Now ⟶ **Vision**

Description
Predicted grade

Description
Predicted grade

Description
Predicted grade

Description
Predicted grade

What are the obstacles or challenges to your vision?

What are the first steps you will take in school to work on your vision?

Examine GCSE questions. List the questions that test each process.

Thinking process		Questions
Apply	Recognition of the concept in a genuinely unfamiliar situation, and reasoning about which are the relevant aspects and how to use them	
Analyse	(Apply plus) Use given information to draw a not previously made inference to interpret, conclude, judge or evaluate	
Enquiry		
Hypotheses	Think of possible explanations for unfamiliar observations or data, making predictions, or working out which hypothesis fits the data best	
Variables	Understand which variables were chosen in an experiment and whether they were controlled or not, or choose and control variables in your own investigation	
Maths		
Ratio & proportionality	Ratio as a relationship between two quantities, and proportional when one variable is a constant ratio times another	
Probability & correlation	Probabilistic reasoning goes beyond outcomes being present or not to factors increases the chances of the outcome. Identifying correlation means recognising when one factor changes another	

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

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
Starfish eat limpets	Starfish eat mussels	Tuna eat shrimp
Zooplankton eat phytoplankton	Phytoplankton are producers	

4. Decide if each statements 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 producers 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

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Pretend that you are year 7 student about to study weight. You have a misconception about gravity from primary school. Answer the questions:

Prior concepts & skills? — Yes →

No ↓

Re-think →
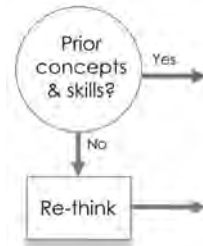
Check your understanding of weight

1 Draw the yo-yos at each place on the Earth. One has been done for you.
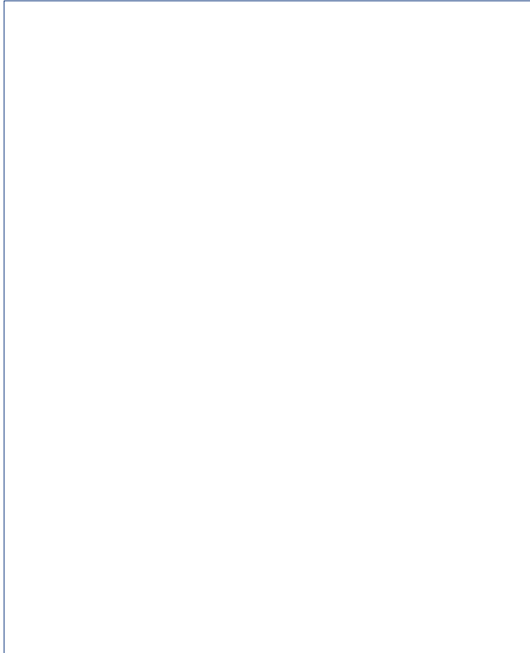

How confident are you about your answer?

Quite confident   Not confident

As a teacher, how could you use the information from this task to:

a) Pre-teach: fill knowledge gaps and address misconceptions

b) Improve your teaching plan for weight

Mellinarks & Magic Paper

Explore thinking processes involved in learning concepts.

What is a Mellinark?

What thinking process did you use to to learn the concept of Mellinark?

How does Magic Paper work?
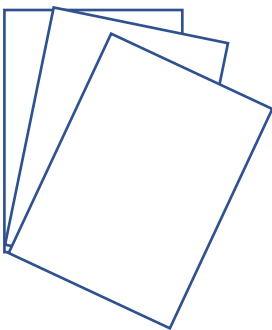
What thinking process did you use to arrive at a good explanation?

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?

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

Example

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.

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 (yo
- 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 shee

KILLER WHALE

EMPEROR PENGUINS

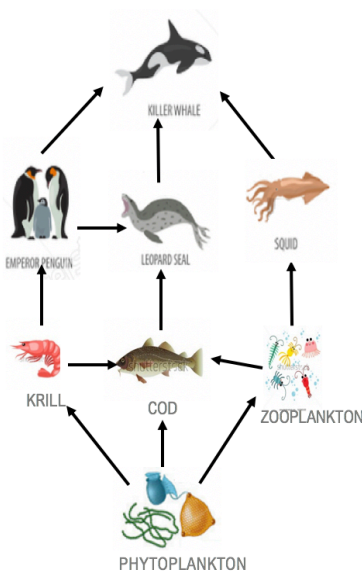LEOPARD SEAL

SQUID

KRILL

ZOOPLANKTON

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.

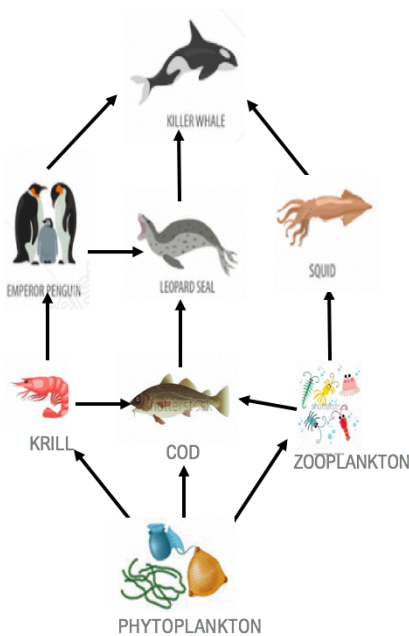The actors are the organisms. The action is the energy being passed along by eating (shown by the arrows).

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.

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.

A good Acquire objective :

❑ Clearly expresses the level of understanding needed
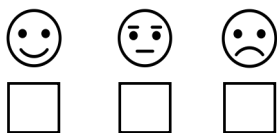
A good Acquire stage has these features:

❑ Target understanding of the concept
❑ Engage students with an interesting phenomenon, problem or issue
❑ Focus around answering a scientific question
❑ Enable exploration of the concept before formal explanation
❑ Explain with enough detail and clarity
❑ Practise modelling or argument (claim, evidence, reasoning)
❑ Practise an investigative, maths or literacy skill

Choose one unit and concept to audit your current scheme against Blueprint. This will tell you the priorities for change.

> Summarise what your scheme does to get students to grasp the Key Concept.

Check off the features of Activate that your current scheme meets.

Overall rating

☺ ☺ ☹
☐ ☐ ☐

> List the important changes you want to make to your scheme.

acquire **Align**

Re-design the Acquire stage. Plan the main activities. It may help to split the stage into:

Engage
- Engage students with an interesting phenomenon, problem or issue
- Focus around answering a scientific question

Explore
- Enable exploration of the concept before formal explanation
- Practise modelling or argument, investigative, maths or literacy skill

Explain
- Explain with enough detail and clarity
- Practise modelling or argument, investigative, maths or literacy skill

Note. This is not rigid: you can have multiple cycles, or some explain before explore
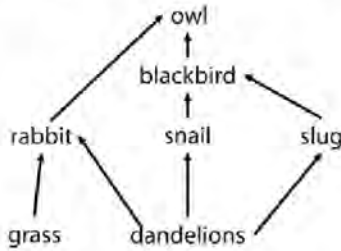
Sample material

> 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
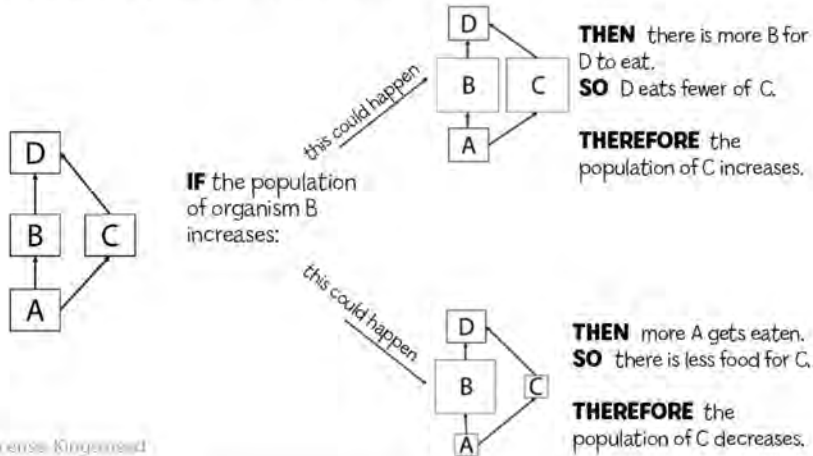
Solve

> Why is this true?

IF the population of snails increases,

THEN the blackbirds will have more snails to eat.

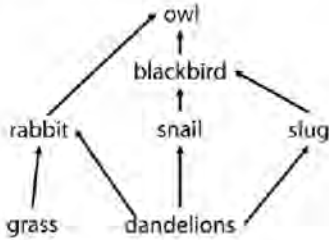**SO** the blackbirds will eat fewer slugs.

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.

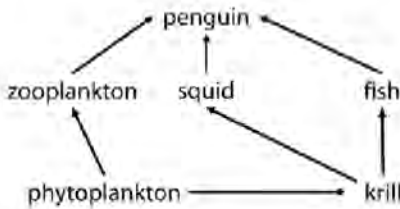Your turn

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

mountain lion
hawk
shrew —— snake
grasshopper   rabbit   deer
squirrel
grass   shrub
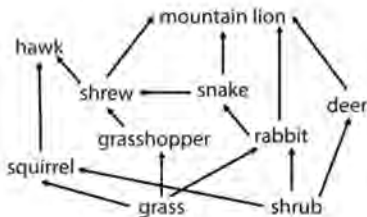
The diagram shows part of a food web in a mountain forest.
Explain why a decrease in the population of shrews might affect the hawks more than the mountain lions.
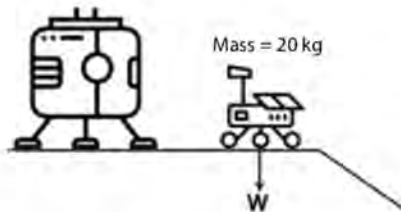
Sample material

> What learning principles can you identify in this worked example?

Example

4.5 Calculate weight

1 A Mars robot travels along a thin metal ramp. It can break if the force on it exceeds 150 N.

Mass = 20 kg

W

The robot's mass is 20 kg. On Mars its weight, shown by W, is 72 N. Could the robot use the ramp on Earth without breaking the ramp? g on Earth = 10 N/kg.
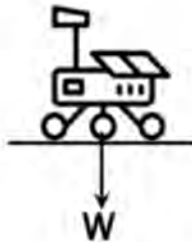
Detect

I need to calculate the robot's weight on Earth.

Recall

Why is the robot's weight different on Earth?

W

1. The force of gravity (weight) pulls downwards on the robot.
2. The robot pushes downwards on the ramp with the same force as its weight.
3. The maximum force the ramp can take is 150 N.
4. The formula for calculating the weight of the robot is:

$$W = m \times g$$

W is weight, m is mass and g is gravitational field strength.

Solve

Licensee Kingsmead

We need to find out whether the robot's weight on Earth is greater than 150 N. The values to put into the weight formula are:

m = 20 kg (mass is the same everywhere)
g = 10 N/kg (Earth)

So W = m x g becomes
    W = 20 kg x 10 N/kg = 200 N,

Why is the weight of 72 N not used?

As this force is more than 150 N, the ramp might break. So the robot cannot use the ramp on Earth.

Your turn

2 The ladder of a spacecraft breaks if the weight on it exceeds 500 N. On Mercury, an astronaut can use it safely. She weighs 360 N and her mass is 100 kg.
Can she use the ladder on Earth? Show your calculation.
g on Earth = 10 N/kg.

3 A table designed for the Moon can support a weight of 4 N. Can it support a 2.5 kg laptop on Mars? Explain your answer.
g on Mars = 4 N/kg.

4 On Earth, a dance mat needs a force of 250 N pressing down on it to work.
Would the weight of a 60 kg person work the mat on Venus?
g on Venus = 9 N/kg.

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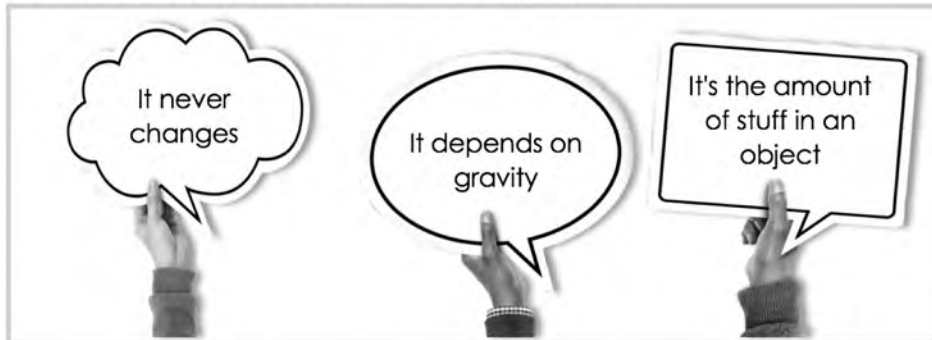
Acquire questions check understanding of AO1, to tell you whether students need more learning time.

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
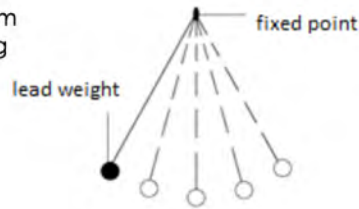
C The rocket has less mass

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.

fixed point

lead weight

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.

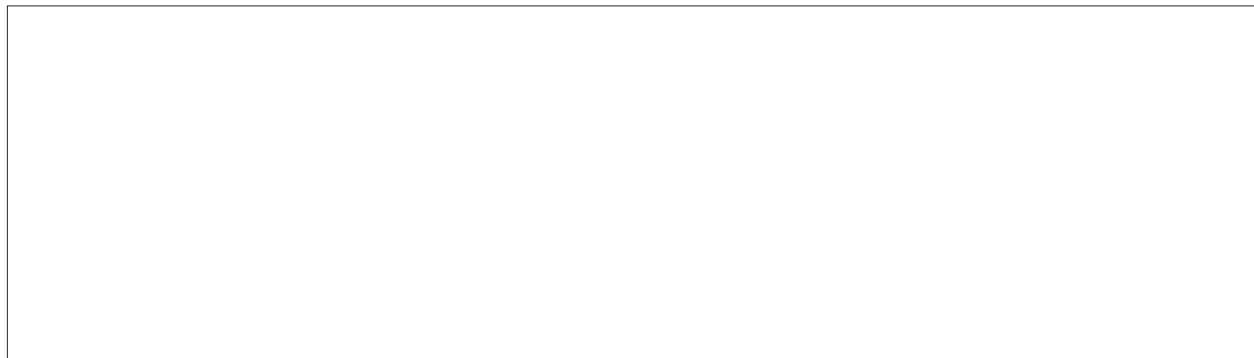| Planet 1	Planet 2	Planet 3
6 kg	2 kg	4 kg
24 N	50 N	36 N
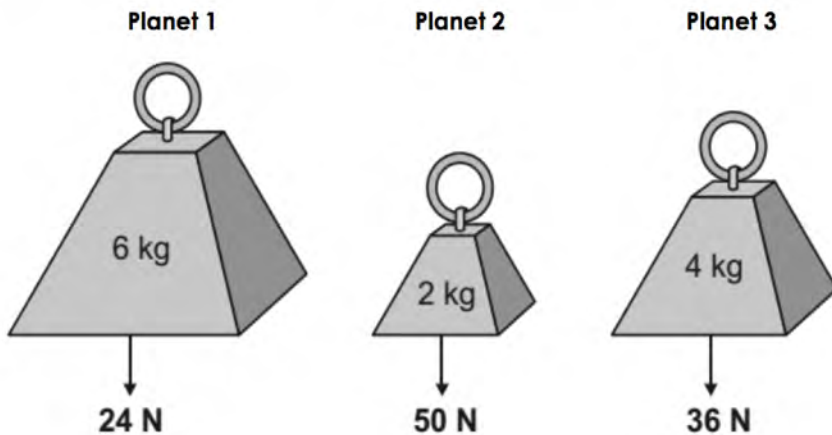
Which answer shows the planets in *increasing order* of gravitational field strength?

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.

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	✔	✔	✔

A good Assess stage has these features:

- ☐ Questions probe understanding, not just factual recall (AO1)?
- ☐ Questions reveal misconceptions? (to identify struggling students)
- ☐ Questions present unfamiliar contexts? (AO2)
- ☐ Questions test more than recall, involving thinking? (AO2)
- ☐ Takes place before end of unit? (so there is time for re-think?)

Choose one unit and concept to audit your current scheme against Blueprint. This will tell you the priorities for change.

Summarise what your scheme does to assess understanding of the Key Concept.

Check off the features of Assess that your current scheme meets.

Overall rating

☺ ☐   😐 ☐   ☹ ☐
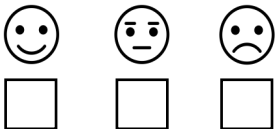
List the important changes you want to make to your scheme.

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

The Reporter
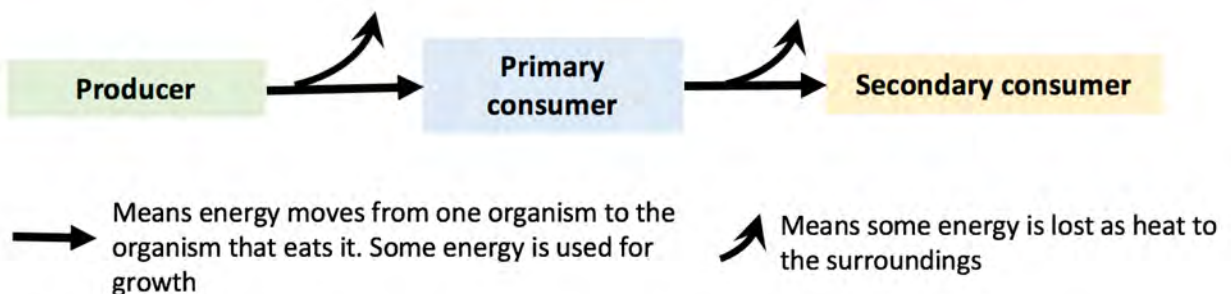
Feed the world: go vegan

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

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.

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

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 ...

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]

An Apply question tests AO2: use in non-taught situations

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]

An Analyse question tests AO3: Interpreting information with higher-order thinking

4

Here are the Olympic records for two sports.

High diving	Weight lifting
2.5	150 kg
Most twists made before hitting water	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]