

Trophic Trouble

Simulation: edtechsims.com/trophic-trouble

Name: _____ Class: _____ Date: _____



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Part A: Escape from Elmbrook Wood

On the sim: Choose Solo or Team mode. Solve at least 4 of the 6 stations (3 questions each) to unlock the Final Vault. In the vault, predict how 5 populations change; you need 4 of 5 correct.

A1 Record your progress. For each station you solve, note one misconception it warned you about.

Station	Solved (✓)	Misconception I learned about
Who Eats Whom?		
Trophic Ladder		
The Energy Leak		
Falling Leaves		
Rain on the Hill		
Relationship Status		

A2 Record your Final Vault case and results.

Vault case	Correct predictions	Final time
	/ 5	

Part B: Station Practice

The game's questions vary. Use these questions, based on the food web in Fig. 1, to practise the same skills.

B1 Who Eats Whom?

Rabbits and mice eat grass. Mice also eat acorns from the oak tree. Caterpillars eat oak leaves. Blue tits eat caterpillars. Foxes eat rabbits and mice. Hawks eat rabbits, mice and blue tits.

(a) Draw arrows on Fig. 1 to complete the food web.

[3]

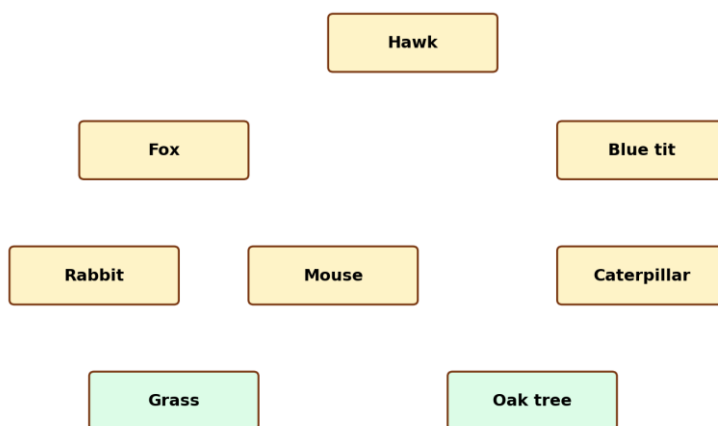


Fig. 1

(b) What does the direction of an arrow in a food web show?

[1]

B2 Trophic Ladder

Complete Table 1 using the food web in Fig. 1.

[4]

Organism	Trophic level(s)
Grass	
Oak tree	
Rabbit	
Mouse	
Caterpillar	
Blue tit	
Fox	
Hawk	

Table 1

(b) Explain why the hawk occupies more than one trophic level. [1]

.....

(c) Why are decomposers not placed on a single rung of the food chain? [1]

.....

B2 The Energy Leak

(a) Grass traps 20 000 kJ of energy. Assuming 10% is passed on at each step, calculate the energy reaching each level in grass → rabbit → fox. [2]

rabbit = ... kJ fox = ... kJ

(b) State three ways energy is lost between trophic levels. [3]

.....

.....

.....

(c) Fig. 2 shows three pyramids for oak tree → caterpillar → blue tit. Which is the pyramid of numbers, and which is the pyramid of biomass? Explain. [3]

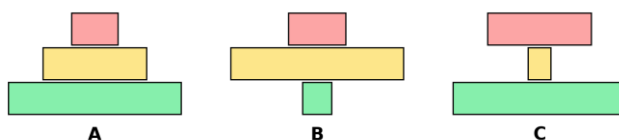


Fig. 2

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.....

.....

B4 Falling Leaves

(a) Fig. 3 shows part of the carbon cycle. Name the processes P to V.

[4]

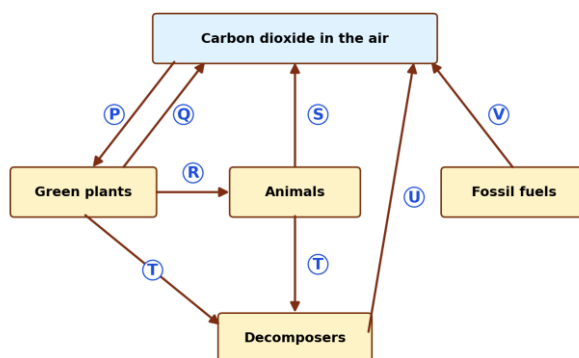


Fig. 3

P:

Q:

R:

S:

T:

U:

V:

(b) Predict what would happen to the leaf litter and to the CO₂ released if there were fewer decomposers in Elmbrook Wood.

[2]

.....

.....

B5 Rain on the Hill

(a) Number the stages of the water cycle from 1 to 5, starting with water in the sea.

[2]

Stage	Order
Water vapour cools and condenses to form clouds	
Water evaporates from the sea	
Water flows back to the sea as run-off and through rivers	
Water vapour rises into the air	
Water falls as rain (precipitation)	

(b) Number the route water takes through a plant, from 1 to 5. [2]

Stage	Order
Water evaporates from mesophyll cells into air spaces	
Water enters root hair cells by osmosis	
Water vapour diffuses out through the stomata	
Water moves up the xylem vessels	
Water moves across the root cortex	

(c) Explain the difference between evaporation and transpiration. [2]

.....

.....

B6 Relationship Status

Classify each relationship and give its signs (+, – or 0). [6]

Scenario	Relationship	Signs
A tapeworm lives in the human gut and absorbs digested food.		
Bees collect nectar from flowers and carry pollen between them.		
Barnacles attach to a whale to be carried to food-rich waters; the whale is unaffected.		
A lion hunts and eats a zebra.		
A clownfish shelters in a sea anemone and keeps it free of parasites.		
Mistletoe grows on a tree and takes water and minerals from it.		

Part C: The Final Vault

Case: A farmer sprays a pesticide that kills most of the caterpillars in Elmbrook Wood (Fig. 1). Predict what happens to each population, and explain.

Population	Increase / Decrease / Same	Reason
Caterpillar		
Oak tree		
Blue tit		
Hawk		
Mouse		

Part D: Practice Questions

D1 In a food chain, the producers trap 15 000 kJ of energy and the primary consumers receive 1 200 kJ. Calculate the percentage of energy transferred. [2]

percentage = ... %

D2 Explain why food chains rarely have more than four or five trophic levels. [2]

.....

.....

D3 Large areas of forest are cut down and burned. Explain how this affects the carbon dioxide concentration in the air. [3]

.....

.....

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Answer Key: Trophic Trouble

Part A: Escape from Elmbrook Wood

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The Energy Leak		
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Rain on the Hill		
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Student's own records. Examples: arrows drawn from predator to prey; decomposers placed on a consumer level; thinking energy is recycled; confusing pyramids of numbers and biomass; mixing up evaporation and transpiration; calling any close relationship mutualism.

A2 Record your Final Vault case and results.

Vault case	Correct predictions	Final time
	/ 5	

Part B: Station Practice

The game's questions vary. Use these questions, based on the food web in Fig. 1, to practise the same skills.

B1 Who Eats Whom?

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(a) Draw arrows on Fig. 1 to complete the food web.

[3]

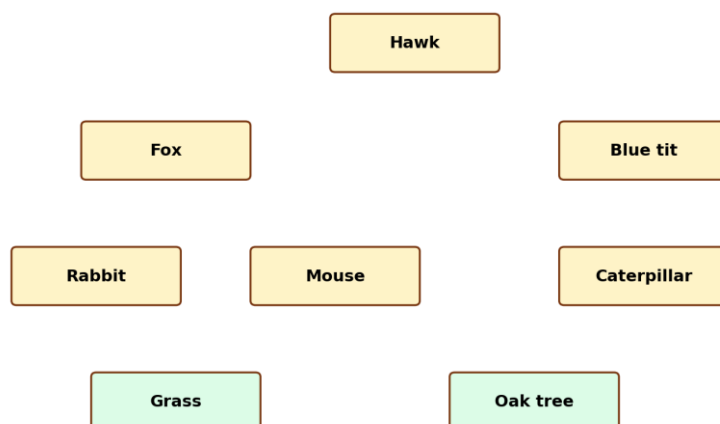


Fig. 1

Arrows from food to feeder: grass→rabbit, grass→mouse, oak→mouse, oak→caterpillar, caterpillar→blue tit, rabbit→fox, mouse→fox, rabbit→hawk, mouse→hawk, blue tit→hawk.

(b) What does the direction of an arrow in a food web show?

[1]

The direction in which energy flows (from the organism eaten to the organism that eats it).

B2 Trophic Ladder

Complete Table 1 using the food web in Fig. 1.

[4]

Organism	Trophic level(s)
Grass	Producer
Oak tree	Producer
Rabbit	Primary consumer
Mouse	Primary consumer
Caterpillar	Primary consumer
Blue tit	Secondary consumer
Fox	Secondary consumer
Hawk	Secondary and tertiary consumer

Table 1

(b) Explain why the hawk occupies more than one trophic level.

[1]

It eats primary consumers (mice, rabbits), making it a secondary consumer, and a secondary consumer (blue tit), making it a tertiary consumer.

(c) Why are decomposers not placed on a single rung of the food chain?

[1]

They feed on dead organic matter and waste from every trophic level.

B3 The Energy Leak

(a) Grass traps 20 000 kJ of energy. Assuming 10% is passed on at each step, calculate the energy reaching each level in grass → rabbit → fox. [2]

Rabbit: 2 000 kJ. Fox: 200 kJ.

(b) State three ways energy is lost between trophic levels. [3]

Any three: heat from respiration; movement; undigested material in faeces; excretion (urine); parts not eaten (bones, roots); energy remaining in dead organisms passed to decomposers.

(c) Fig. 2 shows three pyramids for oak tree → caterpillar → blue tit. Which is the pyramid of numbers, and which is the pyramid of biomass? Explain. [3]

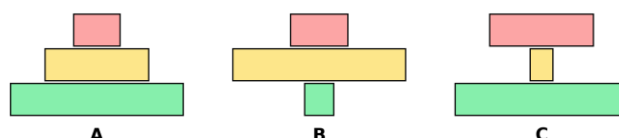


Fig. 2

Numbers: B. One oak tree supports many caterpillars, so the base is narrow. Biomass: A. The oak tree has a very large mass, so the base is widest and each level is smaller.

B4 Falling Leaves

(a) Fig. 3 shows part of the carbon cycle. Name the processes P to V. [4]

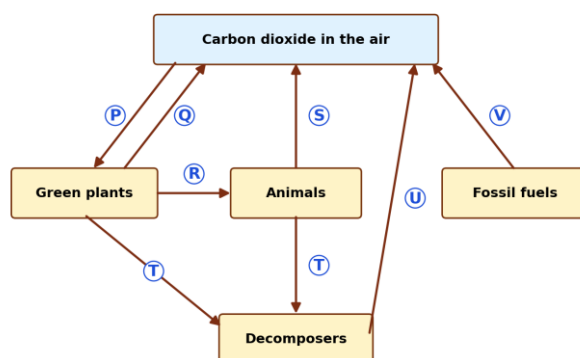


Fig. 3

P: photosynthesis. Q: respiration (plants). R: feeding. S: respiration (animals). T: death / decay (waste and dead matter). U: respiration by decomposers. V: combustion.

(b) Predict what would happen to the leaf litter and to the CO₂ released if there were fewer decomposers in Elmbrook Wood. [2]

Leaf litter would build up on the forest floor; less carbon dioxide would be returned to the air; nutrients would not be recycled.

B5 Rain on the Hill

(a) Number the stages of the water cycle from 1 to 5, starting with water in the sea. [2]

Stage	Order
Water vapour cools and condenses to form clouds	3
Water evaporates from the sea	1
Water flows back to the sea as run-off and through rivers	5
Water vapour rises into the air	2
Water falls as rain (precipitation)	4

(b) Number the route water takes through a plant, from 1 to 5. [2]

Stage	Order
Water evaporates from mesophyll cells into air spaces	4
Water enters root hair cells by osmosis	1
Water vapour diffuses out through the stomata	5
Water moves up the xylem vessels	3
Water moves across the root cortex	2

(c) Explain the difference between evaporation and transpiration. [2]

Evaporation is water turning to vapour from surfaces such as the sea and land. Transpiration is the loss of water vapour from plants, mainly through the stomata.

B6 Relationship Status

Classify each relationship and give its signs (+, – or 0). [6]

Scenario	Relationship	Signs
A tapeworm lives in the human gut and absorbs digested food.	Parasitism	+ / –
Bees collect nectar from flowers and carry pollen between them.	Mutualism	+ / +
Barnacles attach to a whale to be carried to food-rich waters; the whale is unaffected.	Commensalism	+ / 0
A lion hunts and eats a zebra.	Predation	+ / –
A clownfish shelters in a sea anemone and keeps it free of parasites.	Mutualism	+ / +
Mistletoe grows on a tree and takes water and minerals from it.	Parasitism	+ / –

Part C: The Final Vault

Case: A farmer sprays a pesticide that kills most of the caterpillars in Elmbrook Wood (Fig. 1). Predict what happens to each population, and explain.

Population	Increase / Decrease / Same	Reason
Caterpillar	Decrease	Killed directly by the pesticide.
Oak tree	Increase	Fewer caterpillars eat its leaves.
Blue tit	Decrease	Its only food source (caterpillars) falls.
Hawk	Stay about the same / decrease slightly	It loses blue tits but can switch to mice and rabbits.
Mouse	Decrease (accept increase with reasoning)	Hawks eat more mice to replace blue tits; accept increase if the student argues more acorns are available.

Part D: Practice Questions

D1 In a food chain, the producers trap 15 000 kJ of energy and the primary consumers receive 1 200 kJ. Calculate the percentage of energy transferred. [2]

$$(1\,200 \div 15\,000) \times 100 = 8\%$$

D2 Explain why food chains rarely have more than four or five trophic levels. [2]

Only about 10% of energy is passed on at each level; the rest is lost as heat, movement and waste. After four or five levels there is too little energy left to support another population.

D3 Large areas of forest are cut down and burned. Explain how this affects the carbon dioxide concentration in the air. [3]

Burning (combustion) releases CO₂ into the air. Fewer trees means less photosynthesis, so less CO₂ is removed. Both increase the CO₂ concentration.