# Ecology and the Living Planet

¶ 6.1



Biology 101 B – Lecture 6

¶ 6.2

# Ecology

Interaction of living things

with each other

and their surroundings.







From single organisms upward to the whole planet.

¶ 6.3



*Ernst Haeckel, 1866*

**Biosphere**
Sum of all ecosystems

**Ecosystem**
Adds nonliving surroundings

**Community**
All populations together

**Population**
One species in one place

**Organism**
One individual

+ Adds the nonliving surroundings.

¶ 6.4

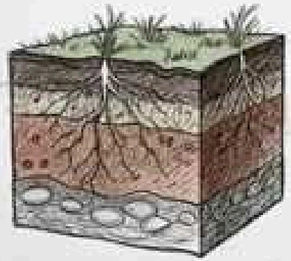
## HABITAT: The Place
(Where it is found)



Temperature



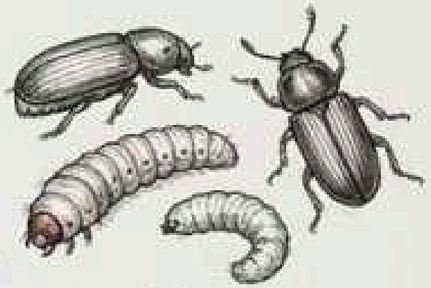
Water



Soil & Shelter



## NICHE: The Role
(What it eats, what eats it, resource use)

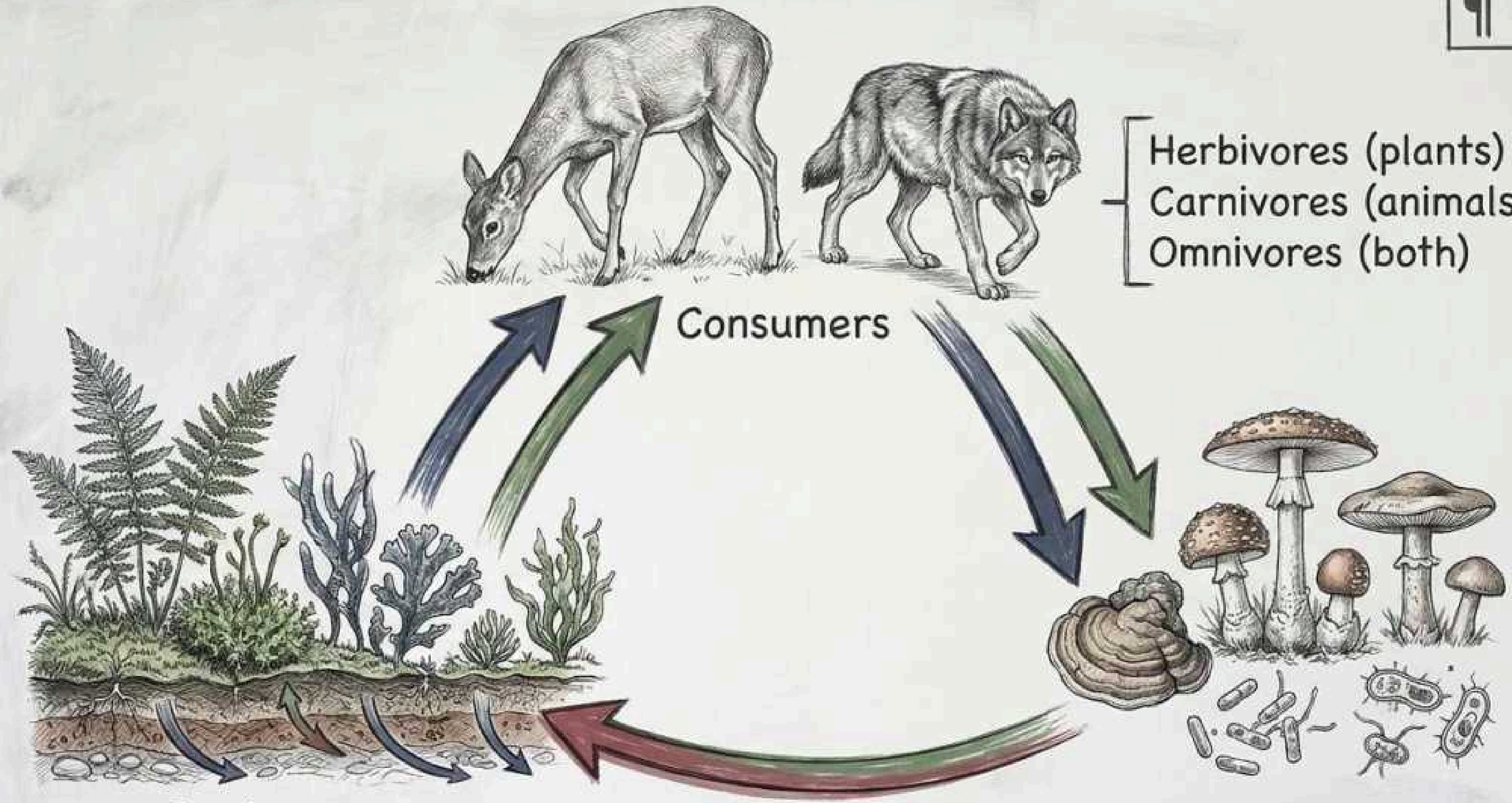


Food Source
(Beetles)



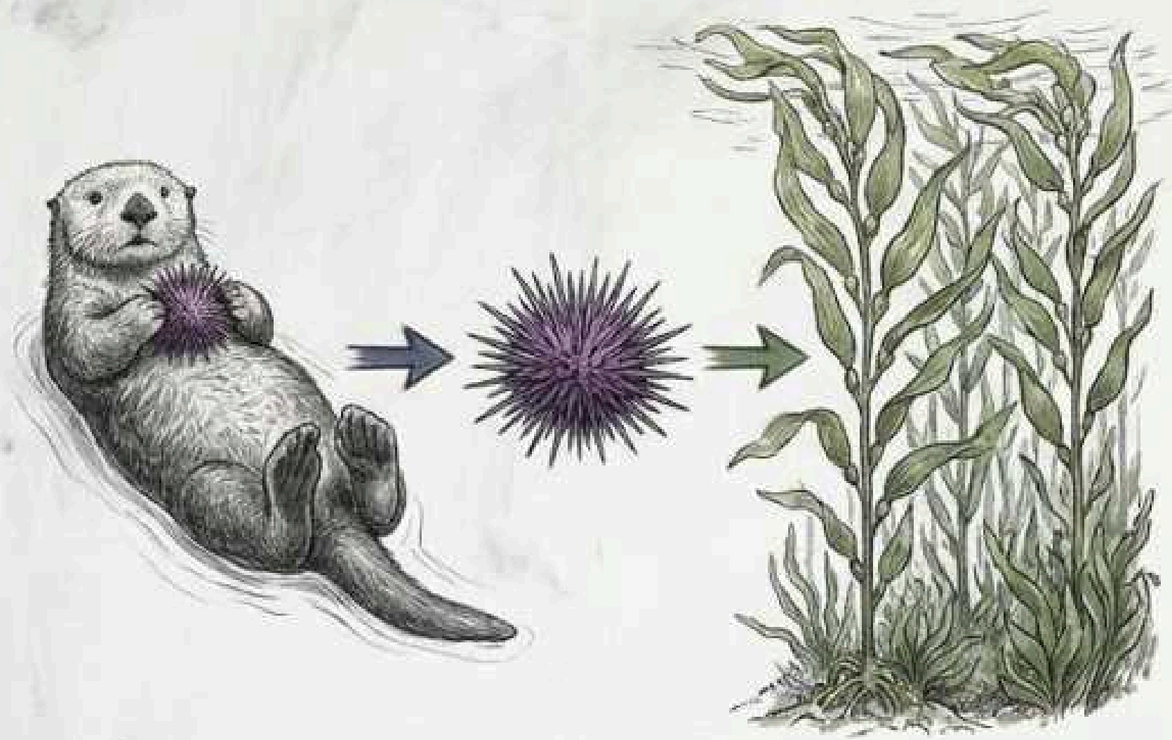
Predator
(Hawk)

¶ 6.5


Herbivores (plants)
Carnivores (animals)
Omnivores (both)
Consumers
Producers
Decomposers

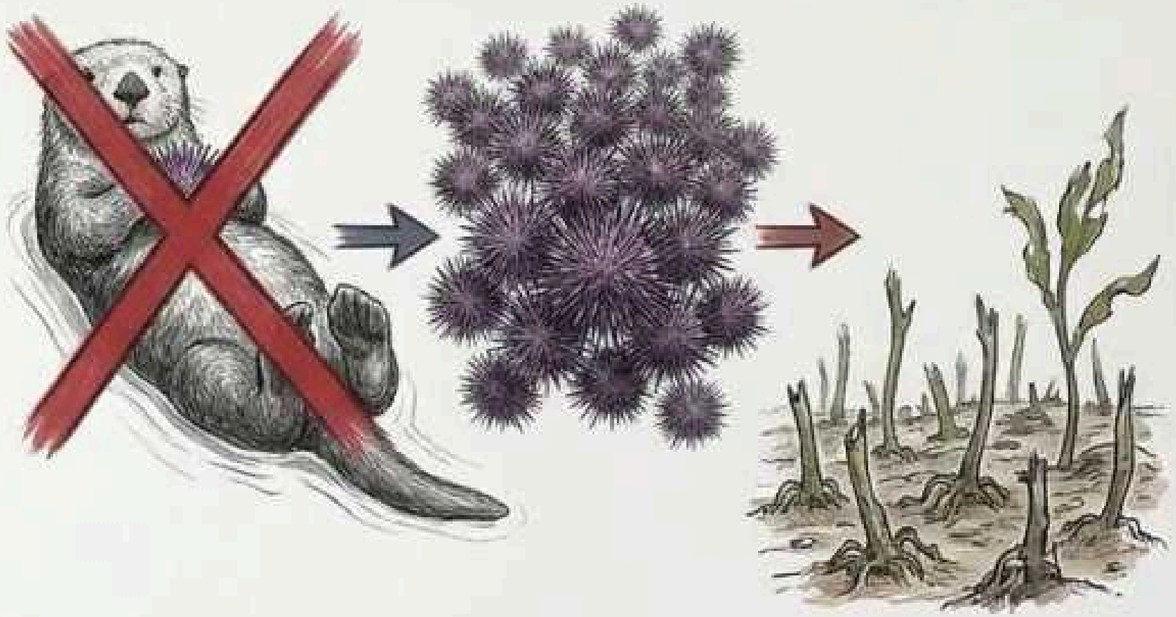
# The Keystone Species Effect

## Scenario A



Otter present → Urchins controlled → Kelp thrives

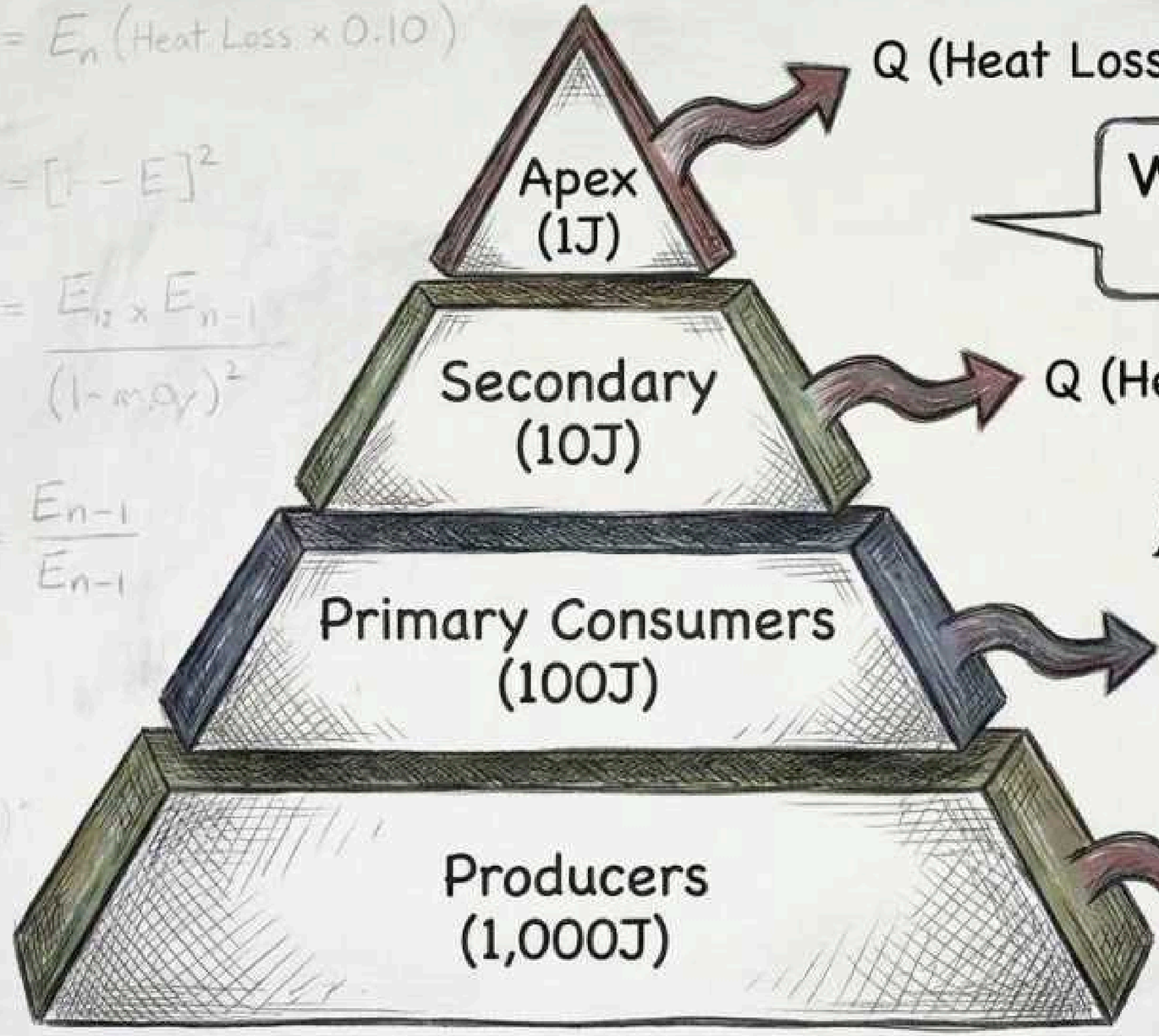
## Scenario B



Otter removed → Urchins multiply → Kelp destroyed

Some species matter far more than their numbers suggest.

¶ 6.7




Q (Heat Loss & Metabolism)

Why there are far fewer lions than zebras.

Q (Heat Loss & Metabolism)

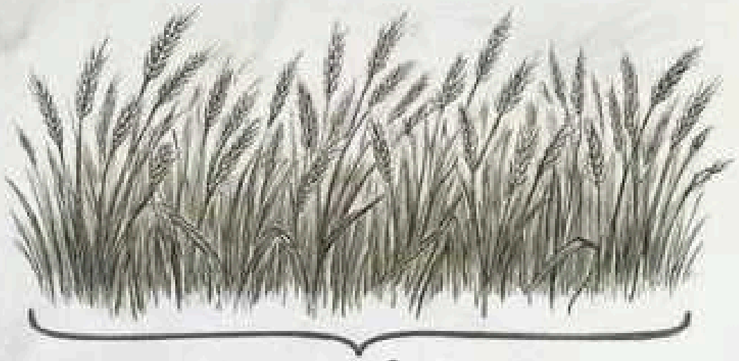
$$E_n = E_{n-1} \times 0.10$$

Q (Heat Loss & Metabolism)

Q (Heat Loss & Metabolism)

¶ 6.8

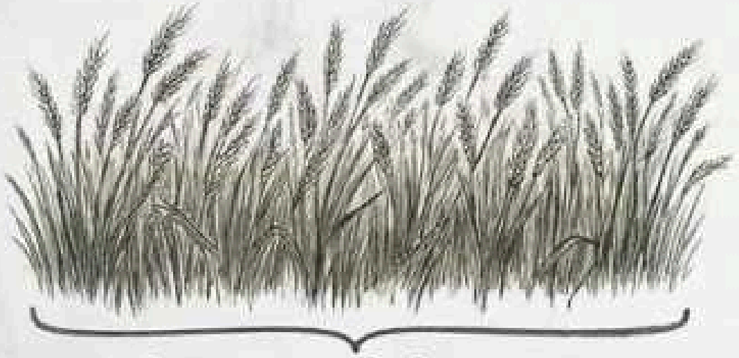
# Eating lower on the food chain feeds more people from the same land.



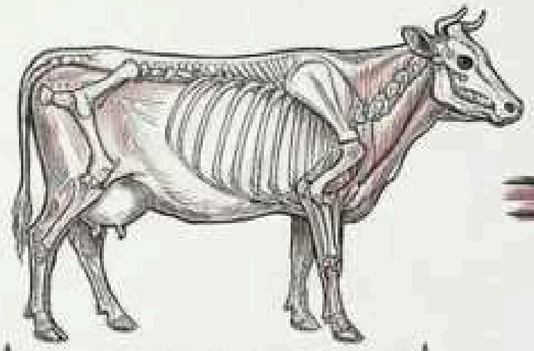
1 Acre of Grain



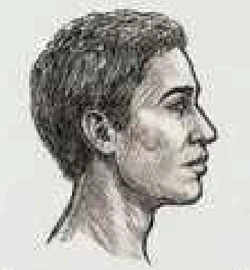
Feeds ≈ 10 People



1 Acre of Grain



Feeds 1 Cow

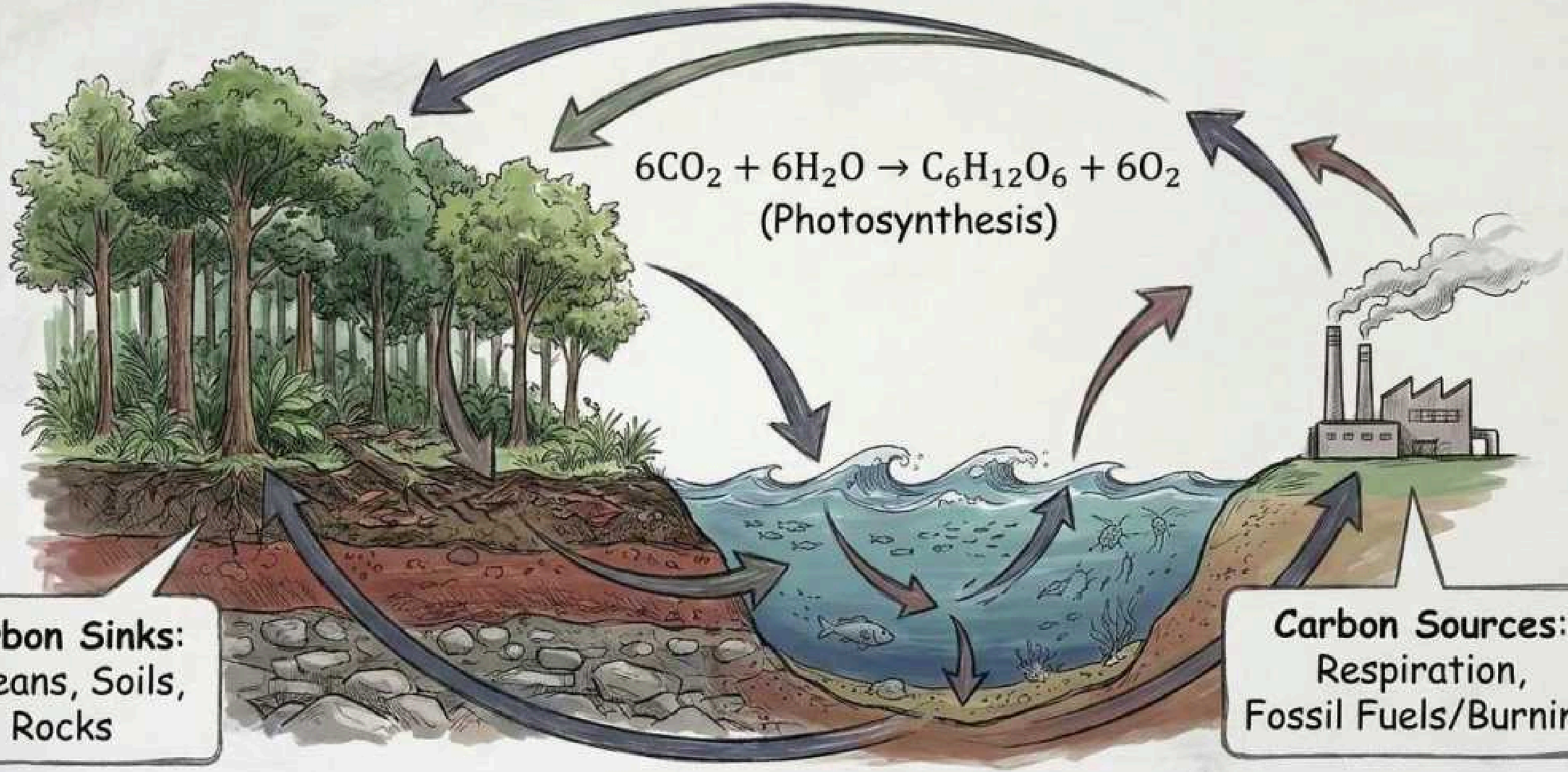


Feeds ≈ 1 Person

*Caveat: Livestock often graze on land unsuited for crops.

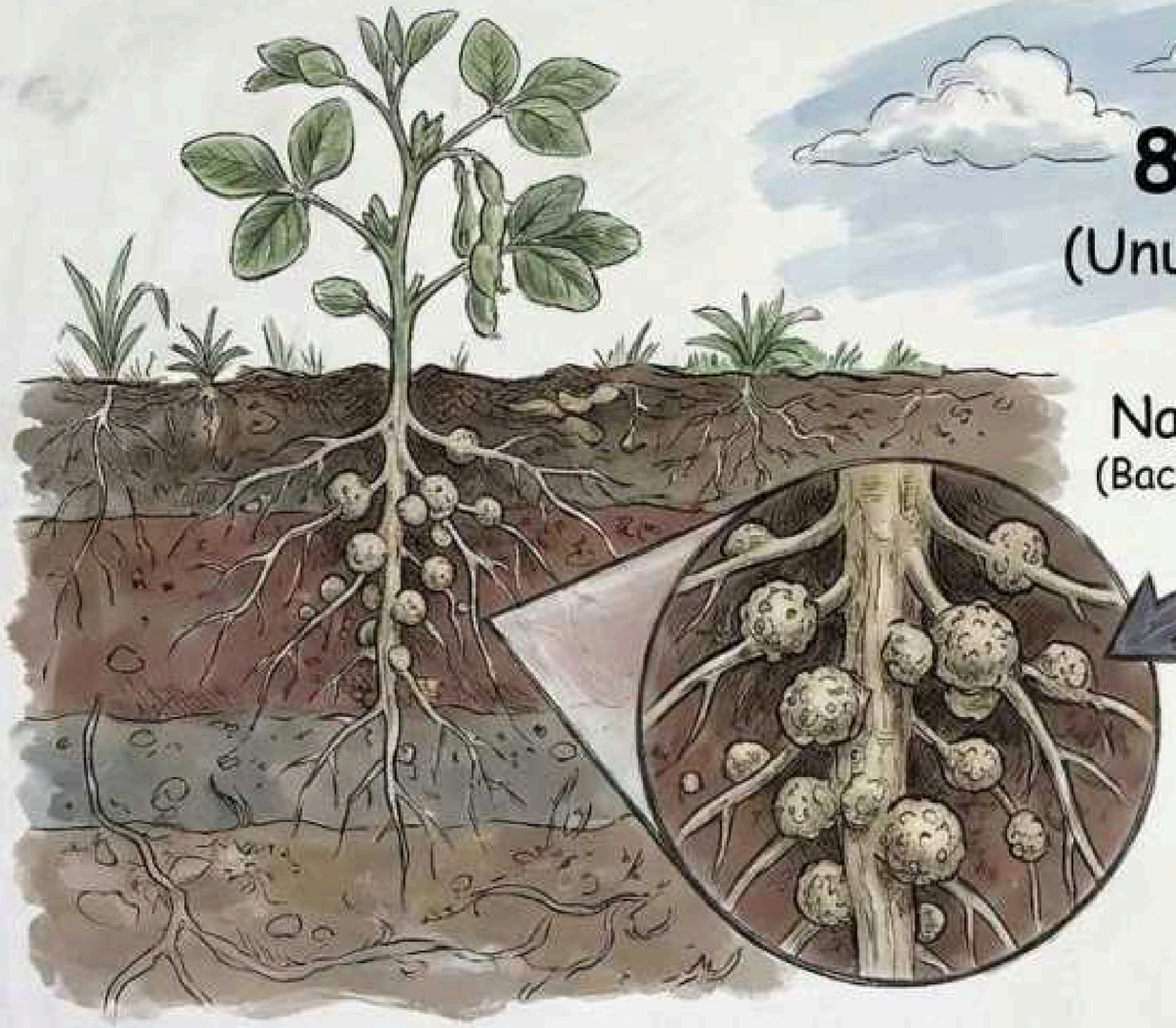
# Matter, unlike energy, is recycled.

¶ 6.9



¶6.10

# Nitrogen is essential for DNA & Proteins.

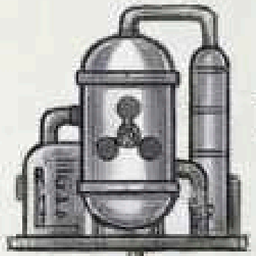


**80% $N_2$ Gas**

(Unusable to most life)

Natural Fixation
(Bacteria in beans/peas)

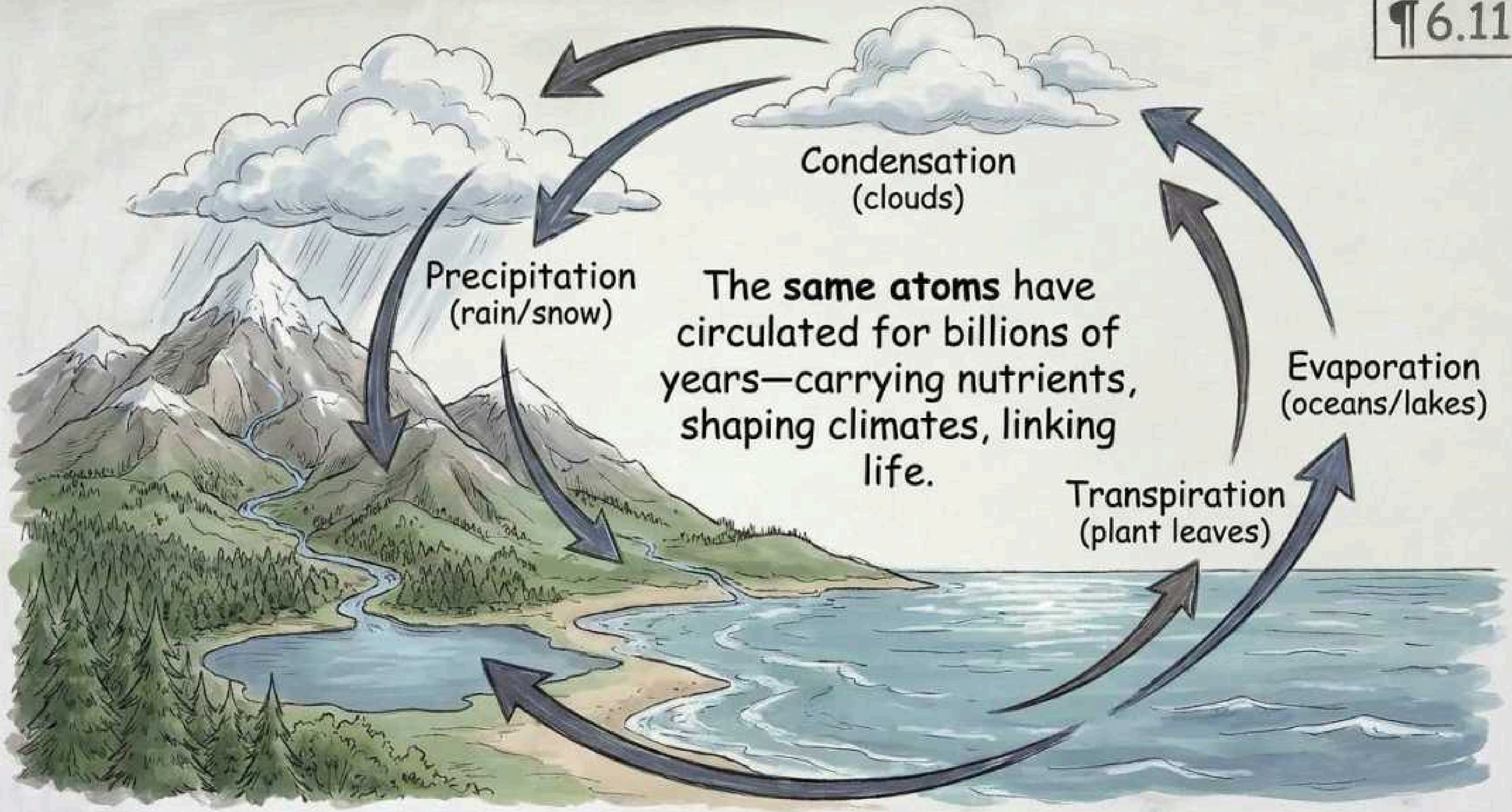
Industrial Fixation



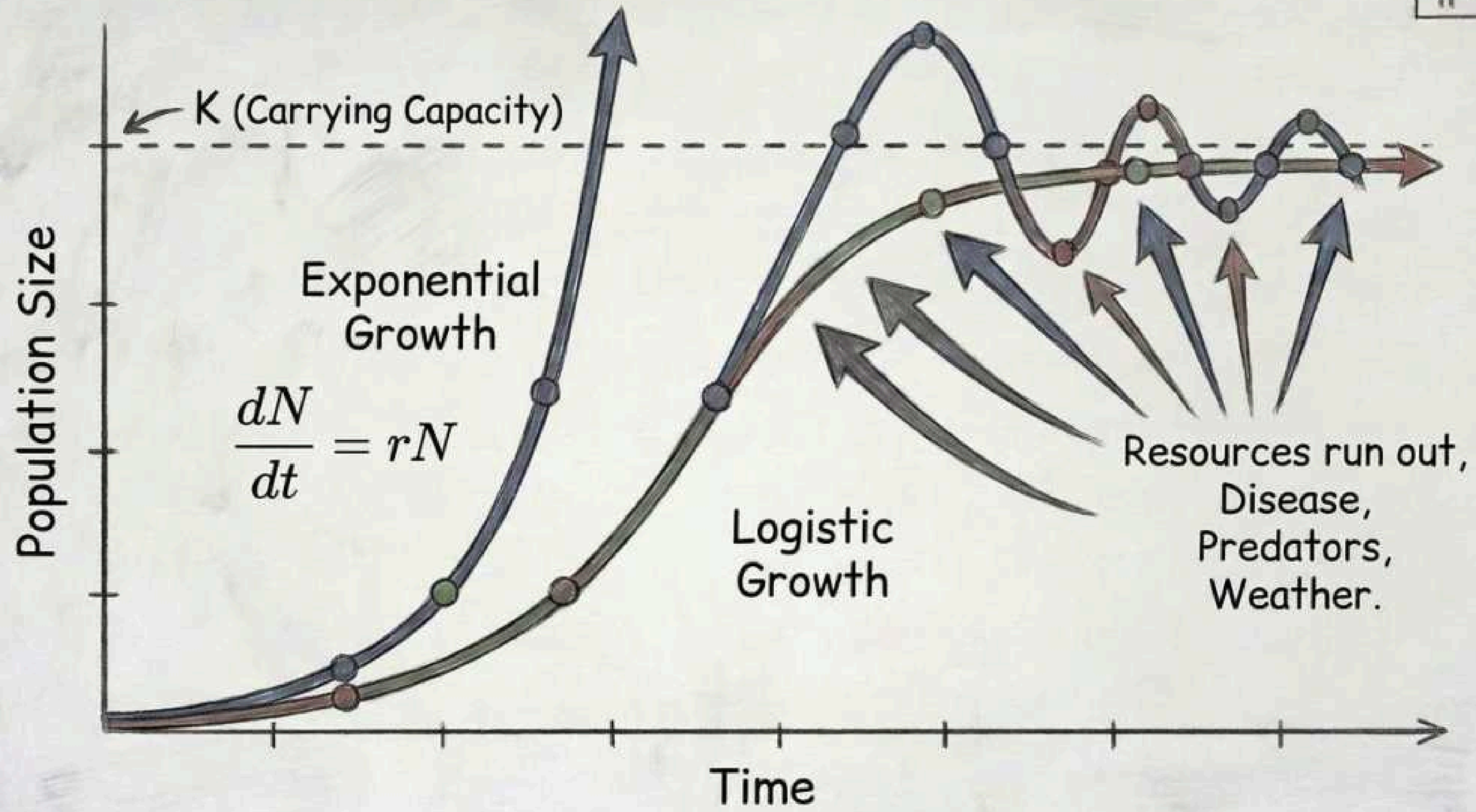
$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

(Industrial Fertilizer)

¶6.11


Condensation
(clouds)
Precipitation
(rain/snow)
The **same atoms** have circulated for billions of years—carrying nutrients, shaping climates, linking life.
Evaporation
(oceans/lakes)
Transpiration
(plant leaves)

¶6.12

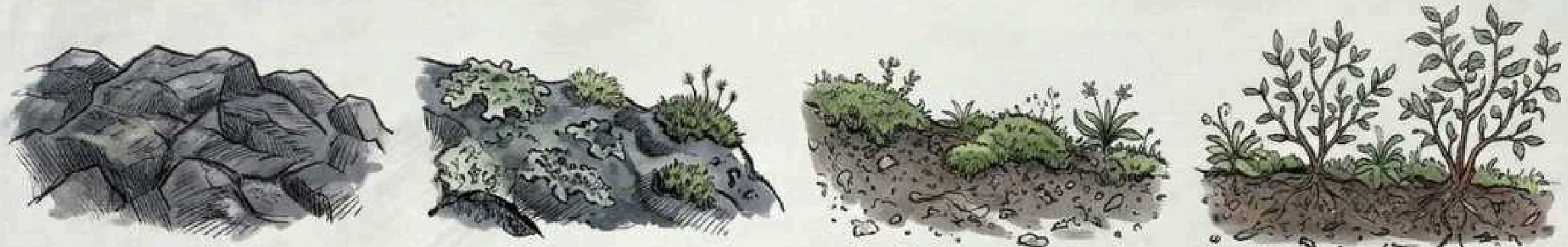

K (Carrying Capacity)
Exponential Growth
$\frac{dN}{dt} = rN$
Logistic Growth
Resources run out, Disease, Predators, Weather.
Population Size
Time

¶6.13

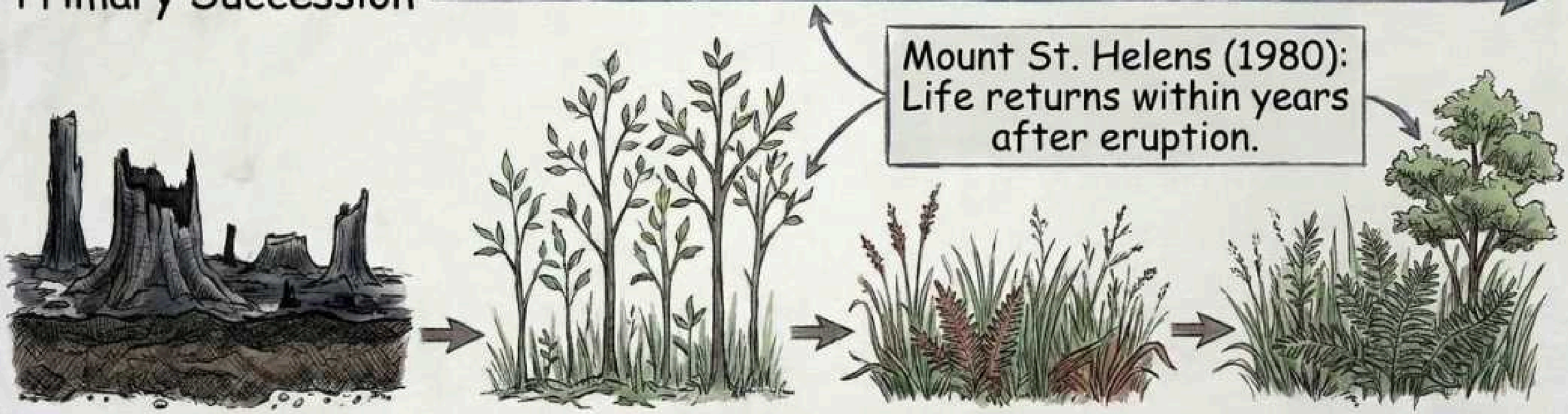
| Species Interaction | (Interaction Symbols) | Explanation |
|---|---|---|
| Competition | (- / -) | Both lose a little |
| Predation | (+ / -) | One eats the other |
| Parasitism | (+ / -) | One gains, host harmed |
| Mutualism | (+ / +) | Both gain |
| Commensalism | (+ / 0) | One gains, other unaffected |



¶6.14



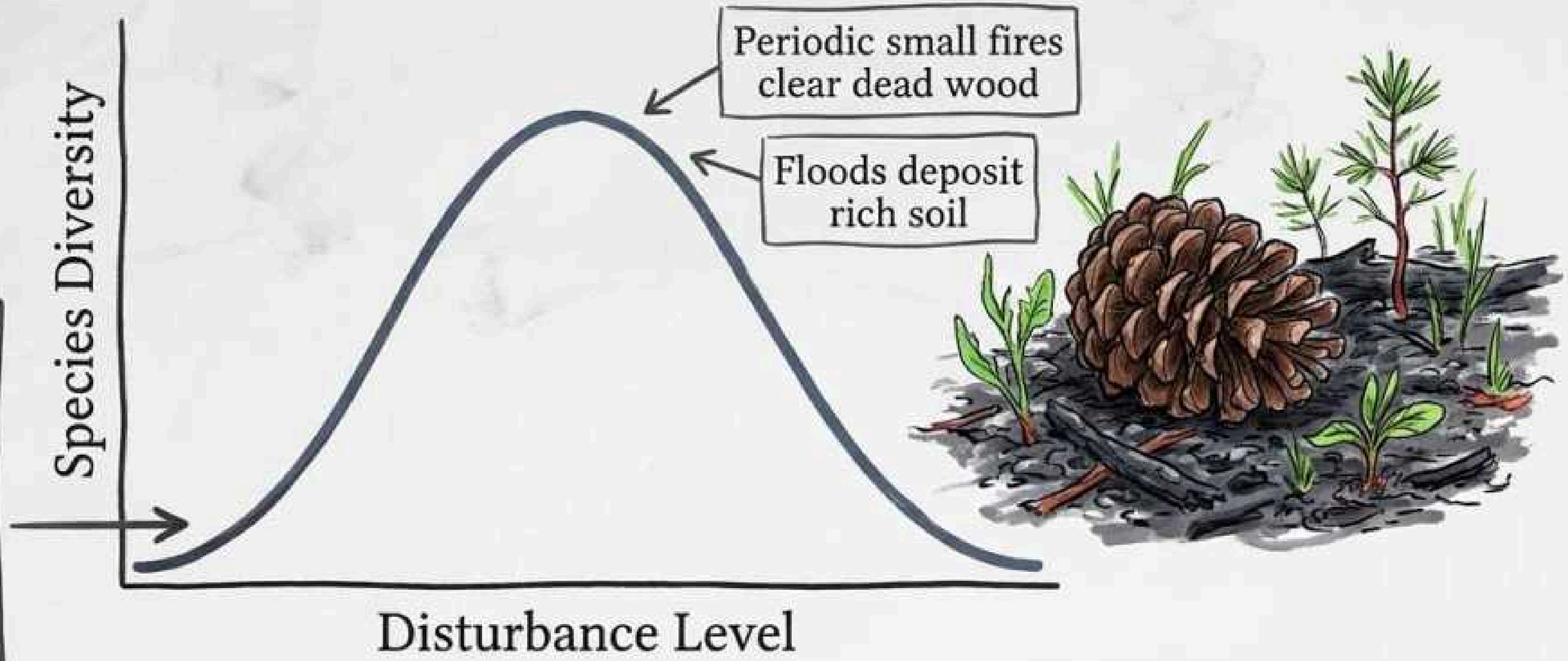
Primary Succession




Secondary Succession

¶ 6.15

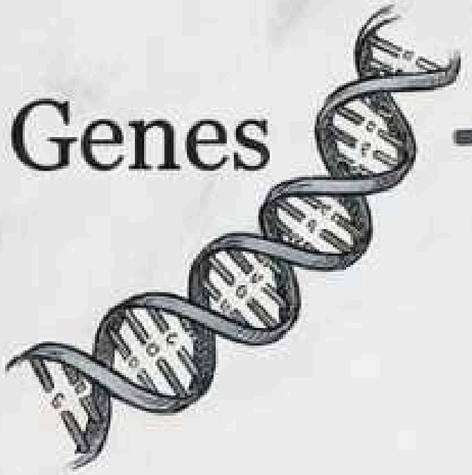
# Intermediate Disturbance Hypothesis




20th-century forest management suppressed all fires → Fuel build-up caused later, severe disasters

¶ 6.16

Genes → Species → Ecosystems



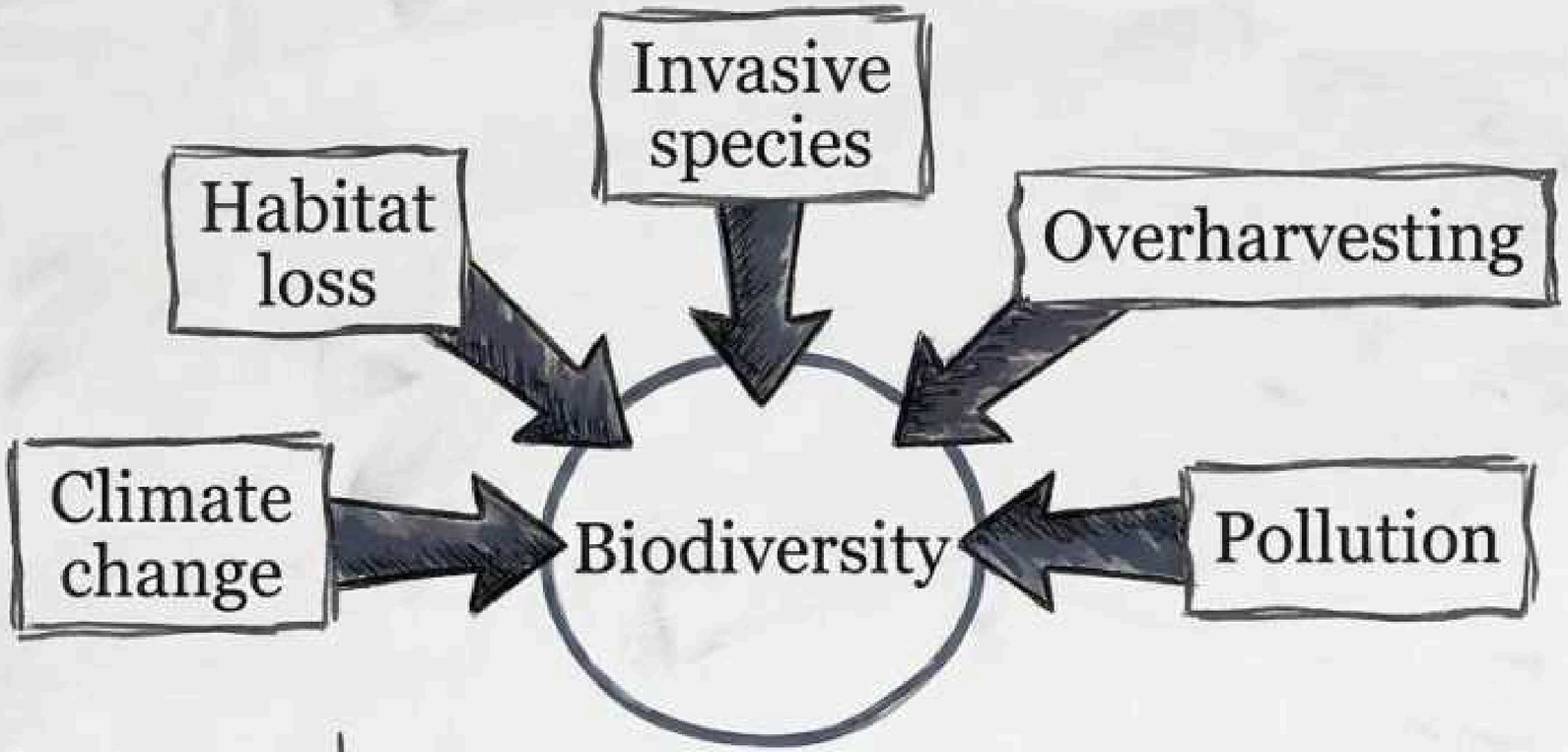
2M+ named, millions more unknown

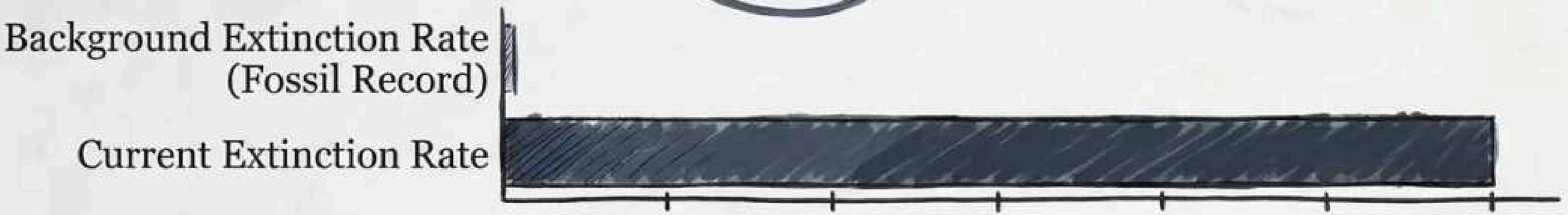


## Ecosystem Services (Costly or impossible to replace)

- ☒ Pollination
- ☒ Fertile Soil
- ☒ Clean Water
- ☒ Flood Protection

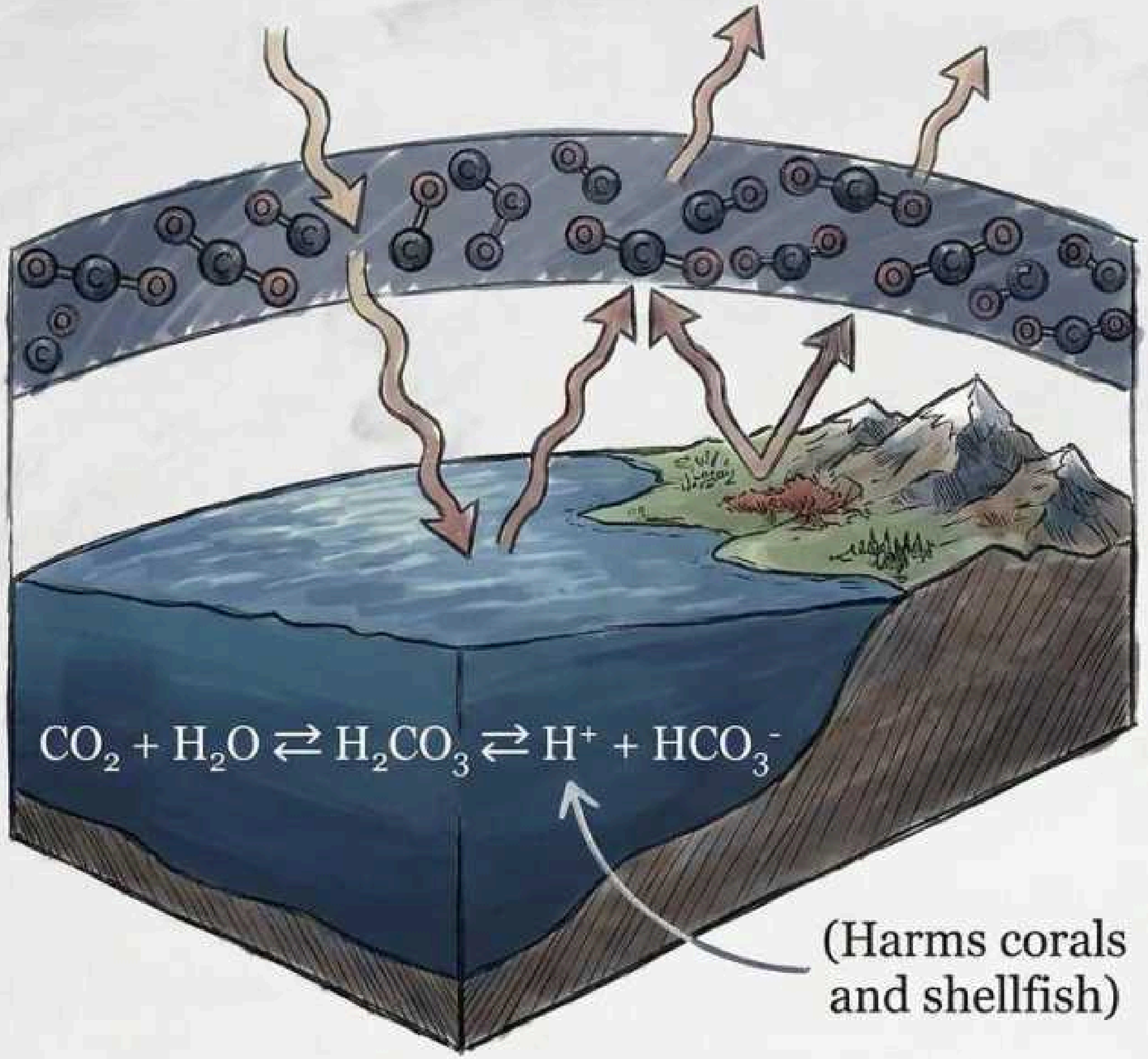
¶ 6.17



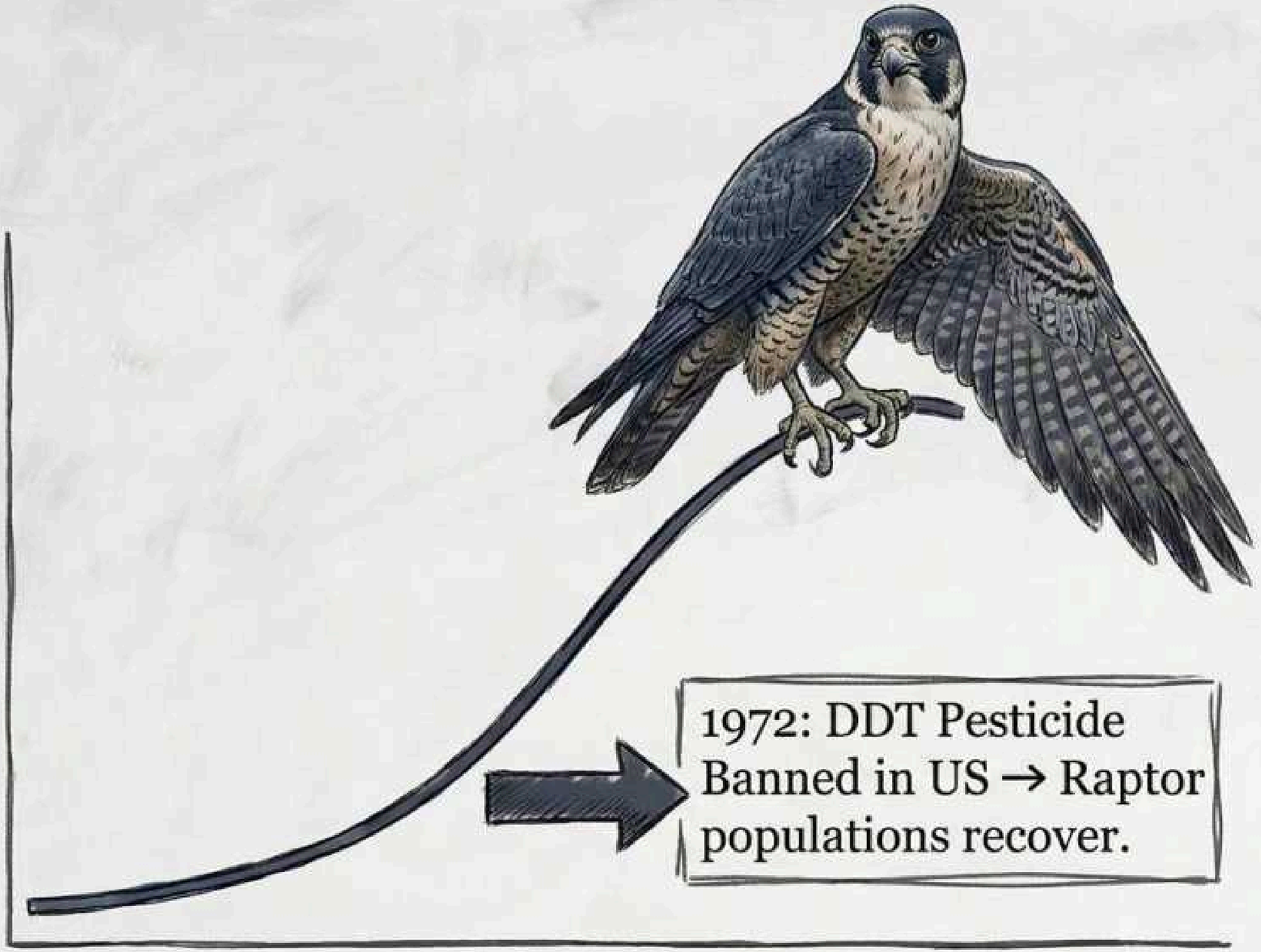

# The Sixth Mass Extinction

¶ 6.18




- Trapped heat
- Acidifying oceans
- Shifting ranges (species migrating toward poles and up mountains)

¶ 6.19

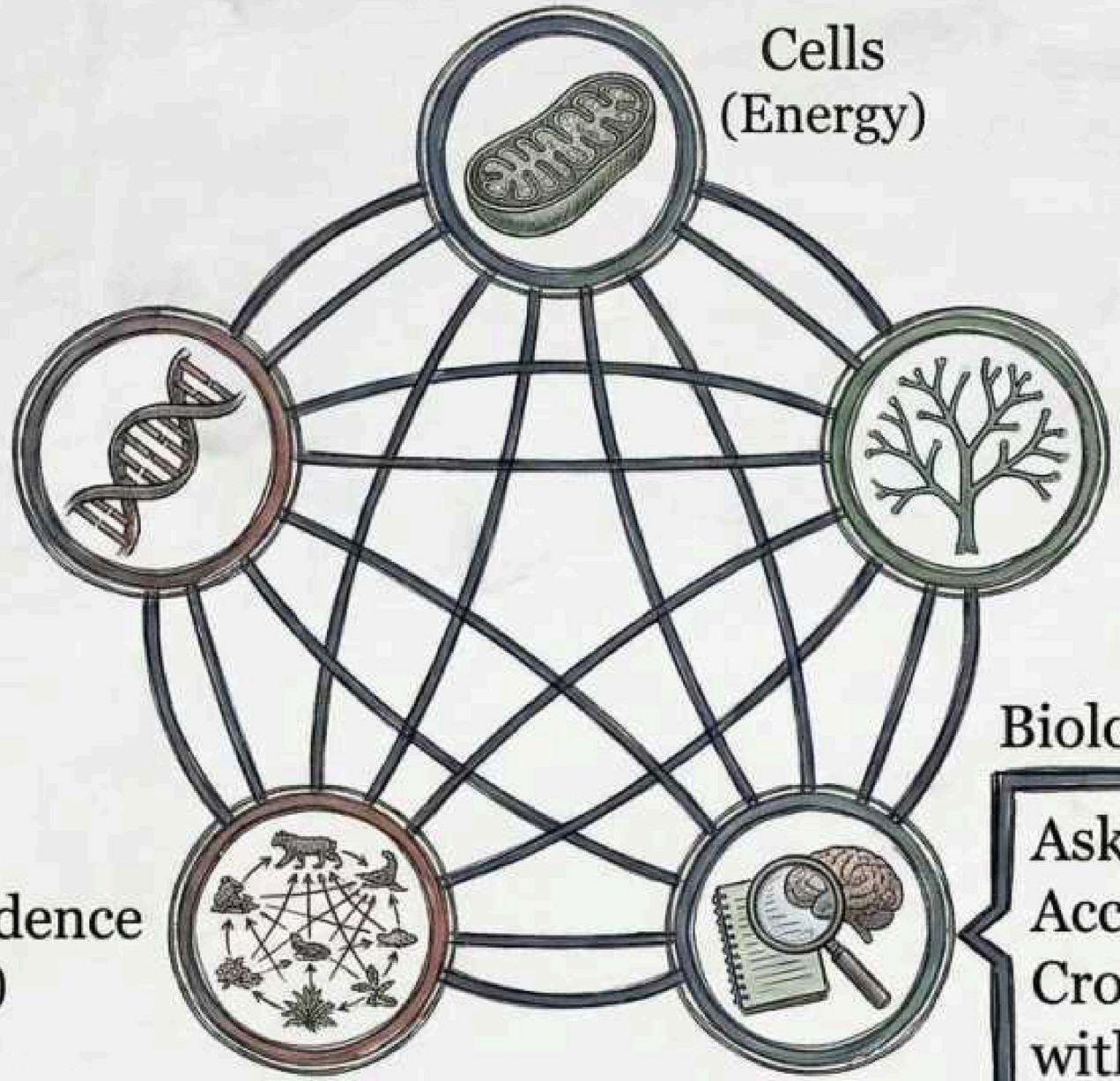


1972: DDT Pesticide Banned in US → Raptor populations recover.

Tools for Repair (requires knowledge & cross-border cooperation)

- Protected areas
- Restored wetlands
- International agreements

¶ 6.20




Biological Habits

Ask for evidence.
Accept uncertainty.
Cross-check AI tutors
with primary sources.

¶ 6.21

Trace its cells, its energy, its genes, its evolutionary history, and its place in an ecosystem.



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