

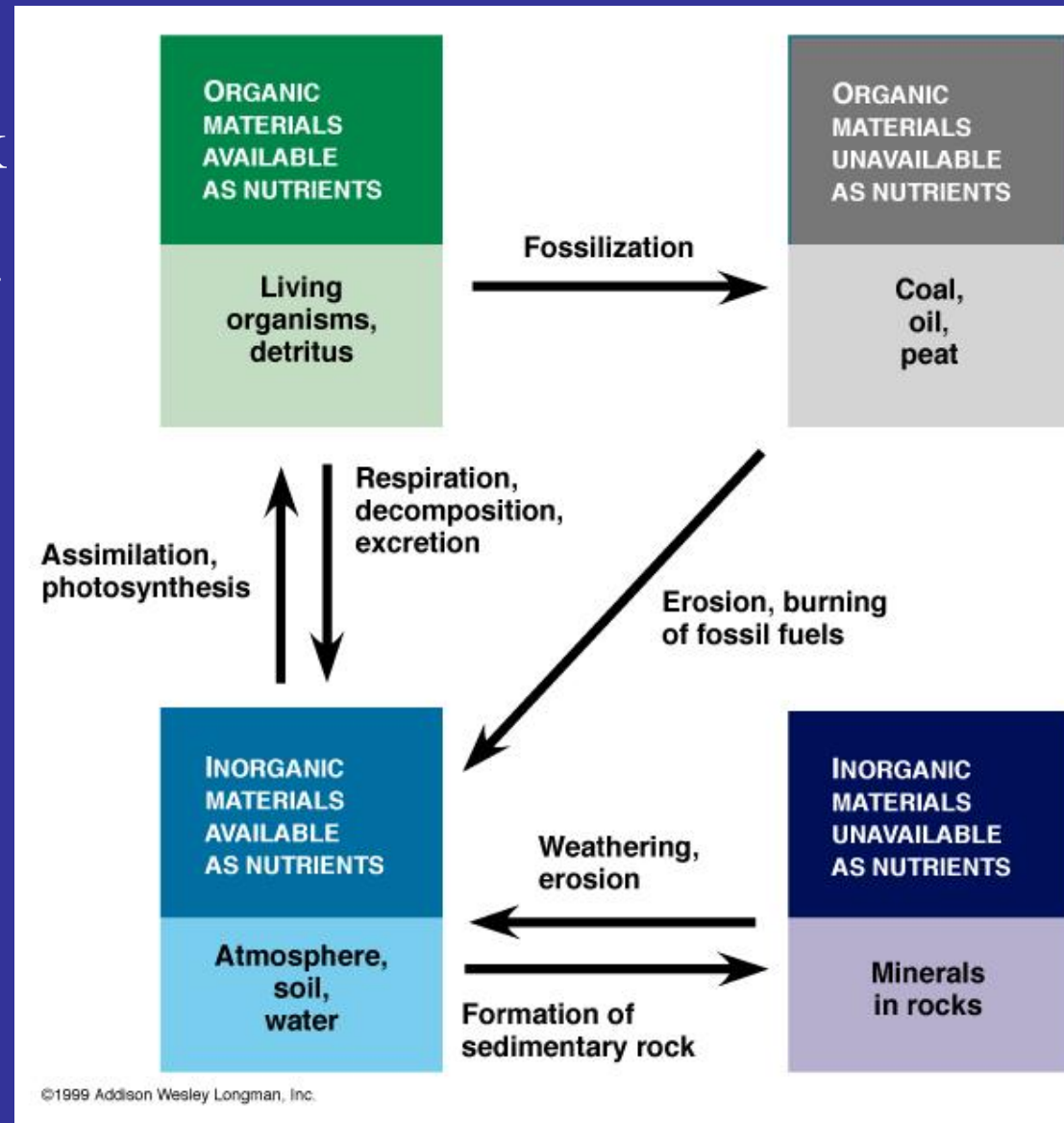
Prof . Dr. Idham Ali Abed / collage of Agriculture /
University of Anbar

أسس دورات العناصر الحيوية

Gas (Symbol)	Percentage
Nitrogen (N)	78.03
Oxygen (O)	20.99
Argon (Ar)	.94
Carbon dioxide (CO ₂).	.035 -.04
Hydrogen (H)	.01
Neon (Ne)	.012
Helium (He)	.0005
Krypton (Kr)	.0001
Ozone (O ₃)	.00006
Xenon (Xe)	.000009

Basics of nutrient cycling

- Short-term: fixed stock available for organisms; question of turnover time
- Long-term: exchange between short-term pools and minerals/fossils
- Anthropogenic *perturbations* of nutrient cycling, local and global

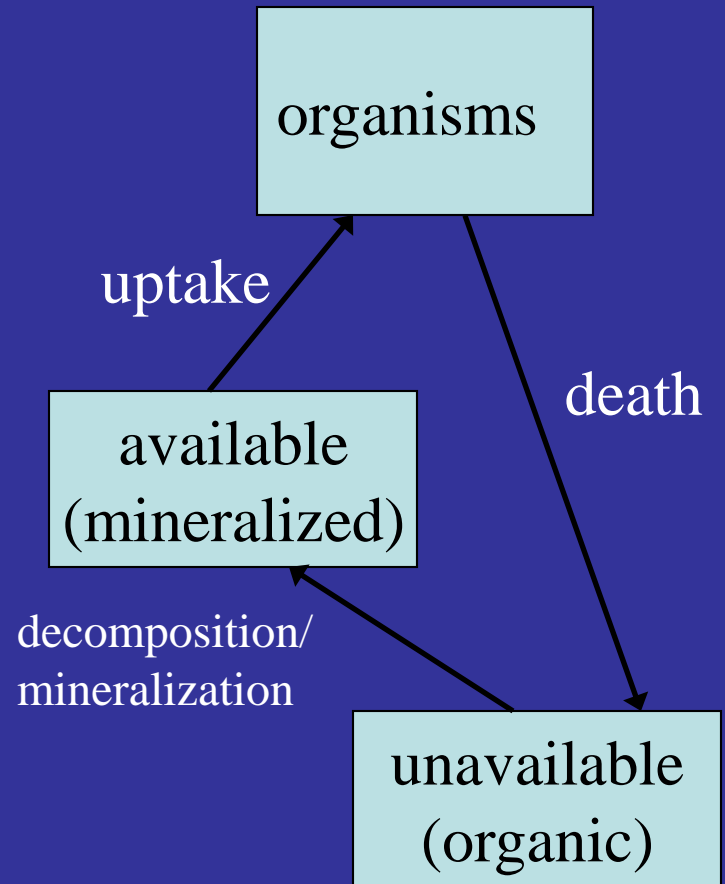


Local and global cycling

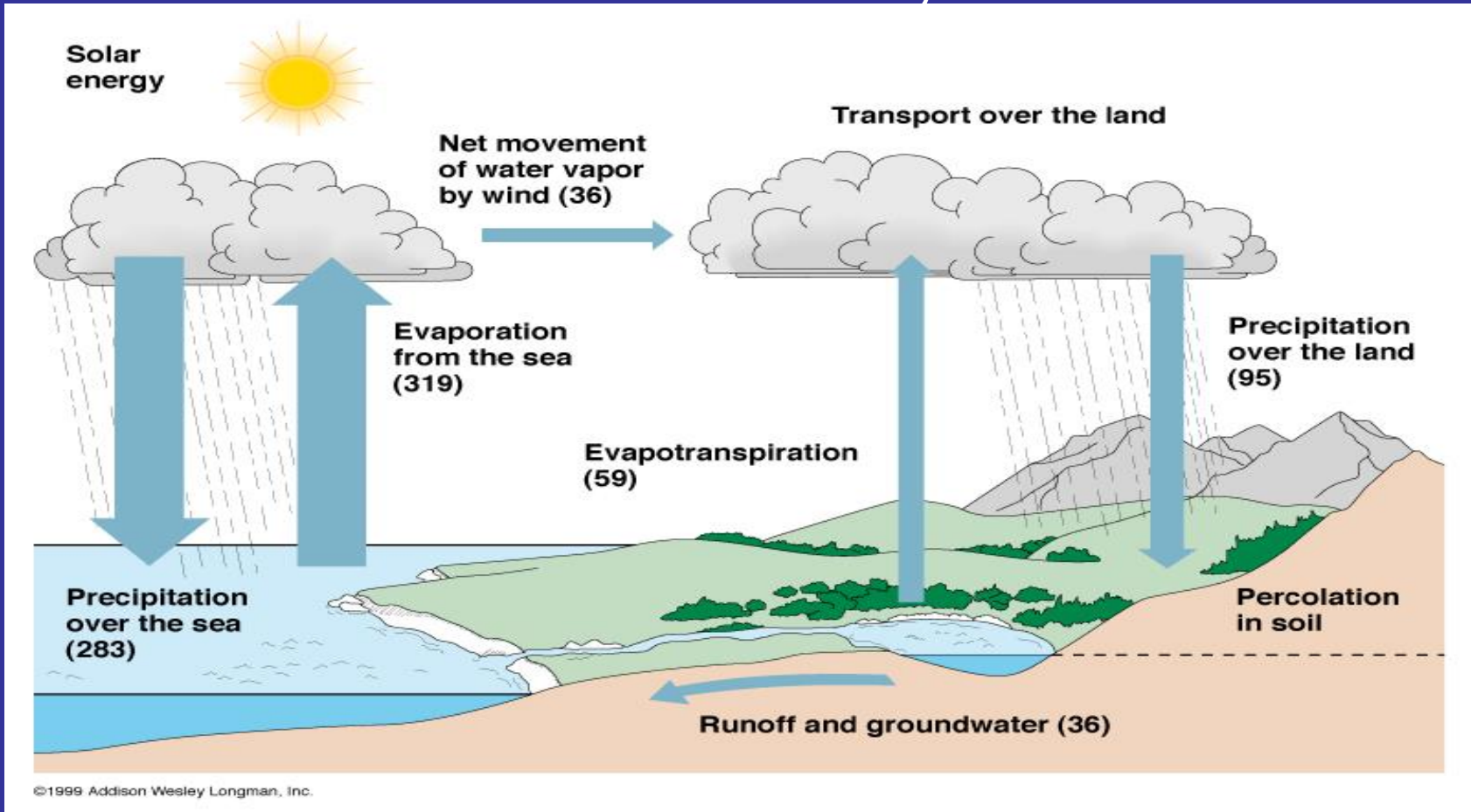
- *Local vs. global feedbacks* in nutrient dynamics (recycling vs. one-way flow) depend on physics: gaseous phases mix, solid/liquid phases stay
 - one-way: energy, water
 - partly recycled: carbon, nitrogen
 - mostly recycled: phosphorus
- Humans have long affected local landscapes, but only recently affected *global* biogeochemical cycles

Dynamics of recycled nutrients

- cycling: available, temporarily unavailable, incorporated
- amount of biomass in plants = biomass:nutrient ratio (approx. 2:1 for carbon, varies more for other nutrients)
- fast cycling can be good for organisms (lots of available nutrient), but can also lead to long-term nutrient losses



The water cycle



- water goes through biological systems on essentially a *one-way* trip
- cycle is fairly quick (except for aquifers, deep ocean circulation)

Let's consider four biogeochemical cycles of elements required by organisms for life

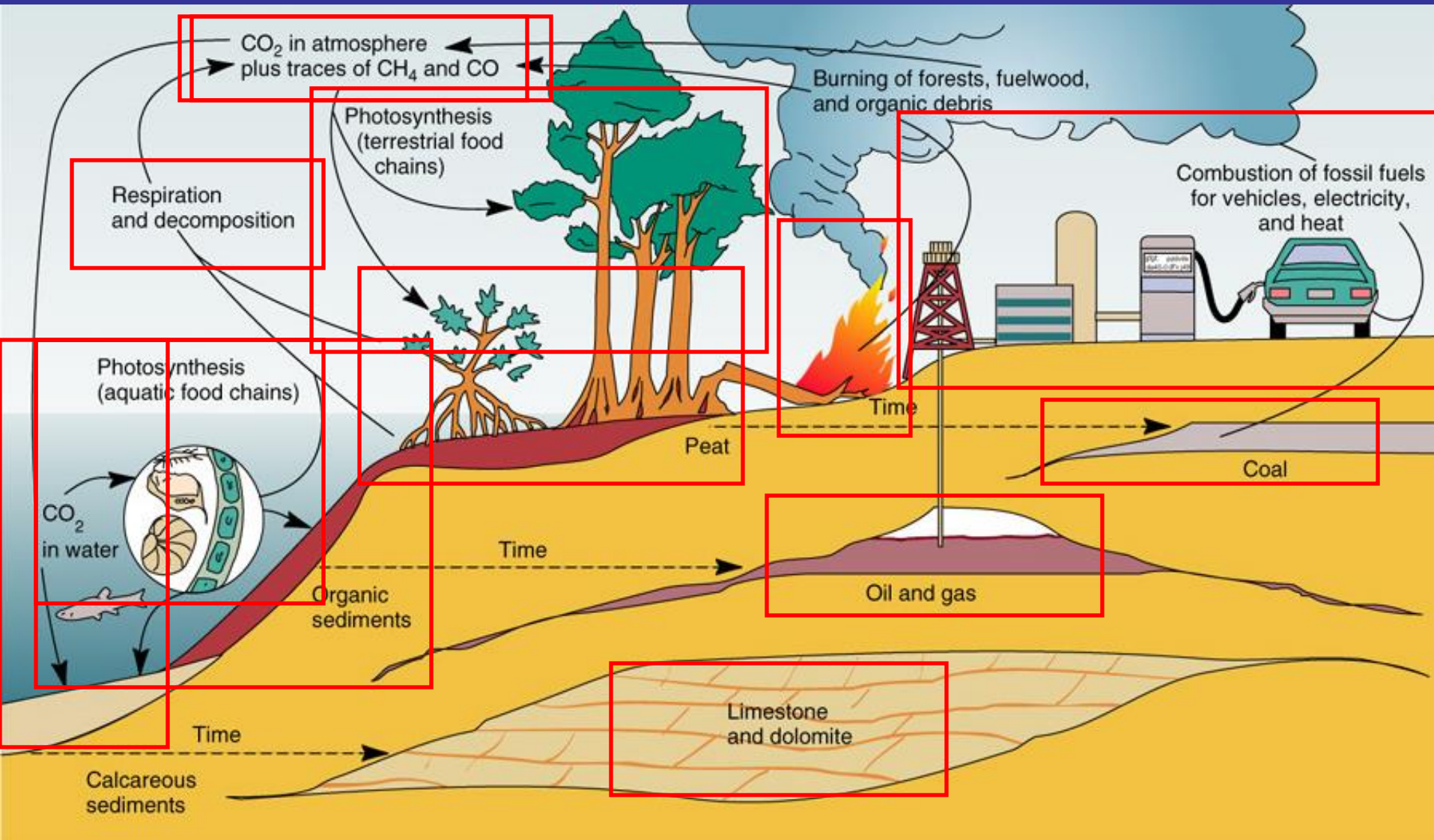
Carbon

Phosphorus

Sulphur

Nitrogen

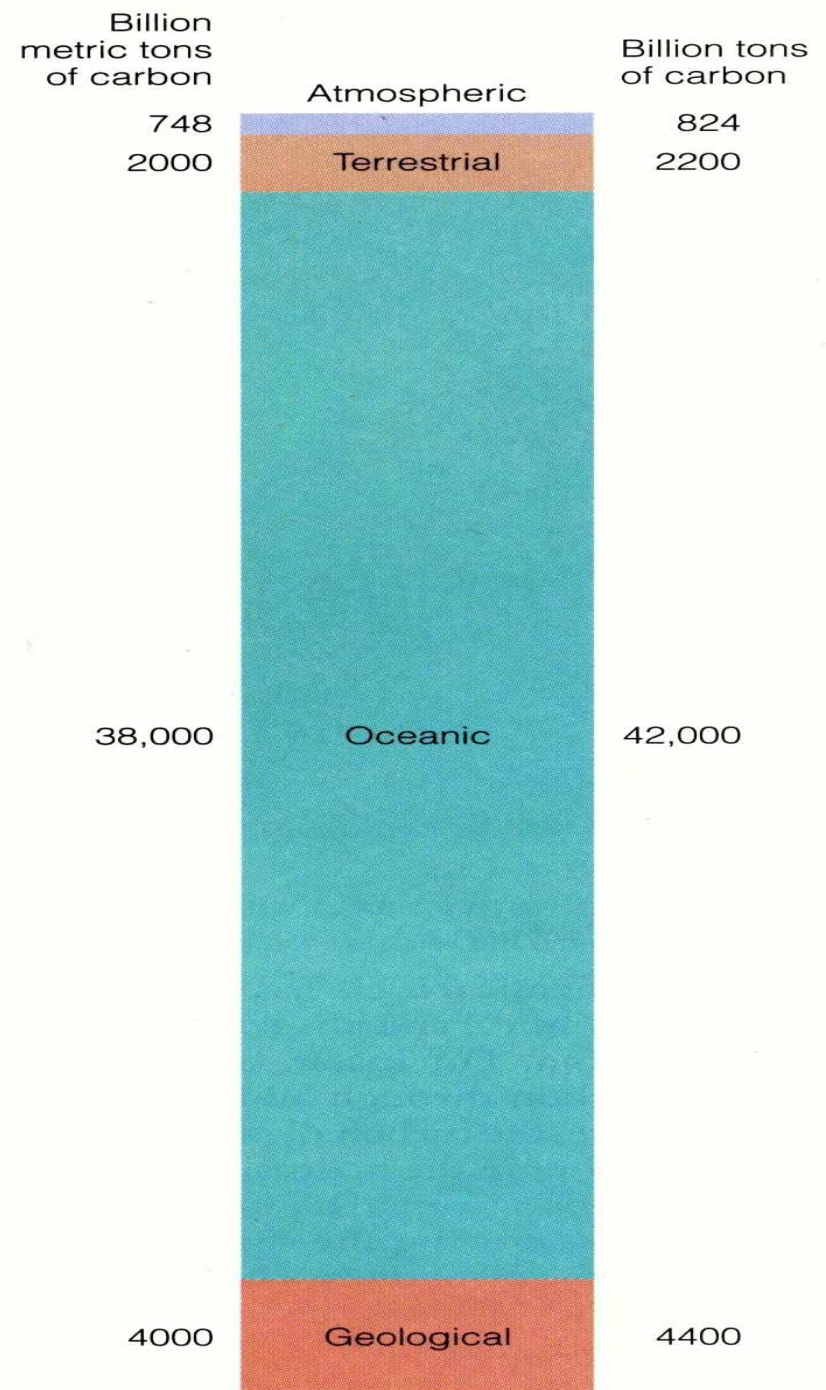
The Carbon Cycle

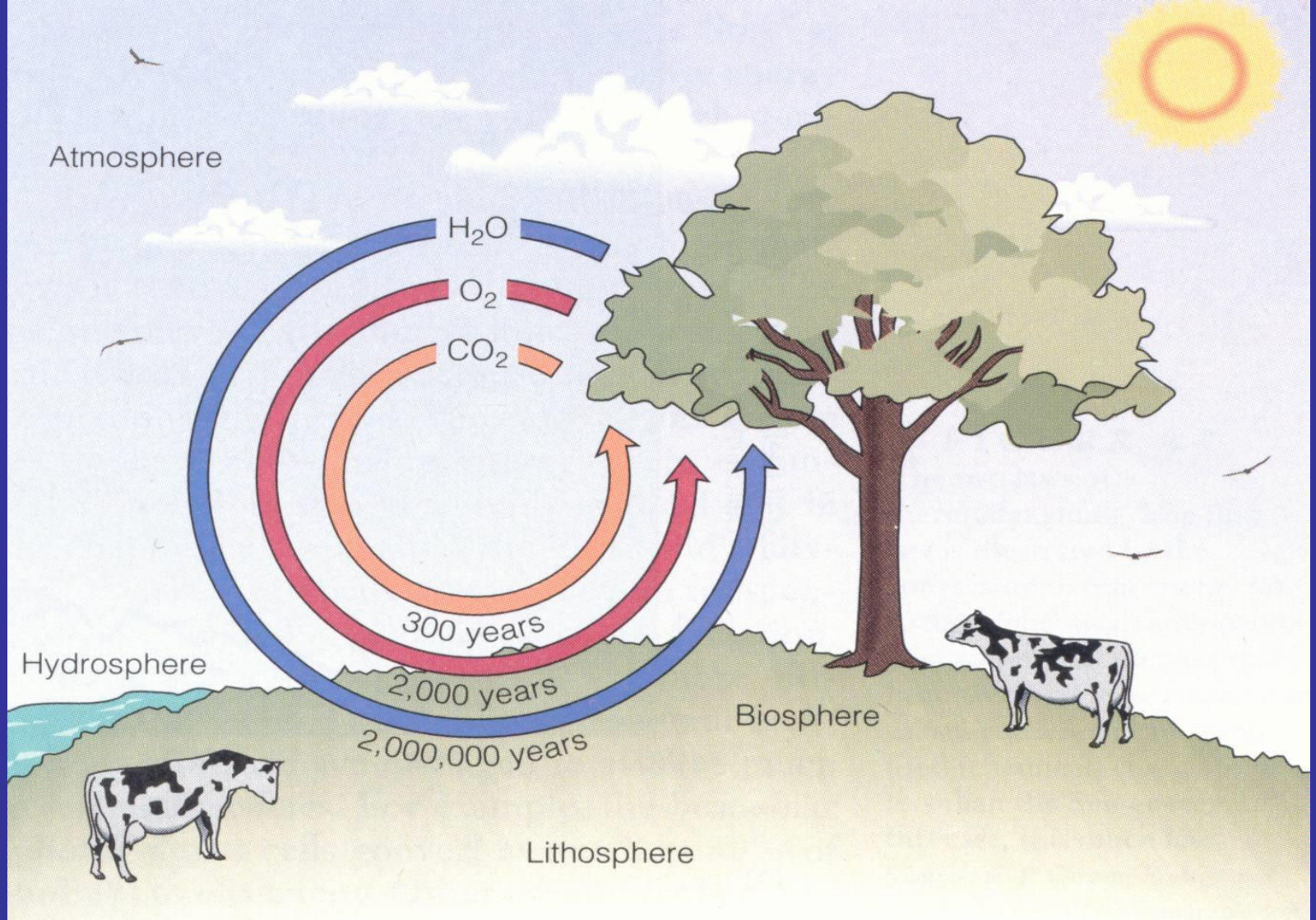


Carbon Forms: CO_2 , CO , CH_4 , H_2CO_3 , organic matter, CaCO_3

Major pools of the carbon cycle in billions of tons of carbon.

The oceans contain the largest pool of carbon.

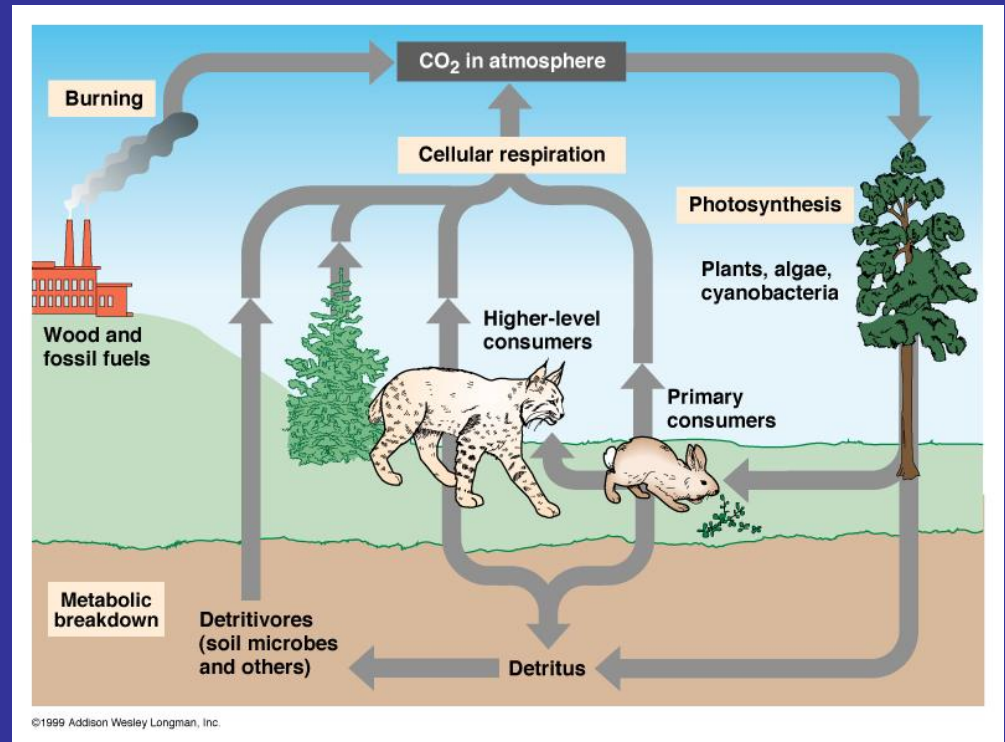




Recycling rate of H_2O , O_2 and CO_2 among the atmosphere, hydrosphere, biosphere and lithosphere

Carbon cycle

- Central “nutrient”:
 - closely bound to energy
 - bound to N
 - makes up structure of most organisms: 50% of dry biomass

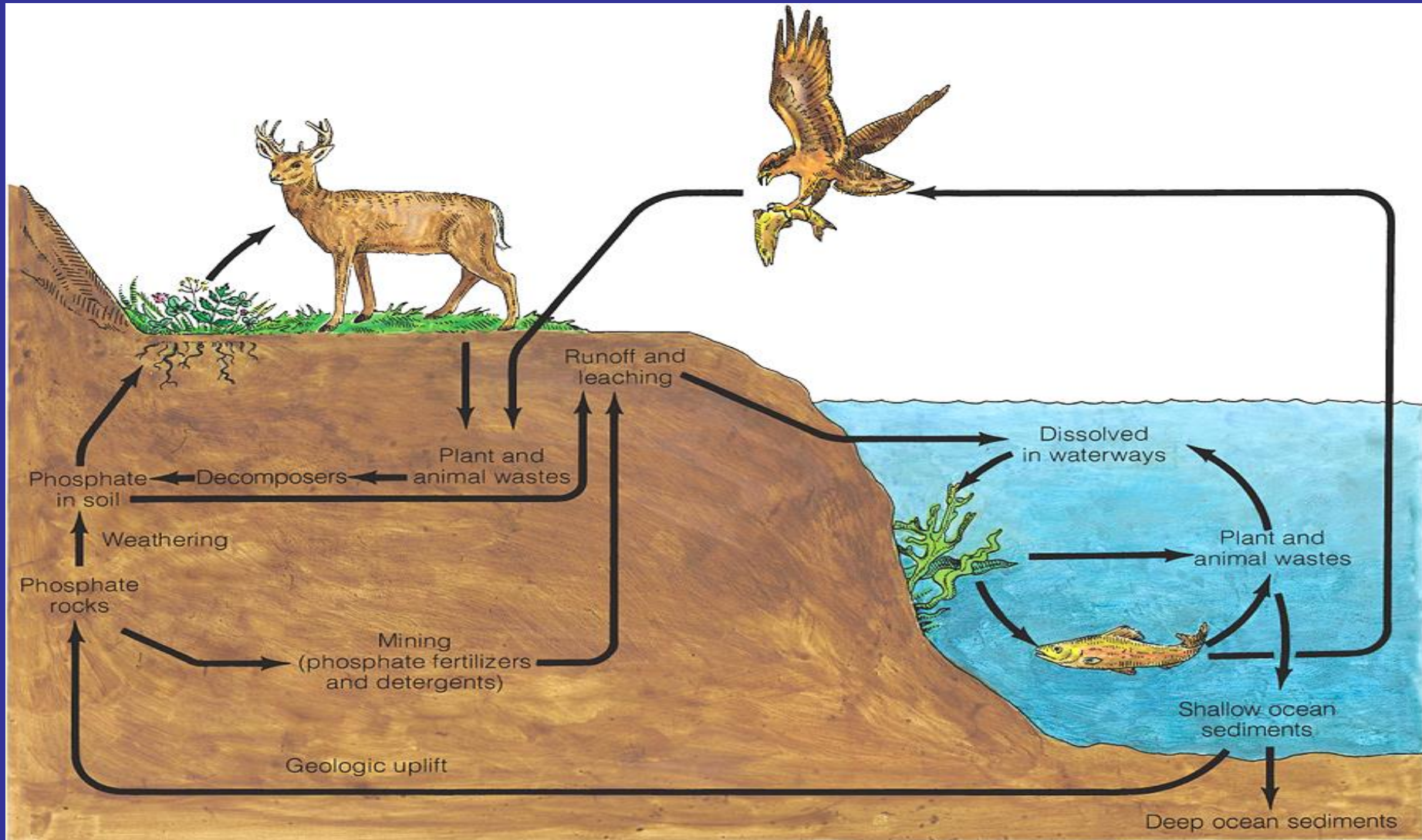


- Major carbon storage, or *sinks*:
 - slow-decomposing compounds in soil
 - bicarbonate in the ocean
 - fossil fuels
 - wood

Carbon (2)

- Gaseous phase: well-mixed. Atmospheric concentration ≈ 350 ppm (pre-industrial ≈ 250 ppm)
- Aqueous phase: dissolves in ocean water (bicarbonate buffer).
- Solid phase: residence times of carbon in soil, and in plants, from weeks to centuries

The Phosphorus Cycle



The phosphorus cycle is much slower than that of C or N