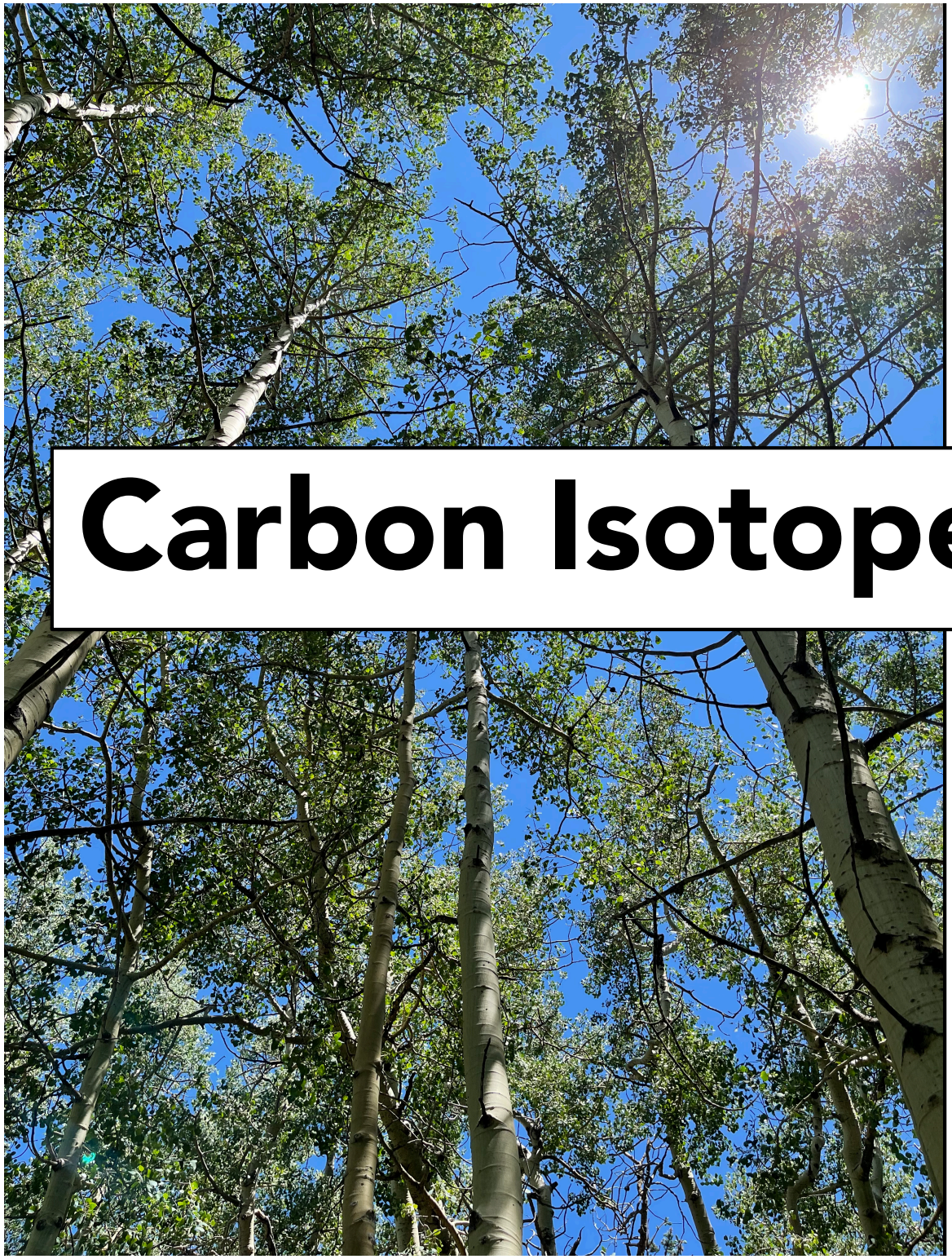
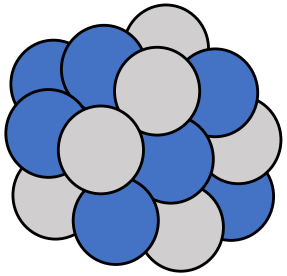


Carbon Isotopes in Plants

neutron

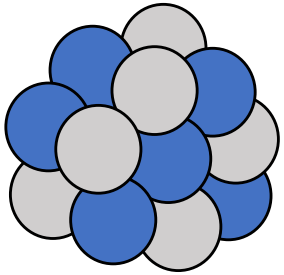
proton



one extra neutron,
8% heavier than ^{12}C!

1.1% abundance

^{13}C



98.9% abundance

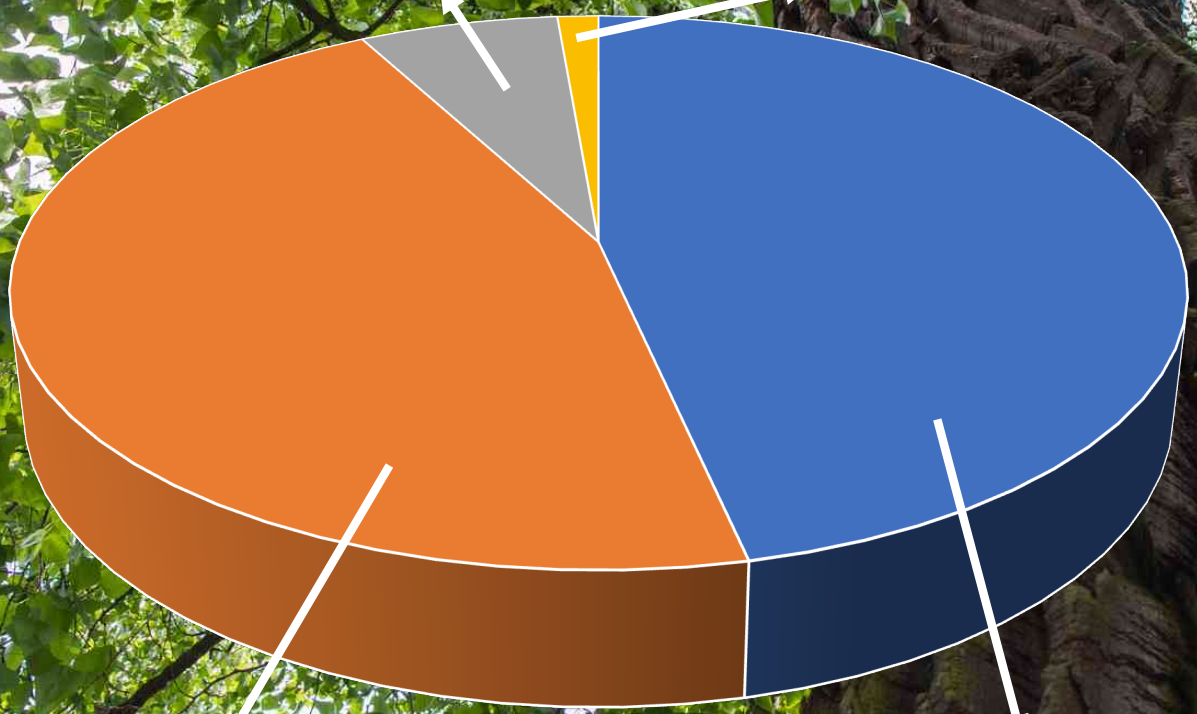
^{12}C

Vienna Bee Dee Belemnite

$$\delta^{13}C = \left(\frac{[^{13}C/^{12}C]_{sample}}{[^{13}C/^{12}C]_{standard}} - 1 \right) \times 1000$$

expressed as a permill (‰)

What are plants made of?



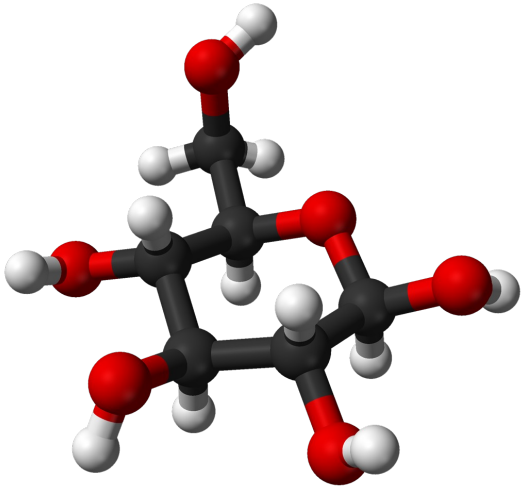
Hydrogen
6.3%

Nitrogen
1.3%

Carbon
44%

Oxygen
45%

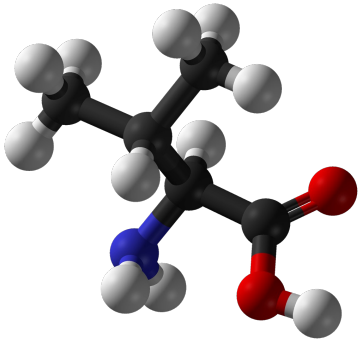
What are plants made of?



Carbohydrates

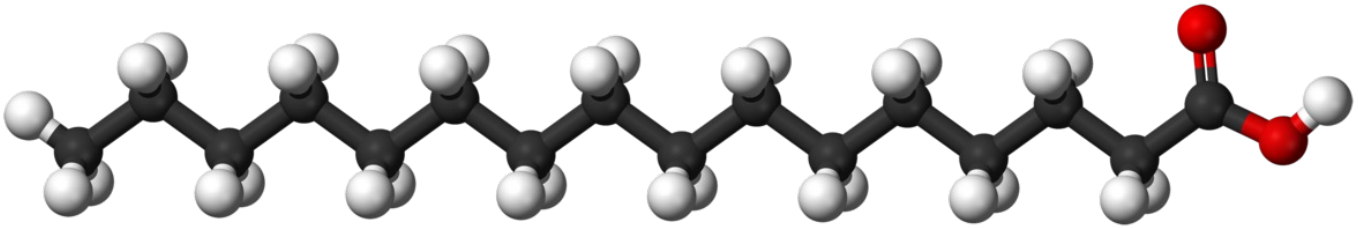
Glucose

Cellulose



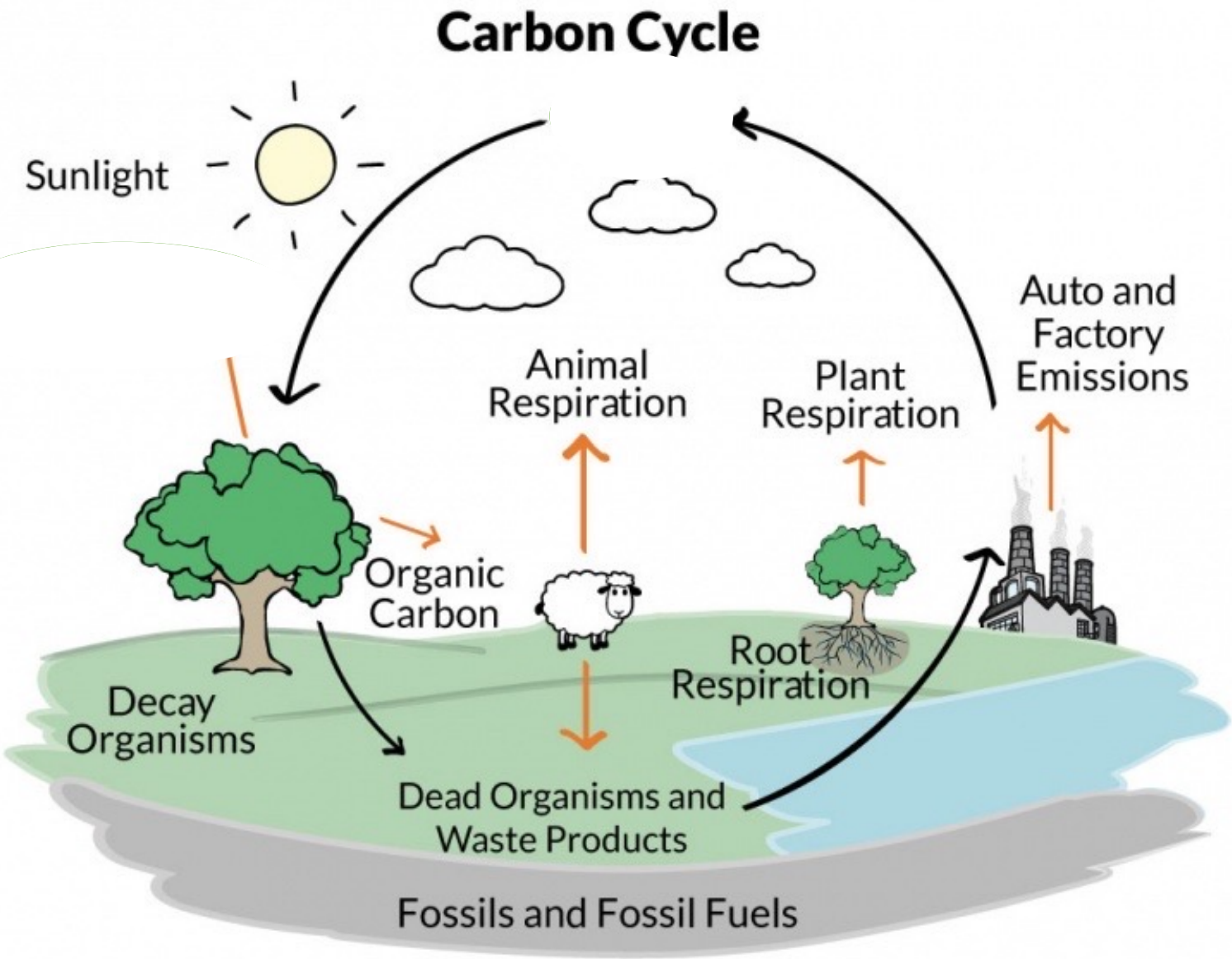
Proteins

Amino Acids



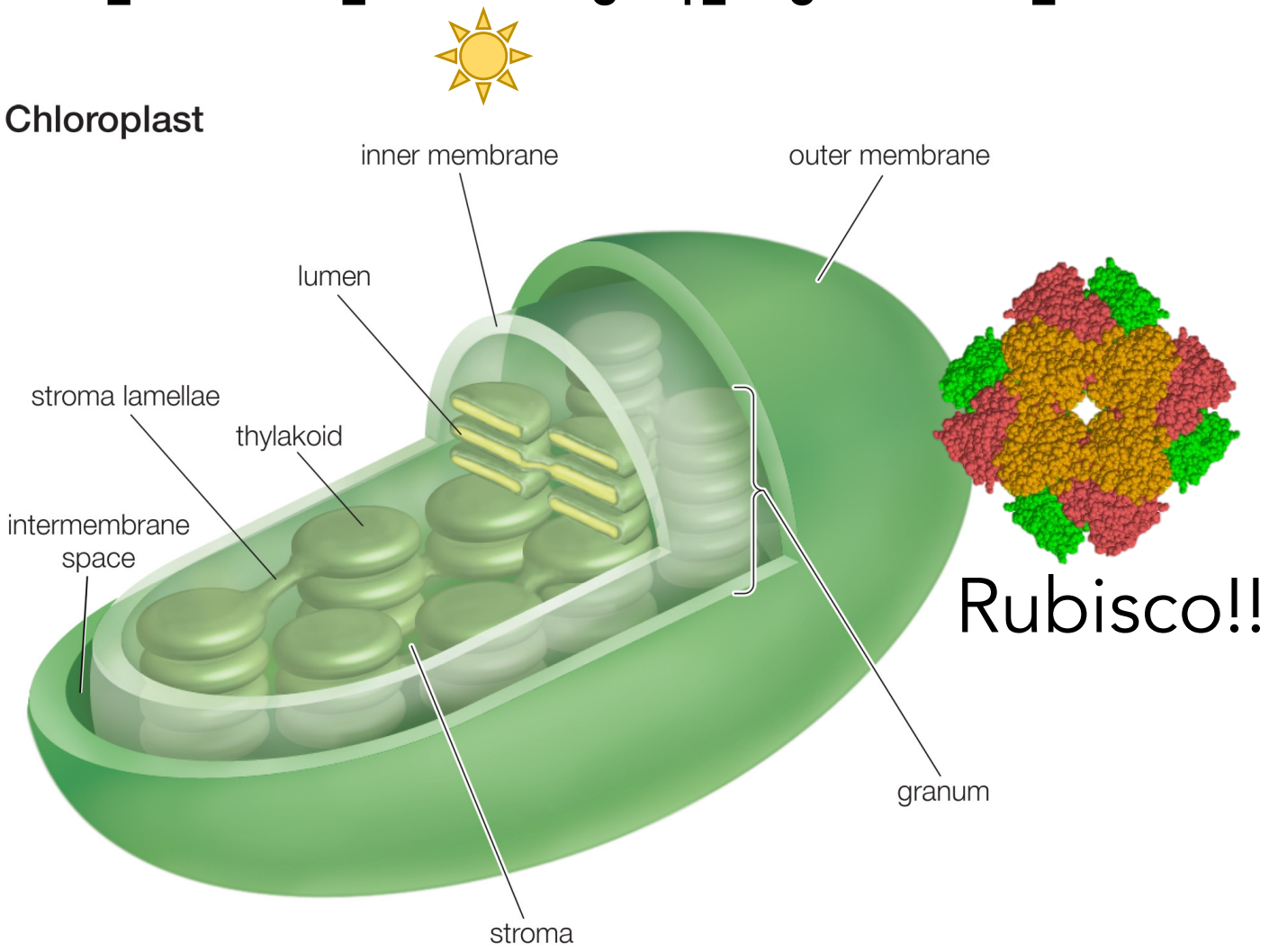
Lipids

How do plants get carbon?



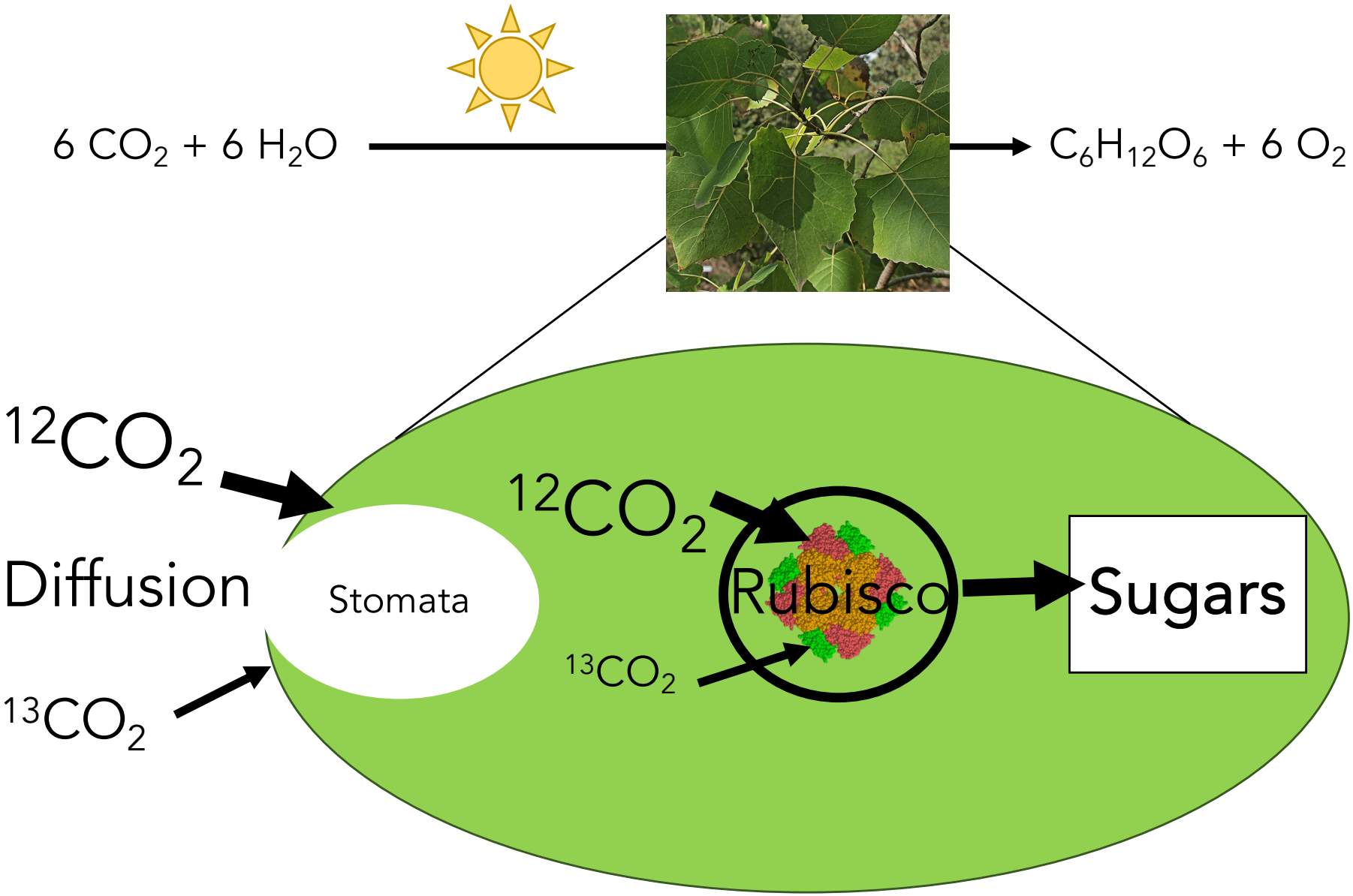
Photosynthesis

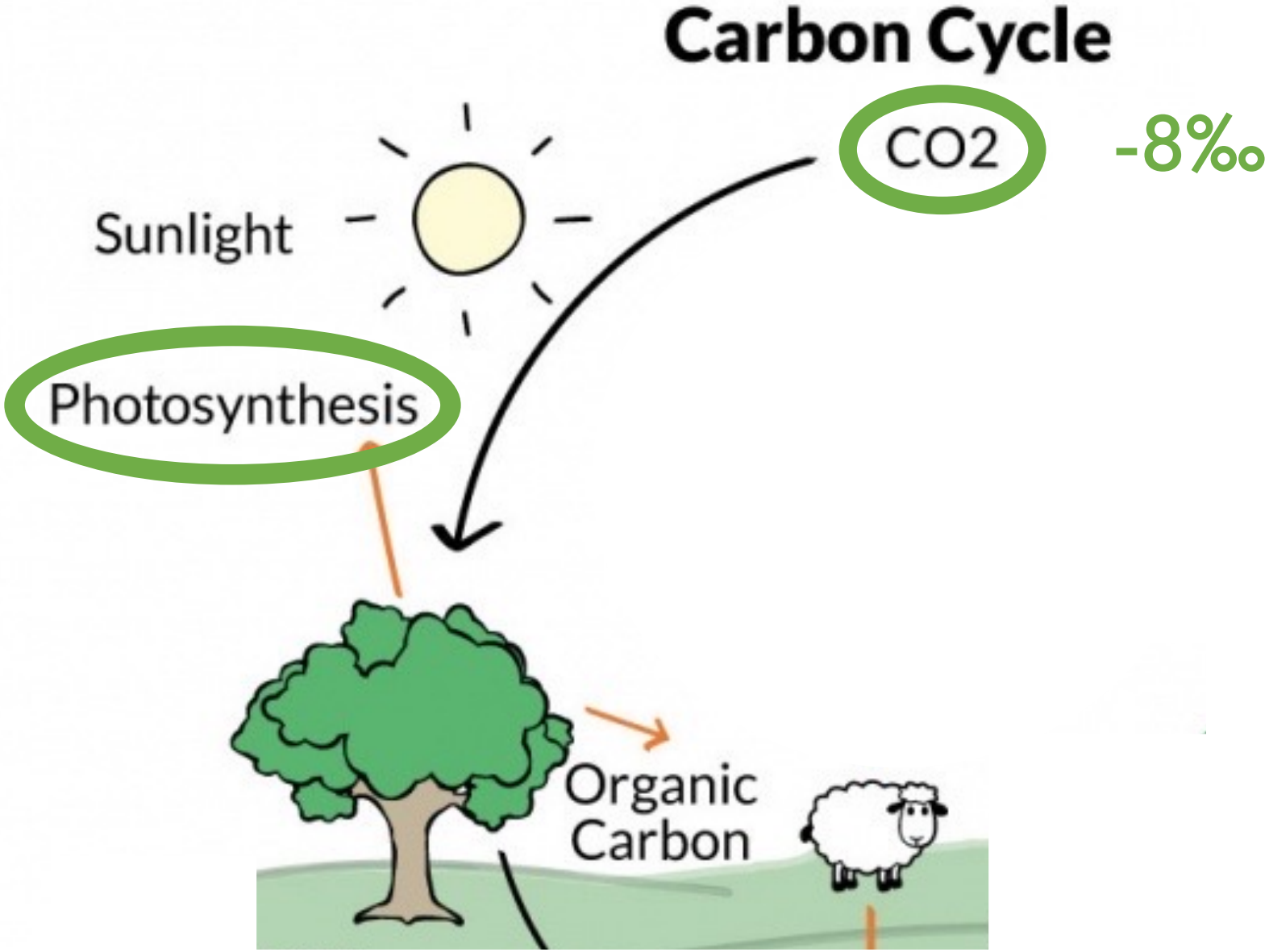
$$6\ CO_2 + 6\ H_2O \rightarrow C_6H_{12}O_6 + 6\ O_2$$

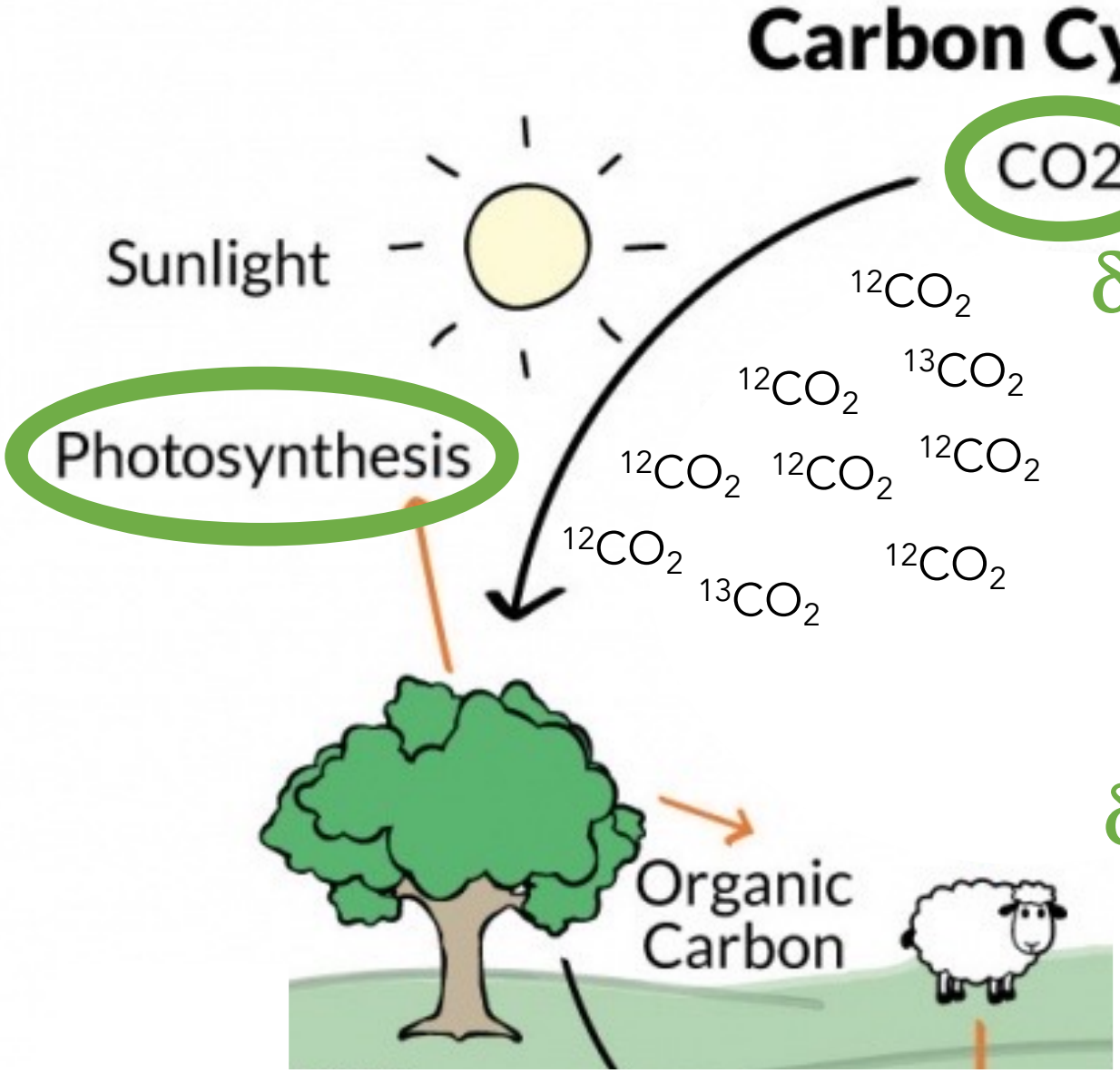


Rubisco!!

Photosynthesis and Carbon Isotopes

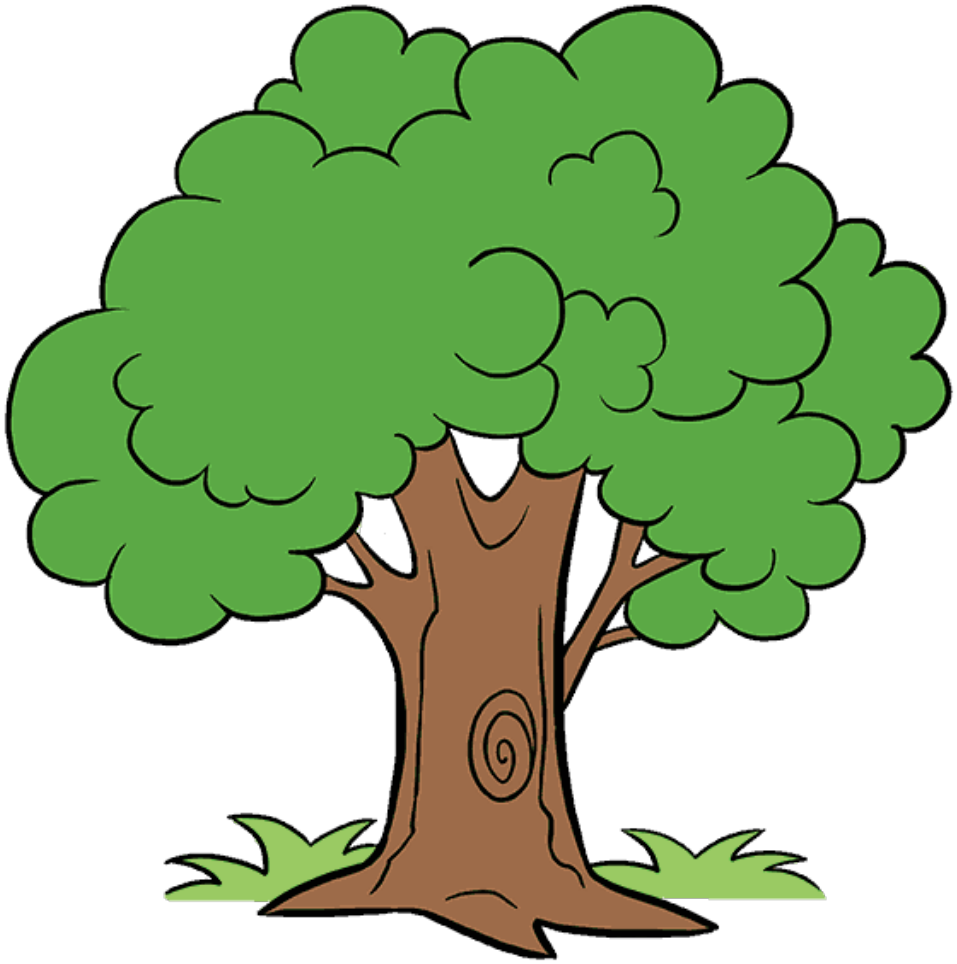



Carbon Cycle
CO2
-8‰
Sunlight
Photosynthesis
Organic
Carbon



$\delta^{13}C = -8‰$

$\delta^{13}C = ??$



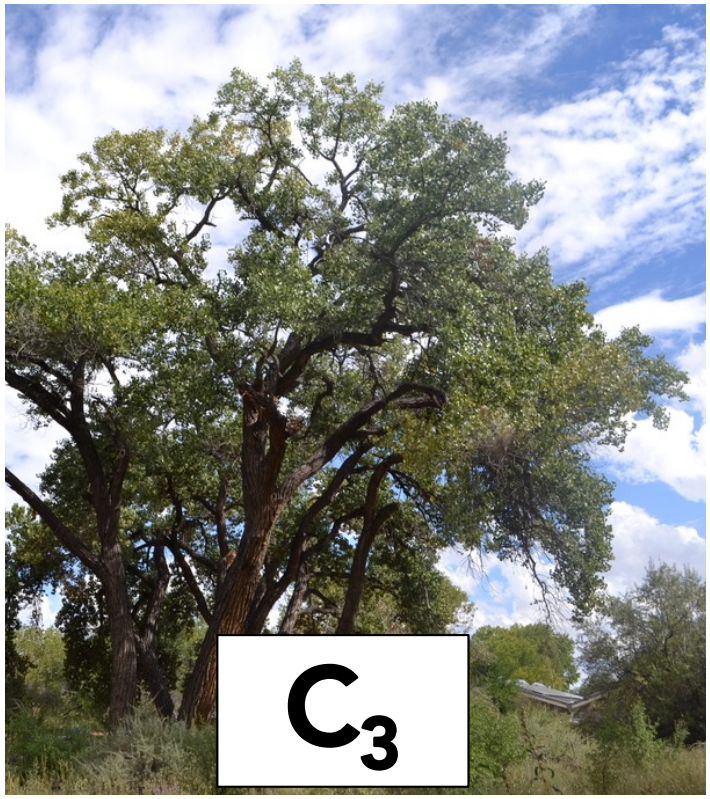
Plants have $\delta^{13}C$ values around

-12 to -31‰

LOTS of $^{12}CO_2$

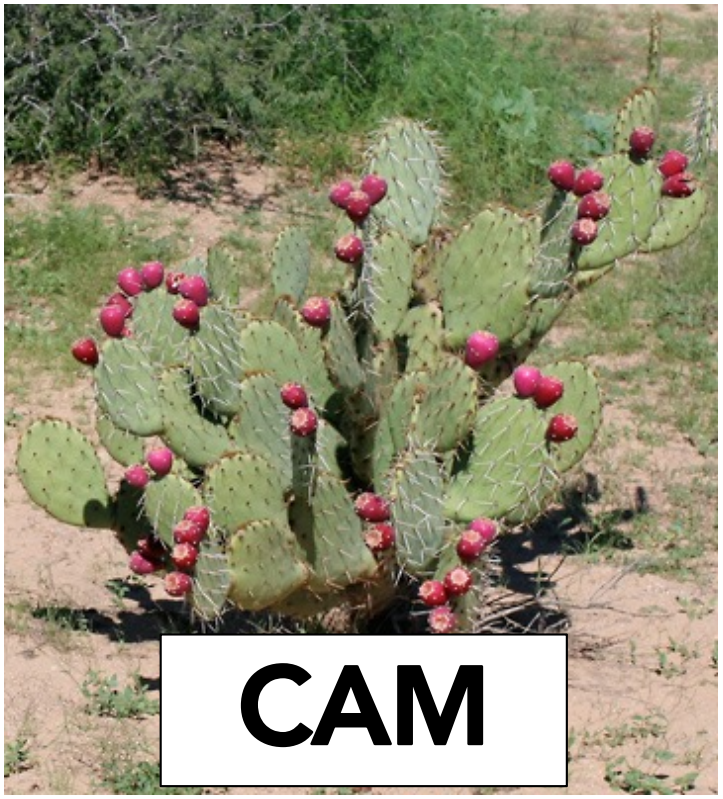
Not much $^{13}CO_2$

$\delta^{13}C$ values can tell you about *how* plants are doing photosynthesis



$\delta^{13}C$
-30‰ to -20‰

Cottonwood



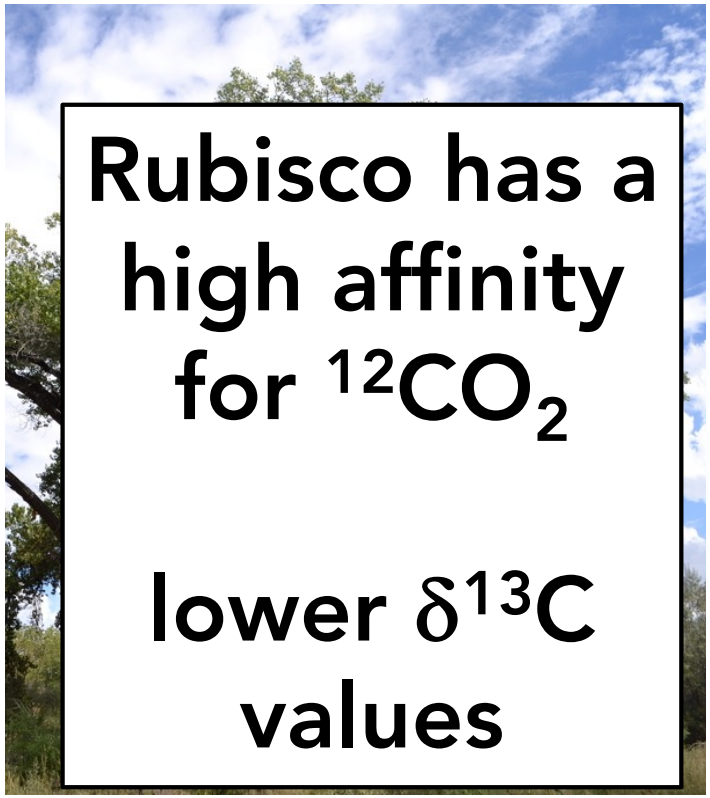
$\delta^{13}C$
-27‰ to -12‰

Prickly Pear

$\delta^{13}C$
-15‰ to -9‰

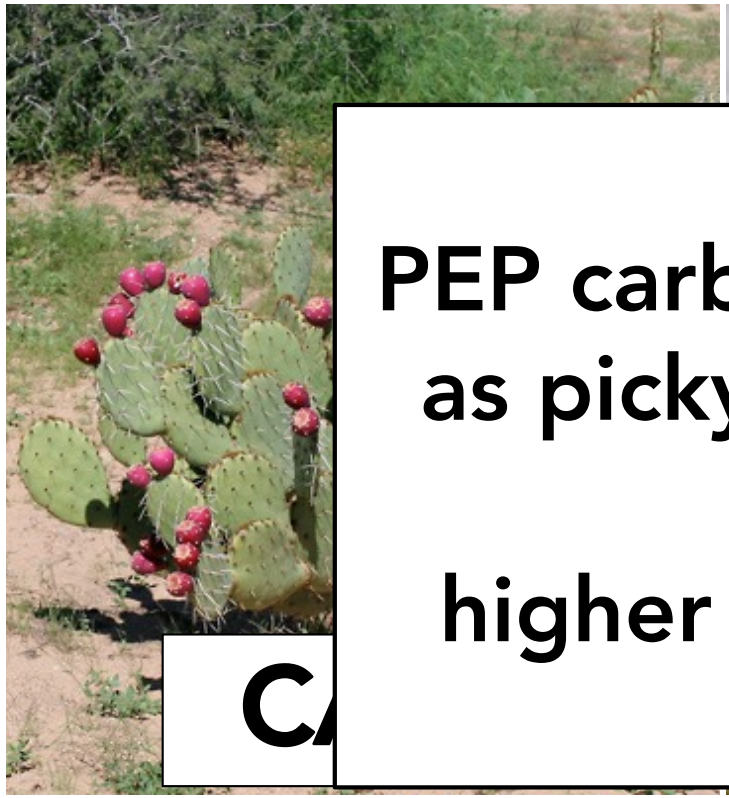
Black Grama

$\delta^{13}C$ values can tell you about *how* plants are doing photosynthesis

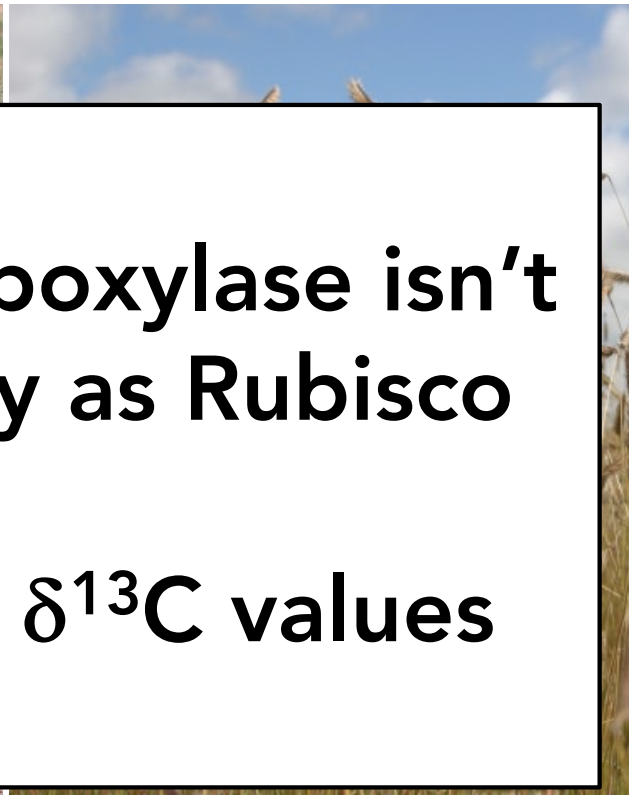


Rubisco has a high affinity for $^{12}CO_2$

lower $\delta^{13}C$ values

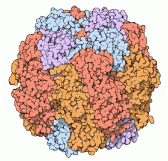


C

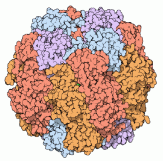


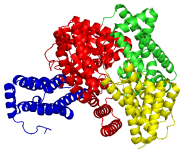
PEP carboxylase isn't as picky as Rubisco

higher $\delta^{13}C$ values



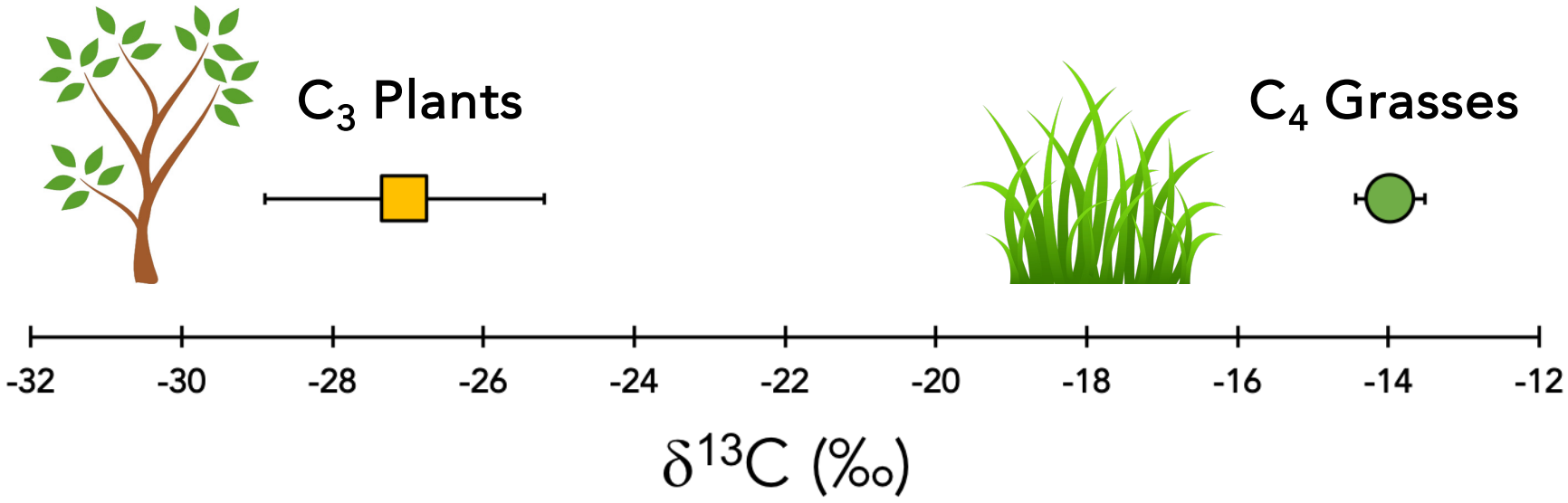
Rubisco



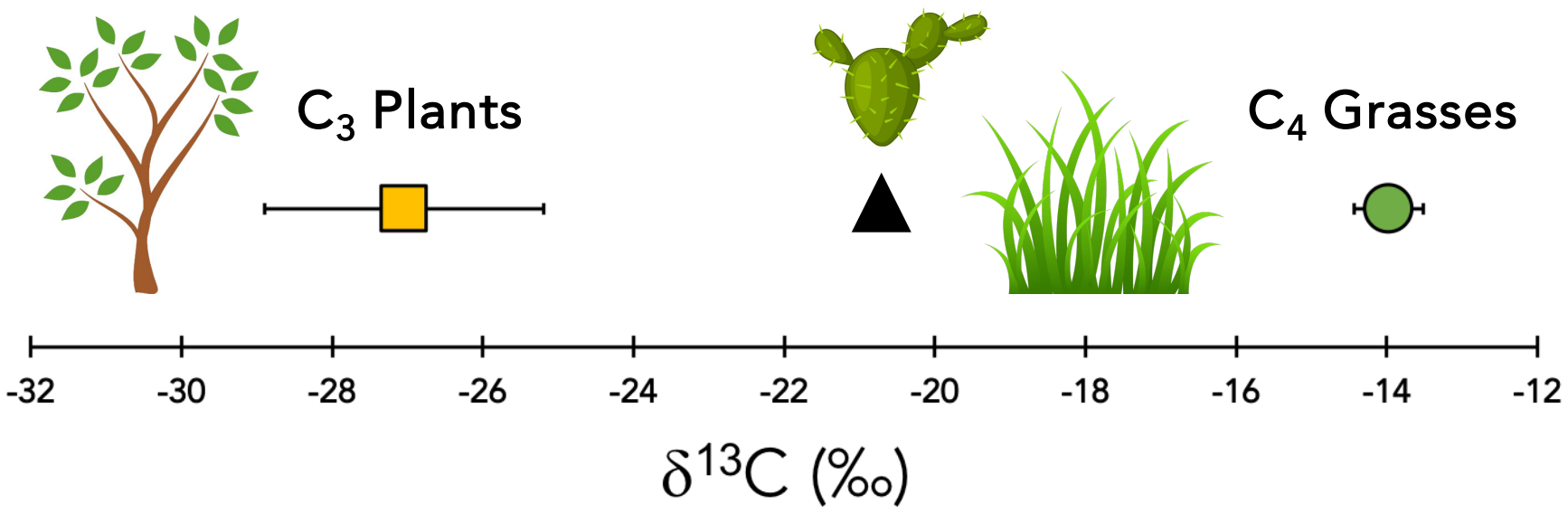


Rubisco & PEP Carboxylase

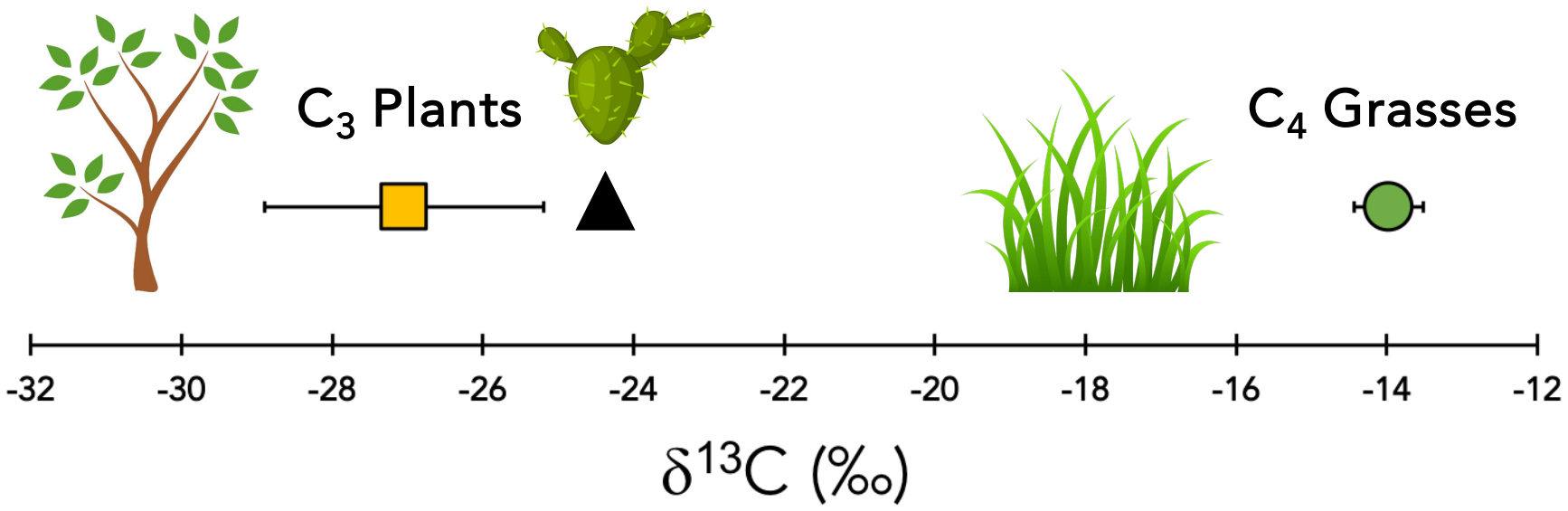
Different types of plants have different $\delta^{13}C$ values



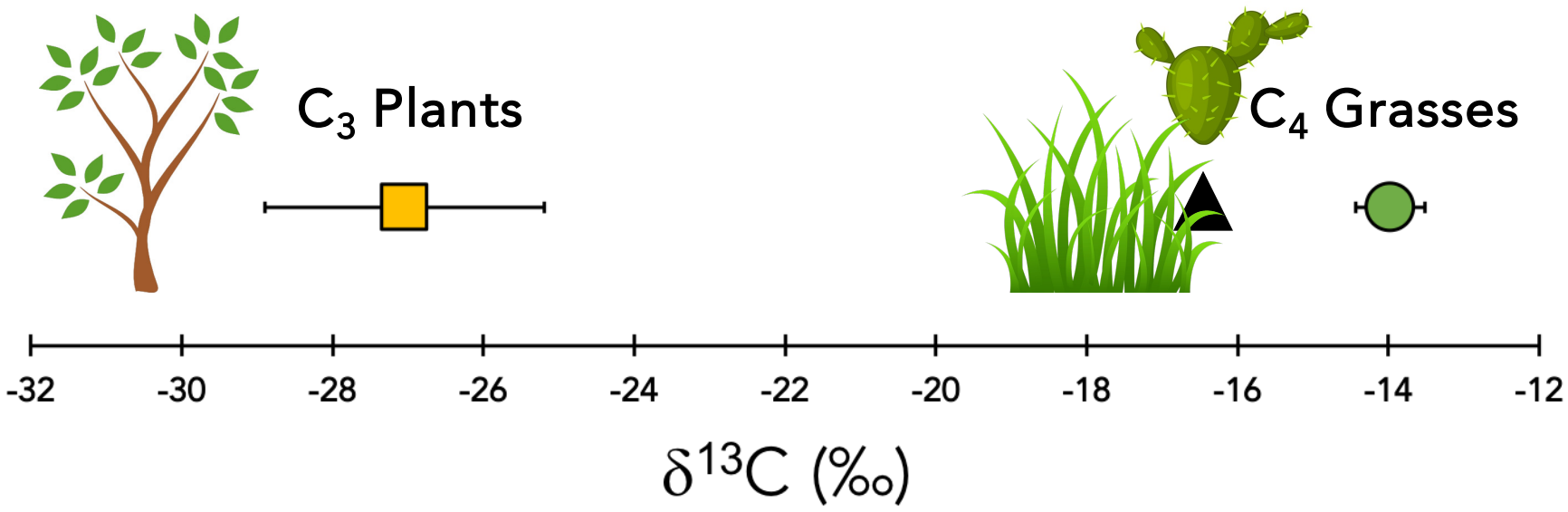
Different types of plants have different $\delta^{13}C$ values



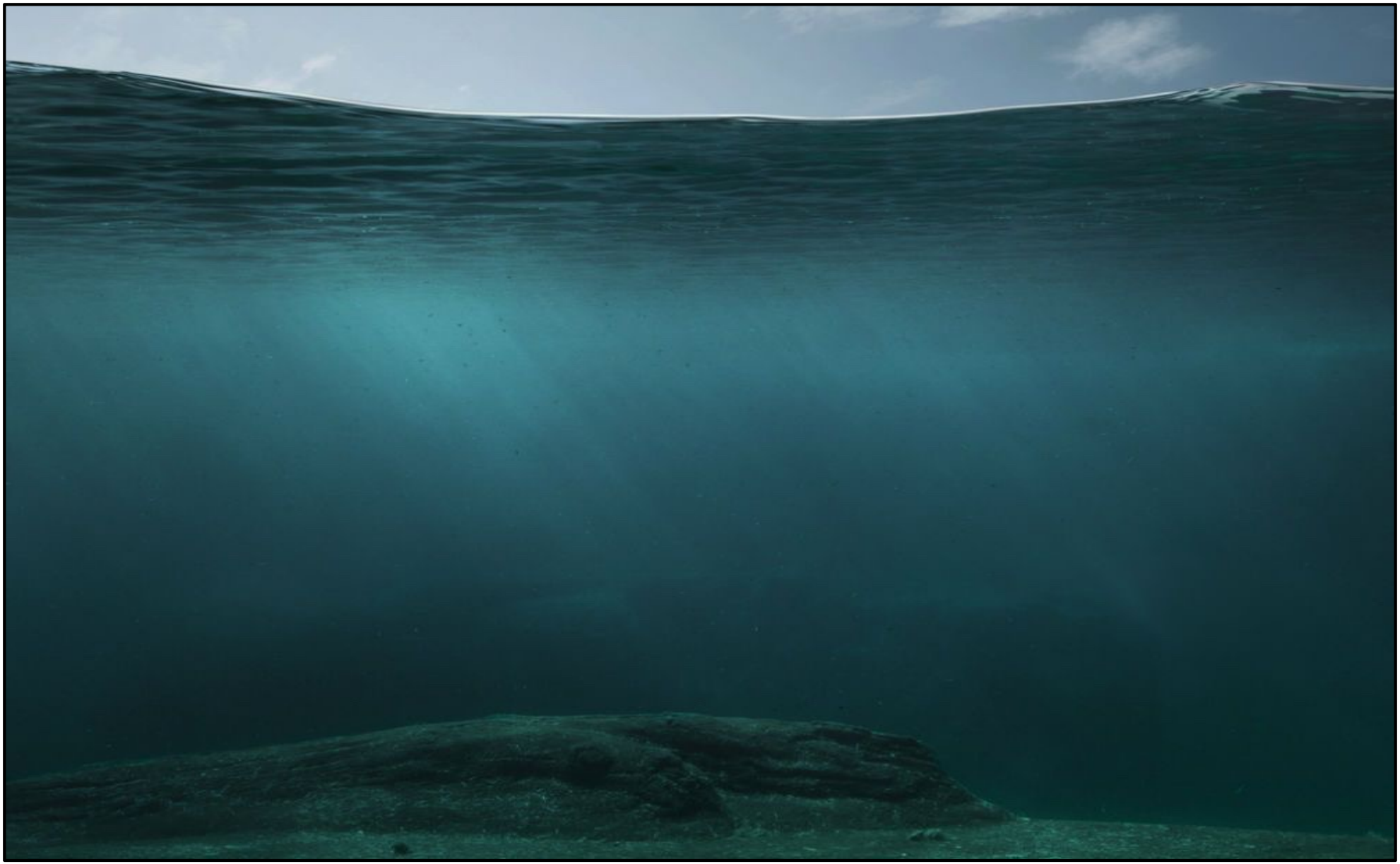
Different types of plants have different $\delta^{13}C$ values



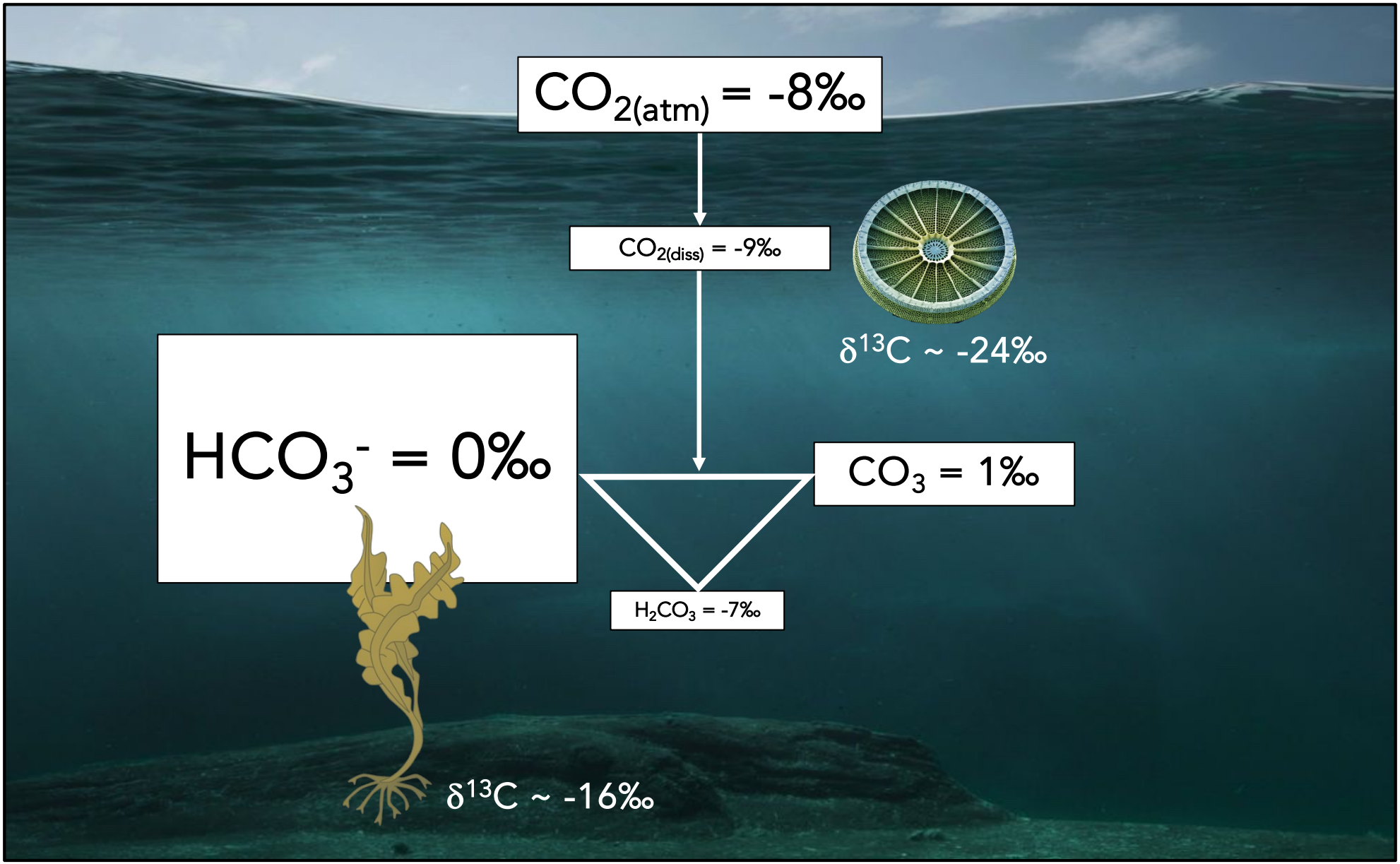
Different types of plants have different $\delta^{13}C$ values



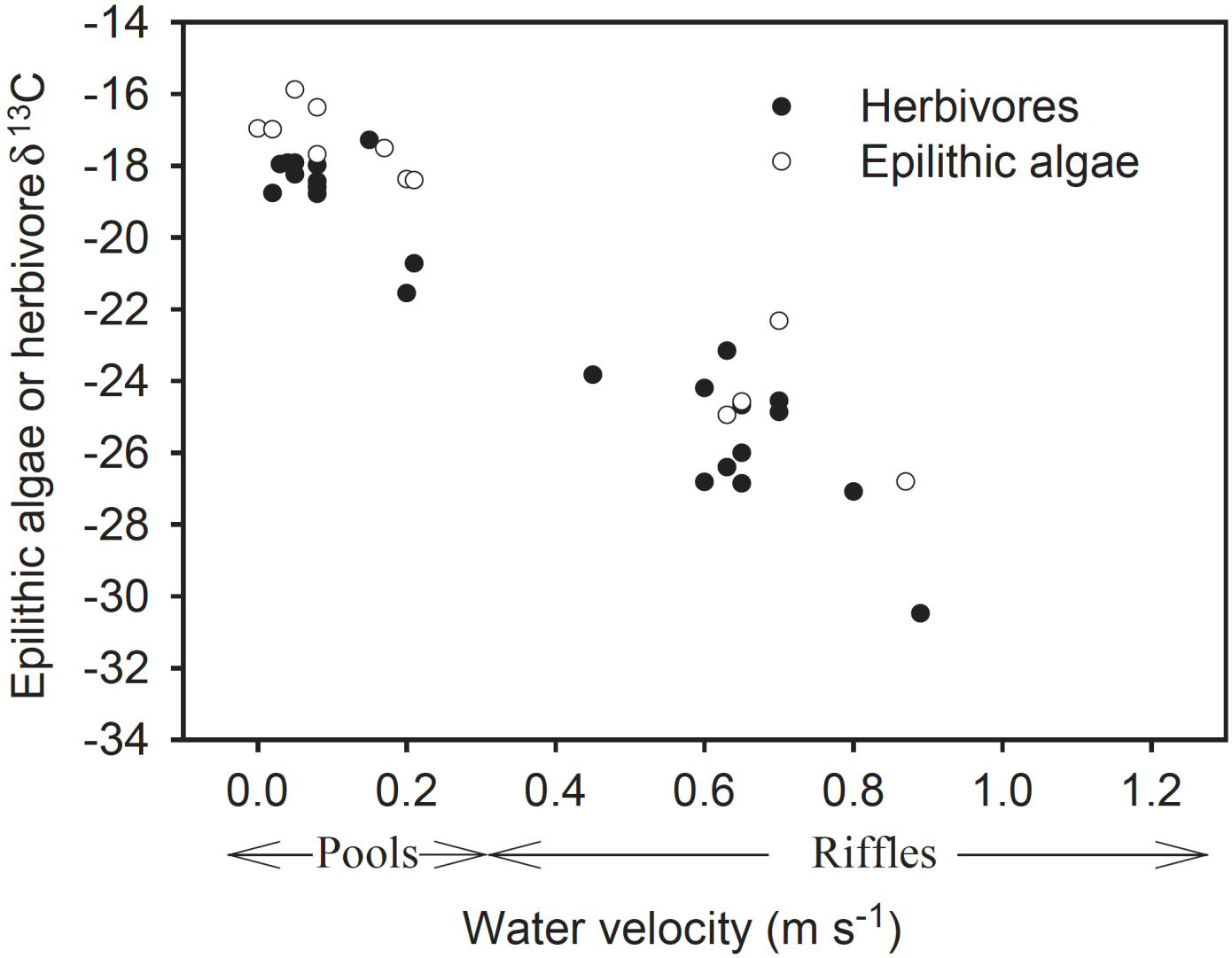
Photosynthesis in water



Aquatic Inorganic Carbon Sources



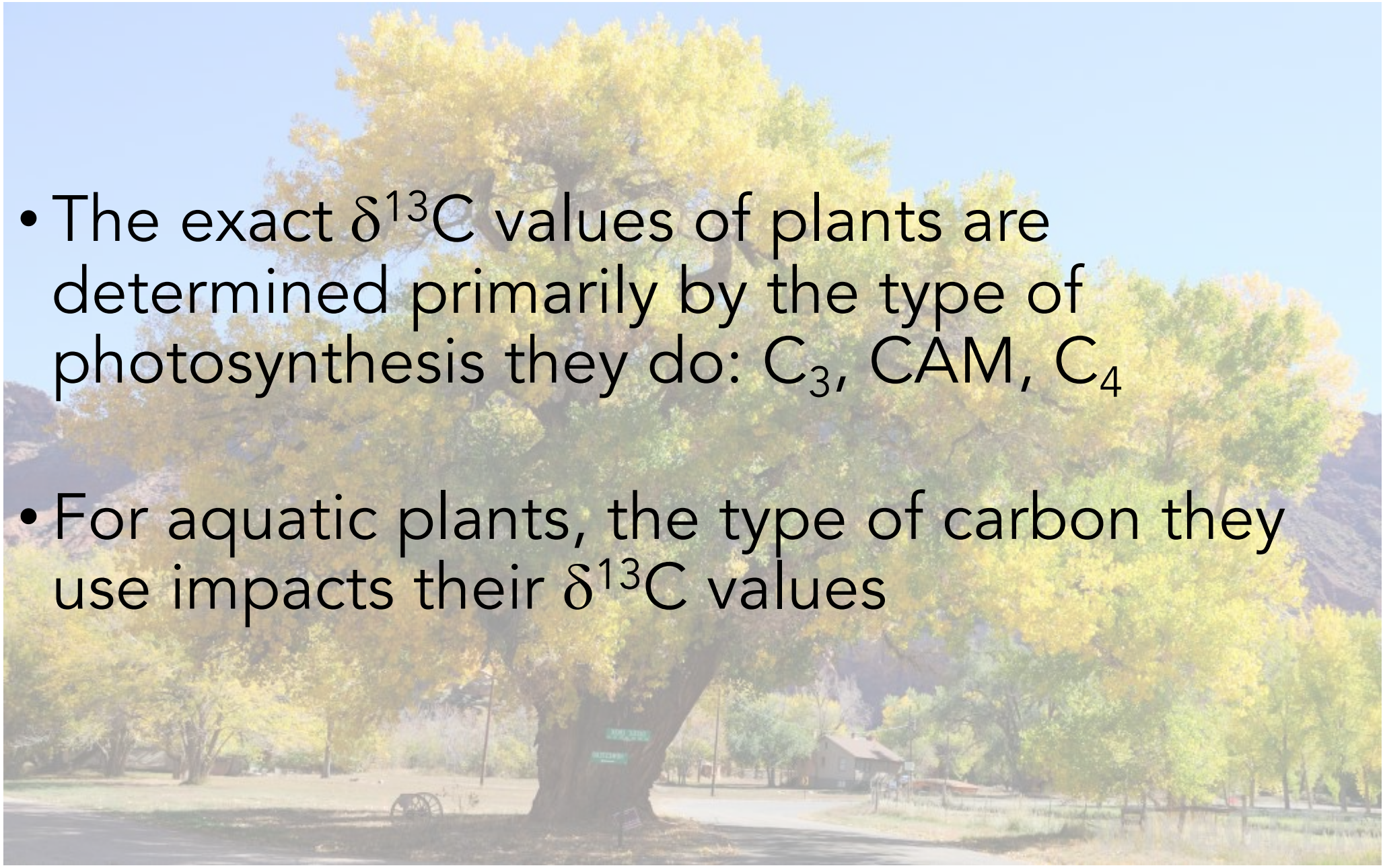
Increasing water velocity decreases algal $\delta^{13}C$ values in streams and rivers



TAKE HOME POINTS

- Plants build their tissues with carbon
- They do this via **PHOTOSYNTHESIS**
  - They take in CO_2 and chemically convert it into sugars
- Because lighter goes faster, plants have more ^{12}C than atmospheric CO_2
  - So, they have $\delta^{13}C$ values that are lower than the $\delta^{13}C$ value of atmospheric CO_2

TAKE HOME POINTS



- The exact $\delta^{13}C$ values of plants are determined primarily by the type of photosynthesis they do: C_3, CAM, C_4
- For aquatic plants, the type of carbon they use impacts their $\delta^{13}C$ values