

Energy flow and Ecological Pyramids

Energy Flow

The flow of energy is an essential feature of every ecosystem. The transfer of energy through trophic levels and up the food chain is often oversimplified by the general rule of thumb known as the 10% rule. This rule assumes that only 10% of the energy consumed by one level is available to the next trophic level. 90% is lost as heat and/or used for the purposes of the organisms for living needs such as metabolism, reproduction, and growth & repair of cells, tissues, and organs. Scientists use this 10% as an average, however, it is not true in all systems. The amount of energy available to one trophic level is limited by the amount stored by the level below. Because energy is lost in the transfer from one level to the next, there is successively less total energy as you move up trophic levels.

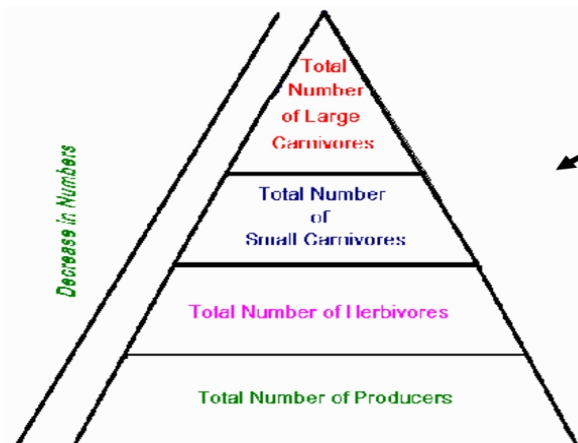
Each **day** the Earth is bombarded with about 250 calories/m² of solar radiation (equivalent to 100 million atomic bombs, like the atomic bombs used during WWII). Of the visible light that reaches the photosynthetic organisms, (the ones we call **producers**: plants, algae, cyanobacteria), only 1-2% is turned into chemical bond energy such as found in lipids or carbohydrates. With this relatively small percentage of energy consumed, these autotrophs use photosynthesis to create 170 billion tons of organic matter each year! These producers are the foundation of almost all food chains. (exceptions: deep ocean vent food chains where sunlight cannot reach any producers).

The amount of light that is changed to chemical bond energy is called primary productivity (PP). PP is the rate at which producing organisms make new biomass. PP is expressed as energy/meter²/year (usually Joules or calories are used as energy units) or in biomass (weight) of vegetation added to the ecosystem (g/m²/yr).

A biome or ecosystem such as an open ocean, for example, might be responsible for a high percentage of the Earth's primary productivity (cumulatively produces a huge biomass) due to its size but actually has a very low PP rate. On the other hand, a prolific ecosystem like a coral reef might have a low percentage of the Earth's PP because there are relatively few of them globally

Ecological Pyramids

Trophic levels and the energy flow from one level to the next can be graphically depicted using an ecological pyramid. There are three types of ecological pyramids:



1. **Number pyramid**-shows the number of organisms in each trophic level
2. **Biomass pyramid**- total amount of living tissue within a trophic level
3. **Energy pyramid**- indicates the total amount of energy present in each trophic level