

Trophic levels in an ecosystem

Revision notes • Trophic levels, pyramids of biomass, and how biomass is lost between levels of a food chain, including efficiency calculations.

For AQA GCSE Biology 8461 and Combined Science: Trilogy 8464. **Triple only** is not in Combined Science. **Higher tier** is only on the Higher paper.

Trophic levels in an ecosystem Spec 4.7.4 Triple only

Trophic levels Spec 4.7.4.1

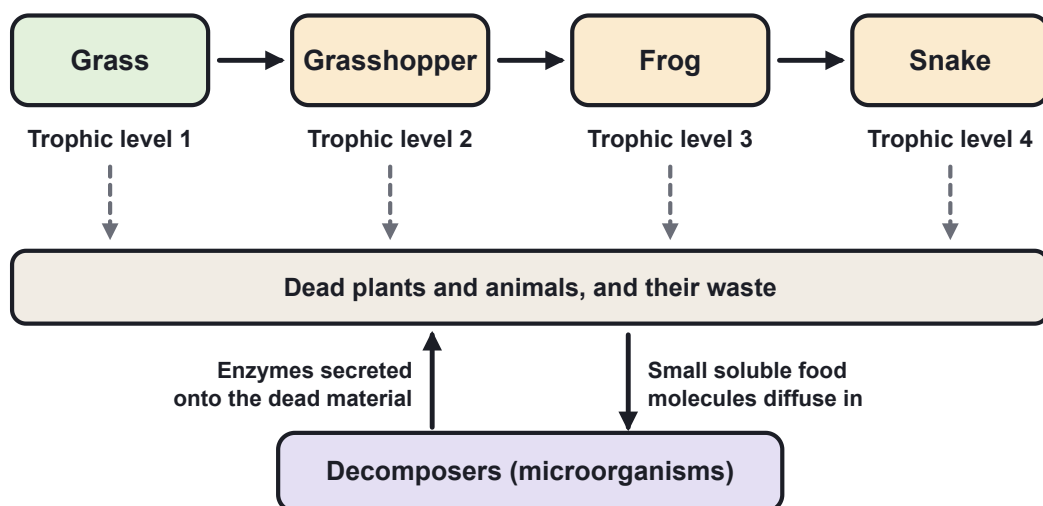
Trophic levels can be represented by numbers, starting at level 1 with plants and algae. Further trophic levels are numbered subsequently according to how far the organism is along the food chain.

Trophic level	Organisms	Name
Level 1	Plants and algae make their own food	Producers
Level 2	Herbivores eat plants and algae	Primary consumers
Level 3	Carnivores that eat herbivores	Secondary consumers
Level 4	Carnivores that eat other carnivores	Tertiary consumers

Apex predators are carnivores with no predators.

Decomposers

Decomposers break down dead plant and animal matter by secreting enzymes into the environment. Small soluble food molecules then diffuse into the microorganism.



Every trophic level ends up as dead material or waste. Decomposers **secrete enzymes** onto it, then the small soluble molecules diffuse in.

Exam tip: Decomposers secrete enzymes outside their bodies, onto the dead material. Small soluble food molecules then diffuse in. Decomposers do not take in the dead material and then digest it.

Pyramids of biomass Spec 4.7.4.2

Pyramids of biomass can be constructed to represent the relative amount of biomass in each level of a food chain. Trophic level 1 is at the bottom of the pyramid.

Each bar is narrower than the one below it, because the **biomass** decreases at each higher trophic level. This gives the pyramid shape.

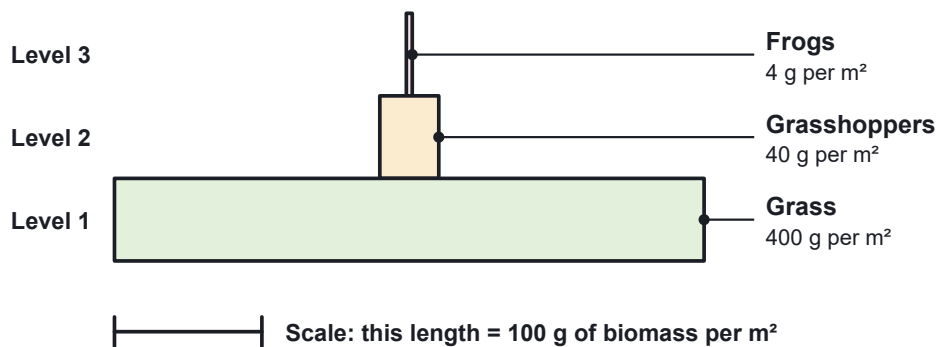
1. Draw horizontal bars, one for each trophic level, with trophic level 1 at the bottom.
2. Choose a scale so that the length of each bar is proportional to the biomass of that level.
3. Centre the bars on a vertical line and label each bar with the organism or level.

Constructing a pyramid

A food chain has biomass of 400 g per m² of grass, 40 g per m² of grasshoppers and 4 g per m² of frogs. Describe how to construct the pyramid using a scale of 1 mm = 4 g.

1. Grass: $400 \div 4 = 100$ mm long, at the bottom.
2. Grasshoppers: $40 \div 4 = 10$ mm long, above the grass.
3. Frogs: $4 \div 4 = 1$ mm long, at the top.

Answer: Three centred bars of 100 mm, 10 mm and 1 mm, with grass at the bottom and frogs at the top.



The pyramid from the worked example, drawn to scale. Each bar is about **10%** of the one below it.

Transfer of biomass Spec 4.7.4.3

Producers are mostly plants and algae which transfer about **1%** of the incident energy from light for photosynthesis.

Only approximately **10%** of the biomass from each trophic level is transferred to the level above it.

How biomass is lost

- Not all the ingested material is absorbed. Some is egested as faeces.
- Some absorbed material is lost as waste, such as carbon dioxide and water in respiration, and water and urea in urine.
- Large amounts of glucose are used in respiration.

Efficiency of biomass transfer

efficiency (%) = biomass transferred to the next level ÷ biomass available at the previous level × 100

Efficiency of transfer

Caterpillars eat 250 g of leaves and their body mass increases by 20 g. Calculate the efficiency of biomass transfer.

1. Biomass transferred = 20 g.
2. Biomass available = 250 g.
3. Efficiency = $20 \div 250 \times 100 = 8\%$.

Answer: 8%

Maths skill: You can also be asked for efficiency as a fraction. $20 \div 250$ simplifies to $2/25$. Check which one the question asks for.

Effect on numbers of organisms

Because so much biomass is lost at each step, less biomass is available to each higher trophic level. This means fewer organisms can be supported at each higher trophic level, and food chains have only a few trophic levels.

Common mistake: Do not just say biomass is 'used up'. Name the losses: egested as faeces, lost as carbon dioxide and water in respiration, and as water and urea in urine.

Quick check

1. What is trophic level 1, and what are those organisms called?
2. What is an apex predator?
3. How do decomposers break down dead material?
4. Approximately what percentage of biomass passes to the next trophic level?
5. Give two ways biomass is lost between trophic levels.

Quick check answers

Trophic levels in an ecosystem

1. Plants and algae, called producers.
2. A carnivore with no predators.
3. They secrete enzymes into the environment and small soluble food molecules diffuse in.
4. About 10%.
5. Egested as faeces; lost as carbon dioxide and water in respiration, and as water and urea in urine.