

Decomposition

- The breakdown of chemical bonds formed during the construction of plant and animal tissue
 - Breakdown of complex organic substances into simpler ones
 - Organic compounds → Inorganic nutrients
 - Many processes → thus many organisms involved

I. Classification of decomposers

- **Microflora** → organisms most commonly associated with decomposition
 - Bacteria → decomposition of animal matter
 - Fungi → decomposition of plant matter

I. Classification of decomposers

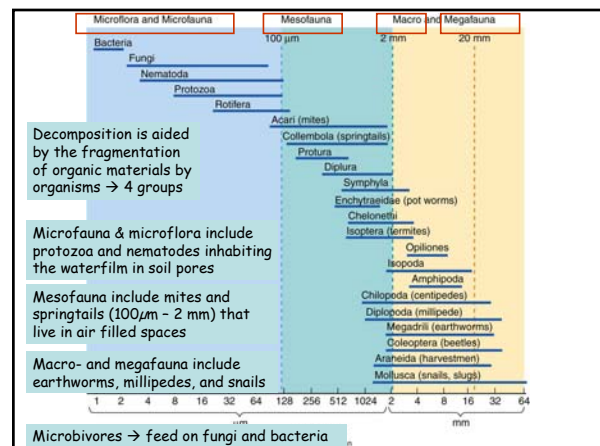
- Bacteria
 - Aerobic → requiring O₂ for metabolism
 - Anaerobic → uses inorganic compounds (i.e., sulfates) as the oxidant
 - Anaerobic respiration usually found in mud or sediments (aquatic habitats) and the stomach of ruminants → **fermentation**

I. Classification of decomposers

- Bacteria (major decomp of animal matter)
 - **Fermentation**: converts sugars to organic acids and alcohols (less efficient way of breaking down organic matter)
 - Many bacteria are **facultative anaerobes** → capable of using oxygen when available, but can shift to fermentation if necessary
 - Other bacteria are **obligate anaerobes** → cannot survive in the presence of oxygen

I. Classification of decomposers

- Bacteria and Fungi secrete enzymes into plant and animal tissue to break down organic compounds
 - Some materials absorbed as food, some remain for further decomposition
- Succession of microflora:
- Bacteria/Fungi → More Bacteria/Fungi → Detritivores → ... → more Bacteria/Fungi...



I. Classification of decomposers

- Microbivores
 - (i.e., Collembola, nematodes, beetles, mites)
- Can act as regulators of decomposition
 - Stimulate microbial activity
 - Influence distribution and abundance of fungi and bacteria
 - Thus can also slow down decomposition
 - Direct return of nutrients through feces

II. Stages of decomposition

- Decomposition of dead material goes through several stages:
 - Leaching → loss of soluble sugars and other compounds (dissolved and carried away)
 - Fragmentation → reduction of organic matter into smaller particles (physical or chemical)

ABIOTIC

II. Stages of decomposition

- Decomposition of dead material goes through several stages:
 - Detritivores oxidate organic compounds → release energy through respiration
 - The release of organically bound nutrients into inorganic form available to plants and microbes → **mineralization**

BIOTIC

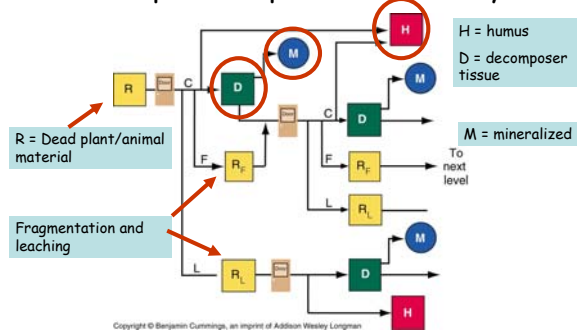
II. Stages of decomposition

- Decomposition of dead material goes through several stages:
 - Decomposer organisms also use these nutrients for their own growth, incorporating them into microbial biomass

- **Nutrient Immobilization**

Can affect plant growth

Decomposition process: Pathways



III. The decomposition process

- Early stages (dead plant material):
 - Microbial decomposition of plant leaves
 - Senescent leaves fall into ground and become rapidly invaded by bacteria and fungi
 - Detritivores break litter into smaller portions (more accessible to smaller org.)

Check out forest decomp videos from britanica:
<http://www.britannica.com/EBchecked/topic/155262/decomposition>

III. The decomposition process

- Decomposition of dead animal material:
 - More direct than decomp of plant materials
 - Why?
 - Chemical breakdown of flesh does not require as many specialized enzymes

Check out rabbit decomp video from You Tube:
<http://www.youtube.com/watch?v=jrSHku6-LFo>

III. The decomposition process

- Decomposition of fecal material:
 - Already highly decomposed
 - Provides a rich energy source for specialized detritivores (coprophagy)
 - (i.e., dung beetles, some flies, earthworms, bacteria, and fungi)

Check out dung beetle video from your Tube:
<http://www.youtube.com/watch?v=1fRHmSm36aE>

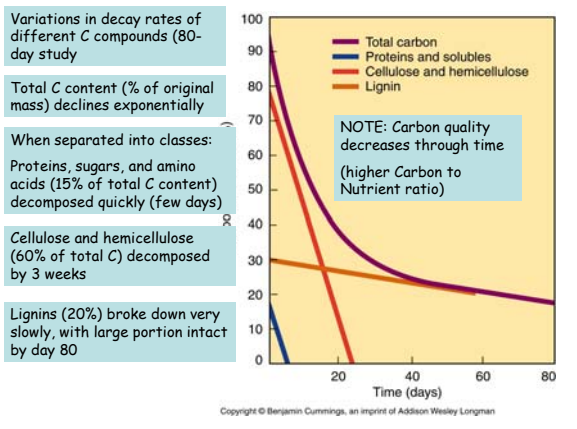


IV. Environmental Control on Decomposers

- Two major factors influencing the rate of decomposition
- 1) the quality of the dead organic matter as a food source
- 2) the physical environment (temp & moisture)

IV. Environmental Control on Decomposers

- Litter quality
 - Provides energy (Carbon) and nutrient (Nitrogen) source for decomposers
 - Not all C's are of equal quality as energy sources
 - Depends on structure and the ability of decomposers to exploit them (palatability)
 - Some sources are easier to break down than others



IV. Environmental Control on Decomposers

- Measuring litter breakdown
 - Litter bag experiments:

- Mesh bags with pre-weighed amounts of post-abscission litter
- Mesh must not exclude biota (unless you deliberately want to)
- Replicates placed in the field and picked up over time
- Calculate % mass remaining after time →



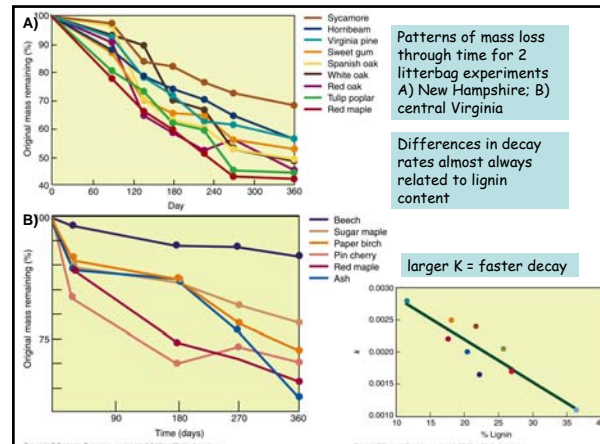
$$W_t (\% \text{ remaining}) = W_i e^{-kt}$$

IV. Environmental Control on Decomposers

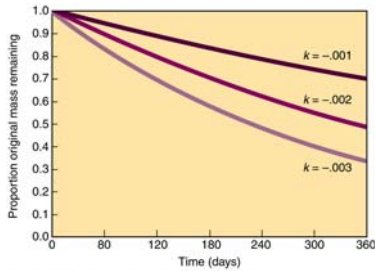
- Measuring litter breakdown

$$W_t (\% \text{ mass remaining}) = W_i e^{-kt}$$

- W_t = weight after time
- W_i = initial weight
- T = time in days
- - K = decay rate = slope of the line (decay coefficient) (units are - days)



General model of decomposition where mass loss is expressed as an exponential decay function $\rightarrow e^{-kt}$. The larger the value of K , the faster the rate of decomposition and the steeper the curve.



IV. Environmental Control on Decomposers

- Physical environment
 - Temperature
 - Low T = reduced microbial activity
 - Moisture
 - Dry conditions limited decomposers
 - The optimum environment for decomposers (i.e., microbes) is warm and moist

IV. Decomposition in Aquatic Environments

- So a leaf falls into a stream, what happens?
 - Initial colonization by aquatic fungi
 - Peanut butter on the cracker
 - Shredders break particles into fine particles
 - CPOM \rightarrow FPOM
 - FPOM either deposited or transported downstream
 - Collectors further breakdown FPOM \rightarrow DOM
 - Filters and gatherers
 - Particle size increased and mineralized as feces
 - Process continues