

Trophic Levels and Biomass Notes

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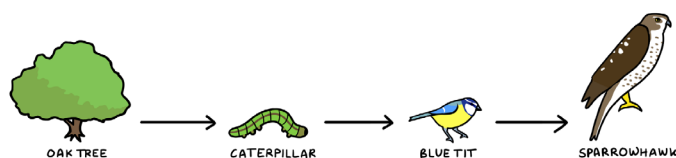
In order to stay alive an organism must absorb energy from another source. Organisms cannot create their own energy. We normally show these levels of organisation in either a food chain or a food web. Energy moves along the food chain or web from one organism to another when one eats the other. So, what is a trophic level?

A trophic level: the feeding level of an organism in a food chain.

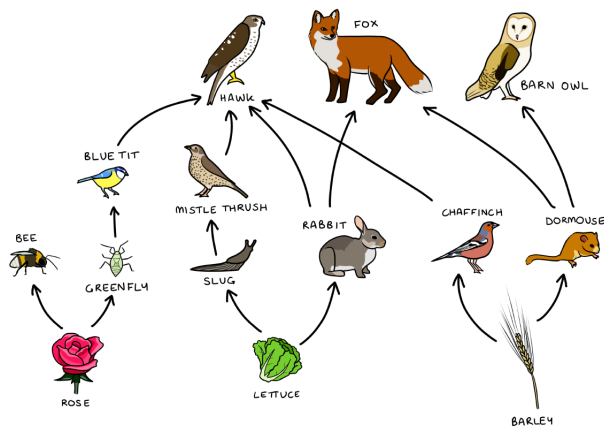
In most food chains that we see there are usually between three and four trophic levels.

Level	Name	Explanation
1 st trophic	Producer	Producers are always at the first stage of a food chain. Producers are always <u>photosynthetic organisms</u> (organisms that photosynthesise).
2 nd trophic	Primary consumer	Are <u>herbivores that eat the producer</u> . For example, a caterpillar.
3 rd trophic	Secondary consumer	Are <u>carnivores that eat the primary consumers</u> . For example, a spider or blackbird.
4 th trophic	Tertiary consumer	Are <u>carnivores that eat the secondary consumer</u> . For example, a fox or owl.

Example of a food chain.



Example of a food web.



Energy transfer between organisms

A common exam question asks “How is energy or biomass lost between different trophic levels or between different organisms in either a food chain or food web?”

Energy/ biomass is lost between each organism due to the life processes of the organism.

Life processes that use energy/ biomass include:

1. Respiration.
2. Excretion.
3. Movement (if the organism is an animal).
4. Reproduction.

This makes sense, as the animal must use some of its energy to do things and even if an organism ate it whole it would not get the energy that the first organism had already used.

In addition to these four life processes energy/ biomass is also lost as not all of the matter eaten by an organism is digested by the consumer some is egested as faeces. Some of the absorbed material is lost as waste as well, such as carbon dioxide and water in respiration, and water and urea in urine.

This energy loss limits the number of organisms in a food web, as the energy will eventually run out.

Energy is always converted to a less useful form. This is true of any energy transfer.

As a general rule, only about 10% of the energy from one trophic level is stored as biomass in the next. The other 90% is lost. Only 1 % of the energy in sunlight is captured in photosynthesis.

Calculations involving transfers of energy

We could be asked to calculate the energy that is lost from one trophic level to the next. This is quite straight forward it is a subtraction question.

Method: we will need to take one value away from another to find the difference between them.

We could also be asked to calculate the efficiency of energy transfers between trophic levels.

To calculate efficiency, we use this formula:

$$\text{efficiency} = \frac{\text{energy in higher trophic level}}{\text{energy in lower trophic level}} \times 100$$

Calculations involving transfers of biomass

You could be asked to calculate the efficiency of biomass transfers between trophic levels.

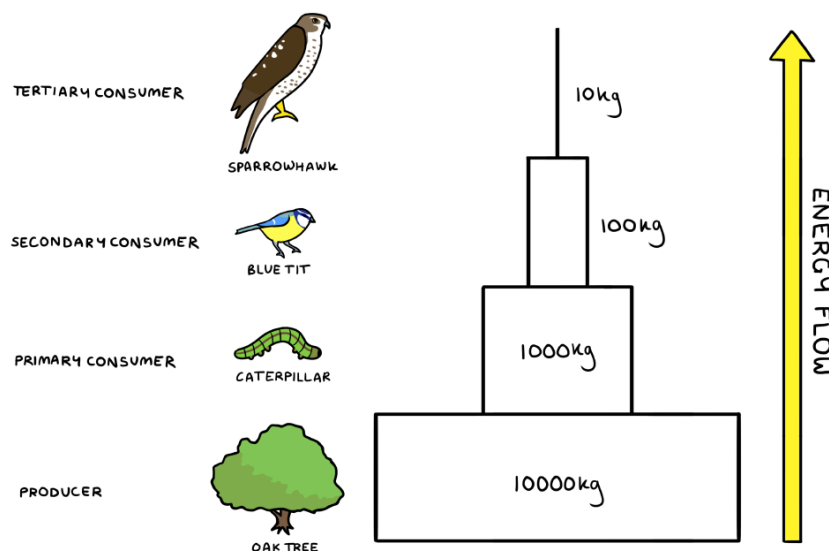
To calculate efficiency of biomass transfer, we use this formula:

$$\text{efficiency} = \frac{\text{biomass in higher trophic level}}{\text{biomass in lower trophic level}} \times 100$$

Pyramids of Biomass

Pyramids of biomass: shows the **mass** of the organisms in each trophic level in a food chain.

The example below shows the mass of one oak tree, followed by the mass of caterpillars that feed on the tree, followed by the mass of bluetits that feed on the caterpillars and finally the mass of the sparrowhawks that feed on the bluetits.



What are the advantages of pyramids of biomass?

1. **They are always pyramid shaped 😊** : A pyramid of biomass for a healthy ecosystem is always a true pyramid. The total mass of organisms decreases as we move up the pyramid from one trophic level to another.
2. This correctly shows that the producer level contains the most stored energy and material.
3. **More Accurate Representation:** biomass is a much better proxy for the amount of stored chemical energy at each trophic level than the number of individuals.

What are the disadvantages of pyramids of biomass?

1. To measure dry mass, the organisms must be killed, which is destructive and often impractical or unethical.
2. They only show the biomass at one specific moment in time (a "snapshot"). They don't account for seasonal changes or rates of reproduction.