The Carbon Cycle

The Unperturbed Carbon Cycle: Stocks & Flows

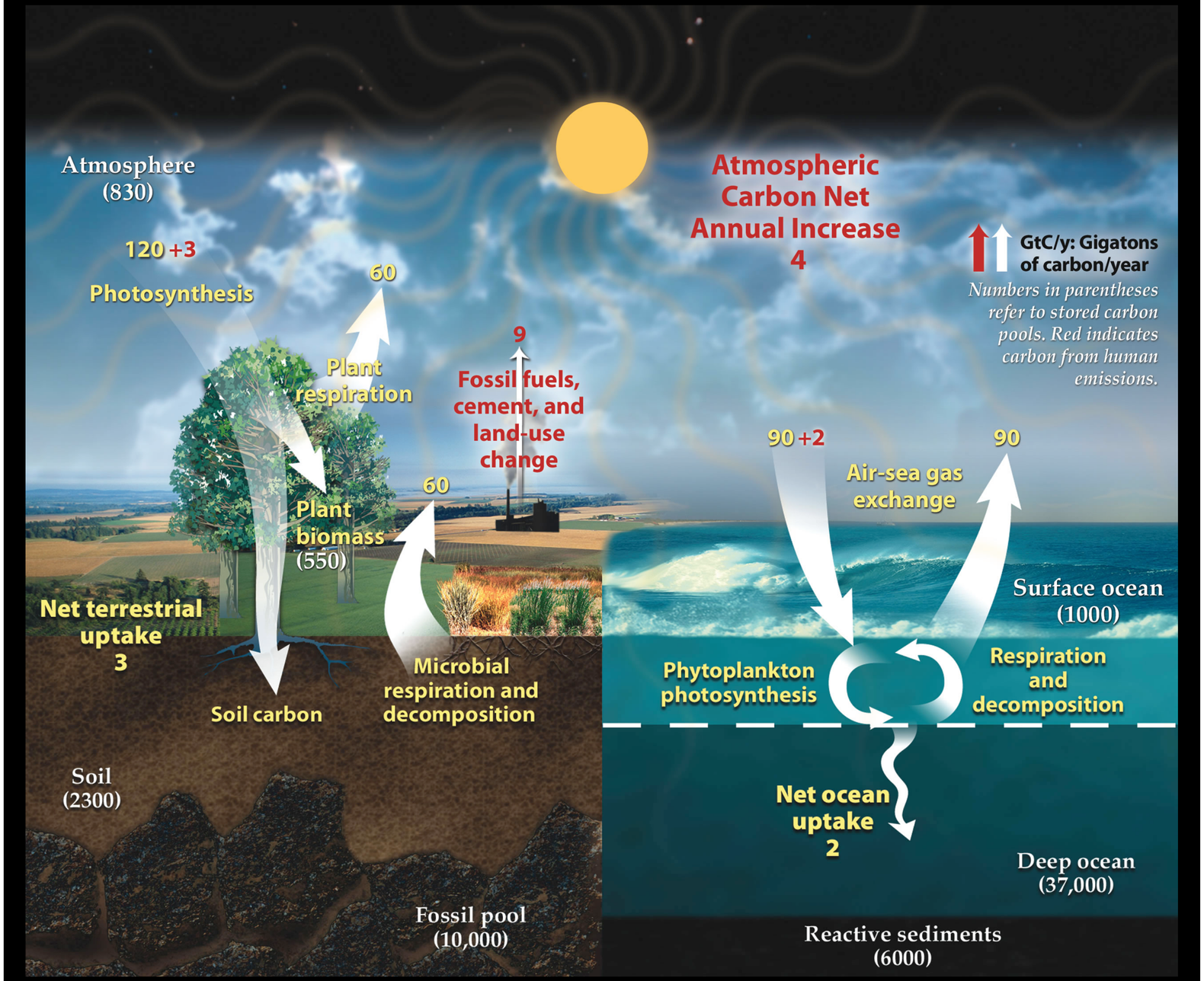
MODULE 4.1

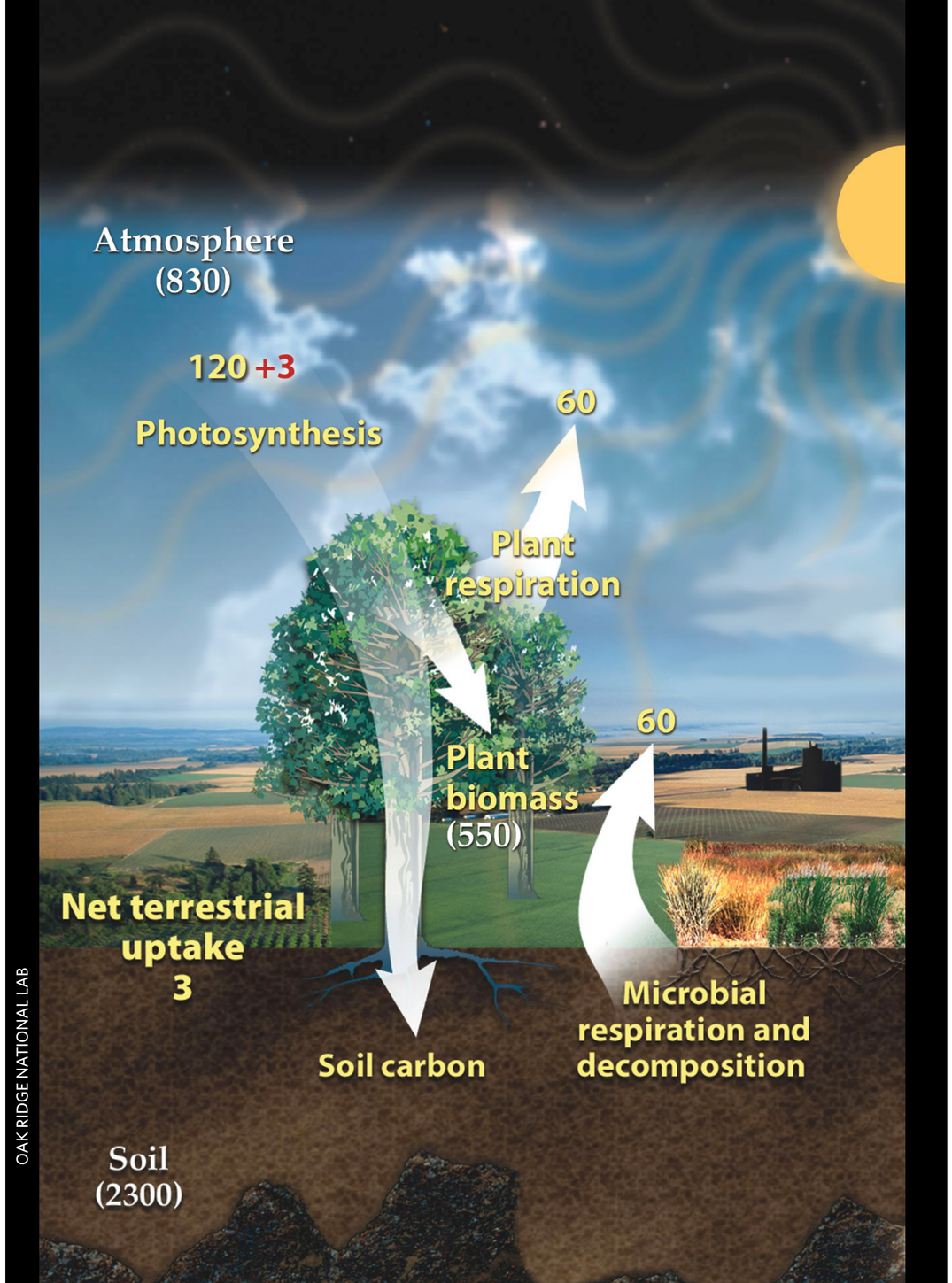
4.1 The Unperturbed Carbon Cycle: Stocks & Flows

Lesson Goals:

» Describe the processes by which carbon exchanges among the atmosphere, hydrosphere, biosphere, and geosphere, and their relative time scales of operation.

» Explain the timing and processes involved in annual cycles of atmospheric CO_2 concentration.





Atmosphere-Biosphere Exchange

Photosynthesis

Solar Energy +
$CO_2 + H_2O +$
nutrients
→ $CH_2O + O_2$

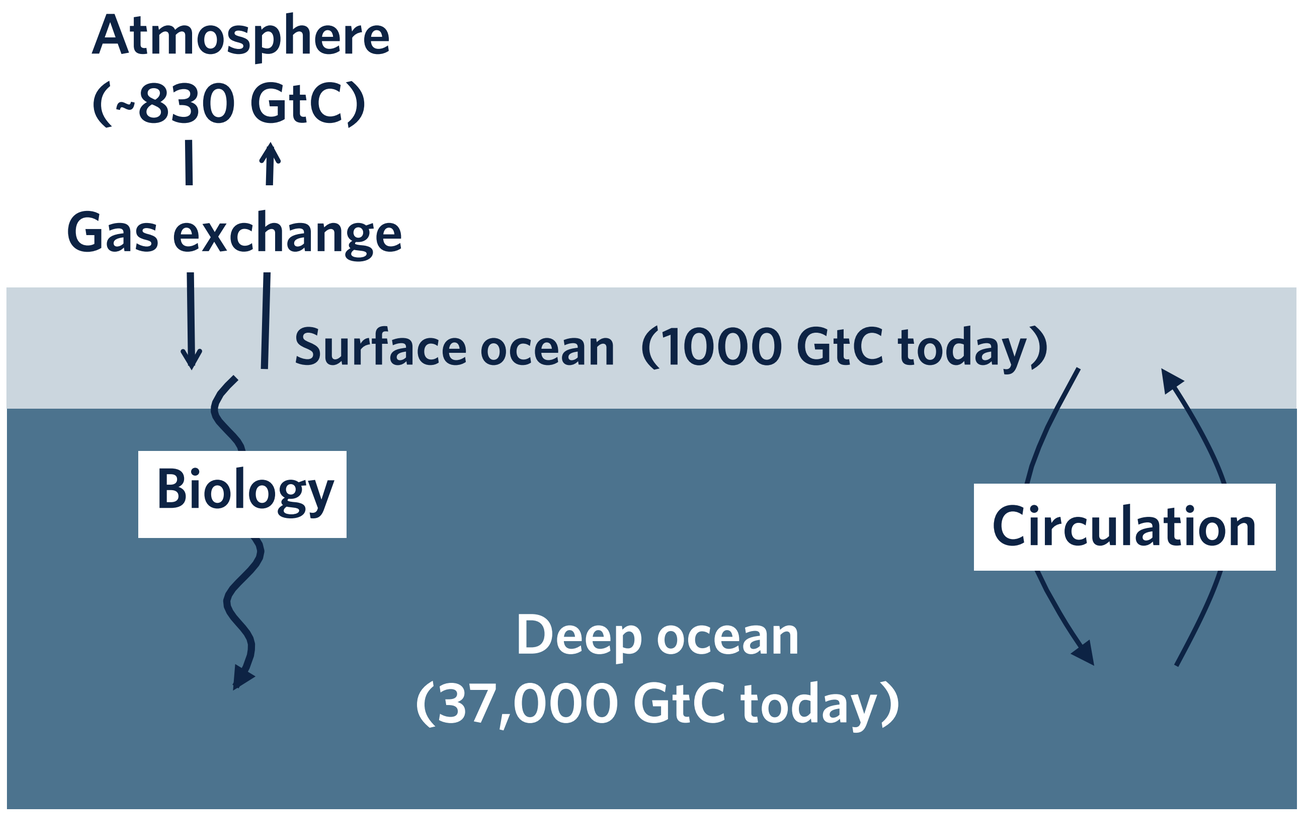
Organic matter

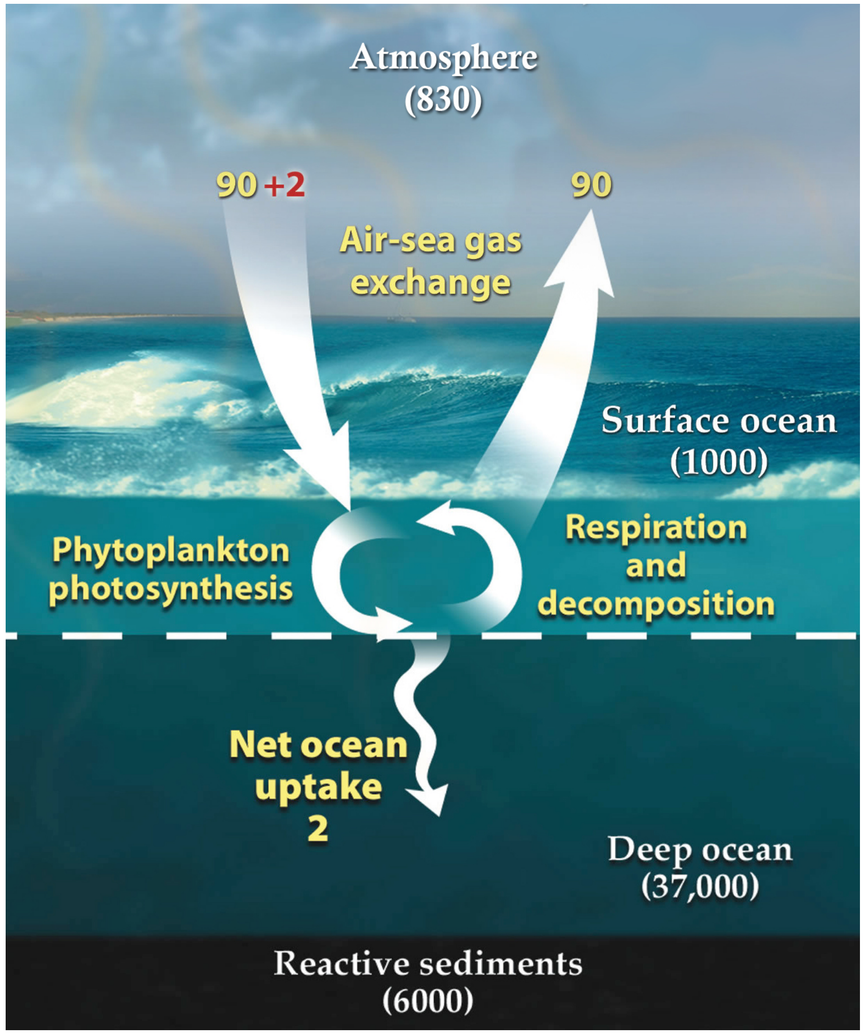
Respiration & Decay

$CH_2O + O_2$ → Energy +
$CO_2 + H_2O +$
nutrients

Organic matter

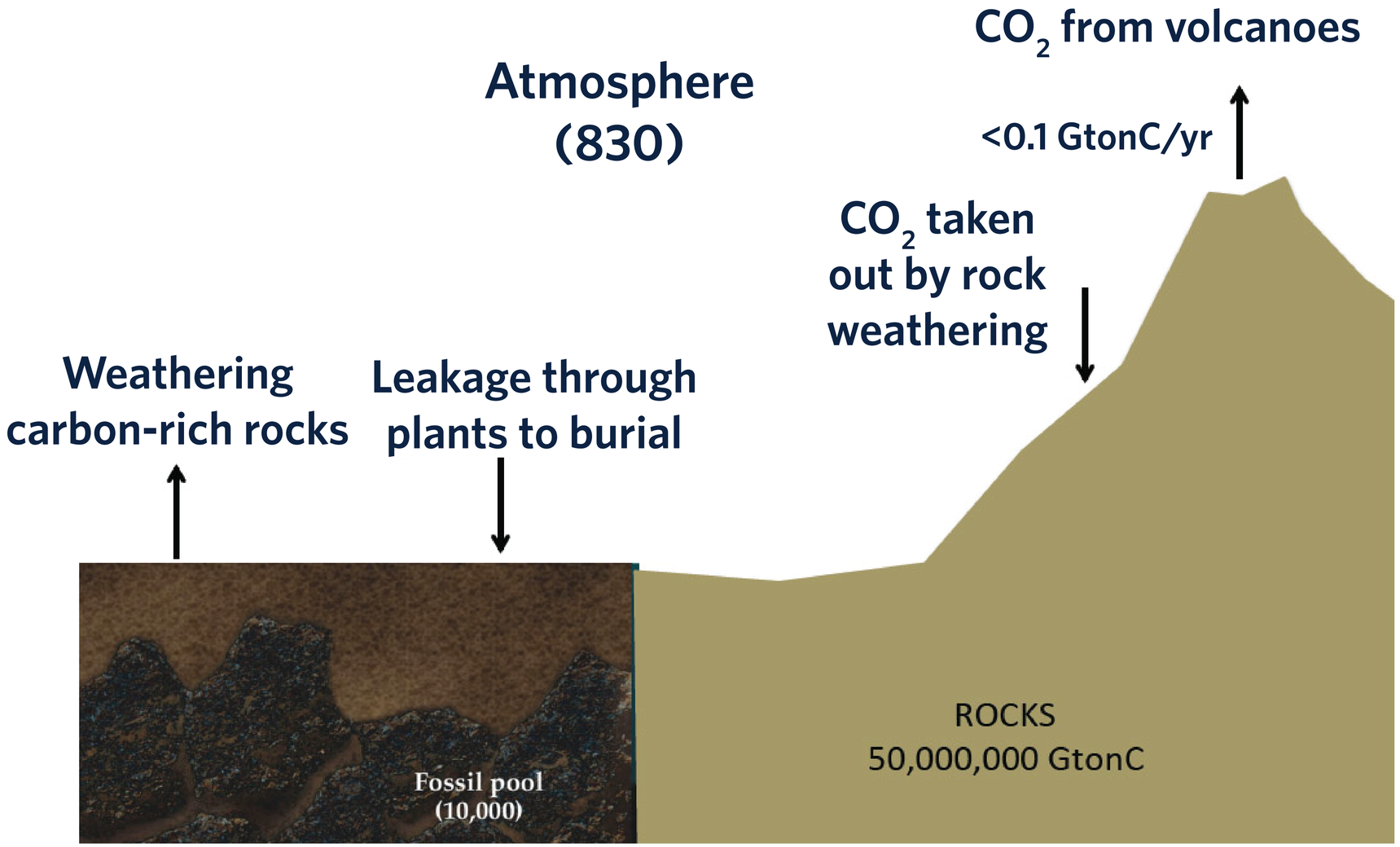
Atmosphere-Ocean Exchange



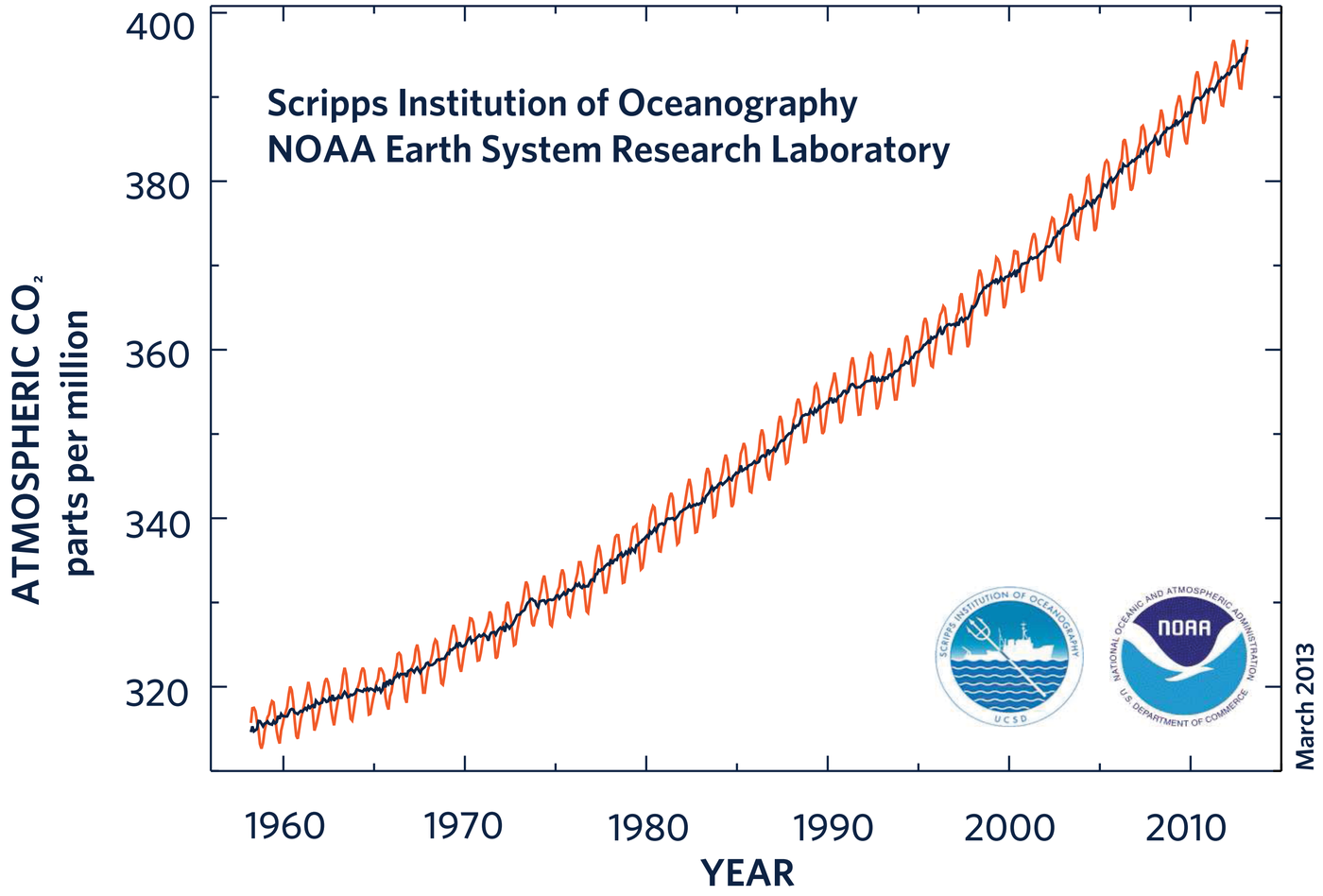


LEFT: S HARRIS ATM-HYDR RIGHT: HTTPS://PUBLIC.ORNL.GOV/SITE/GALLERY/ORIGINALS/BIOCOMPONENTS_CARBON.JPG

Atmosphere-Geosphere Exchange



Considering the annual cycles of photosynthesis and respiration, when do you think the “peaks” occur? What about the “valleys”?



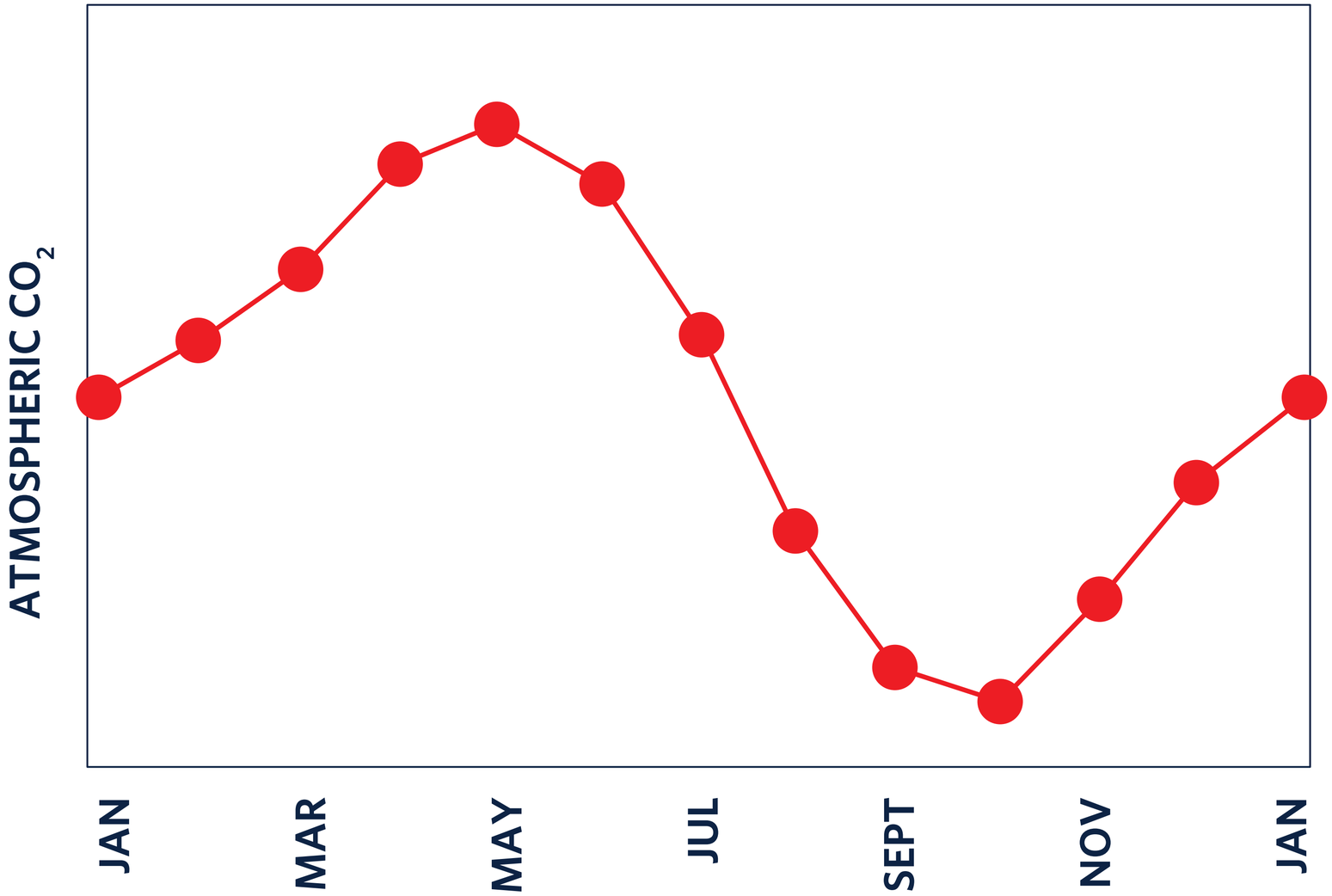
A. Peaks = spring
   Valleys = fall

B. Peaks = fall
   Valleys = spring

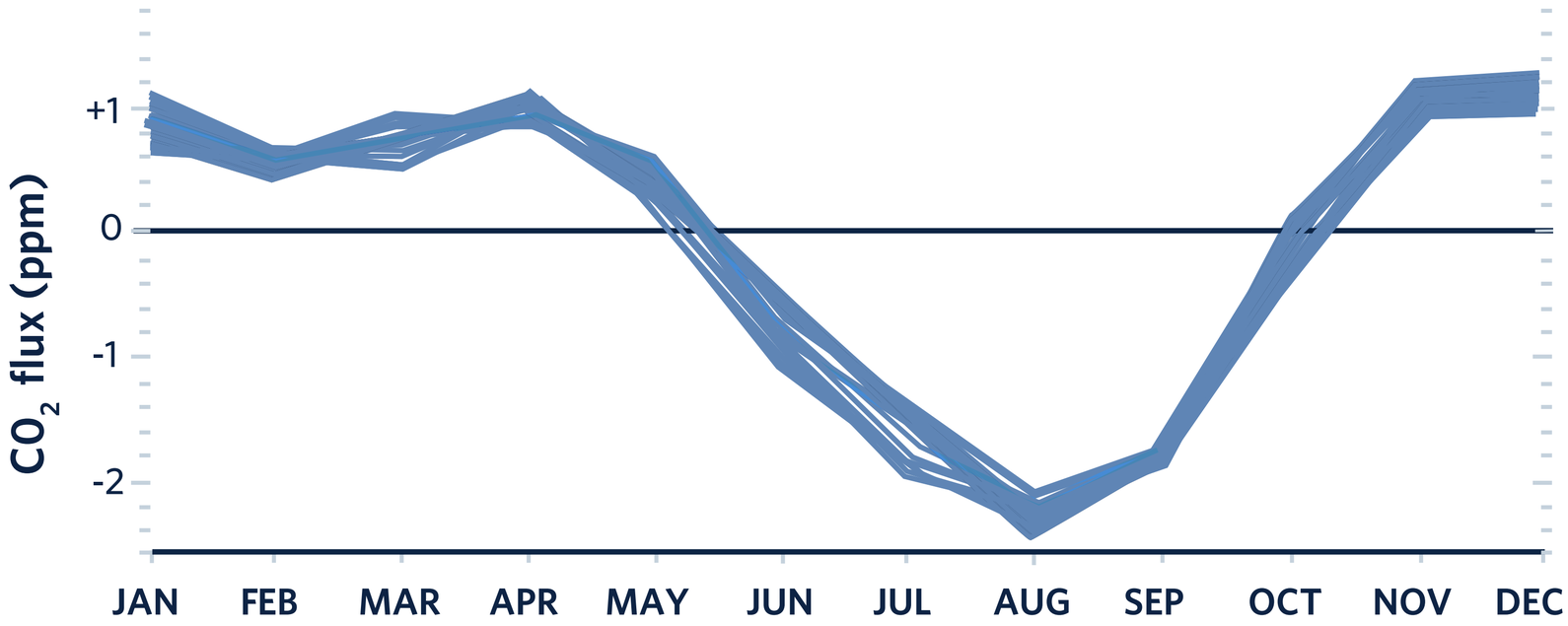
C. Peaks = summer
   Valleys = winter

D. Peaks = winter
   Valleys = summer

Seasonal cycles of CO_2



Monthly Change in Carbon Dioxide 1959–2010



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Key Points

- Carbon resides in various places on Earth, including the atmosphere, biosphere, hydrosphere, and geosphere.
- Atmospheric carbon exchanges with all the other major reservoirs.
- Exchanges with biology and the surface ocean are fast
- Mixing carbon into and out of the deep ocean is slower
- Exchanging carbon between rocks and the atmosphere is really, really slow
- The concentration of CO_2 in the atmosphere at any time depends on the balance of inflows and outflows up until that point.
- On an seasonal basis, atmospheric CO_2 in the northern hemisphere cycles up and down in response to the balance of photosynthesis and respiration through the year.