# Module 6: Energy flow: Trophic levels

- Recall: troph = food
- Autotrophs make their own food (photosynthesis)
- Examples: plants

Trophic levels explain how energy (food) moves up through a food chain

Simple food chain: think of Madagascar...

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- Consumers are known as heterotrophs (hetero=not same, troph = food)
- Herbivores (herb=plant, vore=eat) eat plants, and are primary consumers
- Consumers that eat other consumers are known as carnivores (carne=meat, vore=eat) or secondary consumers
- Tertiary consumers eat secondary consumers
- Apex predators have few predators for them, e.g. sharks, humans (cannibals don't count, and they don't eat clowns, they taste funny)
- Trophic levels are each stage up the food chain
- Only 10% of energy moves up each level (why?)
  - reproduction
  - metabolism (grazing etc.)
  - avoiding predators
  - romping with friends

Other nasty bits:

- scavengers: eat dead animals, e.g. vultures
- detritivores: eat decaying matter, e.g. beetles (not the Beatles, that's something else)
- decomposers: break down decaying matter, e.g. bacteria

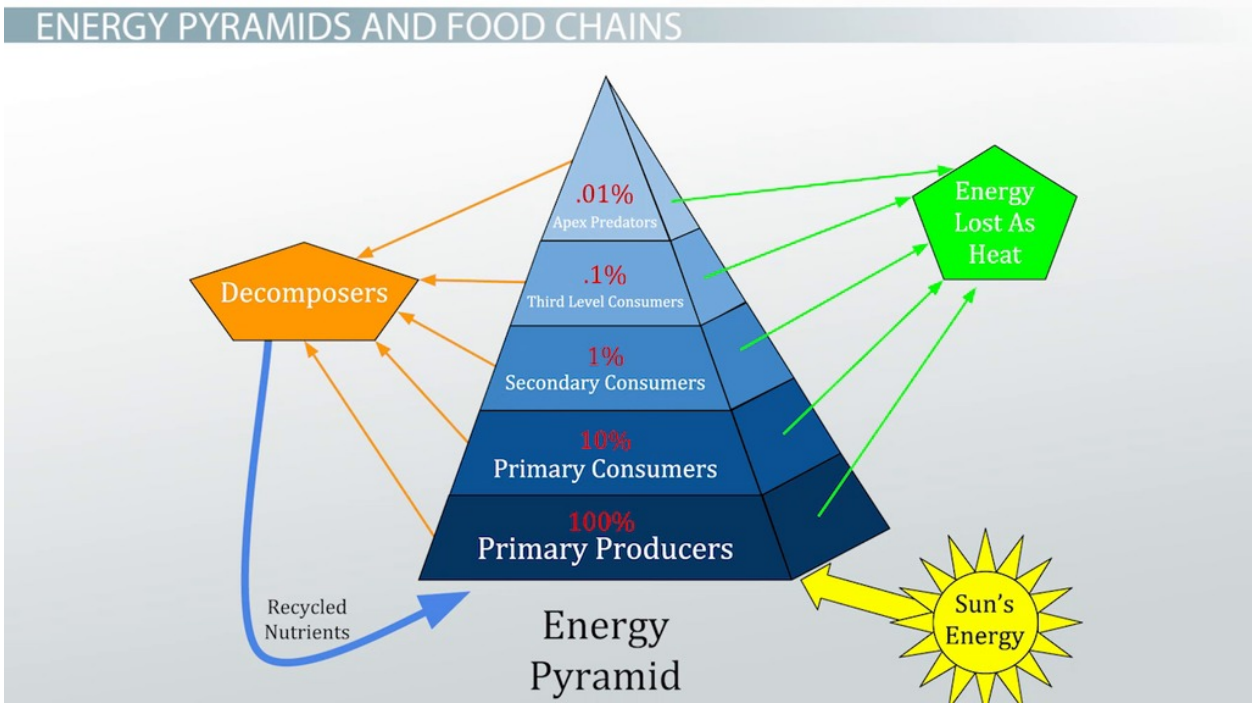
The cycle of life: (just like in Lion King)

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Back to the 10% rule:

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Just like Marty had to romp around, and in some cases run away from Alex, some energy was used for other things (reproduction is included, though Marty did not have kids that we know of...)



pyramid.jpeg

Make sure you understand this: just take one zero off for each level...
Also make sure you can duplicate a complex drama like this:

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Or this wetter version:

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Trick question: could the Lions see the Hyena as a predator or prey? (remember Scar in Lion King?)
Another one: what is the connection between Madagascar and the show Friends?

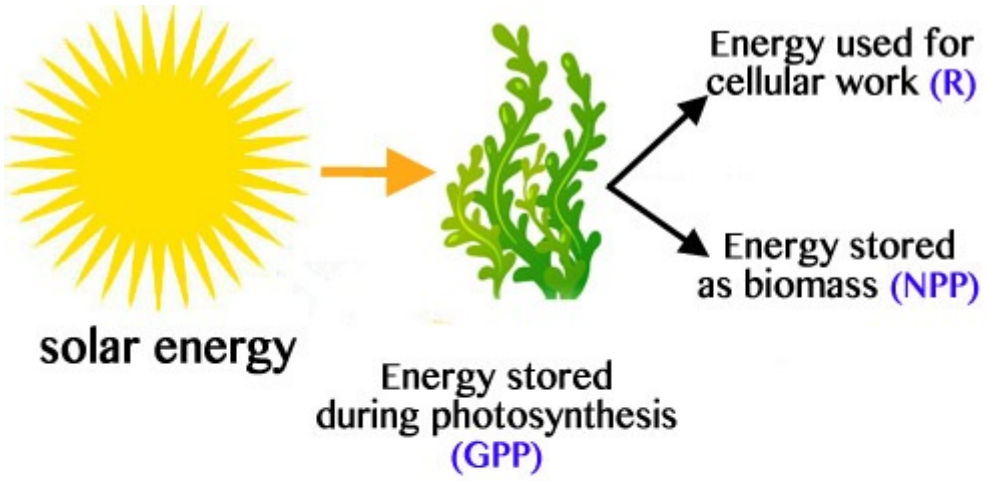
**Net Primary Productivity: The rate of turning solar energy into organic materials**

From last module: photosynthesis (water, CO2 based) or chemosynthesis (sulfur based) turn energy into organic compounds (light+water->sugar)

- Autotrophs= auto (self) troph (food)
- also known as Producers in the food chain
- GPP: gross primary productivity = all energy into all food
- NPP: net primary productivity = gross - energy of respiration
- Net is usually only 25-50% of gross (not much)
- Fun fact: your body is only about 33% efficient, the rest goes to heat
- Same with your gas powered car...

Plants are not very efficient users of solar energy:

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gpp.jpeg

If this were a business, they would charge 20$ for a shirt, that cost them $12, so they only make $8 per shirt. Not good business.

This is most efficient where there is lots of solar radiation, biomass and water:

Look for the richest and the poorest in each ecosystem: Note connection with biomes...

- Richest land biome: lots of sunlight (energy), warm temperatures and lots of water (photosynthesis)
- Poorest land biome: less sunlight, long dark winters, cooler, and drier
- Richest aquatic biome: warm, close to shore, sunlight
- Poorest aquatic biome: cooler, far from shore

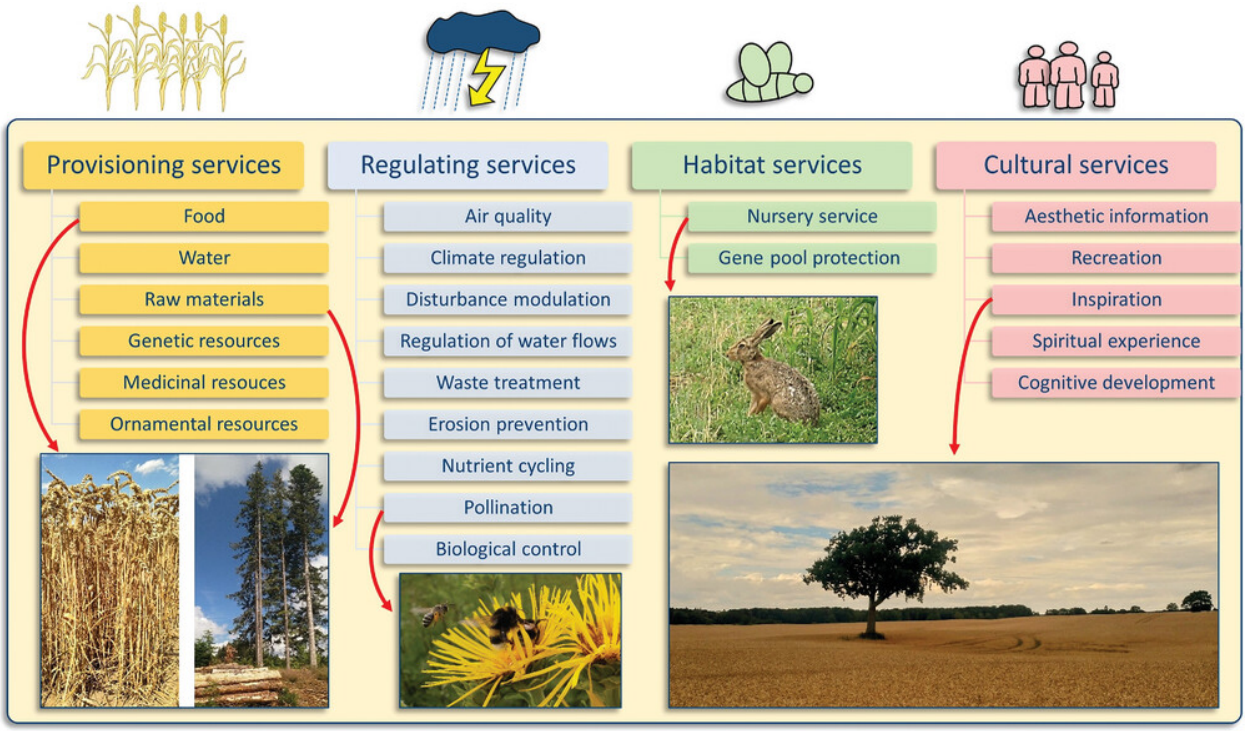
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Net vs. Gross is easy to understand:

- If your business takes in money, this is your gross income, say 100$
- If your materials cost 20$, then your net income would be 80$

**Ecosystem services: terms**

- Ecosystem services: processes by which clean water, timber, fisheries and ag crops are produced
- Provisions: goods humans can use: timber, food crops, plants
- Support systems: pollinators (bees), water filtration (soils)
- Cultural services: aesthetics (John Muir, Ansel Adams)
- Monetary value: lumber, fishing, tourism, ecotourism




services.jpeg

**Island Biogeography: an intro to evolution by location and geography**
**The Galapagos Islands are often used here as an example: far from the mainland, Darwin came up with his theories of Evolution there:**

https://en.wikipedia.org/wiki/Evolution

**Island** (physically separate) **bio**=life, **geography**=mapping the earth
**Important**: Size of islands determines number of species on an island: bigger island=more species

Species-area curve: what this means: larger islands have more species

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Dependent on several factors:

- colonization: how many new species can make it to the island, e.g. is it far from the mainland like Hawaii?
- extinction: how many species die out, and how fast, from what (disasters, humans)
- distance from each other: greater separation=fewer species (think of birds migrating across our island chain)

Invasive species are usually **generalists**, so pose a greater threat to island species (**specialists**)
This is covered when we learn about **niches** soon.

We will see this again when we study biodiversity next...
**Find a game!**

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