

Exercise walk-through

Primary Productivity ■ 1.8

eXercise

You must be able to

- define **gross 总** and **net primary productivity 净初级生产力** (GPP, NPP)
- use $NPP = GPP - \text{respiration}$
- identify the most productive ecosystems

Method — Productivity

Primary productivity is the rate at which producers capture energy (usually by photosynthesis).

- **Gross primary productivity (GPP)** — the **total** energy captured.
- **Net primary productivity (NPP)** — what's **left** after the producers' own respiration.

Method — The equation

$$\text{NPP} = \text{GPP} - \text{respiration.}$$

NPP is the energy actually **available** to consumers.

Method — A worked calculation

If $GPP = 1000 \text{ kcal/m}^2/\text{yr}$ and $\text{respiration} = 400$, then
 $NPP = 1000 - 400 = 600 \text{ kcal/m}^2/\text{yr}$.

Method — Most productive ecosystems

Warm, wet, sunlit systems are most productive: **tropical rainforests**, **estuaries**, and **coral reefs** have high NPP; deserts and open ocean have low NPP.

Practice 2.1 ■ 1 mark

Write the equation relating NPP, GPP, and respiration.

Solution 2.1

Method: The equation

Worked steps

$\text{NPP} = \text{GPP} - \text{respiration}$ **B1**.

Practice 2.2 ■ 2 marks

For $GPP = 800$ and $\text{respiration} = 300$, find NPP.

Solution 2.2

Worked steps

$$\text{NPP} = 800 - 300 = 500 \quad \text{M1} \quad \text{A1}.$$

Practice 2.3 ■ 1 mark

Name one highly productive ecosystem.

Solution 2.3

Worked steps

Any one: tropical rainforest, estuary, coral reef, wetland **B1**.

Exam-style 3.1 ■ 1 mark

Net primary productivity is the energy

- A** captured before respiration
- B** available to consumers after producer respiration
- C** lost as heat only
- D** stored in rocks

Solution 3.1

Method: Productivity

- A captured before respiration
- B available to consumers after producer respiration** 
- C lost as heat only
- D stored in rocks

Worked steps

B — available to consumers after producer respiration.

Exam-style 3.2 ■ 2 marks

A grassland has $GPP = 1200 \text{ kcal/m}^2/\text{yr}$ and respiration = 500.

- (a) Calculate the NPP.
- (b) Explain what NPP represents for the ecosystem.

Solution 3.2

Method: A worked calculation

Worked steps

(a) $\text{NPP} = 1200 - 500 = 700 \text{ kcal/m}^2/\text{yr}$ **M1** **A1**. (b) The energy available to the consumers (the rest of the food web) **B1**.

Exam-style 3.3 ■ 2 marks

Explain why a tropical rainforest has higher NPP than a desert.

Solution 3.3

Worked steps

A rainforest has abundant warmth, water, and sunlight, so producers photosynthesize much more than in a dry, resource-poor desert, giving higher NPP **M1** **A1**.