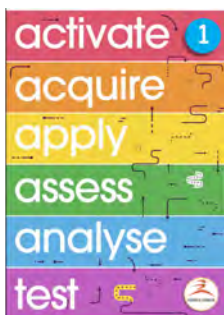# Complete Mastery sample materials

Do your students struggle to apply knowledge? Your scheme may cover all the knowledge, but it may not be helping students learn key concepts in sufficient depth. If there is too much content focus, students may not develop the thinking processes needed to apply (AO2) and analyse (AO3).

We created a 5-year plan (Blueprint) to provide time for what research says about learning for AO2 and AO3.

Complete Mastery implements the principles of Big ideas and Mastery Learning and teaches the thinking strategies low and middle ability students need to succeed. It is designed to enhance your existing year 7 scheme.

**5 reasons to buy Complete Mastery**

A major factor in grasping new concepts is whether students have sufficient prior understanding (not facts). Our **Pre-assessments** will show you whether there are knowledge gaps to fill, or misconceptions to address.

Many schemes explain theoretical concepts before students have had a chance to make sense of them. This encourages memorisation. Our **Explorations** start with a puzzling phenomenon, then guide students towards explaining it using a suitable concept. Students learn that concepts are explanatory tools.

To avoid 'fragile knowledge', students need to practise in a range of situations immediately a concept is introduced. Our **Practice Book** provides problems and a strategy for how to apply relevant knowledge.
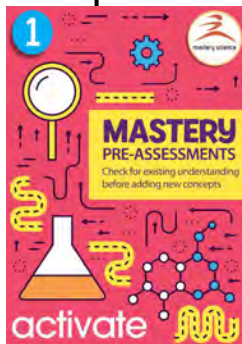
Unless higher order thinking is taught, it often only develops in higher ability students. Our **Challenges** teach a 4-step thinking strategy so that all students can develop skill in analyzing knowledge.

Formative assessment can improve teaching if the information it reveals about student understanding is accurate. Our **Diagnostic quizzes** pinpoint the aspects of each concept that students struggled with, give clear feedback, and provide a re-assessment quiz.

| Big idea | Year 7 units |
|----------|--------------|
| **Ecosystems** | **Interdependence**<br>Feeding relationships<br>Competition<br>Abiotic & biotic factors |

| | activate | acquire | apply | assess | analyse |
|---|----------|---------|-------|--------|---------|
| **Feeding relationships** | ☐ **Understand food chains** | ☐ Construct a visual model to show the feeding relationships in an ecosystem | ☐ Use the model to predict how changing one population affects another<br>☐ Use the model to explain how energy is transferred | ☐ Acquire<br>☐ Apply | ☐ Make a logical argument to support a claim about energy in food chains |



25 **Pre-assessments** on Key Concepts with answers and teacher guide

### Check your understanding of food chains

Here is a list of what eats what in two different habitats.
1. Use this information to write down as many food chains as you can.
2. Label the organism in each food chain as producer, predator or prey.
3. Which organisms are both predator and prey?

**Field**

| Hedgehogs eat frogs | Foxes eat rabbits | Frogs eat slugs |
| Rabbits eat grass | Slugs eat grass | Foxes eat hedgehogs |
| Grass snakes eat frogs | Hawks eat thrushes | Thrushes eat slugs |

**Sea**

| Crabs eat limpets | Shrimp eat zooplankton | Limpets eat seaweed |
| Dolphins eat tuna | Mussels eat seaweed | Seagulls eat starfish |
| Starfish eat limpets | Starfish eat mussels | Tuna eat shrimp |
| Zooplankton eat phytoplankton | Phytoplankton are producers | |

4. Decide if each statement below is True or False and tick the box

| | T | F |
|---|---|---|
| In a food chain, the direction of the arrow is from the predator to the prey | | |
| The arrow in a food chain shows the direction that energy flows | | |
| The producer in a food chain are the smallest animal | | |
| The number of predators in a food chain is always greater than the number of prey | | |
| The last animal in a food chain eats all the other animals in the food chain | | |
| All the energy in a food chain comes originally from the sun | | |
| A producer in a food chain is always a plant or an algae | | |

interdependence > feeding relationships

# Check your understanding of food chains

Here is a list of what eats what in two different habitats.
1. Use this information to write down as many food chains as you can.
2. Label the organism in each food chain as producer, predator or prey.
3. Which organisms are both predator and prey?

## Field

| | | |
|---|---|---|
| Hedgehogs eat frogs | Foxes eat rabbits | Frogs eat slugs |
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## Sea
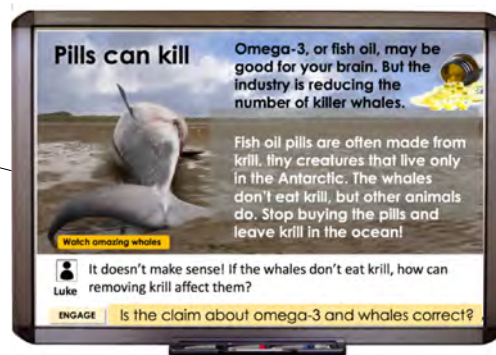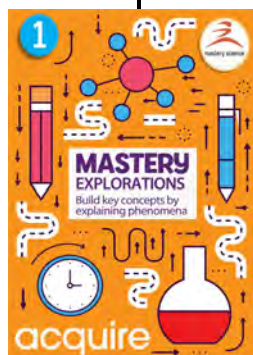
You can check if students have used arrows going in the correct direction to show the flow of energy, rather than what eats what.

| | | |
|---|---|---|
| Crabs eat limpets | Shrimp eat zooplankton | Limpets eat seaweed |
| Dolphins eat tuna | Mussels eat seaweed | Seagulls eat starfish |
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interdependence > feeding relationships

© mastery science 2018

| Big idea | Year 7 units |
|---|---|
| 🌐 **Ecosystems** | **Interdependence**<br>Feeding relationships<br>Competition<br>Abiotic & biotic factors |

| | activate | acquire | apply | assess | analyse |
|---|---|---|---|---|---|
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**MASTERY EXPLORATIONS**
Build key concepts by explaining phenomena

**acquire**

**Pills can kill**

Omega-3, or fish oil, may be good for your brain. But the industry is reducing the number of killer whales.

Fish oil pills are often made from krill, tiny creatures that live only in the Antarctic. The whales don't eat krill, but other animals do. Stop buying the pills and leave krill in the ocean!

Watch amazing whales

Luke: It doesn't make sense! If the whales don't eat krill, how can removing krill affect them?

ENGAGE | Is the claim about omega-3 and whales correct?

25 **Explorations** on Key Concepts with answers and teacher guide

# Pills can kill

Omega-3, or fish oil, may be good for your brain. But the industry is reducing the number of killer whales.

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**Watch amazing whales**

**Luke:** It doesn't make sense! If the whales don't eat krill, how can removing krill affect them?

**ENGAGE** Is the claim about omega-3 and whales correct?

The claim is introduced as an engaging puzzle that students are asked to solve.

**Sample material**

To solve the problem, students start by applying their prior knowledge. They find it is not enough, which drives the search for a more useful concept.

**ENGAGE** | What do you know already?

Krill are not food for whales …

… so reducing the number of krill should not affect them

How do you show what eats what?

**Activity: Check your understanding of Food Chains**

The pre-assessment can be inserted here to put it in context.

# Sample material

> Instead of being told what a food web is, students first make sense of the concept by working out their own representation, using information on the student sheet.

**EXPLORE** | What do you need to find out?

Krill and whales are part of more complicated system.
Leopard seals eat penguins, but they also eat cod.
How could you show this?

EMPEROR PENGUIN

LEOPARD SEAL

COD

**Activity: Model feeding relationships**
Read 'Organisms in the Antarctic'
Draw a diagram to represent all the feeding relationships

Hints:
• Show complete food chains.
• Link food chains together.
• Make sure arrows do not cross (y...
• You could cut out the pictures

**Pills can kill**

**Organisms in the Antarctic**
Krill forms huge swarms at the ocean's surface for protection against animals that eat them, such as penguins and cod, but also because their food, small **producers** called phytoplankton, live in huge numbers there.

Cod have a varied diet – they are **predators** of zooplankton and krill but also eat phytoplankton. Zooplankton eat phytoplankton and are eaten by cod and squid.

The life of an emperor penguin is hard. Not only do they have to survive freezing temperatures but they are also **prey** for killer whales and leopard seals. Leopard seals also prey on cod.

Killer whales are **top predators** – they eat leopard seals, penguins and squid but are not eaten by any animals.

*student sheet*

KILLER WHALE

EMPEROR PENGUINS

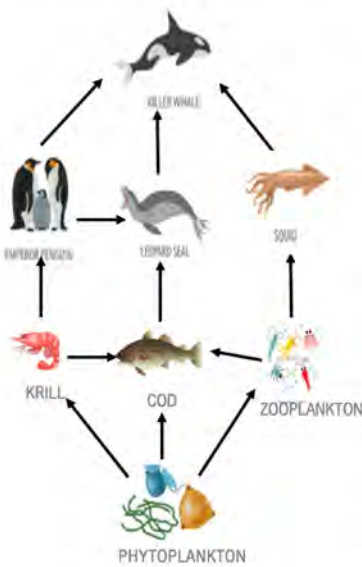LEOPARD SEAL

SQUID

ZOOPLANKTON

KRILL

COD

PHYTOPLANKTON

Students' food webs are reviewed and new terms are introduced.

**EXPLAIN** | What did you learn?

Here is a completed diagram. It is called a **food web**.

A food web shows the feeding relationships in a habitat, like the Antarctic.

A food web is also a **model** that shows what eats what.

A model is a simplified version of reality to make it easier to understand.

Models contain actors and actions – like a movie.

The actors are the organisms. The action is the energy being passed along by eating (shown by the arrows).

KILLER WHALE

EMPEROR PENGUIN      LEOPARD SEAL      SQUID

KRILL      COD      ZOOPLANKTON

PHYTOPLANKTON

Students can now use the concept they uncovered to explain the puzzle.

**EXPLAIN** Could removing krill harm whales?

With a food web, you can find out the effect of changing the **population** of one organism on another.

Population is the number of organisms of one species.

KILLER WHALE

EMPEROR PENGUINS

LEOPARD SEAL

SQUID

KRILL

COD

ZOOPLANKTON
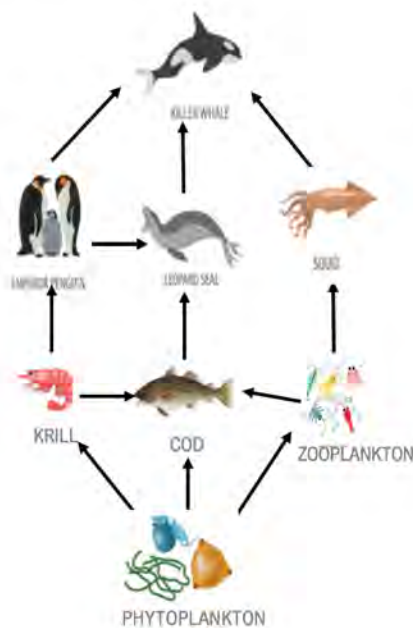
PHYTOPLANKTON

**Example**

**If** lots of the phytoplankton die.
**Then** there's not enough food for zooplankton.
**So** the population of zooplankton goes down

**Click to animate**

**Your turn**

Work out what happens to the killer whales if huge numbers of krill are removed from the ocean to make the tablets.

Write your answer using

**If …. Then …. So …**

The scientific reasoning process of writing an argument is explained and modelled. Then students use it with scaffolding.

| Big idea | Year 7 units |
|----------|--------------|
| **Ecosystems** | **Interdependence**<br>Feeding relationships<br>Competition<br>Abiotic & biotic factors |

| | activate | acquire | apply | assess | analyse |
|---|----------|---------|-------|--------|---------|
| **Feeding relationships** | ☐ Understand food chains | ☐ Construct a visual model to show the feeding relationships in an ecosystem | ☐ **Use the model to predict how changing one population affects another**<br>☐ **Use the model to explain how energy is transferred** | ☐ Acquire<br>☐ Apply | ☐ Make a logical argument to support a claim about energy in food chains |

50 **Problem Types** on Key Concepts with hints & answers
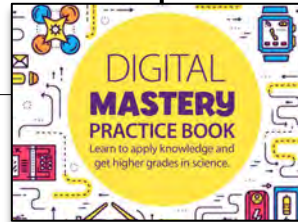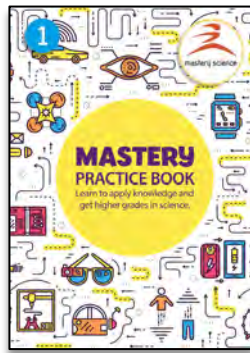
Digital pdf version with school site license

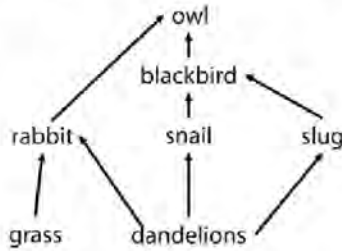50 Bonus Apply questions free with a set of books or digital version

For each type of problem, a worked example breaks down the thinking process and models it step-by-step.

**Example**

# 8.2 Change in population

**1**

owl
↑
blackbird
↑
rabbit    snail    slug
grass    dandelions

The drawing shows a grassland food web. Explain how an increase in the number of snails could cause an increase in the number of slugs.

**Detect**

I need to use the food web to see how a change in one population affects another.

*How does a population change affect the other organisms?*

**Recall**

If the population of an organism changes, it can affect the populations of the other organisms in the food chain.

D
B    C
A

**IF** the population of organism B increases:

*this could happen*

D
B    C
A

**THEN** there is more B for D to eat.
**SO** D eats fewer of C.

**THEREFORE** the population of C increases.

*this could happen*

D
B    C
A

**THEN** more A gets eaten.
**SO** there is less food for C.

**THEREFORE** the population of C decreases.

Licence Kingsmead
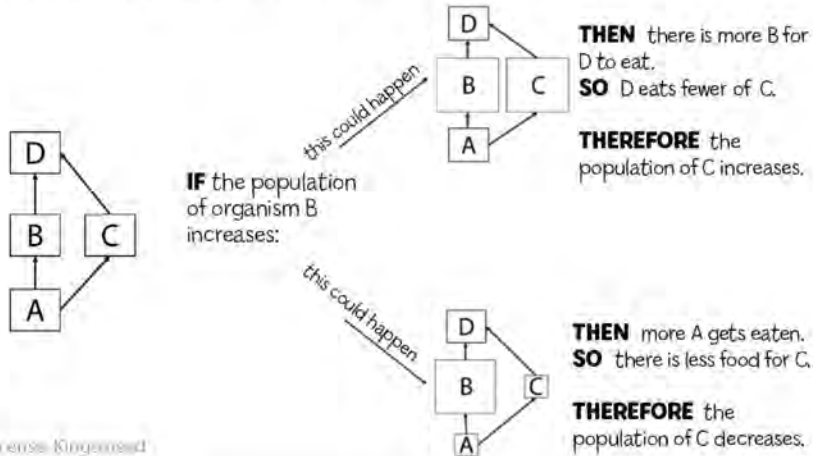
**Solve**

**IF** the population of snails increases,

*Why is this true?*

**THEN** the blackbirds will have more snails to eat.

**SO** the blackbirds will eat fewer slugs.

**THEREFORE** the slug population will increase.

The first question is structurally identical to the worked example but with new values. The following question are more different.

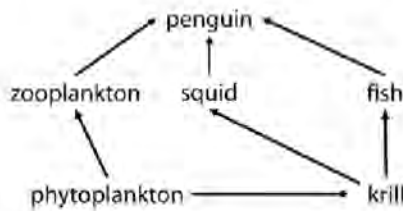**Your turn**

**2**

owl
blackbird
rabbit   snail   slug
grass   dandelions

The diagram shows a grassland food web.
Explain how an increase in the number of snails could cause the number of slugs to decrease.

**3**

penguin
zooplankton   squid   fish
phytoplankton ——— krill

The diagram shows a food web in the Antarctic.
Explain how a decrease in the number of fish could result in the number of squid increasing.

**4**

hawk
mountain lion
shrew — snake
grasshopper   rabbit   deer
squirrel
grass   shrub

The diagram shows part of a food web in a mountain forest.
Explain why a decrease in the population of shrews might affect the hawks more than the mountain lions.

Use the 3-steps template with the Practice Book and Bonus Pack to teach a thinking strategy that will prepare students for AO2.

# 3-steps to apply knowledge

Study the Example. Cover the page and try Your turn. Write down your thinking for each step:

**Detect**

**Recall**

**Solve**

## Feedback

Compare your thinking in Detect, Recall and Solve with the Example's. Did you miss anything? What can you do differently to improve on this step? Write down feedback to yourself:
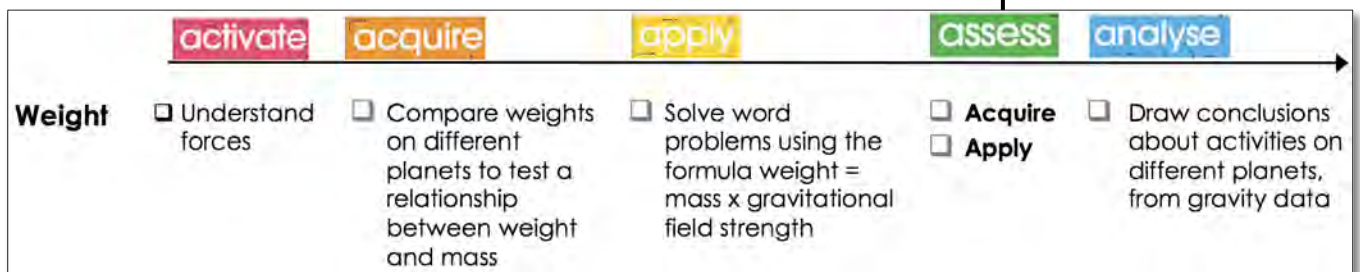
**Detect**

**Recall**

**Solve**

| Big idea | Year 7 units |
|---|---|
| **Forces** | **Gravity** <br> Weight <br> Gravitational force <br> Solar system |

| | activate | acquire | apply | assess | analyse |
|---|---|---|---|---|---|
| **Weight** | ☐ Understand forces | ☐ Compare weights on different planets to test a relationship between weight and mass | ☐ Solve word problems using the formula weight = mass x gravitational field strength | ☐ **Acquire** <br> ☐ **Apply** | ☐ Draw conclusions about activities on different planets, from gravity data |

### Gravity mastery quiz

Idea: Mass & weight                                                        Know

**Q1** Three students argue about the meaning of weight.

It never changes

It depends on gravity

It's the amount of stuff in an object

Student A          Student B          Student C

Which student's answer is correct?          A    B    C

**Q2** An astronaut travels from the Earth to the Moon. On Earth her mass is 70 kg and her weight is 700 N. Which answer shows her mass and weight on the Moon?

|   | Mass | Weight |
|---|---|---|
| A | 70 kg | < 700 N |
| B | < 70 kg | 700 N |
| C | < 70 kg | < 700 N |

**Q3** Two identical rockets take off, one from Earth the other from the Moon. The force needed to leave the launch pad is called the take-off thrust.

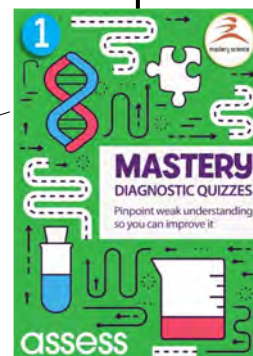Earth                    Moon

Take-off thrust, 12 million N       Take-off thrust, 2 million N

Why is the take-off thrust on the Moon less?
A   There is no air resistance
B   There is lower gravity
C   The rocket has less mass

**1** **MASTERY** DIAGNOSTIC QUIZZES <br> Pinpoint weak understanding so you can improve it

assess

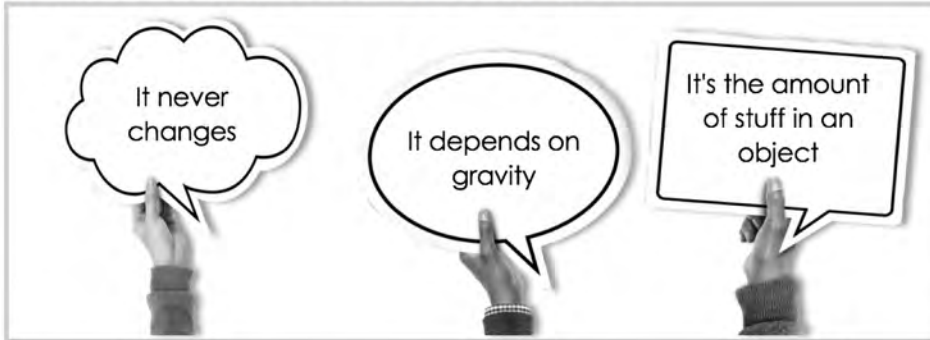25 **Diagnostic quizzes** on Key Concepts with feedback and 25 Re-assess quizzes

Acquire questions check understanding of AO1, to tell you whether students need more learning time.

# Gravity diagnostic quiz

**Weight**                                                                   **Acquire**

**Q1** Three students argue about the meaning of weight

| It never changes | It depends on gravity | It's the amount of stuff in an object |

Student A                    Student B                    Student C

Which student's answer is correct?        **A    B    C**

---

**Q2** An astronaut travels from the Earth to the Moon.
On Earth her mass is 70 kg and her weight is 700 N.

Which answer shows her mass and weight on the Moon?

|   | Mass | Weight |
|---|------|--------|
| A | 70 kg | < 700 N |
| B | < 70 kg | 700 N |
| C | < 70 kg | < 700 N |

**Q3** Two identical rockets take off, one from Earth the other from the Moon.
The force needed to leave the launch pad is called the take off-thrust.

**Earth**                              **Moon**

Take-off thrust, 12 million N        Take-off thrust, 2 million N

Why is the take-off thrust on the Moon less?

**A** There is no air resistance

**B** There is lower gravity

**C** The rocket has less mass

The distractors are designed to reveal misconceptions so you can address them.

Apply questions check AO2, to tell you if students need more practice with unfamiliar situations

## Weight                                                          Apply

**Q8** A group of students make a pendulum by attaching a lead weight to a string which is fixed at the top.
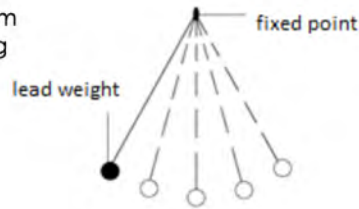


The students wonder how the pendulum will swing on the Moon, where gravity is less.

Which student's prediction and explanation are correct?

| | Prediction | Explanation |
|---|---|---|
| **A** | It will move faster | Gravity will slow the pendulum down less |
| **B** | It will move at the same speed | The motion is not affected by gravity |
| **C** | It will move slower | Gravity pulls the pendulum down less |

**Q9** The diagram shows the weight different masses on three planets.
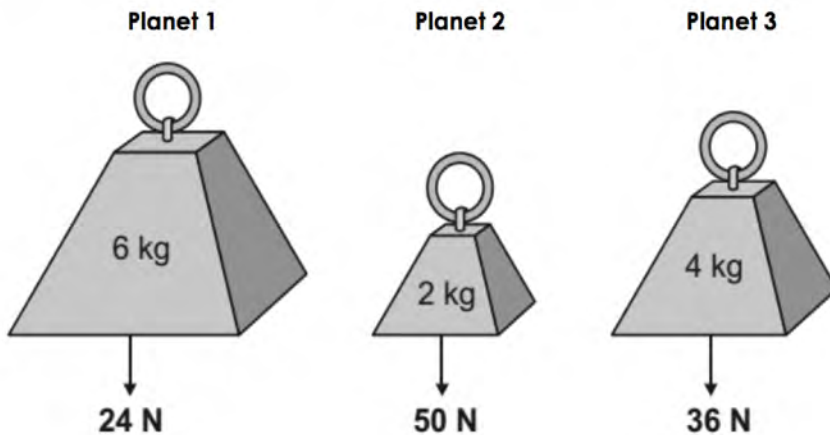


Which answer shows the planets in *increasing order* of gravitational field strength?

Use the formula: weight = mass x g

| | | | |
|---|---|---|---|
| **A** | Planet 1 | Planet 2 | Planet 3 |
| **B** | Planet 1 | Planet 3 | Planet 2 |
| **C** | Planet 2 | Planet 3 | Planet 1 |

Students can review their answers and feedback on why the right answer was right, and the wrong answer wrong.

| Q | A | Review: correct answer | Review: wrong answers |
|---|---|---|---|
| 1 | B | Weight is gravitational force, so it depends on the strength of gravity, g. | A: It is true that Mass does not vary. But the question is about weight<br>C: This is true. Mss is the amount of stuff, but the question is about weight |
| 2 | A | The object's mass, 70kg, does not change. Its weight on the Moon is less because g on the Moon is only 1.6 N/kg compared to 10 N/kg on Earth. | B: The mass does not decrease. The weight does not remain the same.<br>C: The mass does not decrease. |
| 3 | B | If the rocket takes off, the take-off thrust upwards must exceed gravity downwards. On the Moon, gravity is less than on Earth. | A: It is true there is no air resistance. But this does not affect the weight of the rocket<br>C: This is false. The rocket has the same mass on the moon |

The quiz specification shows which aspects of the concept are assessed by each question, and the misconceptions in the distractors

| | Weight | | |
|---|---|---|---|
| | acquire | | |
| | **Q1** | **Q2** | **Q3** |
| | Mass definition | Mass & weight change | Less weight on Moon |
| Correct answer | C | A | B |
| **% Students correct** | | | |
| **Idea** | | | |
| Mass does not vary | ✔ | ✔ | |
| Weight depends on mass | ✔ | ✔ | |
| Weight depends on g | ✔ | ✔ | ✔ |
| Calculate using formula | | | |
| **Misconception** | | | |
| Falling is natural | | | |
| Pressure causes gravity | | | ✔ |
| Mass = weight | ✔ | ✔ | ✔ |

| Big idea | Year 7 units |
|---|---|
| **Ecosystems** | **Interdependence**<br>Feeding relationships<br>Competition<br>Abiotic & biotic factors |

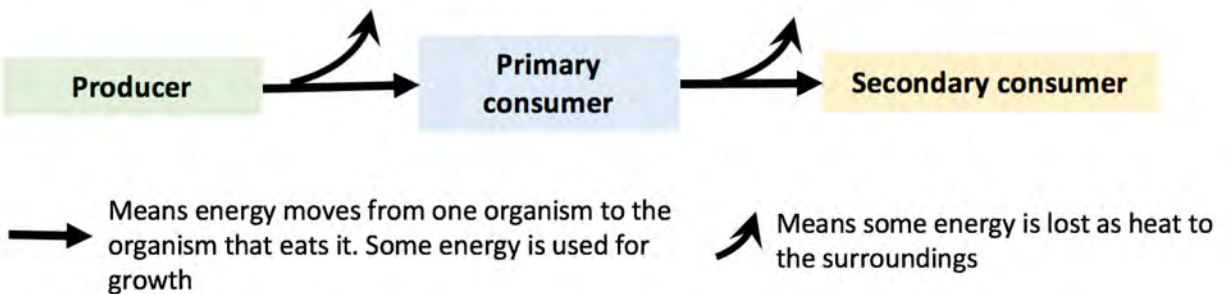| | activate | acquire | apply | assess | analyse |
|---|---|---|---|---|---|
| **Feeding relationships** | ☐ Understand food chains | ☐ Construct a visual model to show the feeding relationships in an ecosystem | ☐ Use the model to predict how changing one population affects another<br>☐ Use the model to explain how energy is transferred | ☐ Acquire<br>☐ Apply | ☐ **Make a logical argument to support a claim about energy in food chains** |

The Reporter

**Feed the world: go vegan**

There is enough food in the world for the entire human population. So why are   1 billion people starving?

In a word, meat. The more meat the world eats, the fewer people we can feed.

A field of wheat can feed 100 people. But if you use that wheat to produce a cow for meat, it only feeds 10 people.

There is a simple solution – go vegan.
**Plants feed more people than meat.**

The writer has made a claim but not given evidence.
Here is a food chain to show the energy involved in growing wheat and cows.

Producer → Primary consumer → Secondary consumer

→ Means energy moves from one organism to the organism that eats it. Some energy is used for growth

↗ Means some energy is lost as heat to the surroundings

Write an argument to support the claim for going vegan, the food chain and energy.

MASTERY CHALLENGES
Learn to analyse knowledge and excel in science exams
analyse

25 **Challenges** on Key Concepts with answers and teacher guide

Students have to combine knowledge and higher order thinking to interpret information in context.

### The Reporter

# Feed the world: go vegan

**There is enough food in the world for the entire human population. So why are 1 billion people starving?**

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↗ Means some energy is lost as heat to the surroundings

Write an argument to support the claim for going vegan, the food chain and energy.

Students practise structuring their answer as an argument, with a claim, evidence and reasoning.

**Sample material**

Use the 4-steps template with the Challenges to teach a thinking strategy that will prepare students for AO3.

# 4-steps to analyse knowledge

**Detect**

What is the question asking? What information is provided? What's missing?

**Hint:** Identify the claim

**Recall**

What concepts, facts and skills you know could be relevant?

**Hint:** Redraw the diagram as two food chains a) vegan diet b) meat diet. Add energy captions

**Solve**

Can you combine the question information and what you recalled to work it out?

**Hint:** Look for differences between the two food chains. How is this evidence for the claim?

**Present**

Can you write a well organised answer to include all the main points?

**Hint:** The claim is ... The information that supports it is ... It supports the claim because ...

| Big idea | Year 7 units |
|---|---|
| **Forces** | **Gravity**<br>Weight<br>Gravitational force<br>Solar system |

| | activate | acquire | apply | assess | analyse |
|---|---|---|---|---|---|
| **Weight** | ☐ Understand forces | ☐ **Weight is the force an object exerts on its support and which causes it to fall. It is mass x gravitational field strength** | ☐ **Solve word problems using the formula weight = mass x gravitational field strength** | ☐ Acquire<br>☐ Apply | ☐ **Draw conclusions about activities on different planets, from gravity data** |
| **Gravitational force** | ☐ Forces | ☐ Draw conclusions from data about the relationship between gravity and distance between objects. | ☐ Explain effects of gravity on different planets | ☐ Acquire<br>☐ Apply | ☐ Compare and contrast gravity with other forces |
| **Solar system** | ☐ Earth movement | ☐ Use a model to explain the apparent motion of the sun and moon, and day and night | ☐ Explain why places on Earth experience different daylight or amounts of sunlight, from diagrams | ☐ Acquire<br>☐ Apply | ☐ Interpret patterns in the properties of planets, from data |





9 **Unit Quizzes** on Key Concepts, with Acquire, Apply and Analyse questions

# Gravity unit quiz: weight

**1**
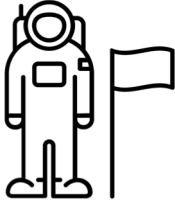
On Earth, an astronaut has a mass of 60kg and weighs 600 N.

What would her mass and weight be on a planet with twice the gravitational field strength of Earth?

| | Mass on planet (kg) | Weight on planet (N) |
|---|---|---|
| Astronaut | | |

[1 mark]

**2**

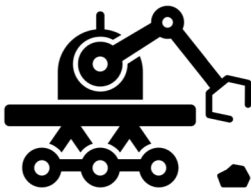A mobile phone has a mass of 200 g. What is its weight?

g on Earth =10 N/kg

[1 mark]

**3**

A Mars rover has a weight of of 2500N on Earth.

Calculate  a) its mass on Mars   b) its weight on Mars.

g on Earth = 10 N/kg. g on Mars = 4 N/kg.

[2 marks]

**4**

Here are the Olympic records for two sports.

High diving

2.5

Most twists made before hitting water

Weight lifting

150 kg

Biggest mass anyone has lifted

How would these records change if each sport were played on the Moon?

Give a reason for your answers.

[3 marks]

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# Key Concepts in Complete Mastery

| Big idea | Year 7 unit | Key Concepts |
|---|---|---|
| **Forces** | Contact forces | Balanced & unbalanced<br>Friction<br>Density |
| | Gravity | Weight<br>Gravitational force<br>Solar system |
| **Energy** | Energy transfers | Energy<br>Wasted energy<br>Heat & temperature |
| | Electric circuits | Electric current<br>Resistance |
| **Matter** | Substances & particles | Particle model<br>Mixtures<br>Solutions |
| | Changing substances | Chemical & physical<br>pH scale<br>Neutralisation |
| **Organisms** | Cells | Cell structure<br>Specialised cells |
| **Ecosystems** | Interdependence | Feeding relationships<br>Competition<br>Abiotic & biotic factors |
| **Genes** | Reproduction | Sexual & asexual<br>Menstrual cycle<br>Embryo development |

# Enquiry skills in Complete Mastery

| Process | Year 7-8 skills (from Blueprint) | Where it is taught |
|---|---|---|
| Manage variables | Choose variables to answer a scientific question | Friction |
| | Control variables that might affect the outcome | Solutions |
| Draw conclusions | Deduce patterns and relationships in data and observations | pH scale<br>Menstrual cycle<br>Abiotic & biotic |
| | Judge how well the evidence fits your conclusion | Solar system |
| Collect evidence | Assess the errors in your measurements | Speed |
| | Plan the data collection for the independent and dependent variables | Heat & temperature<br>Resistance |
| Test hypotheses | Suggest a hypothesis for the observation. | Solutions<br>Particle model |
| | Predict the outcome of an experiment if the hypothesis is correct | Electric current<br>Resistance<br>Neutralisation |
| | Review whether the experiment agreed with the hypothesis | Electric current<br>Resistance |

# Maths skills in Complete Mastery

| Process | Year 7-8 skills (from Blueprint) | Where it is taught |
|---|---|---|
| Algebra | Substitute values into equations, with units and symbols | Density<br>Weight<br>Wasted energy |
| Numbers | Use ratios, fractions and percentages | Weight<br>Energy |
| Graphs | Reading values off graphs, interpolating and extrapolating | Heat & temperature |
| Data | Draw and interpret frequency tables, diagrams, charts and histograms | Energy |

# Complete Mastery pricing
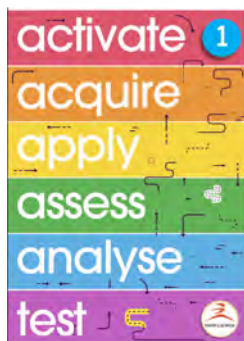
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| --- | --- | --- |
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Complete Mastery is published in two parts. This is to allow time for our development process (yes, we aim for mastery too).

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Part B includes the remaining 5 units: Electric circuits, Interdependence, Changing substances and Gravity.

To help you with advance planning, we will publish on 13th July:
• Unit overviews
• For the first unit to be taught: detailed unit guide setting out lessons, and resources needed
• For the first Key Concept to be taught, the materials for all 6 components (presentations, student sheets + teacher guide)

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