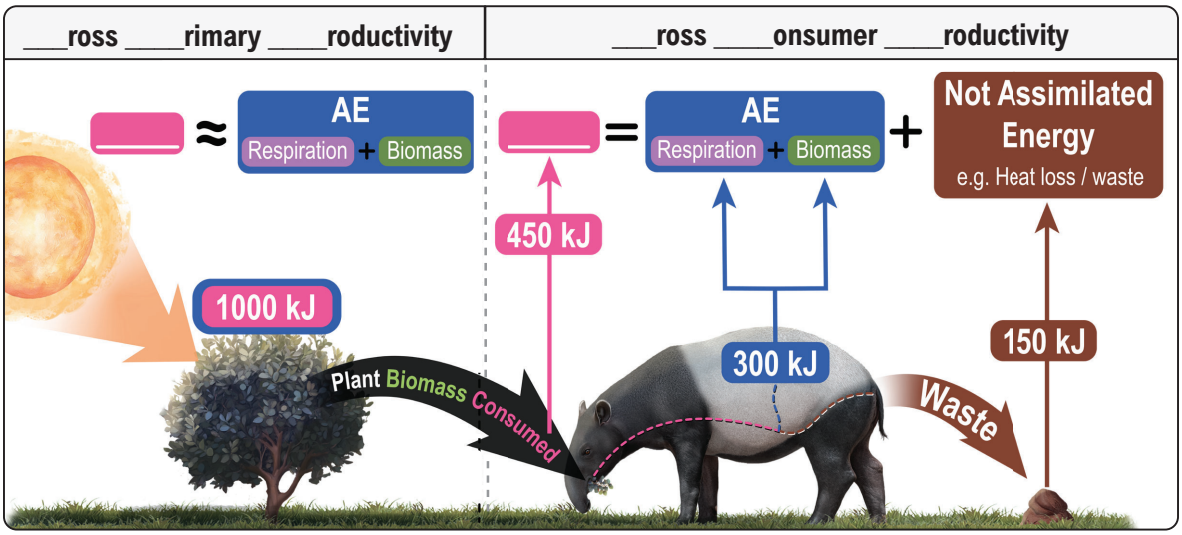
TOPIC: ENERGY FLOW THROUGH ECOSYSTEMS

Gross Productive Energy vs. Assimilated Energy

- **Gross Productivity (GP):** _____ energy initially captured by **P**rimary producer (G**P**P) or **C**onsumer (G**C**P).
- **Assimilated Energy (AE):** portion of GP energy _____ for cellular respiration & new biomass.
  - **Biomass**: the total mass of life (includes growth + reproduction).
  - For primary producers, we assume GPP ≈ AE.



PRACTICE

Which of the following statements is true?

a) The energy assimilated by an organism is used for new biomass only.

b) The energy assimilated by an organism is used for new biomass, respiration & reproduction.

c) The energy assimilated by an organism is used for new biomass, respiration, & is lost as waste (feces).

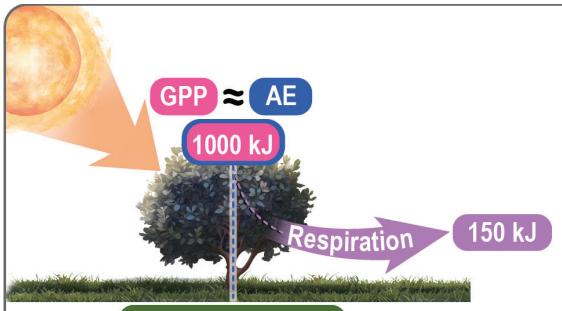
d) Consumers assimilate 100% of the energy they consume.

TOPIC: ENERGY FLOW THROUGH ECOSYSTEMS

Net Productive Energy ≈ New Biomass

◆ **Net Productive Energy:** portion of assimilated energy used for _____; available to _____ trophic level.

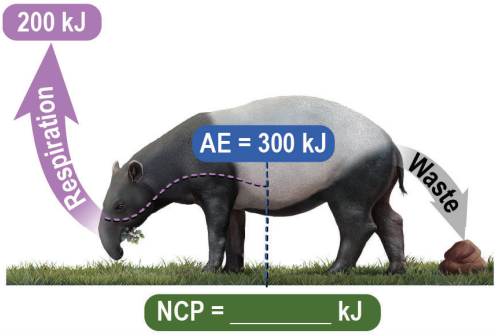
- **Net Productivity** = **AE** – **(Respiration Energy, R)**



Net Primary Productivity (_____):

a _____ producer's net productive energy.

NPP = **GPP** – **R**



Net Consumer/Secondary Productivity (_____):

a _____ net productive energy.

NCP = **AE** – **R**

EXAMPLE

In an experiment scientists found that, over a certain period, the total respiration of an ecosystem exceeded the total amount of energy captured in photosynthesis. How is this possible?

a) The ecosystem's total biomass is increasing.

b) The ecosystem's total biomass is decreasing.

c) The ecosystem must be getting energy from another source.

d) Animals must have been emigrating out of the ecosystem.

PRACTICE

Which of the following statements about NPP & GPP is true?

a) GPP is the total energy captured by producers, NPP is the amount of energy they convert to biomass.

b) Both GPP & NPP can be heavily influenced by climate.

c) The NPP in an ecosystem equates to how much food is available for primary consumers.

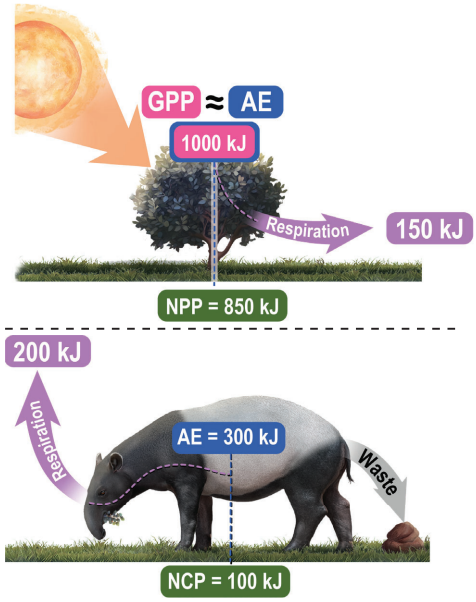
d) All of the above are true.

TOPIC: ENERGY FLOW THROUGH ECOSYSTEMS

Energy Efficiency in Ecosystems

◆ **Energy Efficiency:** the % of energy used or transferred within an ecosystem.

- **Net Production Efficiency (NPE):** % of _____ energy used for new biomass (net productivity).
- **Trophic Efficiency (TE):** % of net _____ energy transferred to next trophic level's net productivity.



$$\text{NPE} = \frac{\text{Net Productivity}}{\text{Assimilated Energy}} \times 100\%$$

$$\text{TE} = \frac{\text{Net Productivity of } \textit{Current} \text{ trophic level}}{\text{Net Productivity of } \textit{Previous} \text{ trophic level}} \times 100\%$$

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EXAMPLE

A grasshopper's body mass contains a total energy of 600J, after it has assimilated 4000J of plant matter throughout its lifetime. A praying mantis then consumes the grasshopper and assimilates 475J of energy. It then gains 220J of biomass.

1. Calculate the **net production efficiency** of both the grasshopper throughout its life, and the praying mantis as it eats the grasshopper.

2. The ecosystem we're looking at is a tree which currently contains 100,000J of energy for grasshoppers to consume. There are 10 grasshoppers in this ecosystem, each containing 600J of biomass, and one praying mantis, which has 1000J of biomass. The tree and the insects collectively respire 20,000J of energy in a year. Calculate the **trophic efficiency** between primary producers & primary consumers, and between primary consumers & secondary consumers.

PRACTICE

Which of the following answers describes the production efficiency of an organism?

a) The amount of assimilated energy divided by the amount of energy ingested.
b) The amount of energy ingested divided by the amount of assimilated energy.
c) The amount of energy used for new biomass divided by the amount of assimilated energy.
d) The amount of assimilated energy divided by the amount of energy used for new biomass.

TOPIC: ENERGY FLOW THROUGH ECOSYSTEMS

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Using the data in this table, calculate the:

1) Net production efficiency of the grass.
   a) 5.4%
   b) 21.7%
   c) 2.17%
2) Trophic efficiency between insects and grass.
   a) 1.2%
   b) 6.3%
   c) 4.6%
3) Net production efficiency of insects.
   a) 19%
   b) 73%
   c) 27%

Form of Energy	Amount [kcal/(m^2*yr)]
Solar radiation	700,000
Gross grass production	37,850
Net grass production	8,230
Gross insect production (assimilated)	520 (380)
Net insect production	102