Unit Preparation Booklet

B3.2 Human Interaction

Teacher name:

Science Mastery

Ark Curriculum+

Contents

Steps to Success

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Unit preparation checklist

Resources can and should be tailored to meet your pupils' needs. We have aimed to do as much resourcing as possible so that teachers' time can be spent on co-planning and preparation; however, they are only ready for your pupils once you have decided how to make use of them.

Here is a suggested checklist:

Locate:
- ☐ **Find** the unit resources using MyMastery or SharePoint

Engage:
- ☐ Work through the preparation booklet. Complete the pre-unit quiz and mastery quiz yourself and reflect (all enclosed)

- ☐ Set your class the **pre-unit quiz** (in advance of the unit).

- ☐ Note which topics are **areas of weakness** for the class (space available in this booklet or on the planning pro-forma)

- ☐ **Decide** which topics you will re-visit 'in advance' and which to tackle during the unit (space available in this booklet or on the planning pro-forma)

- ☐ Identify where in the sequence of learning there are opportunities for embedding **guided reading**

- ☐ Use the **lesson planning guidance** to develop a grasp of the purpose of each lesson element

Adapt:
- ☐ Consider key timings for each lesson. Identify which lessons may need to be adapted to account for the length of your lessons or ability level of your class

- ☐ Identify what could be used as **homework** activities to support in-class learning in line with school policy

- ☐ Review the resources ahead of each lesson and ensure you are clear on the objectives of each lesson

- ☐ **Select** appropriate activities for each lesson from the selection within each lesson folder/on the slide deck

- ☐ **Administer** exit tickets and use outcomes of this to plan 'fix-it' tasks to tackle misunderstanding or misconception.

- ☐ Set the **mastery quiz** for your class. Use the information to plan a suitable re-teach lesson and further response, using the resources available.

Scope and Sequence

Scope

In this unit pupils will be introduced to the concept of biodiversity and learn why it is so important for the survival of organisms as part of the big idea 'organisms are interdependent'. Pupils will learn about the variety of ways that the global human population is affecting the environment; including how different types of pollution and the destruction of habitats is reducing biodiversity. Pupils will also learn different approaches being used across the globe to prevent this decrease in biodiversity. Pupils will consider how indicator species can be used to monitor environmental pollution. Pupils will learn how the efficiency of energy transfer decreases throughout a food chain and apply that to pyramids of biomass. Pupils will use this to consider why food security is so threatened, and how it can be enhanced through the use of initiatives and the development of new technologies.

Sequence

From KS2, pupils should recognise that environments can change and that this can sometimes pose dangers to living things. Many pupils will have watched wildlife documentaries such as Planet Earth, that highlight the importance of biodiversity and how humans can reduce the negative impact we have on biodiversity. Global warming also is a regular feature in the media, and pupils may already be informed about the issues surrounding this, and how human activity contributes. Prior to this unit pupils will have studied the Y7 unit B1.3 Interdependence. Pupils will have studied ecosystems, feeding relationships, competition in animals and plants, and abiotic and biotic factors that affect communities of organisms. Pupils will have also learnt about sampling techniques that are used to measure the distribution of species in an area. Pupils will have an understanding of the different trophic levels in food chains from unit B1.3 Interdependence and this knowledge will be applied and deepened in this unit where pyramids of biomass will be constructed and analysed. This unit prepares pupils to consider atmospheric gases and global warming in more depth when they study the Earth's atmosphere in chemistry. Here, pupils will learn about ways that carbon dioxide is released into the atmosphere and how this is causing global warming, then in Y11 they will extend this by understanding how amounts of atmospheric gases have varied over time and other atmospheric pollutants. This unit is the basis of understanding the importance of sustainability to help pupils make responsible and informed lifestyle choices. At A-level, pupils will take this learning further to consider how environmental factors affect the productivity of the land, and learn how different farming techniques can be used to increase productivity. Pupils will also develop their understanding of the evolutionary relationships between species and discover how new genetic technologies are allowing us to protect the endangered species of our planet.

A full set of knowledge objectives for this unit can be found as **Appendix 5.**

1	2	3	4

Prior Knowledge Review	Biodiversity	How Humans Affect biodiversity	How Humans can Preserve Biodiversity
5	**6**	**7**	**8**
The Effect of Pollution on Biodiversity	Global Warming	Taking is Further Pyramids of Biomass	Taking it Further and Biotechnology
9	**10**		
Taking it Further Food Security	Feedback Lesson		

TASKS:

New teachers: Organise the lesson titles into those you feel most to least confident about

Experienced teachers: Reflect on prior experience of teaching this unit. Which lessons have gone well? Which would you like to target for improvement this year?

Pre-unit quiz

TASK: Below is the pre-unit quiz available for your pupils. Complete yourself and set for your pupils ahead of starting the unit. There is space to record the key outcomes from marking the quiz for your class. **See Appendix 1 for the mark scheme.**

1. Which is the best definition of an ecosystem?   [1]
   Tick (✔) **one** box.

   (a) The place where an organism lives   ☐

   (b) The interaction of a community of organisms with the
       non-living parts of their habitat   ☐

   (c) The relationships between animals that can be
       represented using a food chain   ☐

2. What resources do animals compete for?   [1]
   Tick (✓) **one** box.

   (a) Light, water and space   ☐

   (b) Space, mates and food   ☐

   (c) Food and water   ☐

3. Which of these is always the first stage of a food chain?   [1]
   Tick (✓) **one** box.

   (a) Producer   ☐

   (b) Consumer   ☐

   (c) Herbivore   ☐

4. What do plants need to be able to photosynthesise?   [1]
   Tick (✓) **one** box.

   (a) Light and water   ☐

   (b) Oxygen and glucose   ☐

   (c) Light, water and carbon dioxide   ☐

5. Which is the correct definition of a population? [1]
Tick (✓) **one** box.

(a) A group of organisms of the same species ☐

(b) A group of animals in a specific habitat ☐

(c) A group of different species in the same habitat ☐

6. Which of these is a biotic factor? [1]
Tick (✓) **one** box.

(a) Temperature ☐

(b) Food availability ☐

(c) Water availability ☐

7. Which method of sampling would be used to estimate the number of daisies in a field? [1]
Tick (✓) **one** box.
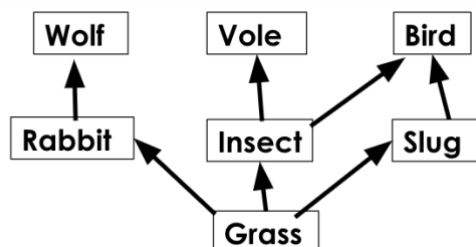
(a) Random sampling ☐

(b) Systematic sampling ☐

(c) Using a quadrat ☐

Use the following food web to help you answer Q8 – Q10.

8. Which term could be used to describe the rabbit? [1]
Tick (✓) **one** box.

(a) Secondary consumer ☐

(b) Predator ☐

(c) Herbivore ☐

9. Which of these species could be described as a primary consumer?   [1]
    Tick (✔) **one** box.

    (a) Wolf ☐

    (b) Grass ☐

    (c) Slug ☐

10. A new disease has affected the rabbit population. Which of these could be a
    consequence of this?   [1]
    Tick (✔) **one** box.

    (a) The population of wolves would increase ☐

    (b) The population of wolves would decrease ☐

    (c) The biomass of grass would decrease ☐

Total = ___ /10

Pre-unit quiz reflections

To be completed once you have reviewed your pupils' response to the pre-unit quiz.

What topics are your pupils confident with?

What topics need to be reviewed?

What are the **highest leverage** piece(s) of knowledge (2-3) to explicitly re-teach?

What could be interleaved throughout the unit?

Other notes

Mastery Quiz

TASK: Below is the mastery quiz available for your pupils to sit at the end of the unit. Complete yourself and consider the key misconceptions this quiz aims to address. See **Appendix 2** for the mark scheme.

Section A

1. Choose the best definition of biodiversity [1]

    Tick (✔) **one** box.

    A. The number of organisms in an ecosystem ☐

    B. The interaction of organisms with the non-living parts of their environment ☐

    C. The variety of different species in an ecosystem ☐

2. Choose the option that would increase biodiversity [1]

    Tick (✔) **one** box.

    A. Selective breeding programmes ☐

    B. Using peat from peat bogs as compost ☐

    C. Maintaining nature reserves ☐

3. Choose the option that is a cause of global warming [1]

    Tick (✔) **one** box.

    A. Deforestation ☐

    B. Extreme weather patterns ☐

    C. Habitat loss ☐

4. Choose which is a type of air pollution [1]

Tick (✓) **one** box.

A. Fertilisers that leach into waterways ☐

B. Smoke from burning peat ☐

C. Rubbish in landfill waste sites ☐

5. A group of students wanted to investigate the distance from a water source affected the growth of daisies in a field.

Choose the best method to use. [1]

Tick (✓) **one** box.

A. Place at quadrat at regular intervals along a transect from a water source and count the number of daisies ☐

B. Use coordinates of the field area for placing the quadrat randomly and calculate total number of daisies ☐

C. Do systematic sampling by placing the quadrat at random places near the water source ☐

6. Ecologists regularly measure the biodiversity in peat bogs.

This is important because… [1]

Tick (✓) **one** box.

A. peat bogs are a source of peat for compost which is used in gardening. ☐

B. data from measurements provide evidence for claims about changes in biodiversity. ☐

C. ecologists can calculate the mean biodiversity using the measurements. ☐

7. Two students, Ali and Ben, used different methods to measure the total number of dandelions in a 100 m² field.

Both used a 1 m² quadrat.

Their results tables are shown below.

Ali

Reading	Number of dandelions
1	3
2	5
3	4
Mean	**4**

Total number = mean number x area
Total number = 4 x 100
Total number = 400

Ben

Reading	Number of dandelions
1	3
2	4
3	4
4	6
5	2
6	7
Total number	**26**

Choose which student's data is most representative. [1]

Tick (✓) **one** box.

A. Ali ☐

B. Ben ☐

C. Need more information to decide which is most representative ☐

8. Biodiversity is so important to future human survival because it ensures that... [1]

Tick (✓) **one** box.

A. natural resources are not depleted. ☐

B. humans can access a balanced diet. ☐

C. humans are not dependent on one food source. ☐

9. Choose an example of an indicator species. [1]

Tick (✓) **one** box.

A. A species that is known to survive in high levels of a type of pollution ☐

B. A species that cannot survive in high levels of a type of pollution ☐

C. Both A and B ☐

10. There can be problems when a non-indigenous species is accidentally introduced to an area because… [1]

Tick (✓) **one** box.

A. the non-indigenous species may increase biodiversity. ☐

B. the non-indigenous species may be a predator of indigenous species. ☐

C. the non-indigenous species may not be able to compete with the indigenous species. ☐

BIOLOGY ONLY

11. Choose the factor **least** likely to threaten food security. [1]

Tick (✓) **one** box.

A. Increasing birth rate ☐

B. Increased use of genetically modified (GM) crops ☐

C. Extreme weather patterns ☐

12. Choose the correct statement about the approximate biomass transfer efficiency between trophic levels [1]

Tick (✓) **one** box.

A. 10% of biomass is passed onto the next trophic level, the rest is lost as waste and through life processes ☐

B. 10% of biomass is lost as waste and through life processes, the rest is transferred to the next trophic level ☐

C. The percentage efficiency is different for each food chain so cannot be approximated ☐

13. Intensive farming of animals can increase food security.

However, there are ethical arguments against intensive farming.

Choose an ethical implication of intensive farming. [1]

Tick (✓) **one** box.

A. Animals will feel stressed being kept in small cages ☐

B. Antibiotic drugs are expensive ☐

C. Animals can be easily transported ☐

14. Fish populations around the UK are declining.

Choose which action would increase food security of fish. [1]

Tick (✓) **one** box.

A. Increase the number of people fishing ☐

B. Have a minimum number of fish per catch quota ☐

C. Increase the size of holes in nets so some fish escape ☐

15. Battery hens are kept in very small cages by a farmer.

The farmer does this to increase the efficiency of food production because…[1]

Tick (✓) **one** box.

A. more hens can live on the farm. ☐

B. it stops them from moving too much and releasing heat energy. ☐

C. it is easier to feed them and give antibiotics. ☐

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Section B

1. State the function of a quadrat.

   _____

2. State one way that humans decrease biodiversity and explain why.

   _____
   _____

3. Explain why global atmospheric temperature must be measured regularly.

   _____
   _____

4. Tempeh, tofu and Quorn are high protein, meat-alternatives.

   The table below compares the protein content and the carbon footprint of these foods.

   Carbon footprint is how much carbon dioxide is produced per year, per kg, of product

	Food product			
	Tempeh	**Tofu**	**Quorn**	**Beef**
Food source	Soybean plant and rhizopus a fungus	Soybean plant	Mycoprotein fungus	Cow farming
Land use (m^2 / kg)	No data available	4	5	325
Carbon footprint (kg CO_2 / year / kg food product)	0.7	0.9	0.7	32

   Explain why a meat-alternative diet is more sustainable than a meat-based diet.

   Use data from the table in your answer.

   _____
   _____
   _____
   _____

Mastery quiz reflections

Which aspects of genetics are likely to be the most challenging to teach?

What are your pupils likely to find most challenging and why?	
Challenging.....	Because....
E.g. The number of new keywords	They are abstract words that aren't used in other areas of science

How can you pre-empt some of the key misconceptions the mastery quiz aims to identify?	
Misconception	**How to avoid**

Exam-style questions

TASK: Using exampro (or the software used by your exam board), look through the typical exam-style questions for this topic. These sorts of questions are posed throughout the unit and pupils should be prepared to answer similar questions in the end-of-year assessments.

Suggested questions to guide this process:

How is knowledge from this unit typically assessed? What are the most common questions?

Which question types are the most challenging?

What general trends can you spot in the typical errors pupils make (from examiner reports/notes)?

How could you help prepare your students for answering these types of questions?

Common mistakes, errors and misconceptions

How would you tackle the following common mistakes, errors and misconceptions by pupils?

TASK: Consider why each of the following typically seen statements is a mistake/misconception. What possible approaches can you plan to pre-empt and respond to this? Which lessons do these correlate to?

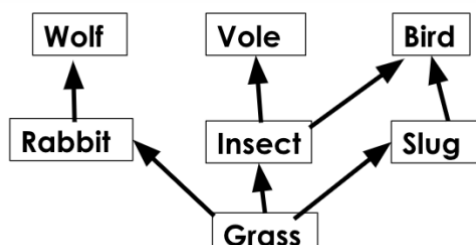CHALLENGE: Cover the middle column and explain yourself why each is a mistake.

Mistake	Reason why it's a mistake	Possible approaches to pre-empt and respond?
A herbivore only eats other animals.	Herbivores eat only plants.	
The definition of a habitat is a forest ocean or desert.	These are specific examples of habitats not the definition.	
A habitat is the interaction between a community and the non-living part.	The definition given is for an ecosystem.	
Quadrats are just used for random sampling and that a transect is the piece of equipment for systematic sampling.	All sampling involves quadrats as quadrat is the name given to the frame.	
Biodiversity refers only to the different species in the world.	Genetic variation contributes to biodiversity.	
High biodiversity is useful for an ecosystem because organisms have lots of food.	High biodiversity is useful for an ecosystem as it means species are not just dependent on one other species, so less likely to be affected if a food source decreases.	
No species can live in peat bog as it is acidic.	Even though peat bog is acidic organisms can still live there.	
One of the effects of a growing population is that because humans need more food than animals so more crops need to be grown.	One of the effects of a growing population is that humans are destroying habitats to be able to grow more crops. Lots of land is required for growing crops that are used for animal feed.	
Selective breeding programmes are a way to maintain biodiversity.	Selective breeding does not increase biodiversity, selecting a genetic trait will reduce variation so reduce biodiversity.	
Farmers grow hedgerows to sell as crops.	Hedgerows are not crops, they are a way to increase biodiversity.	
Pollution affects all species equally.	Some species are more susceptible, and some are more	

	resistant to the effects of pollution.	
Food chains rarely have more than five levels because only half of the biomass is passed on so it will eventually run out.	Food chains rarely have more than 5 levels because approximately 10% of biomass is passed onto the next trophic level.	

Planning for the misconceptions

Misconception: Introducing a new species into an ecosystem increases biodiversity.
Introducing a new species into an ecosystem may reduce biodiversity if it directly outcompetes another species.
Explain what would happen to the biodiversity within this food web if a fox that only at rabbits was introduced into the food web.

Supporting pupil understanding
The pupils should be able to see with the aid of the food web that if a fox was introduced that it would be in direct competition with the wolf. This would mean that the population on the wolf and the fox would decrease due to competition of the same resource but also due to the fact that their food sole food source would become scarce and eventually disappear. The fact that a species has been wiped out means that there is reduced biodiversity.

Taking it further
To help pupils further understand this it can be modelled in the class with different food types (as different prey species) and the pupils are the predators. You as the teacher can be introduced as a new predator. Pupils should be asked what would happen to the variety of 'species' if the teacher only likes one of the foods.

Misconception: Pollution kills animals.
Pollution does not directly kill animals. More often it damages their food source or habitat.

(a) Apart from fertiliser, give **one** other form of pollution that might go into the river as it flows through the city.
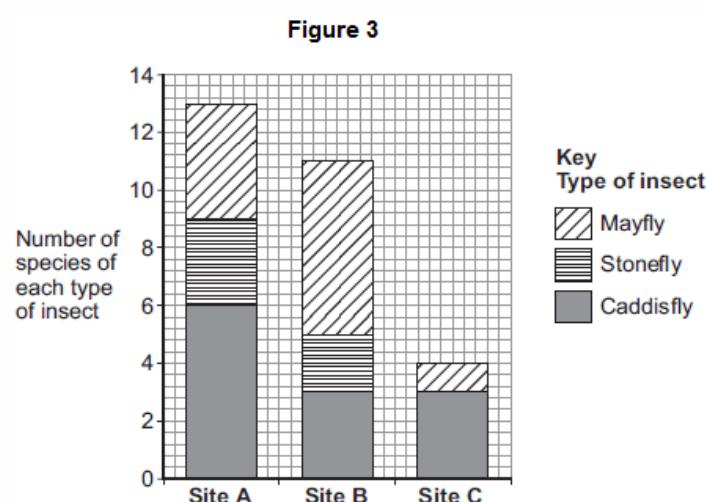
(1)

(b)   Three sites, **A**, **B** and **C**, are shown in **Figure 2**.
Scientists took many samples of river water from these sites.

The scientists found larvae of three types of insect in the water: mayfly, stonefly and caddisfly. For each type of insect the scientists found several different species.

The scientists counted the number of different species of the larvae of each of the three types of insect.

Figure 3 shows the scientists' results.

Figure 3

(i)   How many more species of mayfly were there at Site **B** than at Site **A**?

(1)

(ii)   Suggest what caused this increase in the number of species of mayfly.

(1)

(iii)   The scientists stated that the number of species of stonefly was the best indicator of the amount of oxygen dissolved in the water.

Use information from **Figure 3** to suggest why.

Supporting pupil understanding
Answering the question above takes the pupils through the steps of understanding how water pollution may in directly affect organisms and debunk the misconception that states that pollution kills animals, as these are different species still living in areas of high pollution. To show the effect on food chains, it can be worth dual coding the path of a toxin through a food chain to show bioaccumulation, where the level of toxin becomes harmful in a secondary or tertiary consumer.
Taking it further
To further consolidate the indirect effects of pollution smoking can be explored as a pollutant and the effects on humans. This will make a link across the specification and reinforce the fact that all the topics they learn are linked.

Mistake: Global warming and climate change are the same thing.
Global warming is the increase in global temperature, while climate change is the overall change in weather patterns over a long period of time.
What is the difference between 'global warming' and 'climate change'? - What is meant by the term 'global'? - What is meant by the term 'warming'? When looking at the definition of global warming does it combine the meaning of the two words individually? - What is meant by the term 'climate'? - What is meant by the term 'change'?
Supporting pupil understanding
Allowing pupils the opportunity to talk and have the conversation about the difference between global warming and climate change may help deepen understanding between the two terms

Unit objectives: knowledge, skills and concepts

As you teach the lessons, track here the objectives you meet.

TKT = to know that   TBAT = to be able to

Critical: it is critical that all pupils become proficient; future learning will be very challenging for them if they do not and it is likely they will not come across this content again. These are priority objectives for reteaching, revision, and intervention. Before moving on, discuss a strategy with your HOD if some pupils are not making progress with these objectives.
Core: it is important for all pupils to learn this, and it will be essential for success at GCSE. However, it will not impede them in other units if they are not (yet) proficient in it as they are likely to revisit it again in subsequent units.
Stretch: pupils should have the opportunity to be work on this aspect of science. This content is crucial for pupils to achieve the highest GCSE grades and to succeed at A-level.
Key skill: pupils should have the opportunity to develop this key skill as part of this unit.

Intended outcome for separate sciences pupils are denoted in blue and italised.

Lesson 1: Prior Knowledge Review

Intended outcome	Example questions
*This lesson is a review of content from previously studied units relating to this big idea	
TBAT state the definitions of a producer, consumer, predator and prey.	Define the term producer. Define the term consumer. Define the term predator. Define the term prey. Describe the relationship between predator and prey. Identify producers, consumers, predator and prey from a food chain or web.
TBAT describe the transfer of energy through a food chain.	Describe the difference between a food chain and a food web Explain what the arrows in a food chain/web show
TBAT explain the importance of plants in food chains.	Why are plants so important in a food chain? What group do most plants fall into within a food chain? Why are plants always at the bottom of the food chain?
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 2: Biodiversity

Intended outcome	Example questions
<mark>TBAT</mark> define biodiversity.	State the definition of biodiversity.
<mark>TKT</mark> biodiversity can be measured by using sampling techniques.	Describe the function of a quadrat. Describe the function of a transect. Compare random sampling to systematic sampling.
<mark>TBAT</mark> measure the distribution of organisms in environments.	Describe a method to measure how many daffodils there are in a park.
<mark>TKT</mark> finding the mean median and mode are averages used to help understand data.	Describe how to find the mean, median and mode of the following numbers: 23, 75, 35, 42, 10
<mark>TBAT</mark> explain why high biodiversity is important for an ecosystem	Explain why an abundance of organisms living in one environment is important for an ecosystem.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 3: How Humans Affect Biodiversity

Intended outcome	Example questions
TKT the growth of the human population has increased demand for resources.	Explain how the growth of the human population has led to an increase in demand for resources.
TBAT describe the harmful effects that humans are having on biodiversity.	State the ways humans have reduced the amount of land available. Explain how deforestation has had a negative impact on biodiversity. Give one advantage and one disadvantage for the use of peat bogs.
TBAT explain why scientific data can sometimes be uncertain or incomplete.	Explain why taking 500 samples is better than taking 50 samples when estimating population numbers.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 4: How Humans can Preserve Biodiversity

Intended outcome	Example questions
TKT waste, deforestation and global warming all have an impact on biodiversity	Describe how was is having a negative impact on biodiversity.
TBAT describe how scientists and citizens can reduce human impact on biodiversity	Give three ways humans are attempting to maintain biodiversity. Describe what regeneration of rare habitats does to biodiversity. Explain how breeding programs protect biodiversity. Give one advantage and one disadvantage for breeding programmes.
TBAT evaluate whose responsibility it is to reduce human impact on the environment	Tola says 'India and China have the largest populations so they should be responsible for increasing biodiversity'. Evaluate this statement.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 5: The Effect of Pollution on Biodiversity

Intended outcome	Example questions
TBAT define pollution.	Describe what pollution is. State what is meant by the term sewage. Describe the process of eutrophication.
TBAT describe the effect of the increasing human population on the amount of waste produced.	State two ways humans are contributing to pollution. 'The increase in human population is the reason there is so much pollution' Evaluate this statement.
TKT the different types of pollution are air water and land pollution.	Compare the different types of pollution. State three types of pollution.
TBAT describe some consequences of pollution	Describe the effects pollution has on water. Describe the effects pollution has on humans. Explain why it is important to dispose of sewage correctly. Explain the role farming has to play in the increase if pollution.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 6: Global Warming

Intended outcome	Example questions
TKT global warming is the rise in global temperatures due to greenhouse gases.	Define global warming. Explain the difference between global warming and climate change.
TBAT describe what is happening to carbon dioxide and methane levels in the atmosphere	Give examples of greenhouse gases. Describe what is happening to the carbon dioxide and methane levels in the atmosphere. Interpret greenhouse gas data from graphs.
TBAT describe some source of greenhouse gas emissions.	State three greenhouse gases. Explain how greenhouse gases get into the atmosphere. Explain why greenhouse gases are called greenhouse gases.
TBAT describe the biological consequences of global warming	Explain why global warming is a cause for concern. Describe three biological consequences of global warming.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 7: Taking it Further Pyramids of Biomass

Intended outcome	Example questions
TKT biomass is a measure of the total quantity of organic material	Define the term biomass
TBAT identify the levels of a pyramid of biomass in terms of produces and consumers	Name the type of organism found at each of the trophic levels. Explain why producers are not found on trophic level two Describe what a pyramid of biomass shows. Compare a pyramid of biomass to a pyramid of numbers.
TBAT state the approximate efficiency biomass transfer between trophic levels	How can the biomass of a trophic level be calculated? State the equation used to determine the percentage efficiency of biomass transfer.
TBAT explain the energy losses between trophic levels	Explain where energy is lost to between each trophic level.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 8: Taking it Further Farming and Biotechnology

Intended outcome	Example questions
TKT control of net size and fishing quotas maintain fish stocks.	Explain why net size is used to maintain fish stocks. Explain what is meant by fishing quotas.
TBAT explain how intensive farming methods increase biomass efficiency transfer.	Explain how intensive farming increases the efficiency of biomass transfer.
TBAT describe advantages and disadvantages of intensive farming methods.	Describe an issue with intensive farming. Explain some of the arguments for and against intensive farming methods.
TBAT describe an application of biotechnology in food production.	Give an example of a genetically modified crop and describe how it was modified. Describe an application of biotechnology in food production
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Lesson 9: Taking it Further Food Security

Intended outcome	Example questions
TKT food security is having enough food to feed a population.	Define food security.
TBAT describe factors that may threaten food security.	State factors that threaten food security.
TKT sustainability is supporting long term ecological balance by not depleting natural resources.	Define the term sustainability. Describe some methods of increasing food security.
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Mastery Quiz re-teach planning

To be completed once you have reviewed your pupils' response to the mastery quiz.

What topics are your pupils confident with?

What topics need to be reviewed?

What are the **highest leverage** piece(s) of knowledge (2-3) to explicitly re-teach?

What could be interleaved throughout another unit? When will that be taught?

Other notes

Lesson 10: Feedback lesson

Intended outcome	Example questions
Edit based upon your class' performance in the mastery quiz	
What did the Exit Ticket data tell me?	
What do I need to review in future lessons?	

Advanced subject knowledge

Where does this learning lead?

At A-level, pupils will be expected describe what is meant by conservation and explain how managing succession can help to conserve habitats.

Pupils must know that at each stage in succession, certain species may be recognised which change the environment so that it becomes more suitable for other species with different adaptations.

Pupils will not have heard of the term succession before and so first will need to be able to define the term.

Succession is understanding that ecosystems are dynamic and have not been there forever. They change day to day as populations fluctuate. This may happen quickly or slowly. Succession is the term used to describe these changes.

Have a look at the questions below and think about what this means for this unit.

How does learning from this unit develop at KS4?

What content from this unit is fundamental to student understanding at KS4?

How could you check that students have grasped these fundamentals?

Vocabulary and literacy

Tier 3 vocabulary and phrases in this unit that pupils are likely to already know:

Word	Definition	Example in context
Abundance	The quantity or amount of something present in a particular area.	The ecologist sampled the field to estimate the abundance of daisy plants present.
Carnivore	An animal that only feeds on other animals.	A lion is an example of a carnivore.
Climate Change	The overall change in weather patterns (global or regional) over a long period of time.	Many countries have reported more extreme weather thought to be due to climate change.
Consumer	Organisms that cannot make their own food, so must eat other organisms.	All animals are consumers because they cannot make their own food.
Contamination	Making something impure by polluting or poisoning.	Sewage water must be treated properly otherwise there is a risk of contamination to rivers and seas.
Ecosystem	The interaction of a community of organisms with the non-living (abiotic) parts of their habitat.	A rainforest ecosystem contains gorillas, ants, nut trees, water and sunlight.
Energy transfer	Energy is moved between trophic levels when one organism eats another organism.	The first energy transfer in a food chain happens when a consumer eats a producer.
Famine	An extreme shortage of food.	Decreased food security may lead to famine.
Fertiliser	A chemical added to soil to increase the mineral content which improves plant growth.	Farmers add fertilisers to the soil every year to help their crops grow.
Global warming	The rise in global temperatures due to greenhouse gases.	Burning fossil fuels is a big contributor to global warming.
Habitat	The area where an organism lives.	The habitat of a polar bear is sea ice.
Herbivore	An animal that eats only plants.	A rabbit is an example of a herbivore.
Intensive Farming	A process that uses machines, fertilisers and man-power to maximise food production.	Intensive farming methods have been used because there is high demand for cheap meat and animal products.
Pollution	Caused when human waste isn't properly handled or disposed of.	Water pollution can come from untreated sewage or from fertilisers.
Predator	Consumers that eat other animals.	A fox is the predator of a rabbit.
Prey	Animals that are eaten by other animals.	A rabbit is the prey of a fox.

Producer	Organisms that can make their own food using photosynthesis	Plants and algae are examples of producers.
Resources	A substance or object required by an organism for normal growth, maintenance and/or reproduction	Resources that plants need to live are space, water, sunlight and minerals.
Sewage	Wastewater that is produced from human households and industries.	Sewage water needs to be treated so that it does not pollute rivers and seas.
Species	A group of similar organisms that breed together to produce fertile offspring.	Lions and tigers are different species because when they breed together their offspring are not fertile.

Tier 3 vocabulary that will need to be explicitly taught in context:

Word	Definition	Example in context
Biodiversity	The variety of all the different species in an ecosystem or area.	A stable ecosystem has a high biodiversity.

Biomass	A measure of the total quantity of biological material in one or many organisms.	The total biomass of all the grass plants in the field is 10000 kg.
Efficiency	The proportion of something which is useful vs wasted.	The efficiency of biomass transfers from one trophic level to another is around 10%.
Emissions	The release of greenhouse gases.	Increased carbon dioxide emissions are linked to global warming.
Eutrophication	Excessive nutrients in a body of water which cause excessive plant growth.	Fertilisers running from fields into rivers and streams can cause eutrophication.
Greenhouse gas	A gas that contributes to the greenhouse effect and global warming.	Carbon dioxide and methane are both examples of greenhouse gases.
Leaching	Movement of minerals through soil often due to rainwater.	Leaching of minerals from farmers' fields can lead to eutrophication of surrounding bodies of water.
Peat	A dark brown substance, like soil, that is formed when plant material cannot decay because of acidic and anaerobic conditions	Peat can be burned as fuel or used as compost by gardeners and farmers.
Quadrat	A piece of equipment used to count the number of organisms/individuals in a specific area.	Quadrats are used during both random and systematic sampling to count the individuals in an area.
Quota	A limited quantity of something.	Countries have fishing quotas meaning there is a limited number of fish they are allowed to catch.
Thermoregulation	The process where an animal uses energy to maintain a constant body temperature.	Humans need to use energy to thermoregulate and keep their internal body temperature at approximately 37°C.
Transect	A line placed across a habitat for systematic sampling	The ecologist used a transect to investigate how the presence of a lake affected the distribution of frogs.
Trophic level	An organism's position in a food chain.	A producer is always found at the first trophic level as they are at the beginning of a food chain.

Stretch vocabulary:

Word	Definition	Example in context
Biotechnology	The use of biological processes for industrial or medical purposes.	Genetic modification of bacteria to produce human insulin is an example of biotechnology.

Indicator Species	Organisms that can tell us about the levels of pollution in an area by their presence or absence.	Lichen are an indicator species for air pollution.

Appendices
Appendix 1: Mark scheme for pre-unit quiz

Qu	Answer	Marks	Supporting information for fix-it tasks
1	B	1	Answering A shows that pupils have confused the terms ecosystem and habitat. Answering C shows that pupils are aware that organisms interact but have not managed to identify that this includes interactions with plants/producers as well as animals. *Task: State the definitions of the following terms (from B1.3): organism, population, community, habitat, ecosystem.*
2	B	1	Answering A shows that pupils have incorrectly suggested that plants and animals compete for the same resources. Answering C shows that pupils have not understood that animals also compete for mates to reproduce and for territory (space). *Task: Explain why animals compete for mates and for territory. Compare the resources that plants and animals compete for.*
3	A	1	Answering B or C shows that pupils do not understand where animals get energy from. *Task: Explain where plants get their energy from, and where animals get their energy from.*
4	C	1	Answering A shows that pupils know that plants need light and water to be able to survive but have not recalled that they also need carbon dioxide for the process of photosynthesis. Answering B shows that pupils have confused the reactants and products of photosynthesis. *Task: Write the photosynthesis word equation, and describe where plants get each of the raw materials from.*
5	A	1	Answering B shows that pupils have the

			misconception that a population or species only refers to animals. This misconception is linked to thinking that plants are not alive because they do not move. Answering C shows that pupils have confused the terms population and community. *Task: Give an example of a population, a community, and a habitat within a desert ecosystem.*
6	B	1	Answering A or C shows a lack of understanding of the difference between biotic and abiotic factors. *Task: State the definition of biotic and abiotic factors and give 2 examples of each.*
7	A	1	Answering B shows that pupils are not secure with the meaning of systematic sampling and that it should be used when looking at the effect of a factor. Answering C shows that pupils know that a quadrat should be used to count the number of organisms (daisies) in an area, but have not understood that the quadrats should be randomly positioned/at random coordinates in order to get a representative sample which can then be extrapolated (pupils are not required to do this calculation). *Task: Describe the method of sampling you would use when:* *- Investigating the effect of light intensity on growth of grass* *- Estimating the number of plants in a forest.*
8	C	1	Answering A shows that pupils have not understood the difference between a primary consumer and a secondary consumer. Answering B shows that pupils have assumed that a predator is any species that feeds on another species (rather than a species that feeds on other animals). *Task: State the definition of the following terms: Herbivore, Carnivore, Omnivore, Producer, Primary Consumer, Secondary Consumer.* *Label each of the species in this food web with*

			one or more of these terms.
9	C	1	Answering A shows that pupils have incorrectly suggested that primary consumers feed on other animals, linked to the misconception that plants are not counted as a trophic level. Answering B shows that pupils have assumed the term primary means that it comes first, so must be the first level of the food chain. *Task: Put these species into a food chain; shark, plankton, seal, herring. Describe the species at each trophic level as producer, primary consumer etc.*
10	B	1	Answering A shows that pupils have not understood the feeding relationship between the wolf and the rabbits. Answering C shows that pupils have not understood the relationship between rabbits and grass. *Task: Explain why the population of wolves would decrease if there was a disease in the rabbit population.*

Appendix 2: Mark scheme for mastery quiz

Section A

Qu	Answer	Marks	Supporting information for fix-it tasks
1	C	1	Answering A suggests that there is a misconception that biodiversity refers simply to the numbers of species. *To fix it, ask students to describe how they would compare the biodiversity of two fields using random sampling.* Answering B suggests students have confused ecosystems and biodiversity. *To fix it, reteach the key definitions: ecosystem, species, biodiversity. Then ask students to write definitions using a desert habitat and desert organisms as examples.*
2	C	1	Answering A suggests the misconception that selective breeding programmes increase biodiversity when they actually reduce biodiversity. *To fix it, reteach the why selective breeding is useful but how it also reduces genetic diversity in populations. Then ask students to state one advantage and one disadvantage of selective breeding programmes.* Answering B suggests students may have the misconception that peat being used for compost, and therefore promoting growth of some plant species in different environments, is sufficient to counteract the habitat destruction caused by removing the peat bogs. *To fix it, ask students to explain why destroying peat bogs reduces the biodiversity there.*
3	A	1	Answering B or C suggests a confusion about the causes and effects of global warming *To fix it, give students a mixed-up list of causes and effects of global warming and ask them to sort them into these two columns.*
4	B	1	Answering A suggests a gap in knowledge about leaching of excess fertilisers into waterways. *To fix it, ask students to write out the steps in eutrophication.* Answering C suggests a gap in knowledge about the pollution caused by rubbish in landfill sites. *To fix it, ask students to list three sources of pollution, including landfill, then describe the effect each one has on the ecosystem.*
5	A	1	Answering B suggests a misconception about the use of a transect/systematic sampling. *To fix it, ask students to explain the difference between systematic and random sampling, and then explain why using a transect is an example of systematic sampling.* Answering C suggests a confusion of the terms random sampling and systematic sampling. *To fix it, ask students to explain why this investigation needs systematic sampling and why random sampling is inappropriate.*
6	B	1	Answering A suggests an understanding of the uses of peat but shows a gap in knowledge about the importance of obtaining data as evidence for a scientific claim.

			Answering C suggests an understanding of the importance of calculating mean biodiversity, but shows a gap in knowledge about why these measurements are important. *To fix it, ask students explain what would happen if a scientist made a claim that the biodiversity was decreasing in the peat bog without measuring any biodiversity data.*
7	A	1	Answering B suggests a misconception that taking more readings is representative (in this case, applying the mean number to total area is representative). *To fix it, ask students to describe a method to measure the total number of daisies in a field.* Answering C suggests a gap in knowledge about what representative data is. *To fix it, reteach what it means when data is representative and then give some examples to students who should then evaluate whether the data is representative or not.*
8	C	1	Answering A suggests that students know sustainability is important for the future of the Earth, but not explicitly why this is important for human survival. *To fix it, ask students to explain what food security is and then state the effect of reducing biodiversity on food security.* Answering B suggests that students are aware that humans need a variety of food sources but not understood the relationship between this and biodiversity. *To fix it, show students a food web that shows humans to exemplify how reductions in species populations could affect the amount of food available for humans. Then ask students to explain why biodiversity is so important for food security.*
9	C	1	Answering A or B suggests that students have a gap in knowledge about the fact that indicator species can either thrive in polluted conditions or unpolluted conditions. *To fix it, ask students to explain the reason indicator species are used in measure levels of air pollution.*
10	B	1	Answering A suggests the misconception that adding a non-indigenous species increases diversity (in fact it usually decreases biodiversity because it competes with indigenous species). *To fix it, ask students to define non-indigenous and indigenous species and then explain why it is a risk to biodiversity to accidentally introduce a non-indigenous species.* Answering C suggests a gap in knowledge about the problems with non-indigenous species out-competing or eating indigenous species . *To fix it, ask students to suggest how the non-indigenous grey squirrel causes a reduction in the population number of the indigenous red squirrels.*
11	B	1	Answering A suggests a gap in knowledge about how increasing birth rate increases the threat to food security. Answering C suggests a gap in knowledge about how

				extreme weather patterns increases the threat to food security. *To fix it, ask students to describe what 'food security' is and then list examples of current threats to food security.*
12	A	1		Answering B suggests a misconception that 90% of biomass is transferred (and only 10% is lost). *To fix it, model for students, using data from the pyramids of biomass lesson, why only 10% passes on the next trophic level and show that if it were 90% then it wouldn't be a pyramid shape!* Answering C suggests a gap in knowledge, since we can approximate the transfer efficiency at 10%. *To fix it, ask students to practice interpreting further pyramids of biomass and practice calculating biomass efficiency transfers from these, concluding that the efficiency is usually around 10%.*
13	A	1		Answering B shows a gap in knowledge about the term 'ethical' since buying antibiotics is a medical and economical implications. *To fix it, reteach what ethical concerns are and then ask students to list all the ethical concerns of intensive farming (using small cages, heat lamps and preventing movement).* Answering C suggests a gap in knowledge about advantages and disadvantages of intensive farming, since being able to transport the animals is an advantage. *To fix it, give students a list of mixed-up advantages and disadvantages of intensive farming and ask them to sort them out.*
14	C	1		Answering A suggests a gap in knowledge about what food security of fish means. *To fix it, ask students to define food security.* Answering B suggests a gap in knowledge about the use of quotas in sustainable fishing. *To fix it, ask students to describe what a 'fishing quota' is and then explain why they are enforced over the world.*
15	B	1		Answering A or C suggests a misconception about why reducing movement of livestock increases the efficiency of food production. *To fix it, ask students to explain why chickens grow larger, faster when in a small cage as compared to chickens who are free to roam around a field.*

Section B

Qu	Model answer	Supporting information *Suggestions for fix-it tasks*
1	A quadrat provides a known area in which to count the number of individual organisms.	Although students know that a quadrat is placed on the ground and you count what is inside the frame, they may not link the known area of the quadrat to its function. *To fix it,*

		give students a diagram of three different quadrats with different length sides, ask them to calculate the area of each and suggest why there are different sized quadrats in ecological studies.
2	Any **one** from: • Humans reduce the amount of land available for biodiversity by: - Building - Deforestation - Quarrying - Farming - Waste disposal - Growing biofuels • Destruction of peat bog habitats to extract the peat for compost, which is used for farming and gardening. • Introducing non-indigenous species that can reduce biodiversity if the species out-competes or kills indigenous species.	Students may struggle to link the explanation of the human impact to reduction in biodiversity. *To fix it, ask students to explain how these three impacts reduce biodiversity:* *1. Reducing land available* *2. Destruction of peat bogs* *3. Introducing non-indigenous species*
3	Data must be measured regularly because it provides evidence for answering the scientific question about how global atmospheric temperature is changing.	The answer should contain the fact that data/measurements collected are evidence to support a scientific claim/investigation. Students may struggle to articulate this because it requires the challenging notion of the 'nature of science'. *To fix it, ask students why we couldn't make correct claims about climate change without lots of data.*
4	A meat-alternative diet is more sustainable that a meat-based diet because the carbon footprint of tempeh, tofu and Quorn is less than beef. For example, the carbon footprint of tempeh and tofu is 0.7 kg CO_2 / year / kg, whereas beef is 32 kg CO_2 / year / kg. **This means that** these meat-alternatives contribute less to global warming compared to meat. Tofu and Quorn have land use of less than 5 m^2 / kg whereas beef uses 325 m^2 / kg. The greater land use of beef reduces biodiversity **because** land is turned into farmland for cows, rather than a habitat for indigenous species.	Students may struggle with the cognitive load of analysing this data and comparing it to their scientific knowledge. Students may struggle to answer an 'explain' extended response question. *To fix it, remind students of the success criteria of an 'explain question:* *To 'explain' your answer should:* • *Begin with a **scientific statement**.* • *Use '**this means that**', '**because**' or '**so**' to link your statement to the question. and then they should peer assess each other's answers using this.*

Appendix 3: Core knowledge statements

Biodiversity
- Biodiversity is the variety of all the different species in an ecosystem
- The biodiversity of a habitat can be measured by using sampling techniques to count the abundance of difference species

- High biodiversity in an ecosystem makes it stable because one species will not depend on another species alone
- Many human activities are reducing biodiversity on Earth
- Recent rapid growth in the global human population means that more resources are being used and more waste is produced
- Humans reduce the amount of land available for biodiversity by building, deforestation, quarrying, farming and waste disposal
- Deforestation happens in tropical areas to provide land for cattle, rice fields and to grow crops for biofuels
- Introducing non-indigenous species can reduce biodiversity if the species out-competes or kills indigenous species
- Peat bogs are a habitat that is being destroyed because peat is taken for garden and farming compost. Although we need peat compost for farming, this is also reducing biodiversity
- Peat is a fossil fuel. Decay or the burning of peat releases carbon dioxide into the atmosphere
- Scientists and citizens are using various programmes to reduce the negative impact humans have on biodiversity, including: breeding programmes for endangered species, protecting rare habitats, reducing how many forests are cut down, reforestation, recycling resources to reduce landfill waste and growing hedgerows on farms where previously there was only one crop growing

Pollution
- Rapid growth in the human population and an increase in the standard of living mean that increasingly more resources are used and more waste is produced. Unless waste and chemical materials are properly handled, more pollution will be caused.
- Pollution can occur in water, from sewage, fertiliser or toxic chemicals, in air, from smoke and acidic gases, on land, from landfill and from toxic chemicals
- Pollution is caused when human waste isn't properly handled, for example: air pollution from smoke, land pollution from landfill rubbish and water pollution from sewage and fertilisers
- Pollution kills animals and plants which reduces biodiversity
- Indicator species can be used to monitor the level of pollution in a habitat
- Levels of carbon dioxide and methane in the atmosphere are increasing and contributing to global warming
- The biological consequences of global warming include loss of habitats, changing breeding patterns and changing migratory patterns which all affect biodiversity

Pyramids of Biomass
- Biomass is lost at each stage of a food chain
- Producers are mostly plants and algae which transfer about 1% of the energy from light into new plant biomass during photosynthesis
- Only approximately 10% of the biomass from each trophic level is transferred to the next trophic level

- Biomass is lost from a food chain when it is excreted as waste. This includes the egestion of undigested material in faeces, the loss of water and urea in urine, and the loss of carbon dioxide and water in respiration
- Life processes, including movement and regulation of temperature, require energy from glucose. Energy released during respiration, used to sustain these processes, is not transferred to the next trophic level
- Percentage efficiency transfer can be calculated using the following equation:
$$Percentage\ efficiency\ transfer = \frac{biomass\ in\ higher\ trophic\ level}{biomass\ in\ lower\ trophic\ level} \times 100$$
- The number of organisms at higher trophic levels is often lower because the efficiency of biomass transfer decreases

Food Security
- Food security means that all people on Earth have access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life
- Food security is being threatened due to a range of different biological factors in different countries. These include increasing birth rates leading to a rise in populations, changing diets in developed countries, new pests and pathogens that affect farming, increased costs of farming, conflict over resources and environmental changes that affect biodiversity
- Food security can be increased by making food production more efficient
- Individuals can contribute to improving food security. This can be done by reducing meat intake, increasingly eating food products from producers and eating local, seasonal produce where possible
- The efficiency of food production can be improved by restricting energy transfer from livestock (animals bred for food) to the environment. This can be done by limiting their movement and by controlling the temperature of their surroundings. There are ethical implications to these farming methods
- Livestock can be fed high protein foods to increase growth, and given antibiotics to prevent disease
- Fish stocks in the oceans are declining. It is important to maintain fish stocks at a level where breeding continues or certain species may disappear altogether in some areas · Fish stocks can be controlled by using nets with larger holes. This prevents smaller fish from being caught so they can continue breeding
- Fishing quotas limit the number of fish that can be caught by each country. The fishing of some endangered species of fish is banned
- Alternative food sources have been developed to enhance food security. Modern biotechnology techniques enable large quantities of microorganisms to be cultured for food
- The fungus Fusarium is useful for producing mycoprotein, a protein-rich food suitable for vegetarians. The fungus is grown on glucose syrup, in aerobic conditions, and the biomass is harvested and purified.