

Levels of organisation

4.7.2.1 · Biology · revision notes

Food chains, the names of the feeding levels (producer, primary, secondary and tertiary consumer), predator–prey cycles, and how ecologists use quadrats and transects to measure the abundance and distribution of species. This includes a required practical, so expect planning, calculation and graph questions as well as recall.

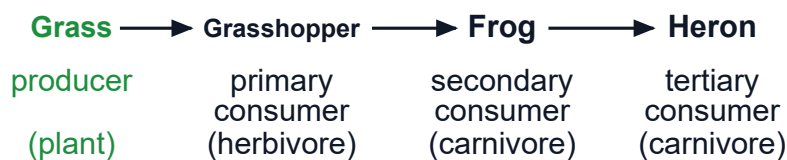
Key facts

- Food chain: producer → primary consumer → secondary consumer → tertiary consumer
- Arrows point towards the organism doing the eating
- Mean = $\text{sum of values} \div \text{number of values}$
- Population estimate = $\text{mean number per m}^2 \times \text{total area in m}^2$
- Producers make glucose by photosynthesis (usually green plants or algae)
- Predator–prey graph: predator peaks come after prey peaks
- Median = middle value when in order; mode = most common value
- Random quadrats → population size; transect → distribution along a gradient

Notes

Food chains

- Organisms that photosynthesise produce the biomass that all other life on Earth depends on.
- Every food chain begins with a **producer**: usually a green plant or an alga that makes glucose by photosynthesis.
- Next come the **primary consumers** (which eat producers), then the **secondary consumers** (which eat primary consumers), then the **tertiary consumers**.
- The arrows point from the organism that is eaten to the organism that eats it.

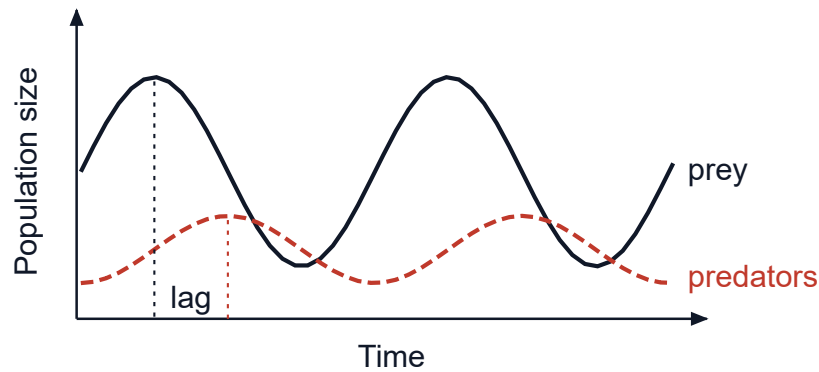


A food chain always starts with a producer. Arrows show what is eaten by what.

- A **predator** is a consumer that kills and eats other animals, which are its **prey**.

Predator-prey cycles

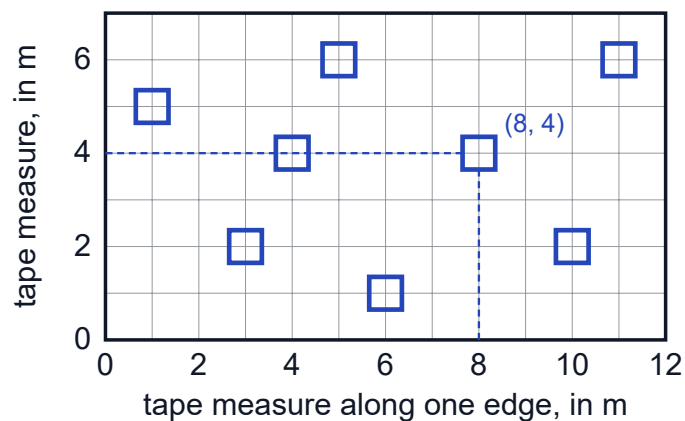
- In a stable community, the numbers of predators and prey rise and fall in cycles.
- More prey → more food for predators → more predators survive and breed.
- More predators → more prey eaten → prey numbers fall.
- Fewer prey → less food → predator numbers fall → prey numbers can rise again.
- On a graph, each predator peak comes **after** a prey peak, and there are usually fewer predators than prey.



Predator-prey cycle: the predator peak lags behind the prey peak.

Quadrats: how many?

- A **quadrat** is a square frame, e.g. 50 cm × 50 cm (0.25 m²).
- Place quadrats **randomly** (e.g. at coordinates from a random number generator on a grid) to avoid bias.

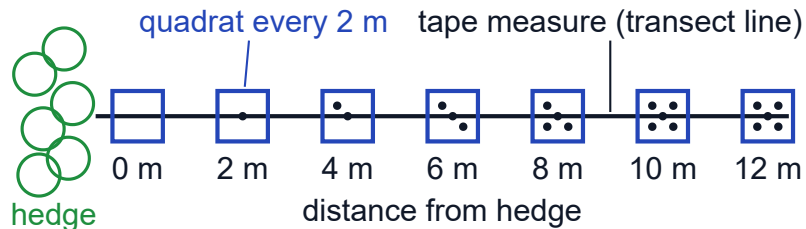


Random sampling: two tapes make a grid and random numbers give each quadrat's coordinates.

- Count the organisms in each quadrat and calculate the mean number per quadrat.
- Estimated population = (mean number per quadrat ÷ area of one quadrat) × total area of the habitat.
- The more quadrats you use, the more representative the estimate.

Transects: where?

- A **transect** is a line (e.g. a tape measure) across a habitat where a factor changes, such as from a hedge out into a field.
- Place a quadrat at regular intervals along the line. Count the organisms (or estimate percentage cover) and measure the abiotic factor at each point.



Transect: count the plants and measure the factor (e.g. light) in a quadrat at each point along the line.

- Plot the results to see how the distribution of the species changes with the factor.

How to answer each type of question

Name the feeding levels in a food chain

1 mark each

Grade 3

1. The first organism is the producer.
2. Count along the arrows: next is the primary consumer, then the secondary, then the tertiary.
3. A herbivore eats producers, so it is a primary consumer.

Example. Here is a food chain from a rocky shore:

seaweed → limpet → crab → herring gull

- (a) Name the producer.
- (b) Name the secondary consumer.
- (c) Name the herbivore.

Model answer. (a) Seaweed (1)

(b) Crab (1)

(c) Limpet (1)

Don't lose marks

- ✗ Drawing food chain arrows the wrong way. They point towards the organism that does the eating.
- ✗ Forgetting to divide by the quadrat area when it is not 1 m².
- ✗ Placing quadrats where the organisms are, instead of randomly. This biases the estimate.
- ✗ Saying that predator and prey numbers peak at the same time.
- ✗ Using a transect to estimate the total population size. Transects show distribution; random quadrats estimate abundance.

More tips

Memory tricks

- Predators lag: on a cycle graph the predator line always peaks a little after the prey line.
- Quadrat check: dividing by 0.25 m^2 is the same as multiplying by 4. If a 0.25 m^2 quadrat holds 4 daisies, 1 m^2 holds 16.
- Random quadrats count 'how many'; a transect shows 'where'.
- Median: put the values in order first, then find the middle one.

Exam technique

- In practical questions, give the details that make a method repeatable: quadrat size, how positions were chosen, the interval along the transect and the number of repeats.
- Show every step of a population calculation.
- When describing a graph, give values (e.g. 'the prey peaked at 800 in year 3') before explaining.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Name producers and consumers in a food chain

The producer comes first, then the primary, secondary and tertiary consumers.

Grade 4

State why food chains start with producers

Producers (green plants and algae) make glucose by photosynthesis, so they produce the biomass for the rest of the chain.

Grade 4

Calculate a mean, median and mode

Mean = total $\div$ number of values; median = middle value when in order; mode = most common value.

Grade 5

Describe using quadrats to estimate population size

Place quadrats randomly, count the organisms, find the mean per quadrat, then scale up to the whole area.

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