tear of the box?

Exercise 6

Curriculum Link (2017)	Curriculum Link (2024)
Unit 5 Energy	Unit 7 Matter and Energy

A student kicked a football into the air as shown in the diagram below.
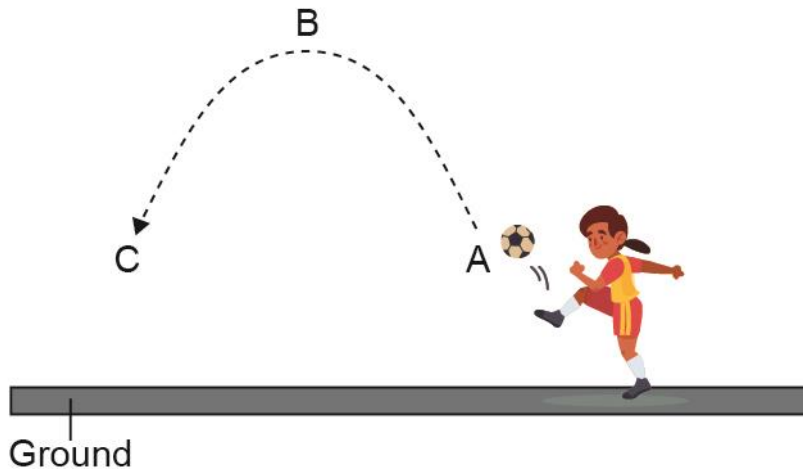
Which of the following graphs shows the potential energy possessed by the ball as it moved from point A to C?

(1)

Potential energy (units)

A   B   C   Points

(2)

Potential energy (units)

A   B   C   Points

(3)

Potential energy (units)

A   B   C   Points

(4)

Potential energy (units)

A   B   C   Points
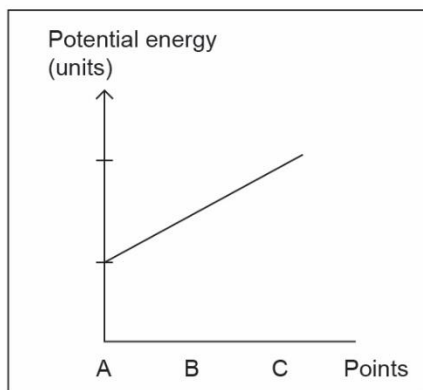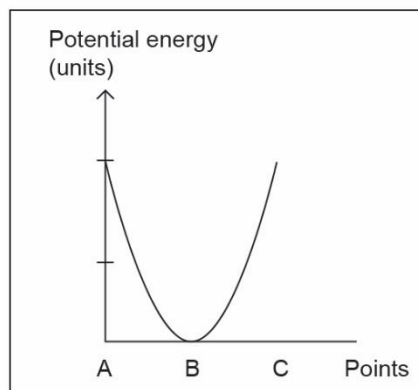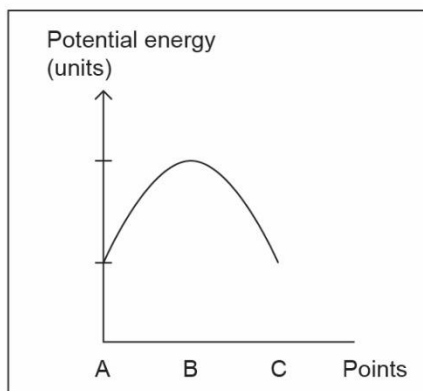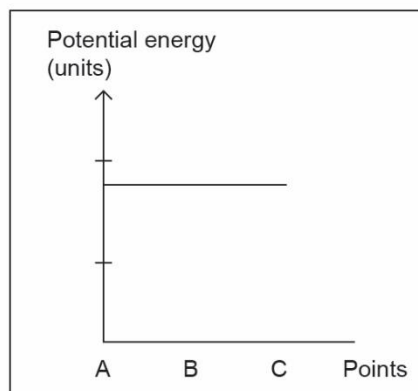
Exercise 7

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 6 Living Things and Environment

The graphs below show a population of animal Y. Animal Y eats grass grown at either location S or K over a period of a year.

Number of animal Y

Location S

Number of animal Y

Location K
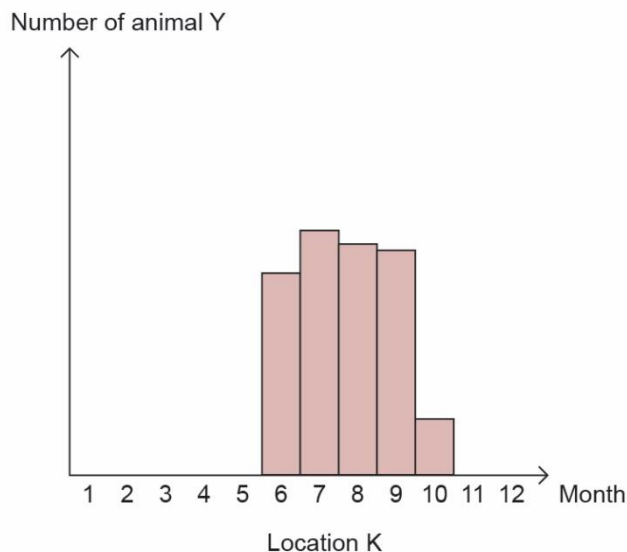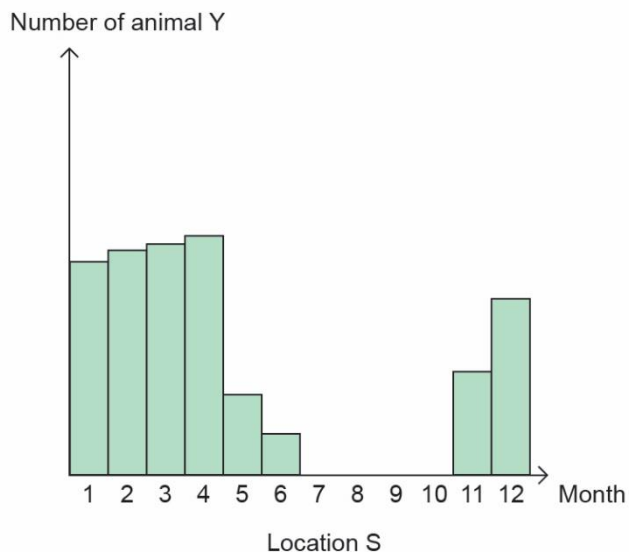
Based on the information given, which of the following statements is likely to be correct?

A. Animal Y was able to survive in places with very low rainfall.
B. Animal Y was completely killed off several times during the year.
C. More grass was available at location K than S from months 7 to 9.
D. The birth rate of animal Y decreased and its death rate increased from months 2 to 4.

Exercise 8

Curriculum Link (2017)	Curriculum Link (2024)
Unit 4 Cells, Human Reproduction and Heredity	Unit 3 Human Reproduction and Heredity

A student survey was conducted with result shown below:
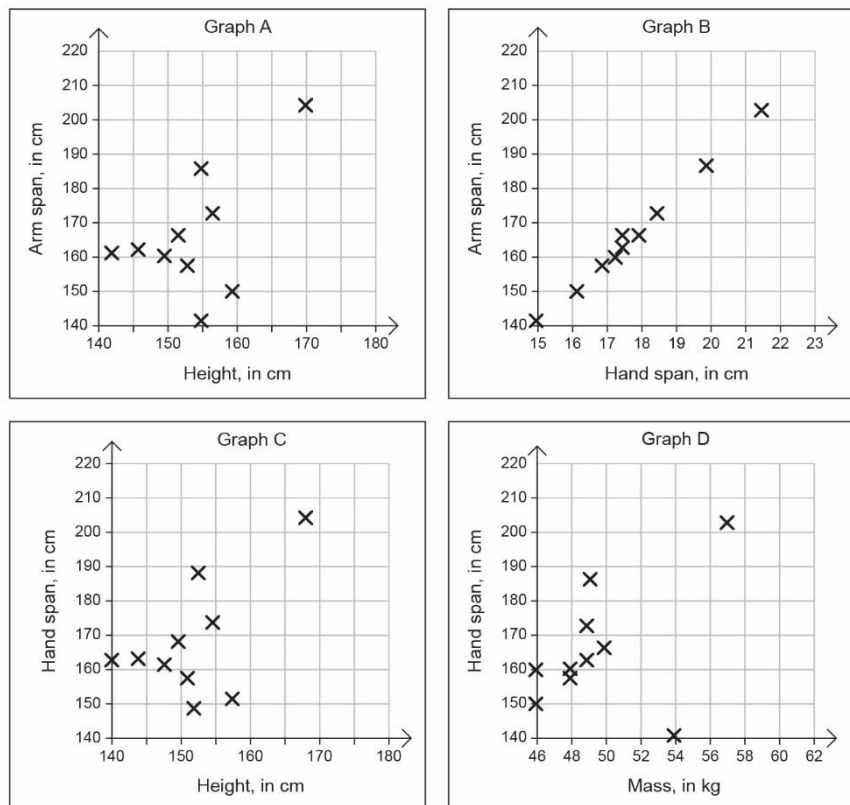
Use the data in the above scatter graphs to verify the conclusions below.

Conclusions	True / False / Not enough evidence to verify
Arm span and hand span are strongly correlated.	
The patterns of Graph A and Graph C look similar because the height of a person is the cause for the variations of arm span and hand span.	
The mass of a person is negatively correlated to arm span.	

Exercise 9

Curriculum Link (2017)	Curriculum Link (2024)
Unit 11 Force and Motion	Unit 9 Force and Motion

The graph below shows a relationship between the distance travelled and time of a car moving along a straight line.
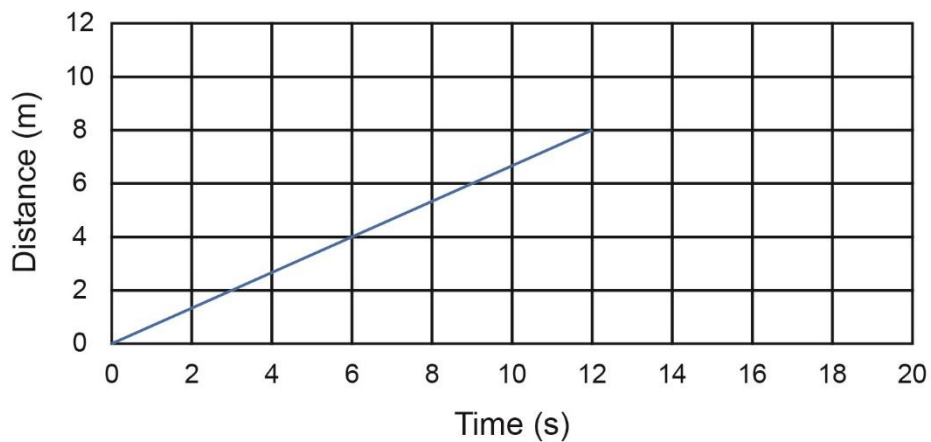
If the speed of the car remains unchanged over the course of travel, how long further does the car take to travel a total of 12 m in distance?

A.   6 seconds
B.   12 seconds
C.   15 seconds
D.   18 seconds

Exercise 10

Curriculum Link (2017)	Curriculum Link (2024)
Unit 10 Sensing the Environment	Unit 12 Light and Sound

The table below shows the maximum time a sound meter can operate at different sound levels without being damaged.

Sound level (decibels)	Maximum time (hours)
86	8
88	4
90	2
92	2
94	0.5

(a)   Plot a graph of sound level versus the maximum time that a sound meter can operate without being damaged.

Title: _____
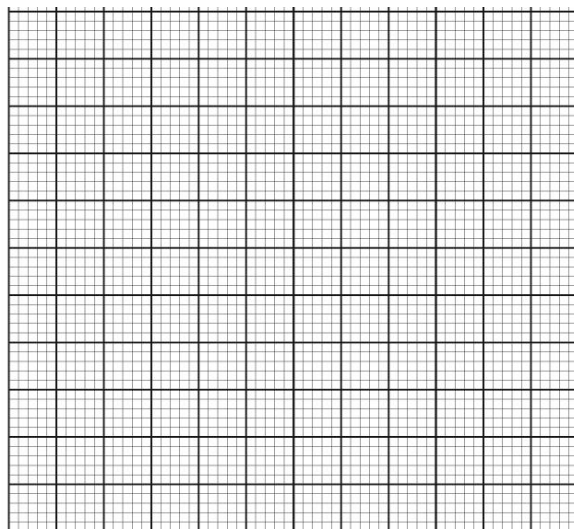
(b)   Identify a data point in the table which may be considered as an outlier.

(c)   Deduce the maximum time that the sound meter could operate at a sound level of 87 decibels without being damaged from the graph.

Exercise 11

Curriculum Link (2017)	Curriculum Link (2024)
Unit 3 Looking at Living Things	Unit 2 Looking at Living Things

A student conducted an experiment as shown below.
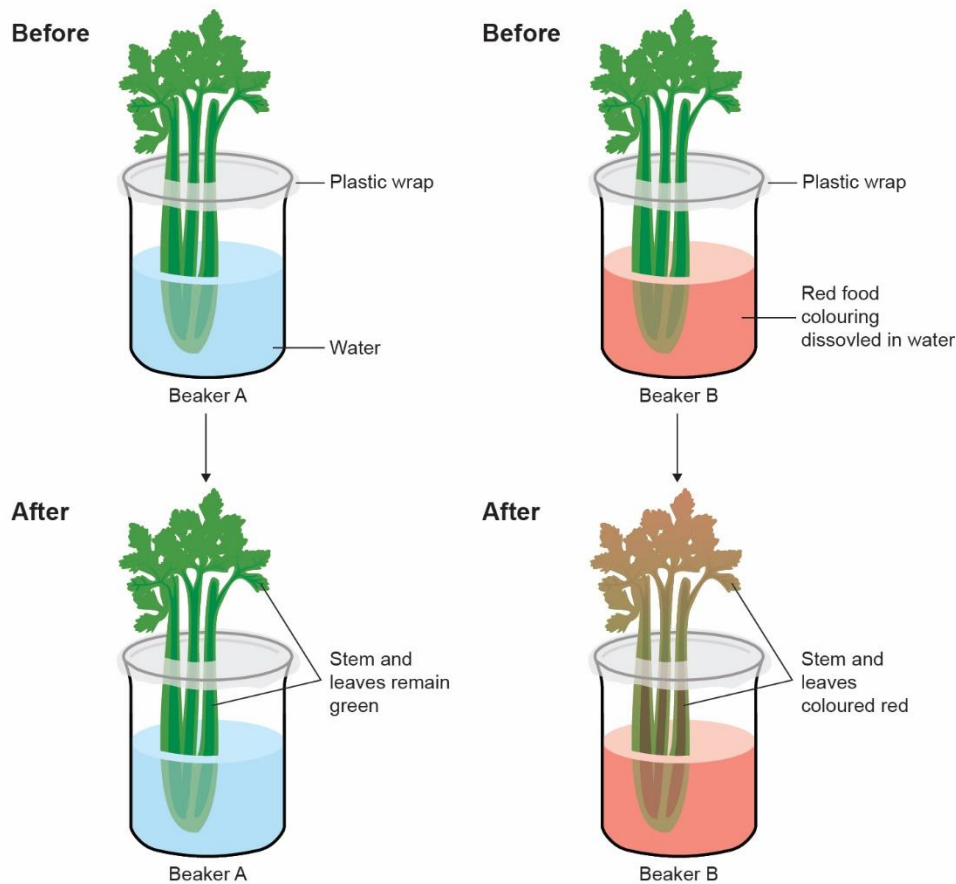
Which of the following observation and conclusion are correct?

	Observation	**Conclusion**
A	The water level in both beakers decreased.	The celery stem absorb the colored water.
B	The celery stem and leaves in Beaker B were colored red.	The tube in the celery stem transport colored water.
C	Only the water level in Beaker A decreased.	The celery stem only transport water that is not colored.
D	There is no change in the water level in both beakers after the experiment.	Without roots, the celery stem cannot take in water.

Exercise 12

Curriculum Link (2017)	Curriculum Link (2024)
Unit 1 Introducing science	Unit 4 Scientific Practice II

A student conducted an experiment to investigate the effect of the size of a jar used to cover a lit candle on the time it takes the candle to go out. The experimental setup is shown below :
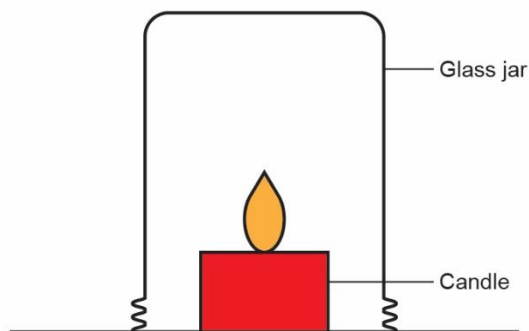
Size of glass jar (cm³)	Time for a candle to go out (s)
100	2
250	6
500	10
1000	24
2000	40
3000	58

(a)   Label the title, axis and draw a line of best fit in the diagram below.

Title: _____

23
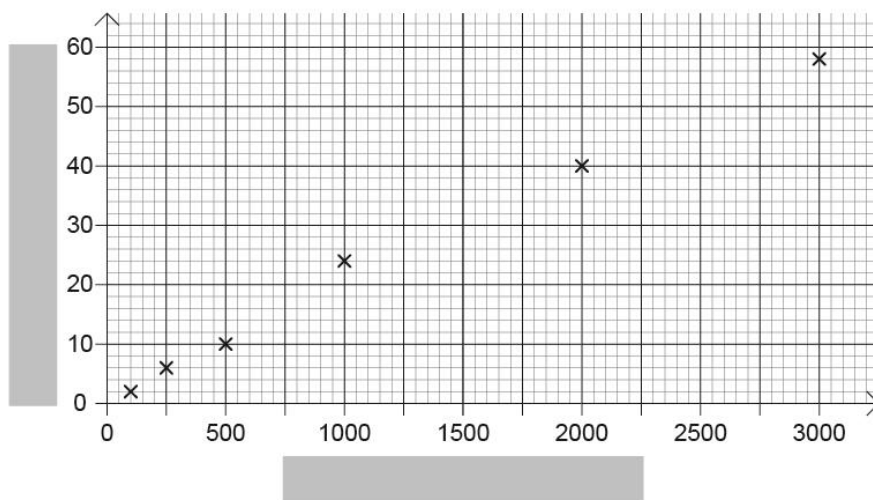
(b)   Draw a conclusion for the experiment.

(c)   Suggest **TWO** ways to make the experiment more reliable.

Exercise 13

Curriculum Link (2017)	Curriculum Link (2024)
Unit 7 Living Things and Air	Unit 6 Living Things and Environment

A student did several experiments to germinate corn, and summed up the results as below:

Moist grains of corn germinate in the light. Moist grains of corn germinate in the dark.

Based on the above results, which of the following statement could be a conclusion?

☐   Water is essential for the germination of corn.
☐   Moist grains of corn can germinate with or without light.

Exercise 14

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 4 Scientific Practices II

Pineapple juice contains a substance that speeds up the digestion (消化) of a protein in jelly. An experiment was conducted using the following set ups. Time required for the jelly to be digested in each test tube is recorded and tabulated below :

A   B   C   D
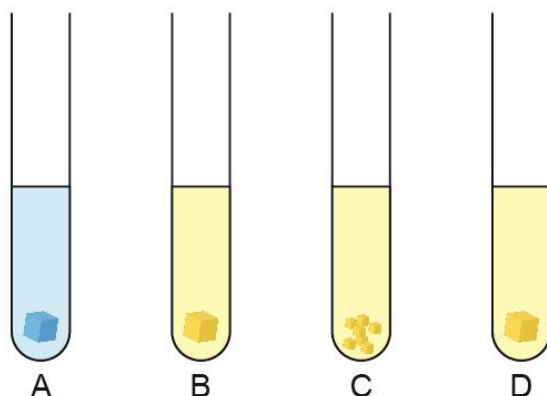
Test Tube		Time required for the digestion of jelly
A	5 g jelly cube + 15 cm^3 water at room temperature	Not digested after 2 hours
B	5 g jelly cube + 15 cm^3 fresh pineapple juice	1.5 hours
C	5 g jelly cube cut into pieces + 15 cm^3 fresh pineapple juice	40 mins
D	5 g jelly cube + 15 cm^3 boiled fresh pineapple juice	Not digested after 2 hours

(a)   Which test tube (A, B, C or D) could serve as a control for the experiment?

(b)   Write a hypothesis for the experiment based on setup in test tube A and B.

(c)   What conclusion can be drawn from the results obtained in test tube B and test tube C?

(d)   What conclusion can be drawn from the results obtained in test tube B and test tube D?

Exercise 15

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 1 Scientific Practices I

Different groups of students conducted an experiment about the combustion of magnesium in air. The magnesium reacted with oxygen in the air to form magnesium oxide.

The table below shows the masses of the magnesium and magnesium oxide formed in the experiment :

Student Group	Mass of magnesium (g)	Mass of magnesium oxide (g)	$Z = \dfrac{\text{Mass of magnesium (g)}}{\text{Mass of magnesium oxide (g)}}$
A	4.4	7.3	
B	5.1	8.5	
C	5.6	9.33	
D	6.1	10.0	
E	6.5	9.1	
F	7.1	11.8	

(a)   Calculate the value of Z, correct to 1 decimal place, using the results obtained from each student group. Complete the table above.

(b)   Which group's results is an outlier?

(c)   The results suggest a relationship between the mass of magnesium and the mass of magnesium oxide formed, which can be expressed by a mathematical formula. Fill in the space below.

Mass of magnesium	=		x	

(d)   Use the formula in (c), predict the mass of magnesium oxide formed by the combustion of 6.0 g magnesium.

Exercise 16

Curriculum Link (2017)	Curriculum Link (2024)
Unit 12 A Healthy Body	Unit 11 Healthy Body

A new drug was tested on six healthy human participants. They all immediately became very sick after the drug testing. Before the drug testing, which of the following steps should have been taken to ensure this is an ethical investigation?

A.   Choose participants randomly
B.   Pay the participants for joining the drug testing
C.   Tell participants of possible side effects of the drug as far as possible
D.   Choose participants with good immune system

Exercise 17

Curriculum Link (2017)	Curriculum Link (2024)
Unit 12 A Healthy Body	Unit 11 Healthy Body

There were two diseases called cowpox and smallpox. Cowpox wasn't very dangerous, but smallpox could kill many people.

Dr. Edward Jenner had an idea that if someone had cowpox, they might not get smallpox.

He tested this idea by putting some cowpox virus into a boy's arm. Later on, he exposed the boy to smallpox virus many times, but the boy didn't get sick.

Dr Jenner did more tests and in 1801, he said that smallpox could be prevented by getting a vaccine.

Why would Dr Jenner's investigation NOT be acceptable in today's society?

A.   This investigation has harm to society is much greater than the good it brings.
B.   Making a child exposing to a deadly virus is unethical.
C.   We can't create a trustworthy vaccine using only one person.
D.   Cowpox is an animal disease and should not be transferred to people.

Exercise 18

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 6 Living Things and Environment

1. P, Q, R and S are four populations living in a community. The following relationships exist amongst them.
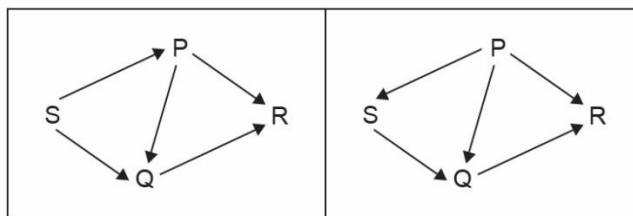   - P has two predators.
    - Q and R have two sources of food.
    - Q is the only animal and plant eater.
    - S is the only producer.

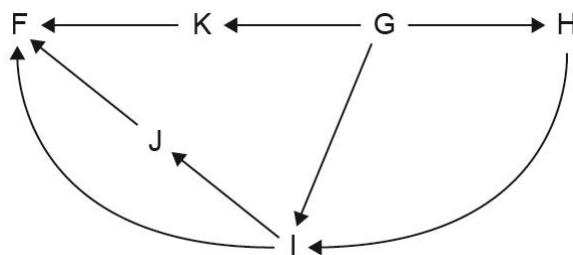   Which of the following food webs shows the food relationship in the community?
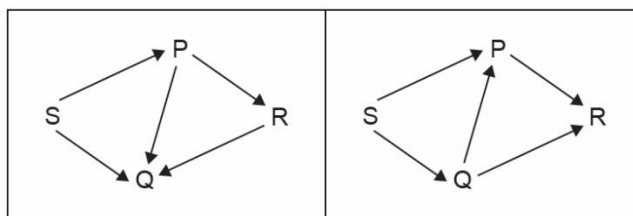
(A)   (B)

(C)   (D)

2. The diagram below shows a food web in a community.

    Which of the following correctly identifies organisms F, G, H, I, J and K?

	Producer	Prey only	Predator only	Prey and Predator
(A)	F	I, J	G	H, K
(B)	G	F, K	H	I, J
(C)	F	G, H	I	J, K
(D)	G	H, K	F	I, J

Exercise 19

Curriculum Link (2017)	Curriculum Link (2024)
Unit 11 Force and Motion	Unit 9 Force and Motion

With the Laws proposed by Newton, we can relate the weight and mass of an object using the formula

Weight of an object (W) = Mass of the object (m) x Gravity (g)

When an object falls to the ground, *gravity* is the force pulling it downward and causing it to accelerate. The gravity (重力) on the Earth is about 10 N/kg and on the moon is about 1.6 N/kg.
The formula above enables us to deduce the weight of an object on different planets or moons. For example :

	Gravity (N/kg)	**The weight of a 5 kg ball (N)**
Earth	10	5 x 10 = 50
Moon	1.6	5 x 1.6 = 8

Using the formula W = m x g, answer the following questions :

(a)   If an object has a weight of 100 N on Earth, what is its weight on the Moon?

A   10 N

B   16 N

C   62 N

D   160 N

(b)   The weight of a meteorite (隕石) on Earth is 680 N and on Mars is 252 N. The gravity on Earth   is   10 N/kg.

What is the gravity on Mars?

A   0.27 N/kg

B   0.37 N/kg

C   2.7 N/kg

D   3.71 N/kg

Exercise 20

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 9 Force and Motion

An experiment was conducted using a spring balance. Its original length was 10 cm. Different weights were added and the lengths of the spring were measured.
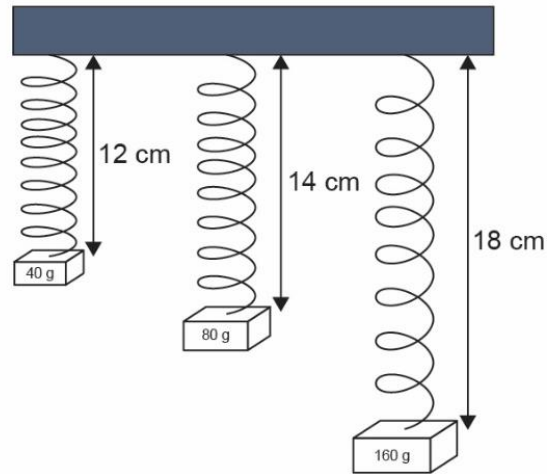
(a)   What would be the possible extension of the spring when the load was 100 g?

A   2 cm
B   3 cm
C   4 cm
D   5 cm

(b)   Which of the following would NOT be the possible extension(s) of the spring when the load was 320 g?

(I)   6 cm
(II)   10 cm
(III)   16 cm

A   (I) only
B   (II) only
C   (I) and (II)
D   (I)、(II) and (III)

Exercise 21

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 11 Healthy Body

A study is carried out to investigate whether adding fluoride to drinking water can help prevent tooth decay. The graph below shows the results of this study:

Average number of cases of tooth decay per child

Fluoride concentration in drinking water (mgL⁻¹)
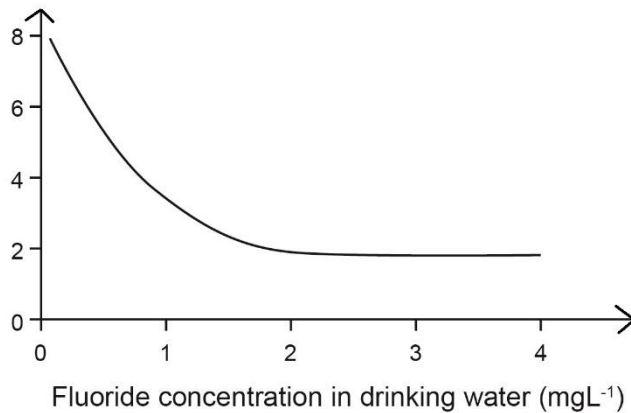
Which of the following can be deduced from the above results?

A.   Adding fluoride to drinking water helps reduce tooth decay.
B.   Beyond 2 mgL⁻¹ an increase in fluoride concentration does not further reduce tooth decay.
C.   Each child has at least 2 teeth which have decayed regardless of the fluoride concentration in water.

Exercise 22

Curriculum Link (2017)	Curriculum Link (2024)
Unit 11 Force and Motion	Unit 9 Force and Motion

The diagram below shows the positions of four sprinters at time t = 7 s and t = 14 s in a race:

t - 7 s
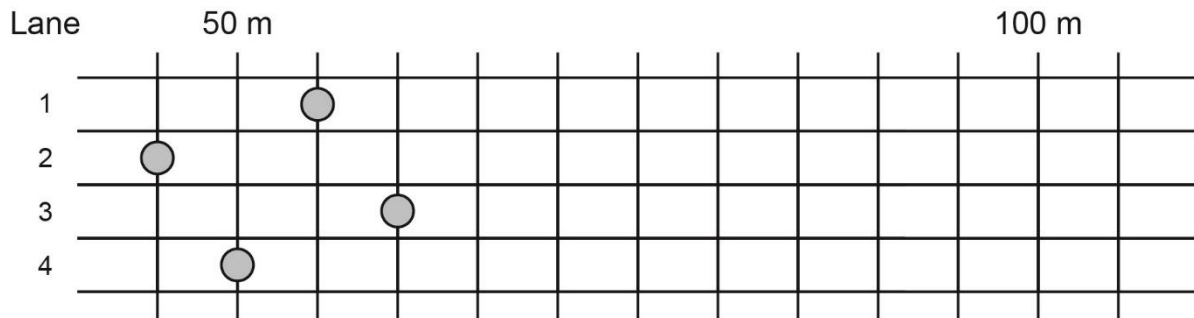
t - 14 s
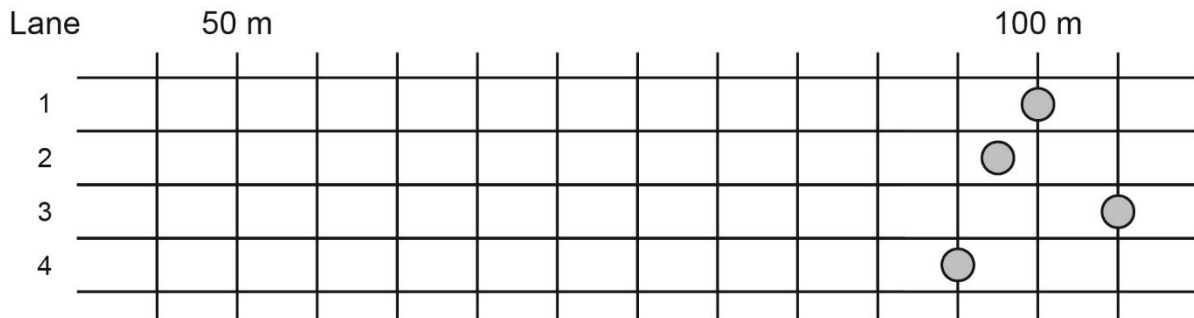
Given:

Distance = speed x time

The sprinter on which lane has the greatest average speed between t = 7 s and t = 14 s?

A.   Lane 1
B.   Lane 2
C.   Lane 3
D.   Lane 4

Exercise 23

Curriculum Link (2017)	Curriculum Link (2024)
Unit 11 Force and Motion	Unit 9 Force and Motion

Calculate the force exerted by effort to lift the load by using the information below.
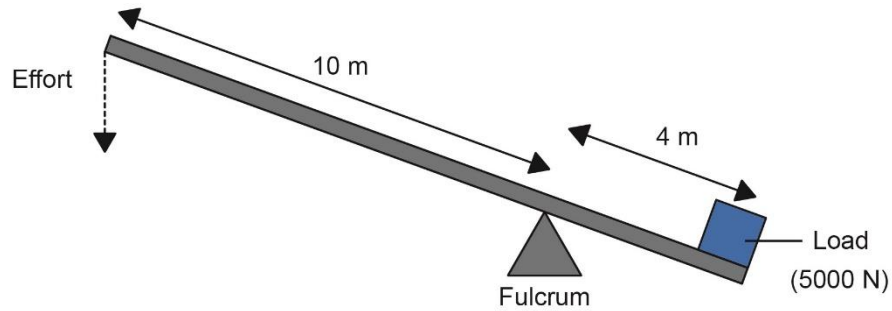
$$\frac{\textbf{force exerted by load}}{\textbf{force exerted by effort}} = \frac{\textbf{length between effort and fulcrum}}{\textbf{length between load and fulcrum}}$$

Force exerted by effort = _____ N

Exercise 24

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 8 Atomic World

Corrosive acids and alkalis are some typical chemicals that would be used in hair dye. A student conducted an experiment to investigate the effect of hair dye treatment on the strength of hair.

In the experiment, 5 hair samples of equal length were prepared and soaked separately in different concentration (%) of hair dye solutions for 15 minutes.

The following set up was used to test the strength of the hair samples.
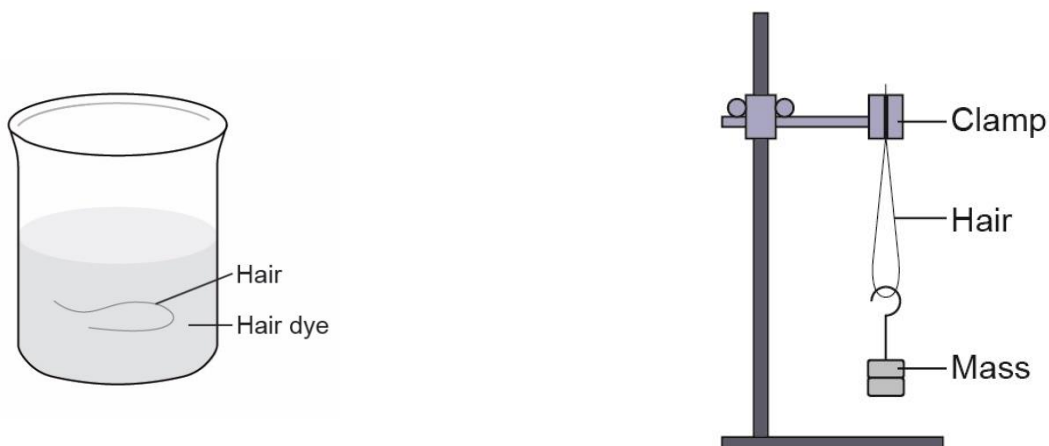
The results of the experiment are shown in the table below :

Concentration of hair dye solutions (%)	Mass needed to break the hair (g)
0.5	70
1.0	65
1.5	61
2.0	57
2.5	53

(a) Write the independent variable and the dependent variable of the experiment in the space below.

Independent variable	
Dependent variable	

(b) With the aid of a graph, find the correlation, if any, between the independent variable and the dependent variable of the experiment.

Title: _____
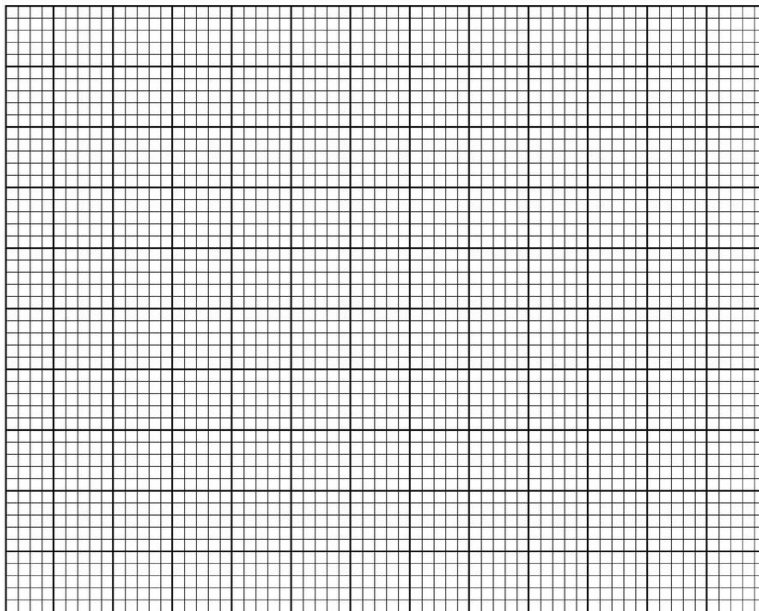
There is a _____ correlation between _____ and _____.

(c)   Predict the mass needed to break the hair sample if the concentration of hair dye is 1.8 %.

(d)   Suggest **TWO** ways to make the experiment more reliable.

(e)   Another student commented that the graph plotted in (b) cannot be used to deduce the mass needed to break the hair sample if the concentration of hair dye used is greater than 2.5 %.
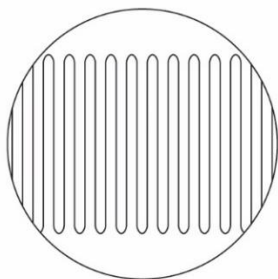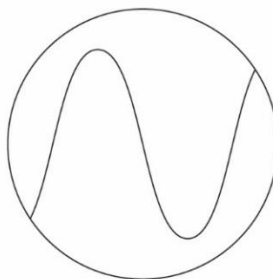
Do you agree? Explain your answer.

Exercise 25

Curriculum Link (2017)	Curriculum Link (2024)
N/A	Unit 12 Light and Sound

The diagrams below show the patterns of four sound waves (聲波) displayed on an oscilloscope (示波器) screen. They are in the same scale.
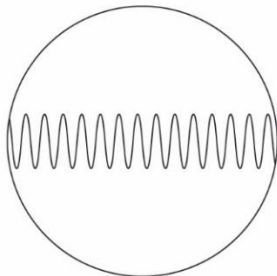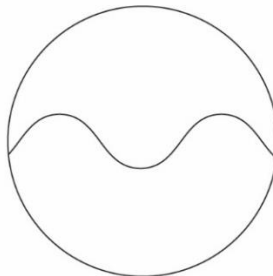

The soundwave produced by an alarm is shown below.
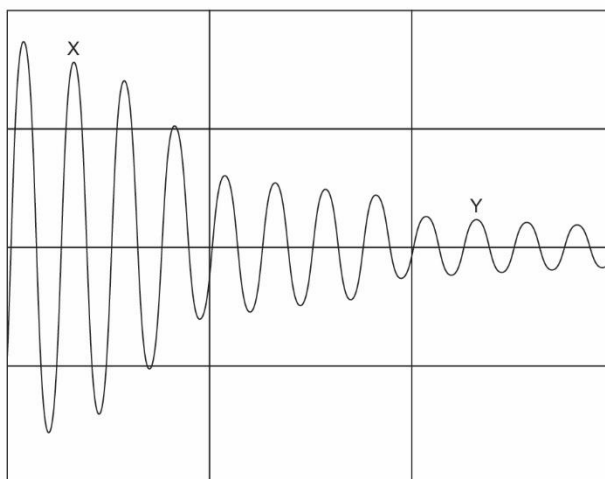
With reference to the information above, describe the change in frequency (頻率) and amplitude (振幅) of the sound between points X and Y.
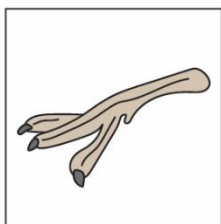
Exercise 26

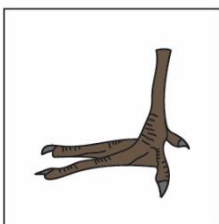| Curriculum Link (2017)	Curriculum Link (2024)
Unit 3 Looking at Living Things	Unit 2 Looking at Living Things

1. Organism Y is a bird that does not swim and fly in the sky. It needs to hold on the tree branches when it is not flying. Which of the following feet most likely belongs to organism Y?
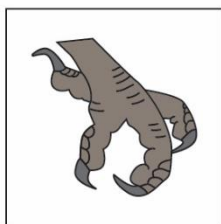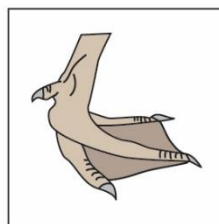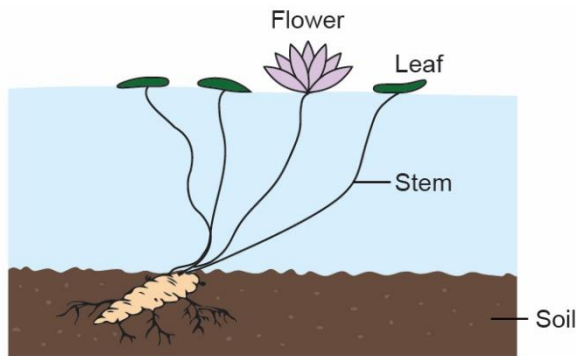

(A)   (B)   (C)   (D)

2. The picture below shows a water lily in a lake.

Which of the following is not an adaptation needed for water lily's survival in a lake?
A. Deep roots to absorb more water from the soil.
B. Flexible stems to withstand the movement of water.
C. Dark green leaves on the upper side to trap maximum sunlight.
D. More stomata on the upper side of the leaves for gaseous exchange.

Exercise 27

Curriculum Link (2017)	Curriculum Link (2024)
Unit 7 Living things and air	Unit 6 Living Things and Environment

The graph below shows the average change of global temperature from the year 1880 to 2020.
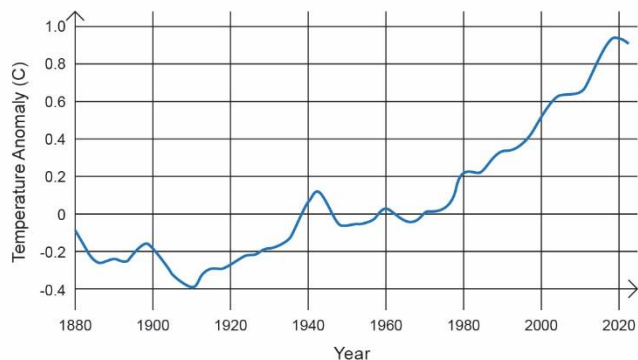

Which of the following is not a possible cause for the above observation?

A.   Deforestation
B.   Rise in sea level
C.   Burning fossil fuel
D.   Increase in the number of motor vehicles

Exercise 28

Curriculum Link (2017)	Curriculum Link (2024)
Unit 5 Energy	Unit 7 Matter and Energy

An ice cube is wrapped in metal gauze sinks at the bottom of the test tube and the heat from a Bunsen burner cause the water to boil at the top.
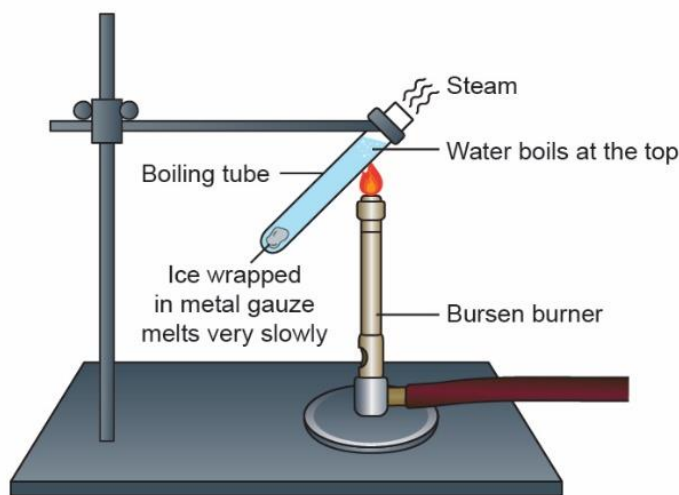
Which of the following statement(s) is most probable for explaining why the ice would melt very slowly?

A.   Heat does not reach the ice via convection.
B.   The test tube is a bad conductor of heat.
C.   Heat does not reach the ice via radiation.
D.   Heat does not reach the ice via conduction.

Exercise 29

Curriculum Link (2017)	Curriculum Link (2024)
Unit 12 A Healthy Body	Unit 11 Healthy Body

Obesity (肥胖症**) and Diabetes (**糖尿病**)**

Maintaining a healthy lifestyle requires establishing healthy habits, and having a balanced diet is essential. Different age groups, genders, and occupations have different energy requirements. Therefore, it is important to consume an appropriate and proportionate variety of food substances to achieve a balanced diet. If the proportions of different food substances consumed are imbalanced, such as excessive intake of high-energy foods containing fats, it can have an impact on our weight and health, increasing the risk of certain health issues, such as diabetes.

We can calculate the 'Body Mass Index (BMI)' (體重指標) to assess whether our weight is healthy.

$$BMI = Weight (kg) / [Height (m)]^2$$

Some studies suggested that there is a correlation between the probability of developing diabetes and the Body Mass Index (BMI). The table below shows some relevant data collected from a specific population of a certain region.

Body Mass Index	Diabetes Occurrence
< 18.5	4.5 %
18.5 – 24.9	7.6 %
25.0 – 29.9	12.8 %
≥ 30.0	18.5 %

(a)   With reference to the data above, if the BMI of a person decreases from 32 to 23, by how many times is his risk of developing diabetes reduced?

(b)   Suggest how we can change our lifestyle habits to reduce the risk of developing diabetes.

Reference: https://www.chp.gov.hk/tc/healthtopics/content/25/59.html

Exercise 30

Curriculum Link (2017)	Curriculum Link (2024)
Unit 12 A Healthy Body	Unit 11 Healthy Body

Receiving the Influenza Vaccination

Influenza (流感), commonly known as the flu, is a common infectious disease (傳染病) in the local area. According to data from the Department of Health (2022), the probability of death due to influenza is approximately 1 in 1,000 cases. Citizens receiving the influenza vaccine (疫苗) can reduce the risk of death following infection (感染).

However, individual persons may experience the following conditions after receiving the vaccine:

- Approximately 1 or more out of every 10 individuals who received the vaccine may experience mild and temporary discomfort (不適), such as a runny or stuffy nose.

- Less than 1 out of every 10,000 individuals who received the vaccine may experience extremely rare and severe side effects (副作用) that require hospitalisation (入院).

(a) Based on the given information, write the hazards and risks associated with the incidents in the table below.

Incident	Having influenza without receiving vaccination
Hazard involved	
Risk involved	

	Incident	Receiving the influenza vaccination
(i)	**Hazard involved**	
	Risk involved	
(ii)	**Hazard involved**	
	Risk involved	

(b) Given the risks and hazards associated with the incidents in (a), explain why citizens should receive the influenza vaccine.

Reference: https://www.drugoffice.gov.hk/eps/do/tc/consumer/news_informations/dm_38.html#f
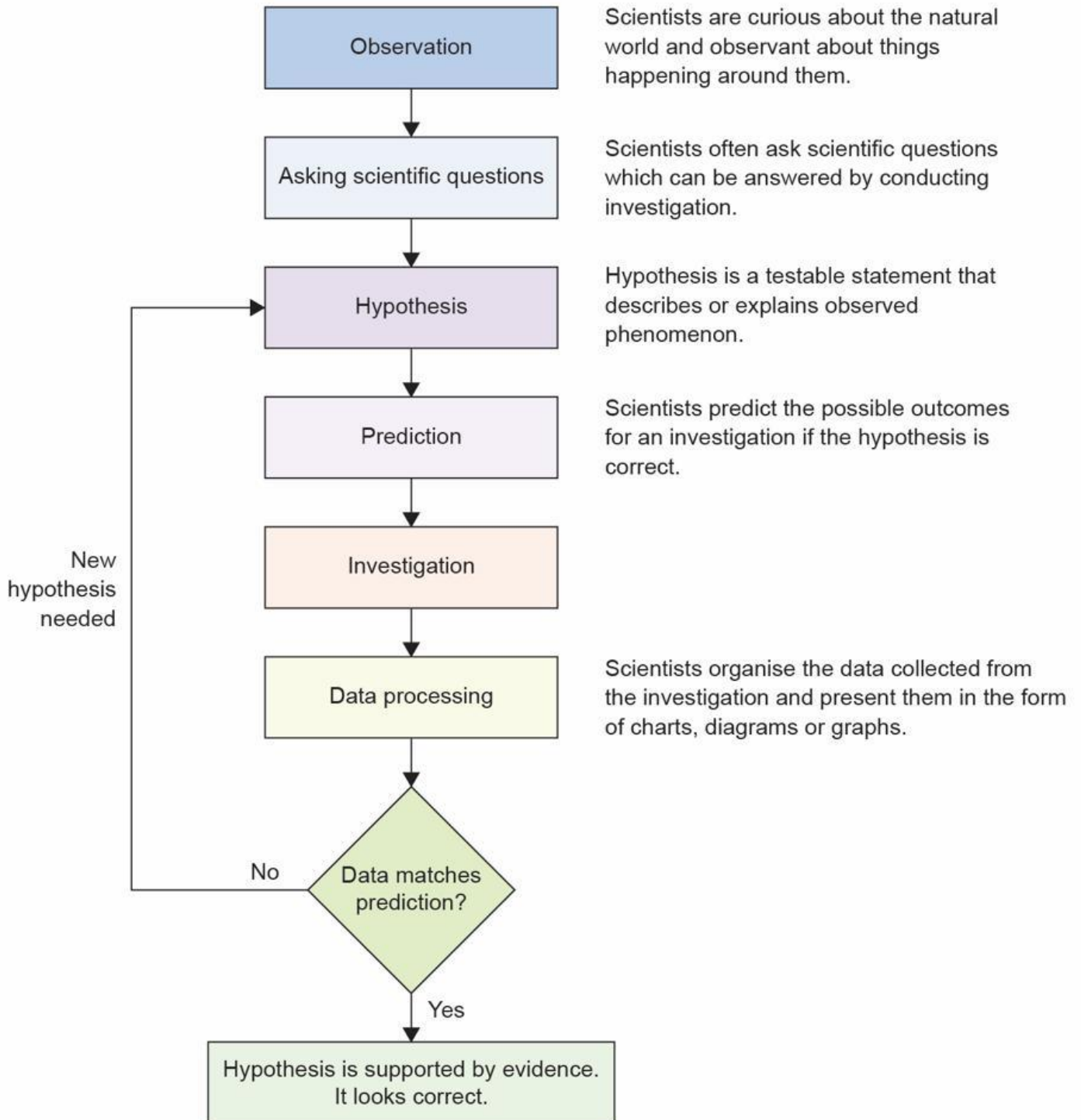
Supporting Materials for
Updated Science (S1-3) Curriculum

Teacher's Reference Materials

[Version 1.0]

1 Steps in Scientific Investigation

Scientific knowledge is built from experimentation, analysis of data and scientific reasoning based on the evidence. The process of the use of scientific method (科學方法) to establish scientific knowledge is called scientific investigation. The steps for scientific investigations as shown below:

| Step	Description
Observation	Scientists are curious about the natural world and observant about things happening around them.
Asking scientific questions	Scientists often ask scientific questions which can be answered by conducting investigation.
Hypothesis	Hypothesis is a testable statement that describes or explains observed phenomenon.
Prediction	Scientists predict the possible outcomes for an investigation if the hypothesis is correct.
Investigation	
Data processing	Scientists organise the data collected from the investigation and present them in the form of charts, diagrams or graphs.
Data matches prediction?	No → New hypothesis needed
Yes ↓	
Hypothesis is supported by evidence. It looks correct.	

2 Taking Measurements

Measurements in an experiment allow us to obtain objective evidence to support or refute the hypothesis.

To make a reliable conclusion (可靠結論) from the experiment, the measurements should be repeated (重覆) and the difference between the values of the data obtained should be checked.

Accuracy (準確度)	The closeness of agreement between a measured value to the true value or the reference value
Precision (精密度)	The closeness of agreement between measured values obtained by repeated measurements
True value (真實值)	The value that would be obtained in an ideal measurement
Uncertainty (Error) (誤差)	The difference in value for the measured value compared to the reference or true value

Accuracy and Precision

Accurate and precise

Accurate but imprecise

Inaccurate but precise

Inaccurate and imprecise
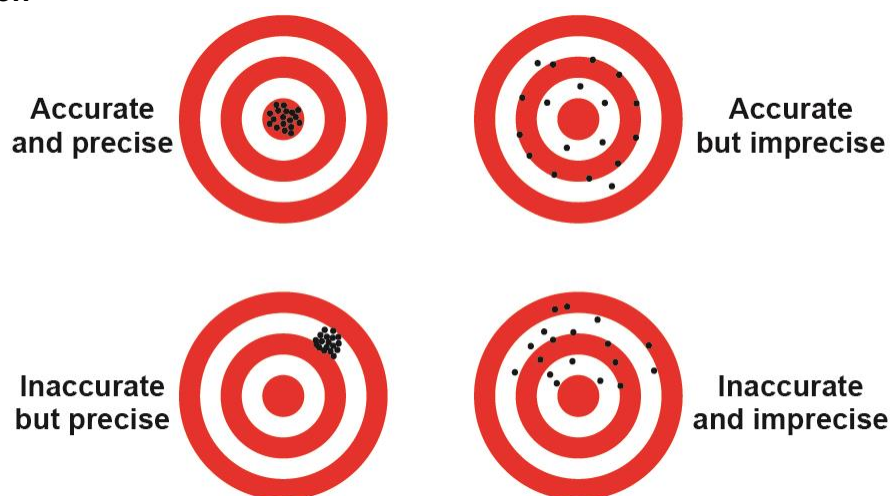
Source of error

Reading error (讀數誤差)	Taking measurements with quantities smaller than half the smallest division on the scale (limit of reading).	Lengh = 6 cm (1 significant figure) 0 1 2 3 4 5 6 7 8 9 10 11 12 (cm)
Parallax (視差)	Reading the scale on the instrument at an incorrect viewing angle	40 30 20 10
Zero error (零位誤差)	The instrument does not show a zero reading when no measurement is conducting.	Parcel 3.4 kg - 0.8 kg

3 Planning Experiments

A careful planning is important for an experiment to be conducted systematically (系統性) and objectively (客觀性) so as to give a valid result (有效結果). The results obtained in an experiment provide us the evidence to make conclusion for supporting or refuting (反駁) the hypothesis (假說).

Variables (變量) should be identified clearly and carefully monitored in an experiment. There are three types of variables :

Independent variable (獨立變量)	Variable to be changed in an experiment.
Dependent variable (因變量)	Variable to be measured or observed in an experiment.
Control variable (控制變量)	Variable to be kept constant in an experiment.

A **hypothesis (假說)** is a testable (可測試的) statement that describes or explains observed phenomenon (現象). The hypothesis of an experiment should be carefully set in order to ensure it can be tested by scientific measurements (科學量度) or observations (觀察).

Example	Independent variable	Dependent variable	A proper hypothesis?	Comment
A plant will grow better in my friend's home.	?	?	No	The statement is subjective without mentioning the independent variables and dependent variables.
Plastic is a better insulating material than metal.	Type of insulating material	?	No	The dependent variable is not well defined.
Salts will dissolve faster in water.	?	Time taken for all salts to dissolve in water	No	The independent variable in the investigation is not mentioned.
Ball bounces higher on hard surface.	Hardness of surface	Height of bounce	Yes	The statement includes both independent variable and dependent variable which are measurable.

A **controlled experiment** (對照實驗) consists of a control group (對照組) and an experimental group (實驗組). The two groups have all factors being the same except one. A controlled experiment is useful for scientists to infer whether or not the independent variable would lead to the change on the dependent variable.

Example:

The following shows a controlled experiment to investigate the effect of different insulating materials used to wrap the beaker containing hot water could slower the temperature drop. The control group is set using identical apparatuses and materials as the experimental group. The control group differs from the experimental group only that it has no insulating material wrapped on the beaker.

The controlled experiment is said to be valid for scientists to identify among the insulating materials under tested, which could serve the best to reduce the temperature drop of the beaker of water.
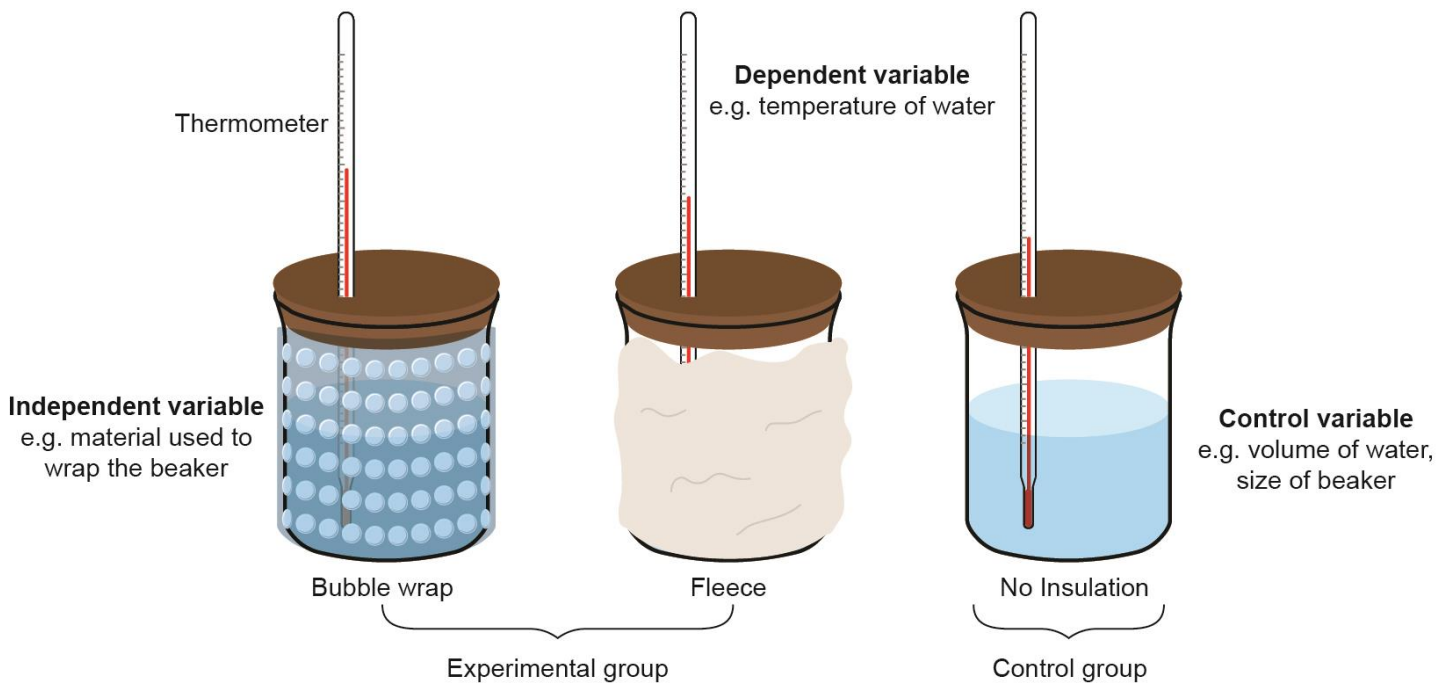
4 Data Analysis and Pattern Seeking

Data refers to the facts and measurements collected in experiments. To present data in an appropriate manner, we have to identify the variables in the scientific investigation into two categories :

Discrete variables (不連續數據)	Variables that can only have certain values. Examples : gender, eye colour
Continuous variables (連續數據)	Variables that can take any value and may not be a whole number. Examples : height, mass, hand span, arm span

Tables can be used to present discrete or continuous variables in an organised manner for a fair comparison.

	Food substance contained (in g)		
	Carbohydrate	**Fat**	**Protein**
100 cm³ of human milk	7.2	4.1	1.0
100 cm³ of cow milk	4.8	3.5	3.6

Bar charts can be used to show discrete variables.
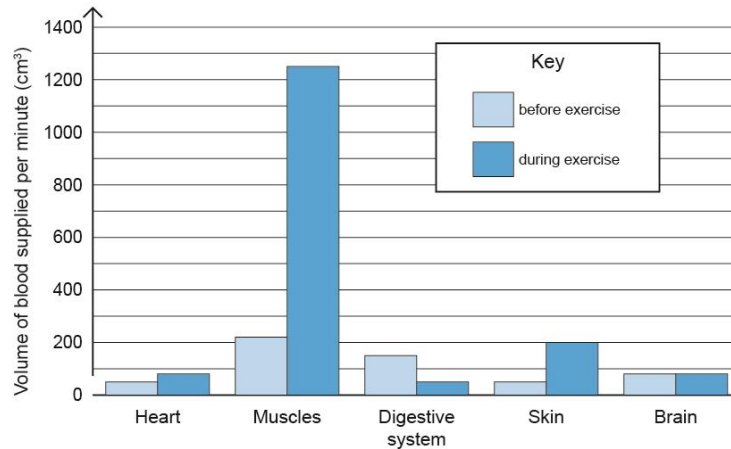
Line graphs can be used to show continuous variables.
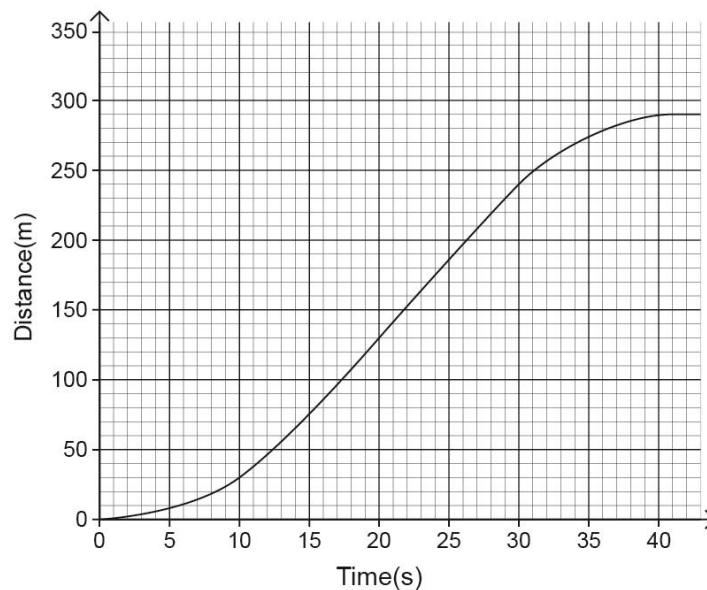
Pattern seeking (尋找規律) is a way of scientific inquiry involving measurements or observations to explore situations where the variables cannot be easily controlled. Scientists will try to identify patterns in the observations, such as whether there are any correlation between different variables in the scientific investigation.

Example :

The following shows some data extracted from a student survey :

Student	Gender	Height (cm)	Mass (kg)	Hand span (cm)	Arm span (cm)	Eye colour
A	female	151	49	17.2	160	black
B	male	158	52	16.0	149	black
C	female	160	50	18.4	171	brown
D	male	146	45	17.4	162	black
E	male	172	60	21.5	200	black
F	female	154	56	16.2	154	black
G	female	162	54	15.0	138	brown
H	male	160	55	15.2	143	black
I	female	157	51	20.0	186	brown

● The variables are said to be correlated (相關) when one variable changes with another variable. However, it should be noted that a correlation does not mean that the variables are in causational relationship (因果關係). For example, we may notice that the hand span and the arm span might be correlated to each other; however, there might not be a causational relationship among them.

● When studying the data, we have to be aware of the limitation in a scientific investigation, and not to over-interpret the data. For example, a false interpretation of the above data could be "males do not have brown eyes", due to the small sample size.
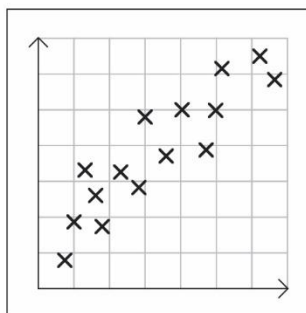
Correlation
To identify correlation more easily, we may use a scatter graph (散點圖) to present the data.
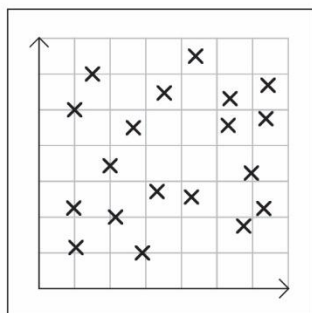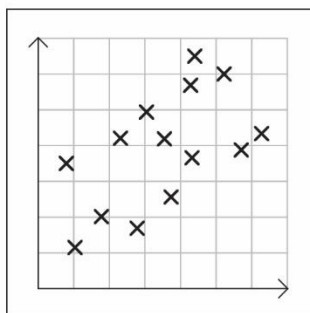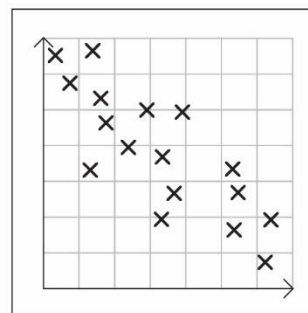

No correlation   Weak correlation   Strong positive correlation   Strong negative correlation

If the data plot in a scatter graph exhibits positive correlation or negative correlation, a '**line of best fit**' (最佳擬合線) can be used to show the trend of the data.

Example :
An experiment was conducted to investigate the relationship between mass (質量) and weight (重量). Five different objects were weighted using a force meter.

Mass (g)	Weight (N)
150	1.5
250	2.5
300	3.8
400	4.0
580	5.8

A scatter graph plotted using the results above is shown below. A line of best fit is also drawn on the graph to show that there is a positive correlation between the mass and the weight of the objects measured in the experiment.

Title: Relationships between the mass and the weight of the objects measured in the experiment
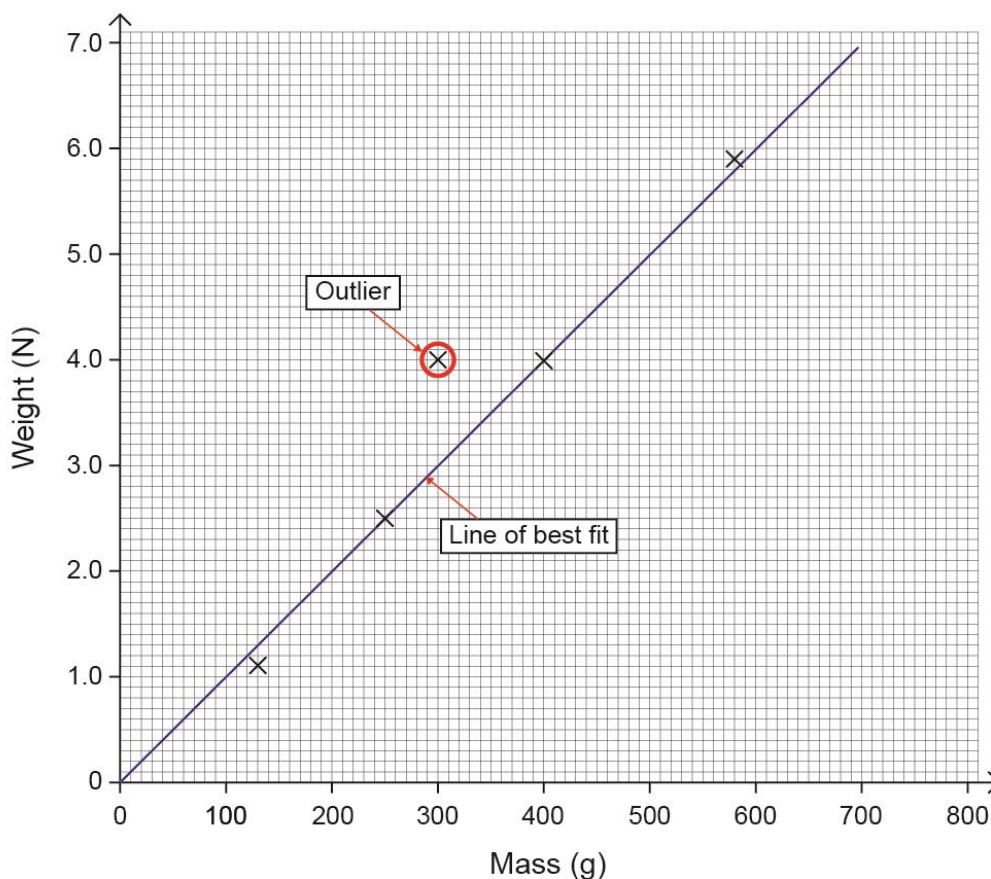
Point to note :

● The line of best fit should be drawn as close to all data points in the scatter graph as possible.

● It is not necessary for the line of best fit to joint all data points or pass through the origin (原點) in the graph.

● The line of best fit enables us to make deduction by interpolating (插值) in the graph, so that we can deduce an unknown value within the range of the measurements.

● The data point circled in the graph above is considered as an "outlier" (離群值) which does not fit the pattern, and should be checked whether there were mistakes (失誤) incurred in that measurement.

5 Making Conclusion

The conclusion (結論) of an experiment describes whether the experiment results support the hypothesis made or agree with the prediction (推測).

Example :
An experiment is carried out to investigate the relationship between the current (電流) flowing through a bulb and the voltage across it in a closed circuit (閉合電路).

A student formulates a hypothesis that the current flowing through a bulb and the voltage across the bulb is in proportional relationship (正比關係).

By using an ammeter (安培計) to measure the current flowing in the circuit and a voltmeter (伏特計) to measure the voltage across the bulb, the results are obtained and shown in the graph below.
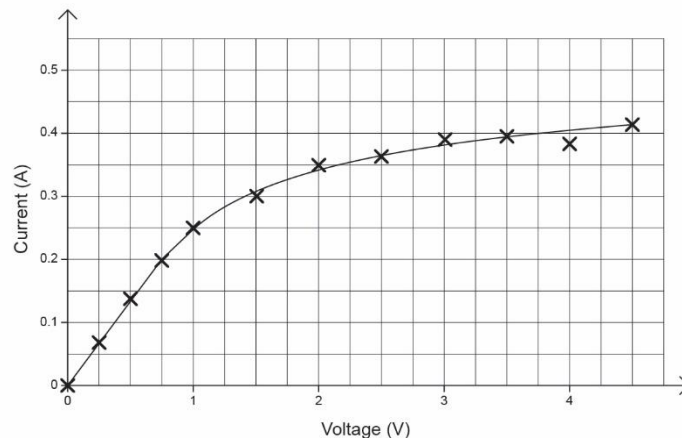
The following table shows three conclusions drawn by different students based on the results :

Conclusions	Comments
"The current increases when the voltage increases. The hypothesis is supported."	The conclusion is incorrect. The description is not detailed, and the graph does not show a proportional relationship, which would produce a straight line instead.
"The current increases as voltage increases, but the graph is a curve. As a proportional relationship would produce a straight line, the hypothesis was not supported."	This is a better conclusion as an explanation was given to describe why the hypothesis was not supported by the results.
"The graph shows that the current increases as the voltage increases. At voltage measured less than 1 V, the relationship could be proportional, as the first few points fall on a straight line. However, for the case which the voltage measured above 1 V, the relationship is no longer proportional as there is a smaller increase in current for every increase in voltage. The experimental results provided evidence to support the hypothesis for a certain range of voltage only."	This is an excellent conclusion. The description of the correlation between current and voltage measured at different range was detailed. The conclusion provided a thorough explanation to deliberate that the results supported the hypothesis only at a certain situation.

The following are some criteria for evaluating whether the experiment conducted is reliable (可靠) or not.

Repeatability (重複性)	If the same person repeated the experiment using the same equipment and collected similar results, the experiment is repeatable.
Reproducibility (再現性)	If a different person conducted the experiment using similar equipment and observed similar results, the experiment is reproducible.
Validity (有效性)	Validity refers to how well an investigation (e.g. fair testing) is designed to test the hypothesis with the variables properly controlled.

Are the variables in the experiment properly controlled to ensure a fair test?

Is the experiment reproducible?

Is the experiment repeatable?
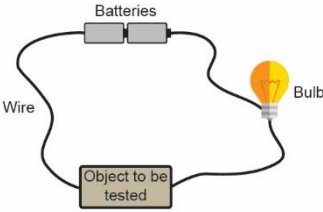
Can the conclusion drawn from the experiment support or refute the hypothesis?

6 Scientific Reasoning

During a scientific investigation, we may analyse the results obtained in an experiment and try to draw a conclusion to support or refute the hypothesis formulated. During the process, scientists will adopt different types of reasoning (推理) for building scientific knowledge.

The types of scientific reasoning that are commonly adopted in scientific investigations include:

Induction (歸納)	Using specific observations to come up with a general conclusion or trend.
Example 1	**Scientists discovered that twelve people with Down Syndrome have an extra chromosome in their cells.** ↓ **If one extra copy of chromosome is found in cell, the person must possess Down Syndrome.**
Example 2	A student conducted an experiment to test the conductivity of some selected objects : Results : ● The bulb grows when objects made with iron, copper, alumnium, silver, zinc and gold are tested ● The bulb did not grow when objects made with wood, plastic, glass are tested ⬇ Draw conclusions All metals are conductor. All non-metals are not conductor. **Both conclusions can be inferred from the experiment. (What scientific evidences will you give to support or refute the conclusion above?)**

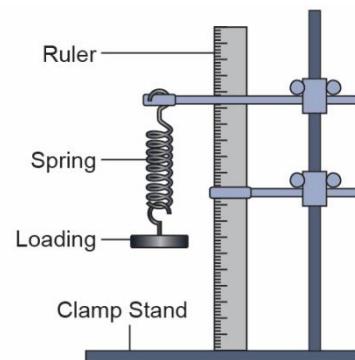| Deduction (演繹)	Using a set of general observations or trend to come up with a specific conclusion.
Example 1	**All substances sour in taste are acids.** ↓ **Vinegar is sour in taste. Vinegar is an acid.**
Example 2	A scientist conducted an experiment to investigate the extension (cm) of the spring changes with loading of different weights applied on a spring. The results are shown below: Ruler Spring Loading Clamp Stand The scientist propose that the following formula could be used to describe the relationship: Weight of loading (N) = 0.5 x Extension (cm) If it is found that the extension of the spring is 9 cm, what would the weight (N) of the loading be? ↓ Weight of loading (N) = 0.5 x 9 cm **The weight of the loading is found to be 4.5 N.**

Table inside Example 2:

Weight of loading	Extension of spring
1 N	2 cm
2 N	4 cm
3 N	6 cm
4 N	8 cm
5 N	10 cm

Abduction (溯因)	Inferring (推論) the best possible explanation to the observed phenomena.
Example	When a burning candle is placed inside an inverted beaker, the flame went out very shortly. Why? **Some possible explanations** The oxygen inside the beaker has been used up…? The flame is put out by carbon dioxide produced during the burning…? A convection current was formed in the beaker. Air with lower temperature is sinked to the bottom and blown away the flame…? Conduct experiments and find the best explanation for the observation

7 Probabilistic Thinking

In our daily life, we will encounter some scientific challenges. When solving problems, we may consider different actions and decisions, and each decision will bring us different risks and hazards. "Probabilistic thinking" is a scientific thinking method based on probability for decision-making or data analysis. This method allows us to make scientific decisions based on statistical data (統計數據).

Hazards and Risks

Hazard (危害) refers to anything that can cause harms, injuries or damages, while risk (風險) is the probability (概率) of the occurrence (發生) of a hazard. Understanding the hazards and risks associated with an event can help us make more informed decisions.

Example : Processed Meat and Colorectal Cancer

"According to statistics, in a specific population of a certain region, if individuals consume 50 g of processed meat (加工肉類) daily, the probability of developing colorectal cancer (大腸癌) is approximately 18%."

We can find out the hazard and risk incurred from the incident, based on the information above.

Incident (事件)	Consuming 50 g of processed meat daily.
Hazards involved	Developing colorectal cancer.
Risks involved	Approximately 18%

We can propose remedial actions to lower the risk, such as changing our dietary habits to reduce the risk of developing colorectal cancer :

- Avoid consuming more than 50 g of processed meats per day in order to reduce the risk of having colorectal cancer.

Reference: https://www.cfs.gov.hk/tc_chi/multimedia/multimedia_pub/multimedia_pub_fsf_113_01.html