

Message from Krushnamegh:

if your participation or article (=quiz) score ever had a grading error that you wanted me to rectify, please contact me in my office. **you have time until May 4 (tuesday)** to come to my office to set this record straight. this week and the next i have time on:

monday: whole day beginning 11am.

tuesday: 12.00-12.30; 3-5.

wednesday: 4-5.

thursday: 12.00-12.30; 3-5.

friday: whole day beginning noon.

give a call before you come: 471-4506. office: PAT 627.

Exam IV

- May 6th at 11:00 AM, TAY 2.006
- Absolutely no make up exams will be given
- People getting sick one day or two before the exam or on the day of the exam still need to come to take it unless you are **extremely** sick or are contagious. If you need to make up the exam because of disease problems, you will be given a harder essay type question exam on F morning (**no later**).
- People need to contact me **ASAP** if they missed the exam due to sickness. I will need to see an official medical excuse from UT to allow you to take the exam.

Ecosystem ecology

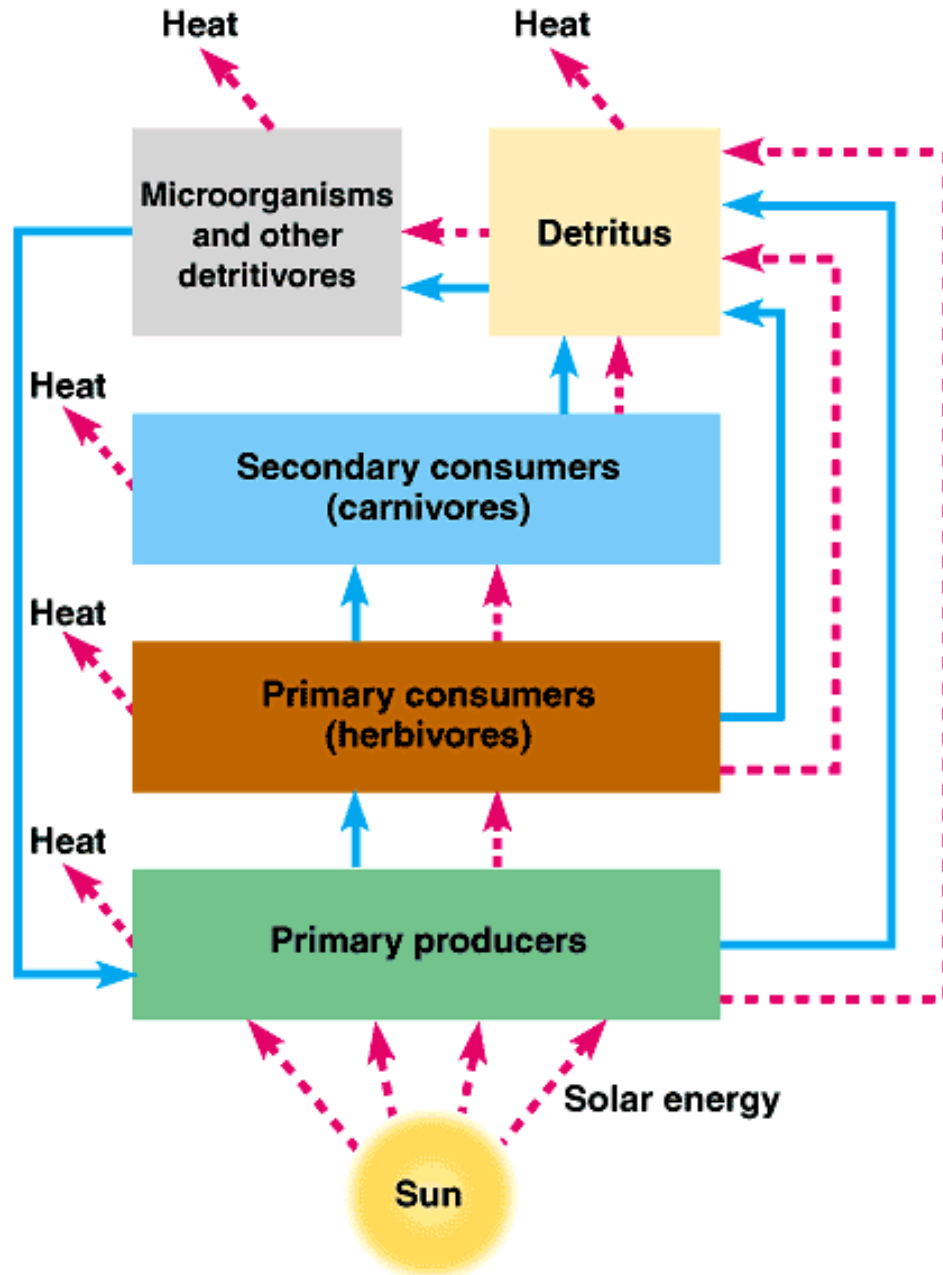
Ecosystem ecology

- Definition: an ecosystem consists of all organisms living in a community as well as all abiotic factors with which they interact
- Goals: Understanding how organisms within a community process energy and materials
- Importance: 1) Incorporates the abiotic and biotic environment into a whole system; 2) Implications for understanding energy budgets in nature and effects of human pollution in natural systems

Ecosystem framework

- Ecosystems are organized into trophic levels:
 - Primary producers, primary consumers, secondary consumers, detritivores
- Laws of physics and chemistry apply to ecosystems
 - Law of conservation of energy, second law of thermodynamics, conservation of Elements

Figure 54.1 An overview of ecosystem dynamics



Primary production

- Amount of light energy converted to chemical energy (organic compounds) by autotrophs in an ecosystem during a given time period
 - It is the result of photosynthetic production
 - Sets the limits for the ecosystem's energy budget

Gross and Net primary production

- Gross primary production (GPP): total primary production
- **Net primary production (NPP):** gross primary production minus energy used by primary producers for respiration
 - $NPP = GPP - R$

Measurements of primary production

- It can be expressed in terms of energy per unit area per unit time ($\text{J}/\text{m}^2/\text{yr}$)
- Or as biomass (weight) of vegetation added to ecosystem per unit area per unit of time ($\text{g}/\text{m}^2/\text{yr}$)
 - Do not confuse with standing crop: total biomass of photosynthetic autotrophs present at a given time

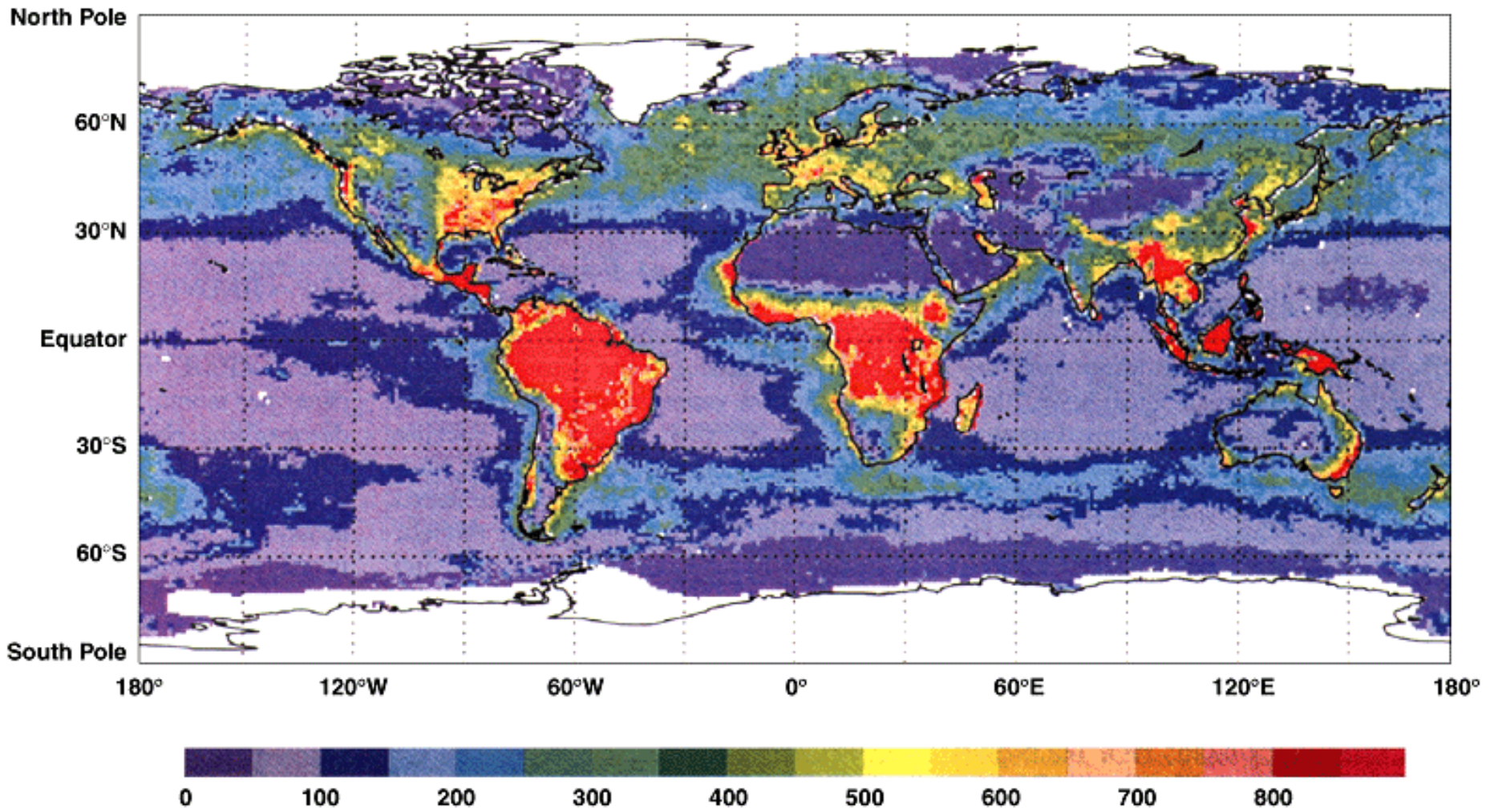
Variation in primary production across ecosystems

- Most productive per unit area: tropical forests, coral reefs, estuaries
- Least productive per unit area: open ocean, tundra, deserts
- Highest contribution because of size: open ocean, tropical rain forest

Factors affecting primary productivity

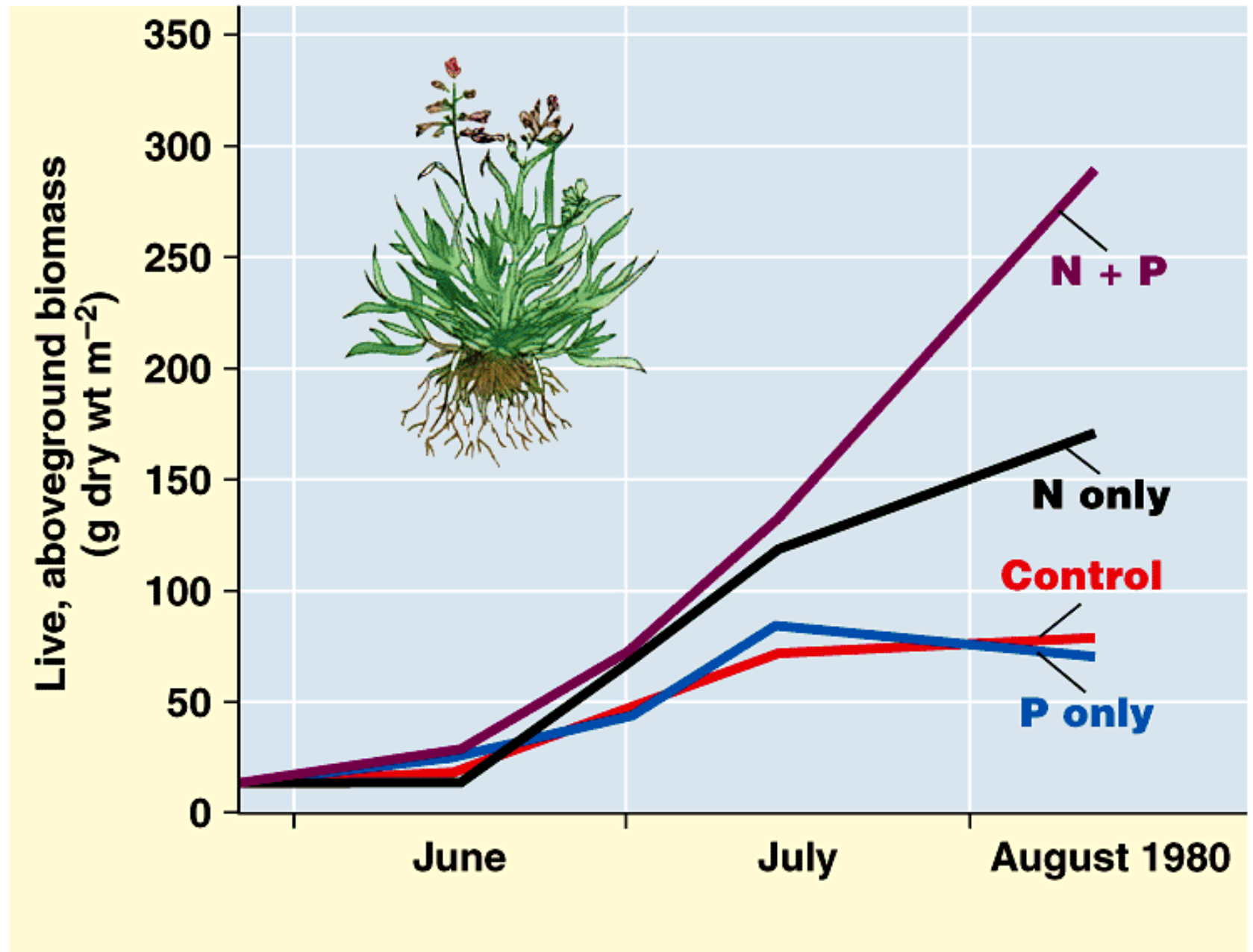
- Marine/aquatic systems
 - Light
 - Nutrients
- Terrestrial systems
 - Temperature
 - Water (moisture)

Regional annual net primary production for Earth



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Nutrient addition experiments in a Hudson Bay salt marsh



Factors affecting primary productivity

- Terrestrial systems
 - Temperature
 - Water (moisture)

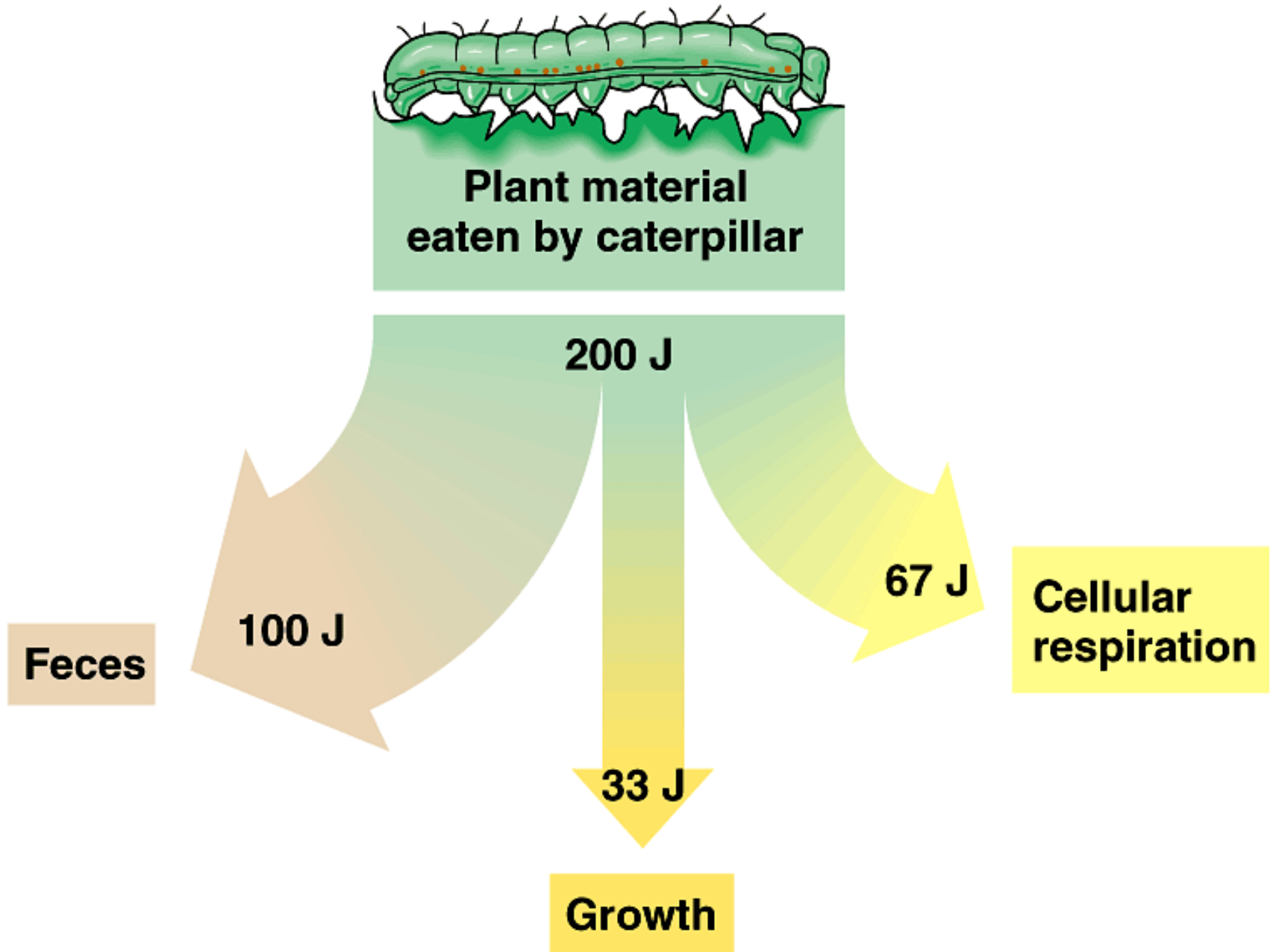
Secondary production

- Amount of chemical energy in consumer's food that is converted to their own new biomass in a given time period
 - Much of primary production is not used by consumers

Flow of energy

- Energy is considered to flow in an ecosystem because much of it, is lost as heat through respiration, thus it does not cycle in an ecosystem

Energy partitioning within a link of the food chain



Production efficiency (in individual consumers)

Production efficiency = net secondary production/assimilation of primary production

Net secondary production: energy stored in biomass represented by growth and reproduction

Assimilation of primary production: total energy taken in and used for growth, reproduction and respiration

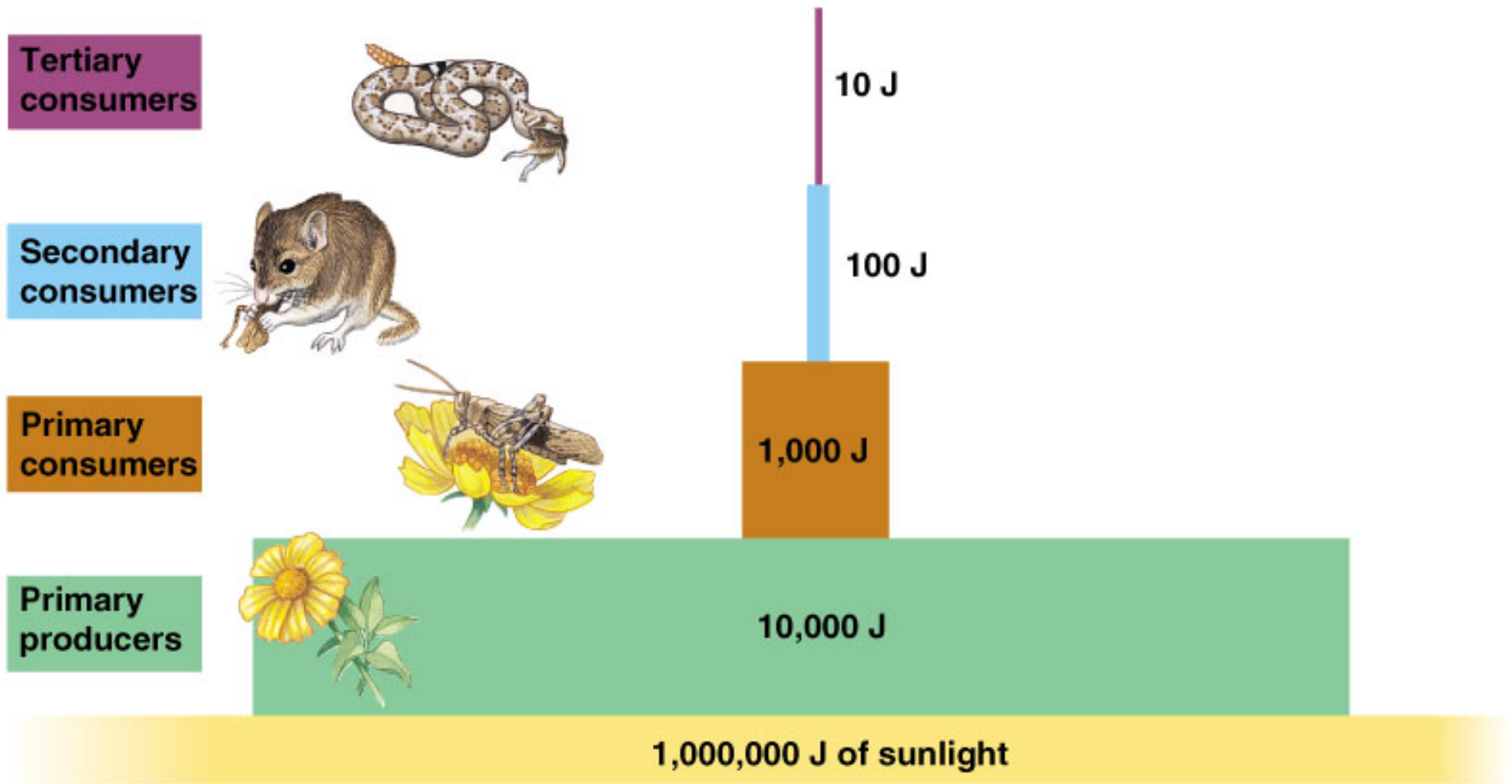
Production efficiency: fraction of food energy that is not used for respiration

Production efficiencies: birds and mammals (1-3%), fishes (10%), insects (40%)

Trophic efficiency

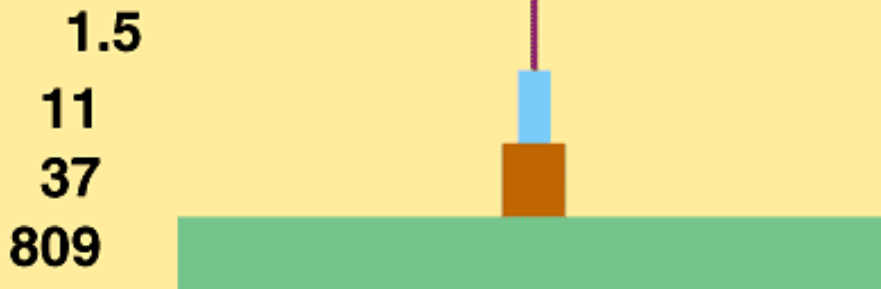
- It is the percentage of production transferred from one trophic level to the next or the fraction of net production at one trophic level as a percent of net production at the level below
 - Trophic efficiencies are always less than production efficiencies because they also take into account the energy in organic material in a lower trophic level that is not used by the next trophic level
 - Trophic efficiencies usually range between 5-20%

An idealized pyramid of net production



Pyramids of biomass (standing crop)

**Dry weight
(g/m²)**



Trophic level

Tertiary consumers
Secondary consumers
Primary consumers
Primary producers

(a) Florida bog

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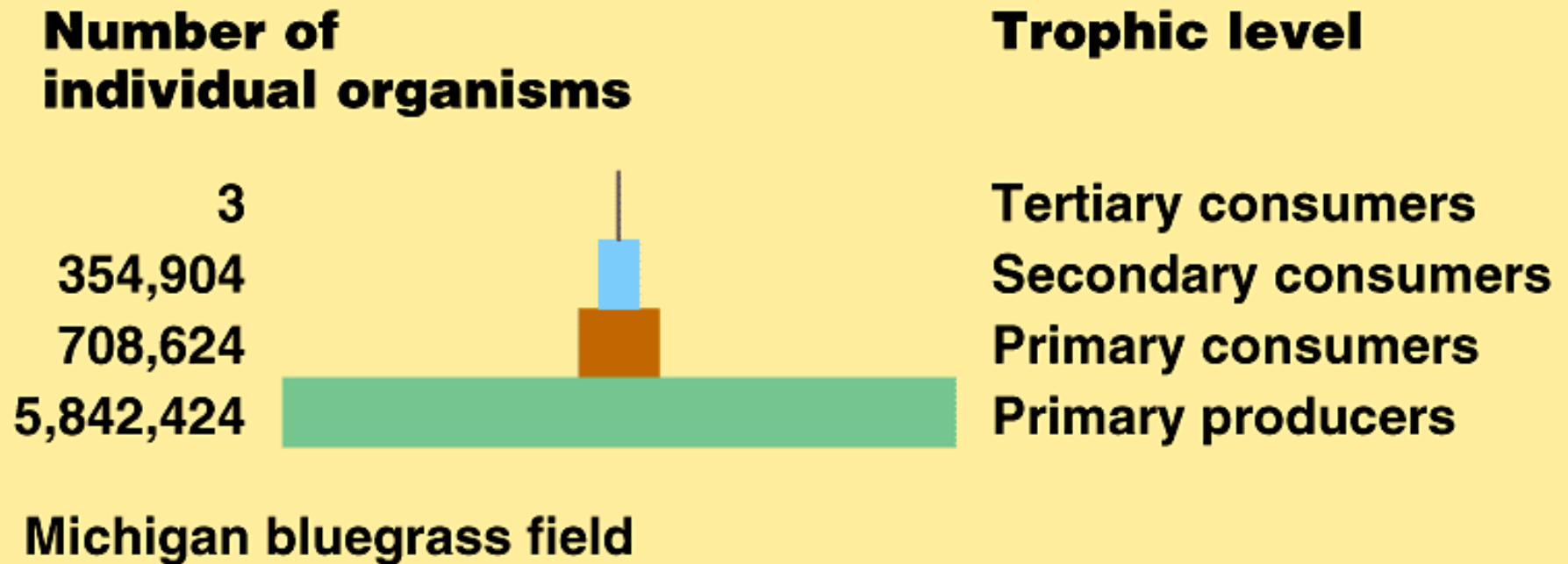
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Primary consumers (zooplankton)
Primary producers (phytoplankton)

(b) English Channel

A pyramid of numbers



Food energy available to the human population at different trophic levels

Trophic level

Secondary consumers

Primary consumers

Primary producers

