19.2 Food chains and food webs

Name: _____ Class: _____ Date: _____ **Total: 25 marks**

KEY WORDS food web • trophic level • consumer • food chain • ecosystem

Objective

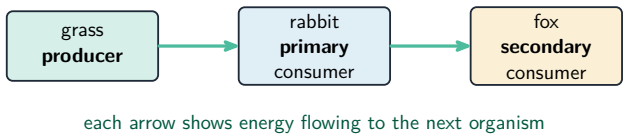
Build the skills to answer exam questions on **food chains and food webs** – the terms, reading a web, and human impact.

You must be able to:

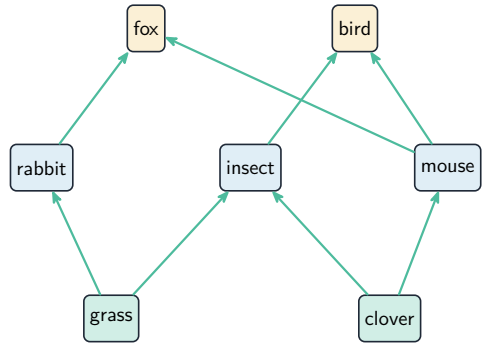
- define producer, consumer, herbivore, carnivore, decomposer
- read a food chain/web and the direction of energy flow
- explain the effect of overharvesting and introduced species

1 Key knowledge and worked examples

■ Food chains and webs



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** is all the organisms in an area together with the non-living parts they interact with. A **food chain** 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** is several interlinked chains.

The trophic levels: a **producer** 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** 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. $\dfrac{180}{20\,000} \times 100 = 0.9\%$.
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

Each answer shows the steps, then the **result**.

2.1

- a producer **makes its own food** (usually by photosynthesis)

2.2

- arrows show the **direction of energy flow**

2.3

- 10% is the energy **passed on** to the next trophic level
- any **two** of: heat from respiration / faeces / urea

2.4

- fox: **secondary consumer**
- grass: **producer**

2.5

- only about **10%** passes to each next level
- after four or five levels **too little energy** is left

3.1 B

- the rabbit eats the producer, so it is a **primary consumer**
- A is grass; C is the fox; D is bacteria/fungi

3.2

(a)

- animals that ate rabbits 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)

- producer: **lettuce**
- secondary consumer: **thrush**

(b)

- arrows show the **direction of energy transfer** (eaten → eater)

(c)

- caterpillars **rise**: less competition for lettuce
- hawks **fall** (or stay similar): thrushes have lost a food source

(d)

$$\text{efficiency} = \frac{\text{energy transferred}}{\text{energy available}} \times 100 = \frac{290\ \text{kJ}}{48\,000\ \text{kJ}} \times 100 = \mathbf{0.60}\%$$

(e)

- energy is lost at **each of the two transfers**
- as heat from respiration, in faeces and in excretory products
- not all of each organism is eaten, so only a **small fraction** reaches the thrushes