

19.2 Food chains and food webs

Name: _____ Class: _____ Date: _____

Total: 25 marks

KEY WORDS food web 食物网 • trophic level 营养级 • consumer 消费者 • food chain 食物链
• ecosystem 生态系统

Objective

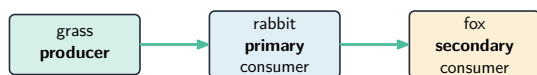
Build the skills to answer exam questions on **food chains and food webs** 食物链与食物网 — the terms, reading a web, and human impact.

You must be able to:

- define producer, consumer, herbivore, carnivore, decomposer
- read a food chain/web and the direction of energy flow
- explain the effect of overharvesting and introduced species

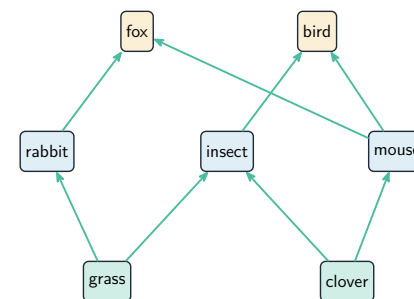
1 Worked examples

■ Food chains and webs



each arrow shows energy flowing to the next organism

Arrows show energy flow; a chain starts with a producer



A food web is several food chains linked together

- **producer:** makes its own food; **consumer:** feeds on others; **decomposer:** feeds on dead matter.

■ Reading a food web, and why the pyramid narrows

An **ecosystem** 生态系统 is all the organisms in an area together with the non-living parts they interact with. A **food chain** 食物链 shows the transfer of energy from one organism to the next; the **arrows point in the direction the energy travels**, that is from the organism eaten to the organism eating it. A **food web** 食物网 is several interlinked chains.

The trophic levels 营养级: a **producer** 生产者 makes its own food by photosynthesis; a **primary consumer** eats the producer (a herbivore); a **secondary consumer** eats the primary consumer; a **tertiary consumer** eats the secondary. A **decomposer** 分解者 breaks down dead organisms and waste, releasing the mineral ions back into the soil.

Why a pyramid of biomass narrows upwards, and why chains are short. Only about **10%** of the energy at one trophic level reaches the next. The rest is lost as heat from **respiration**, in **undigested material in faeces**, and in **excretory products** such as urea; not all of an organism is eaten either. After four or five levels there is too little energy left to support another population.

Worked example. Producers hold 20 000 kJ and the secondary consumers 180 kJ. Calculate the percentage transferred, and explain the loss.

1. $\frac{180}{20\,000} \times 100 = 0.9\%$.
2. Two transfers have taken place, each losing about 90%.
3. The losses are respiration as heat, faeces and excretion, plus the parts never eaten.

△ **Removing one species affects the whole web.** Say which population rises and which falls, and give the reason: if the rabbits go, the foxes that ate them fall because their food supply is reduced, the grass increases because nothing grazes it, and any other prey of the fox falls because the foxes now eat more of it.

2 Practice

2.1 Define a producer. [1]

2.2 State what the arrows in a food chain show. [1]

2.3 State what the 10% figure refers to in a food chain, and name two ways the other 90% is lost. [3]

2.4 Name the trophic level of a fox in the chain grass → rabbit → fox, and of the grass. [2]

2.5 Explain why food chains rarely have more than five trophic levels. [2]

3 Exam-style questions

3.1 In the chain grass → rabbit → fox, the rabbit is a: [1]

- A producer
- B primary consumer
- C secondary consumer
- D decomposer

3.2 A food web links several chains.

(a) Explain what could happen to the other organisms if all the rabbits were removed. [2]

(b) State one way humans can damage a food web. [1]

3.3 A food web in a garden contains: lettuce → slug → thrush → hawk, and lettuce → caterpillar → thrush.

(a) Name the producer, and name one secondary consumer. [2]

(b) State what the arrows in the web represent. [1]

(c) All the slugs are removed by a gardener. Explain the effect on the caterpillar population and on the hawk population. [4]

(d) The lettuces contain 48 000 kJ of energy and the thrushes 290 kJ. Calculate the percentage of energy that reaches the thrushes. [2]

(e) Explain why the answer to (d) is so small. [3]

Solutions

2.1 an organism that makes its own food (usually by photosynthesis).

2.2 the direction of energy flow (from one organism to the next).

2.3 The proportion of energy passed on from one trophic level to the next; any two of: lost as heat from respiration; lost in undigested material in faeces; lost in excretory products such as urea.

2.4 The fox is a secondary consumer; the grass is a producer.

2.5 Only about 10% of the energy passes to each next level, so after four or five levels there is too little energy left to support another population.

3.1 B. The rabbit eats the producer, so it is a primary consumer.

3.2 (a) animals that ate rabbits (e.g. foxes) would have less food and may decrease; plants the rabbits ate may increase.

(b) overharvesting (e.g. overfishing) or introducing a foreign species.

3.3 (a) The producer is the lettuce; a secondary consumer is the thrush.

(b) The direction in which energy is transferred, from the organism eaten to the organism eating it.

(c) The caterpillar population rises, because the slugs no longer compete with them for lettuce and the thrushes have fewer prey species so more lettuce is left. The hawk population falls, or stays about the same, because the thrushes it feeds on have lost one of their food sources, so there are fewer thrushes to eat.

(d) $\frac{290}{48\,000} \times 100 = 0.60\%$.

(e) Energy is lost at each of the two transfers; it is lost as heat from respiration, in undigested material in faeces and in excretory products; not all of each organism is eaten, so only a small fraction of the energy reaches the thrushes.