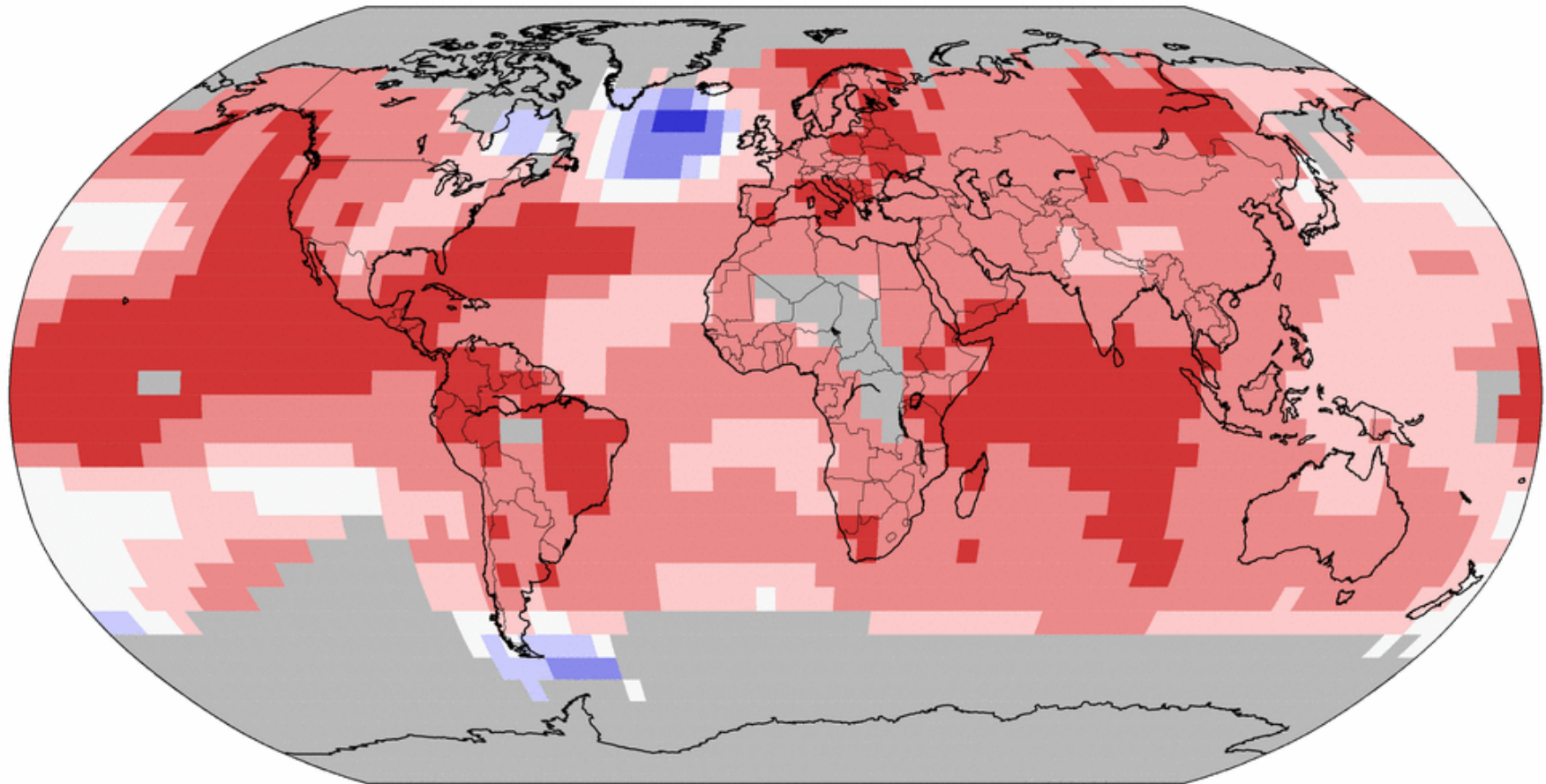


Extreme weather?

Land & Ocean Temperature Percentiles Jan–Dec 2015

NOAA's National Centers for Environmental Information

Data Source: GHCN–M version 3.3.0 & ERSST version 4.0.0



Record Coldest



Much Cooler than Average



Cooler than Average



Near Average



Warmer than Average



Much Warmer than Average

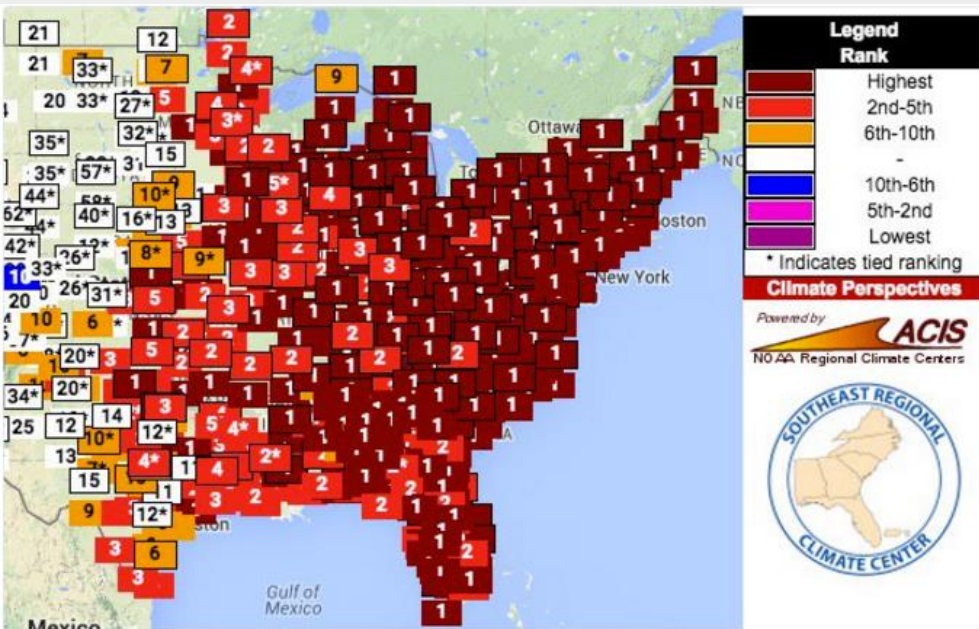


Record Warmest



Record-Breaking Christmas Heat Clinches Record Warm December For Hundreds of Cities

Published: Jan 2 2016 04:00 AM EST | weather.com



Jonathan Erdman @wxjrdman

Follow

Map from @SERCC is truly incredible. All the "1s" are locations setting a record warm December. Many others top 3.

3:23 AM - 1 Jan 2016

78 28

December 2015

Snowstorm Deaths Reach 41 as E to Dig Out

By EMILY KNAPP and MEGHAN KENEALLY · Jan 25, 2016, 11:54 PM ET



Deadly Snowstorm Breaks Records; 80 Million Affected

The East Coast is digging itself out after near-record snowfall forced shutdown of major public transportation and the shuttering of bus government offices and left at least 41 dead.

5K SHARES

January 2016



National Oceanic and Atmospheric Administration's

National Weather Service

[Home](#) > [Products](#) > [National Data](#) >

SXHW70 PHFO 260237
RERHFO

RECORD EVENT REPORT
NATIONAL WEATHER SERVICE HONOLULU HI
437 PM HST MON JAN 25 2016

...RECORD HIGH TEMPERATURE SET AT HILO HI...

A RECORD HIGH TEMPERATURE OF 88 DEGREES WAS SET AT HILO HI TODAY.
THIS BREAKS THE OLD RECORD OF 87 SET IN 1977.

\$\$

Record breaking in Hawaii!

China / Society

- Hot Issues
- Government
- Society
- Innovation
- Education
- Photos

Record-breaking cold freezes 90 percent of China

By Wu Yan (chinadaily.com.cn/Xinhua)

Updated: 2016-01-22 16:18

Comments Print Mail Large Medium Small



ASIA PACIFIC

Hong Kong hit by coldest temperatures in nearly 60 years

Morning temperatures dropped to 3.3°C in urban areas of the southern Chinese city, where most buildings lack central heating and below freezing in the hills.

Posted 24 Jan 2016 13:32 Updated 24 Jan 2016 19:28

VIDEOS PHOTOS



TIME World

MAGAZINE VIDEOS

East Asia Hit by Record Snowfalls and Cold Weather

WORLD EAST ASIA

East Asia Hit by Record Snowfalls and Cold Weather

Mark Rivett-Carnac @mrivettcarnac | Jan. 25, 2016

✉ f t p in

50 cold-related fatalities were recorded in Taiwan

Extreme cold weather pushed through East Asia this weekend, causing deaths and crippling transportation, according to multiple news sources.

The sudden drop in temperature led to 50 deaths in Taiwan, where many victims were elderly people



Sudden freezes in Asia



How to Deal With a Narcissist: 5 Secrets Backed by Research

President Obama Bans Solitary Confinement for Juveniles in Federal Prison

The U.S. Is Point-Blank Accusing

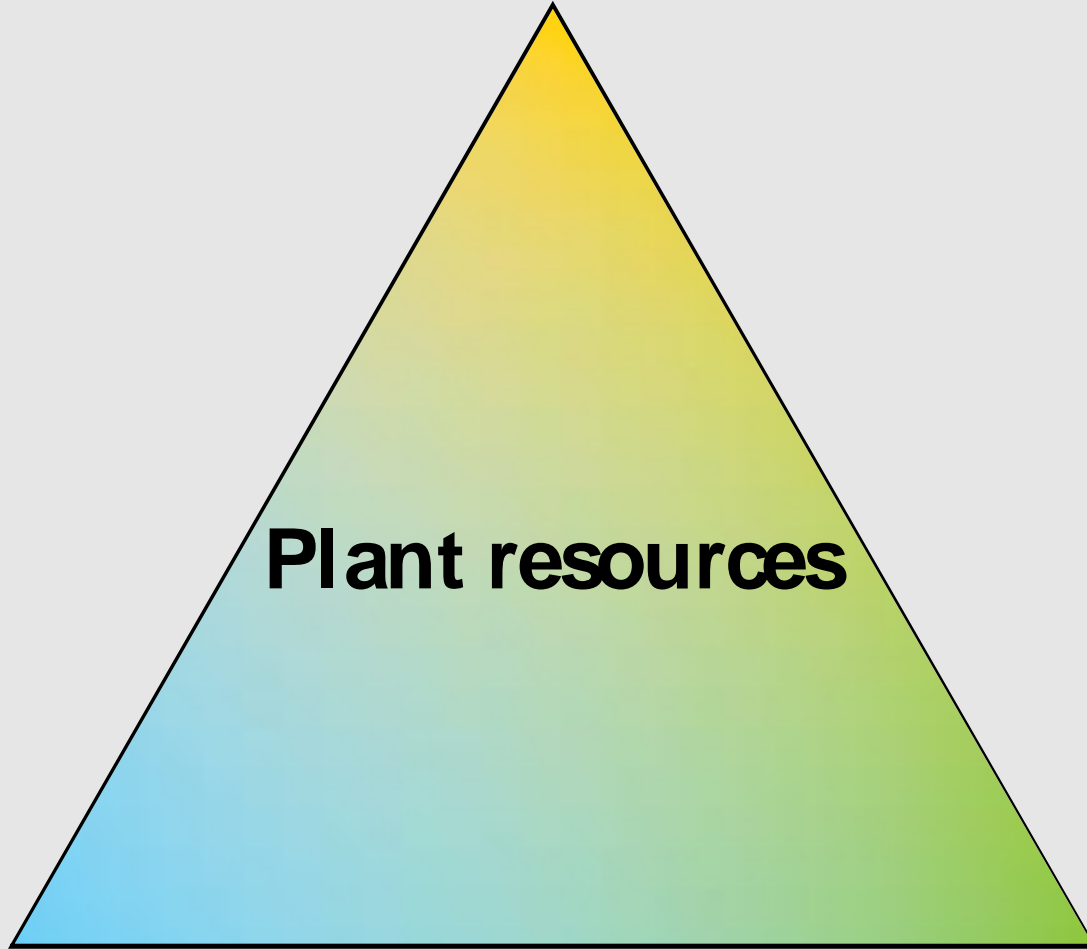


How will predicted climate changes affect the biosphere?

Direct effects of increased CO₂ on organisms

Time or Response	CO ₂ concentration (%)
Ice-age levels	0.018-0.022
Preindustrial levels	0.026-0.028
Current levels	0.038-0.040
Predicted 2100 levels	0.05-0.10
Exhaled from lungs	5.3-5.9
Loss of mental acuity	2.0-7.5
Loss of consciousness	5.0-10.0
Loss of life	20.0-30.0

Energy
(carbon or light)



Water

Nutrients

Plant resources

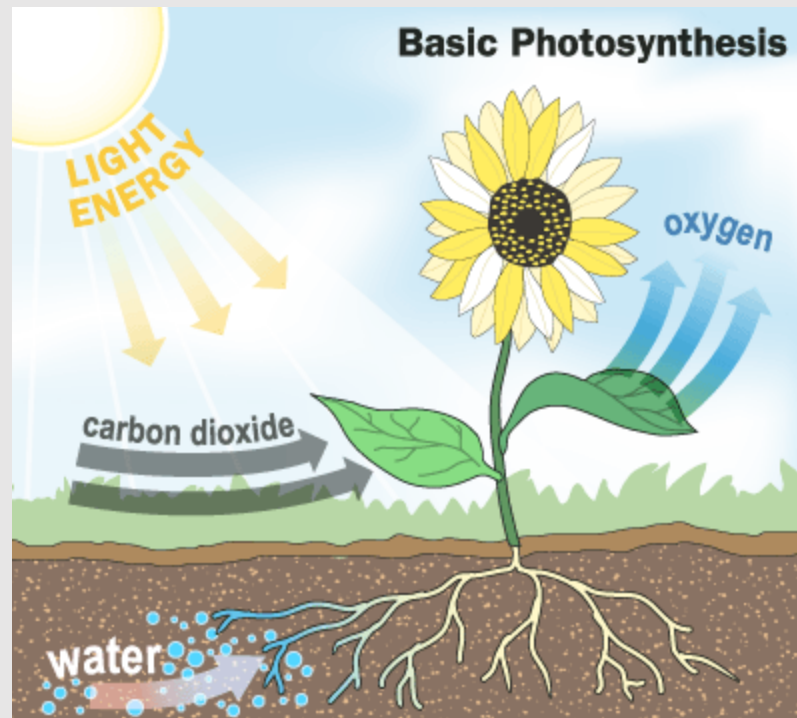
Direct Effect of CO₂ on Plants

- Availability of energy
- Availability of water
- Acquisition of nutrients



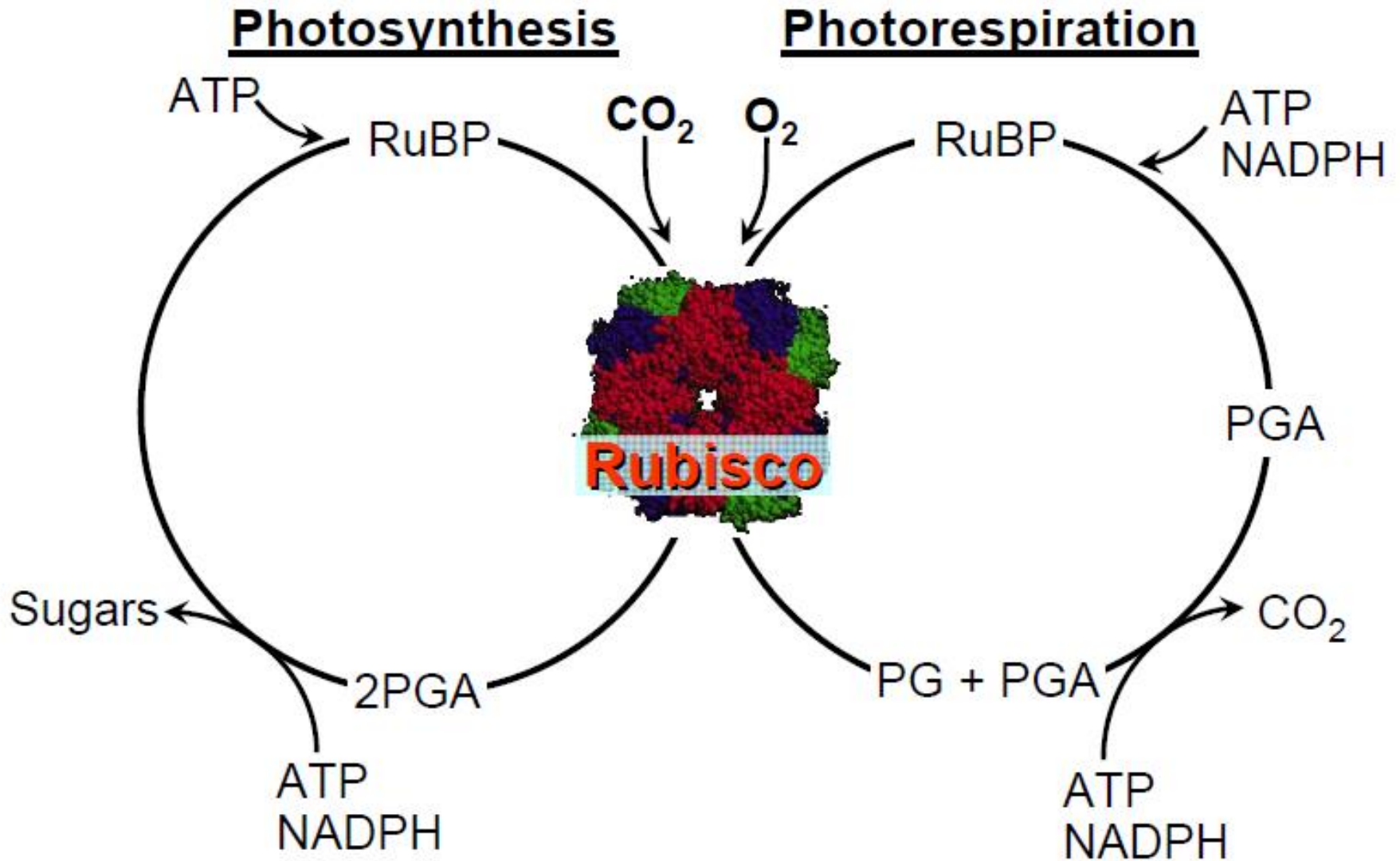
Photosynthesis

$\text{CO}_2 + \text{water} + \text{light} \rightarrow \text{carbohydrates} + \text{oxygen}$

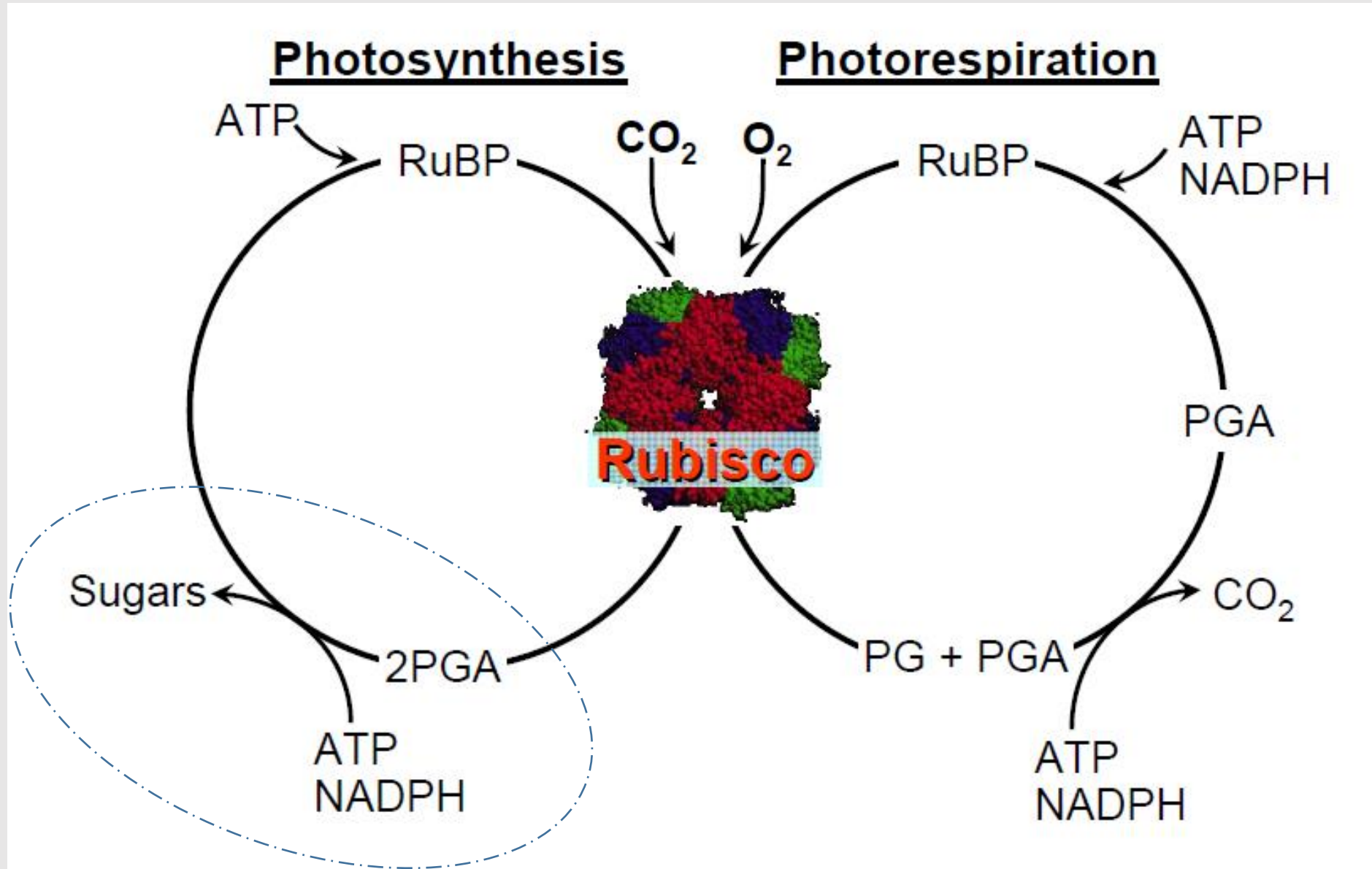


Converts ATP + NADPH into sugars (carbohydrates)

Rubisco enzyme is a catalyst

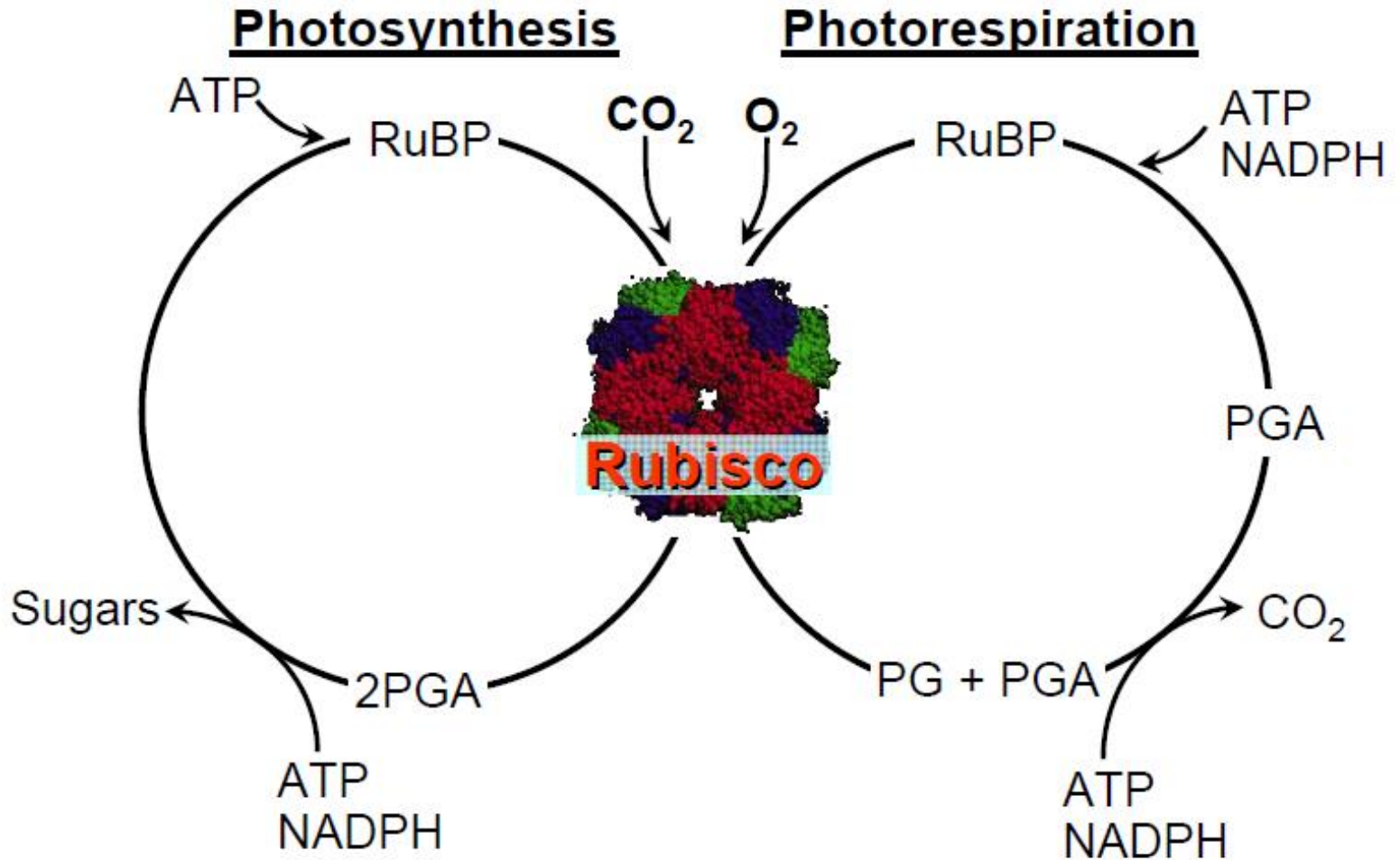


Rubisco enzyme is a catalyst



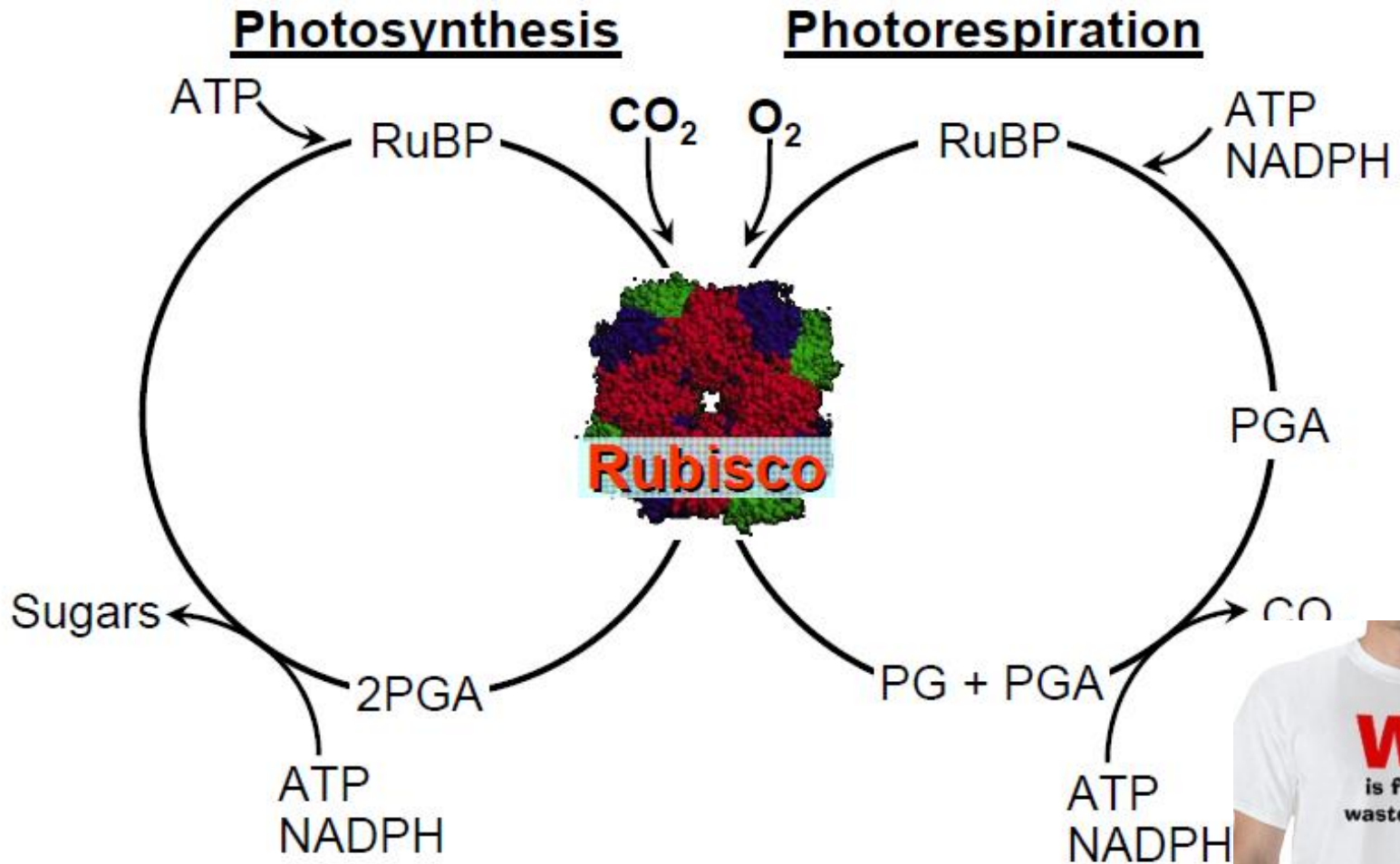
Photorespiration

No net production of energy (ATP, NADPH or sugar)



Photorespiration

No net production of energy (ATP, NADPH or sugar)



Photosynthesis or Photorespiration?

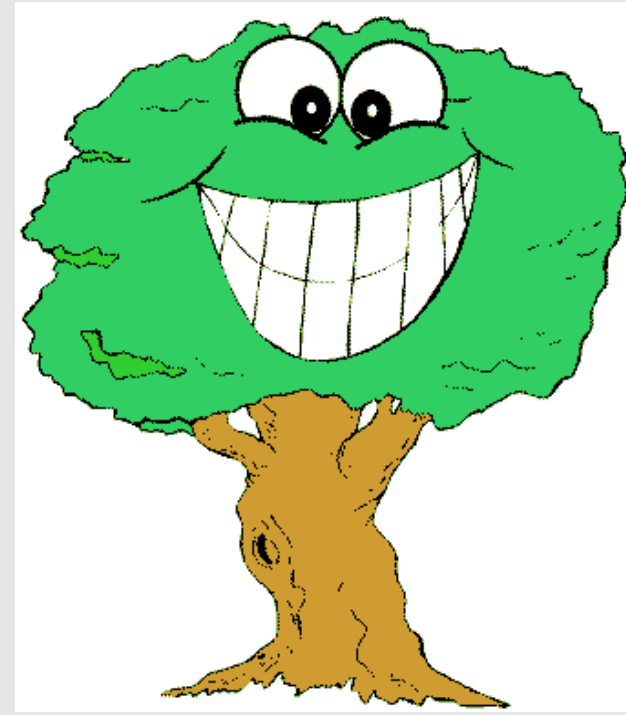
- Depends on relative amounts of CO_2 and O_2 in the atmosphere around the plant
- Currently, 2 – 3 cycles of photosynthesis for every 1 cycle of photorespiration



Photosynthesis or Photorespiration?

With a rising concentration of CO_2 , photosynthesis favored over photorespiration.

- Higher efficiency in converting light into sugars



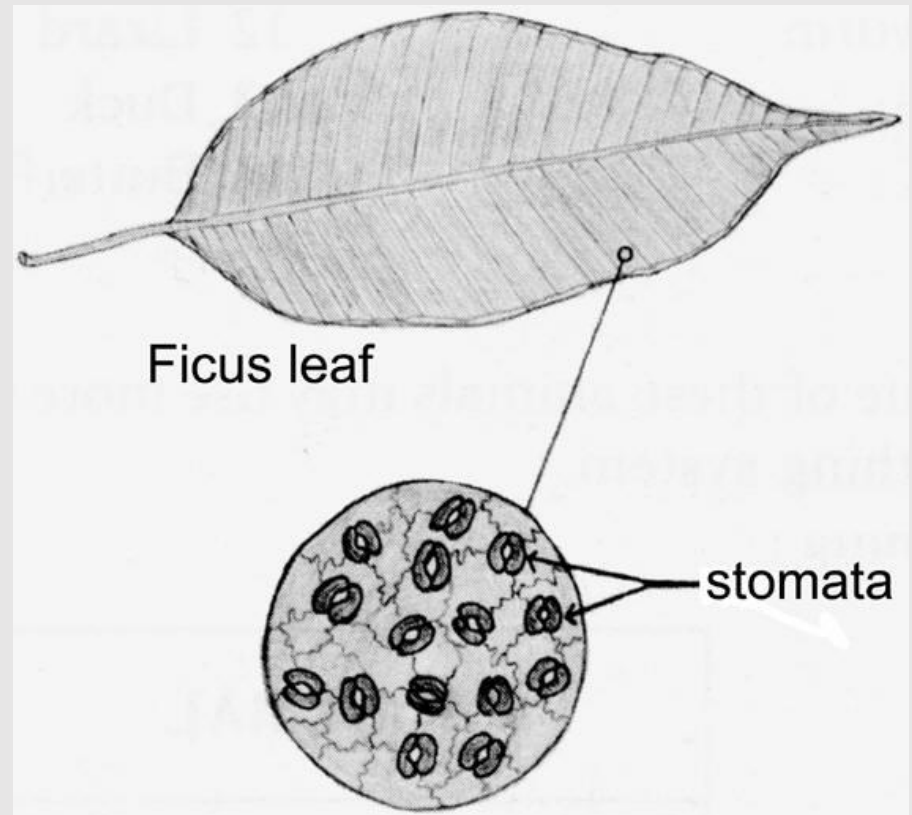
Direct Effect of CO₂ on Plants

- Availability of energy
- Availability of water
- Acquisition of nutrients



Water and Plants

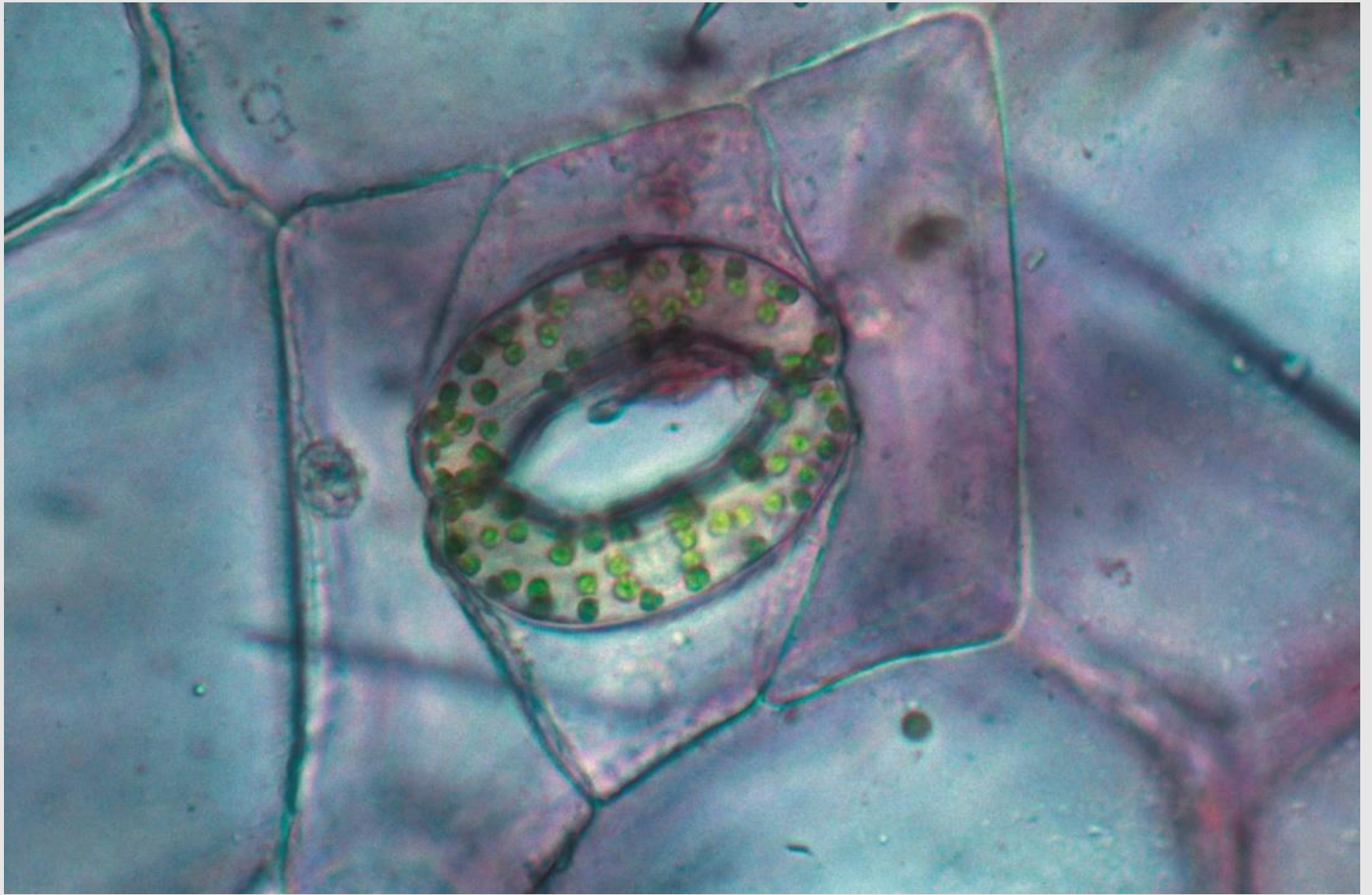
CO_2 enters leaves and H_2O vapor exits them through openings called stomata

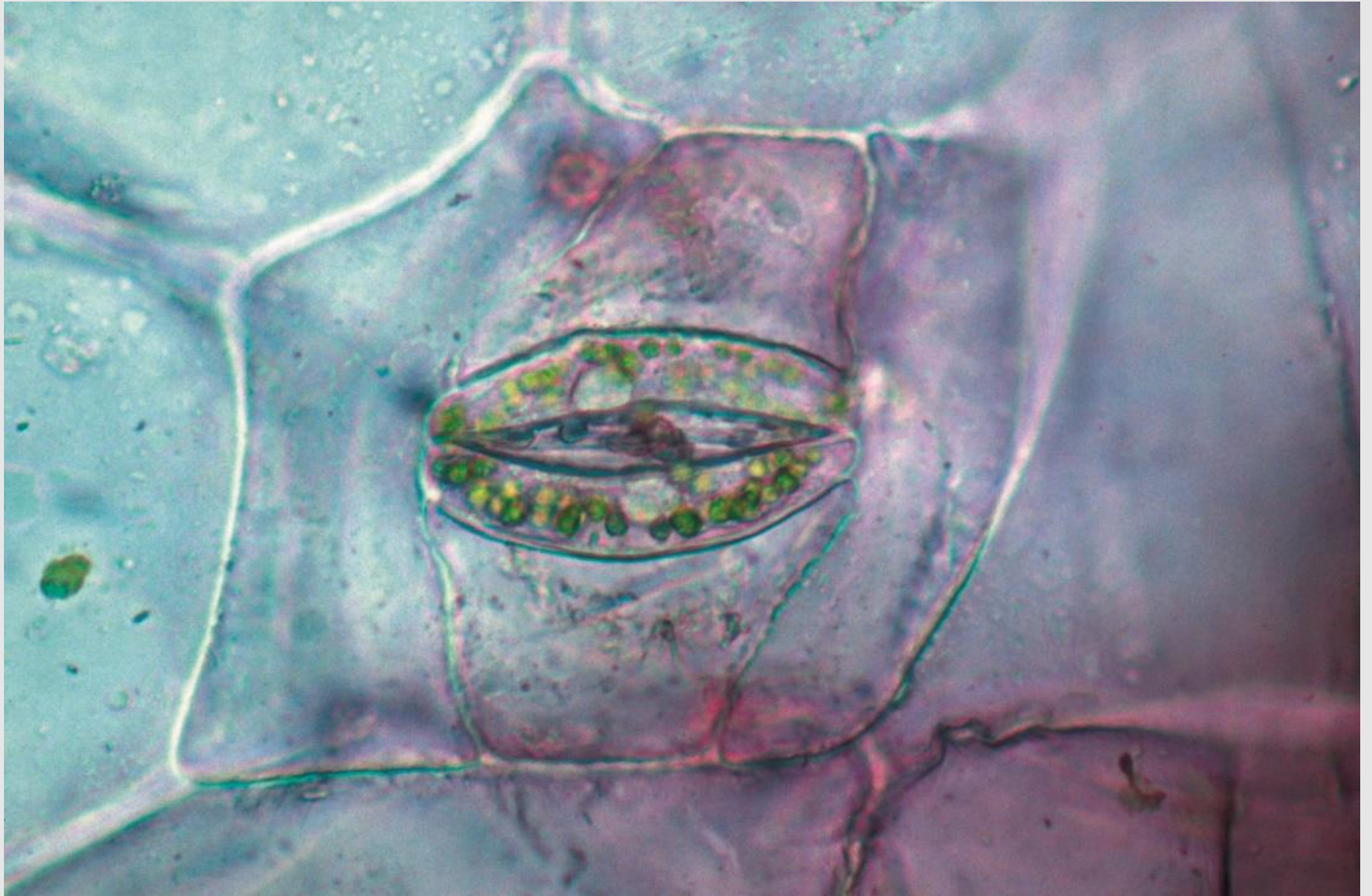


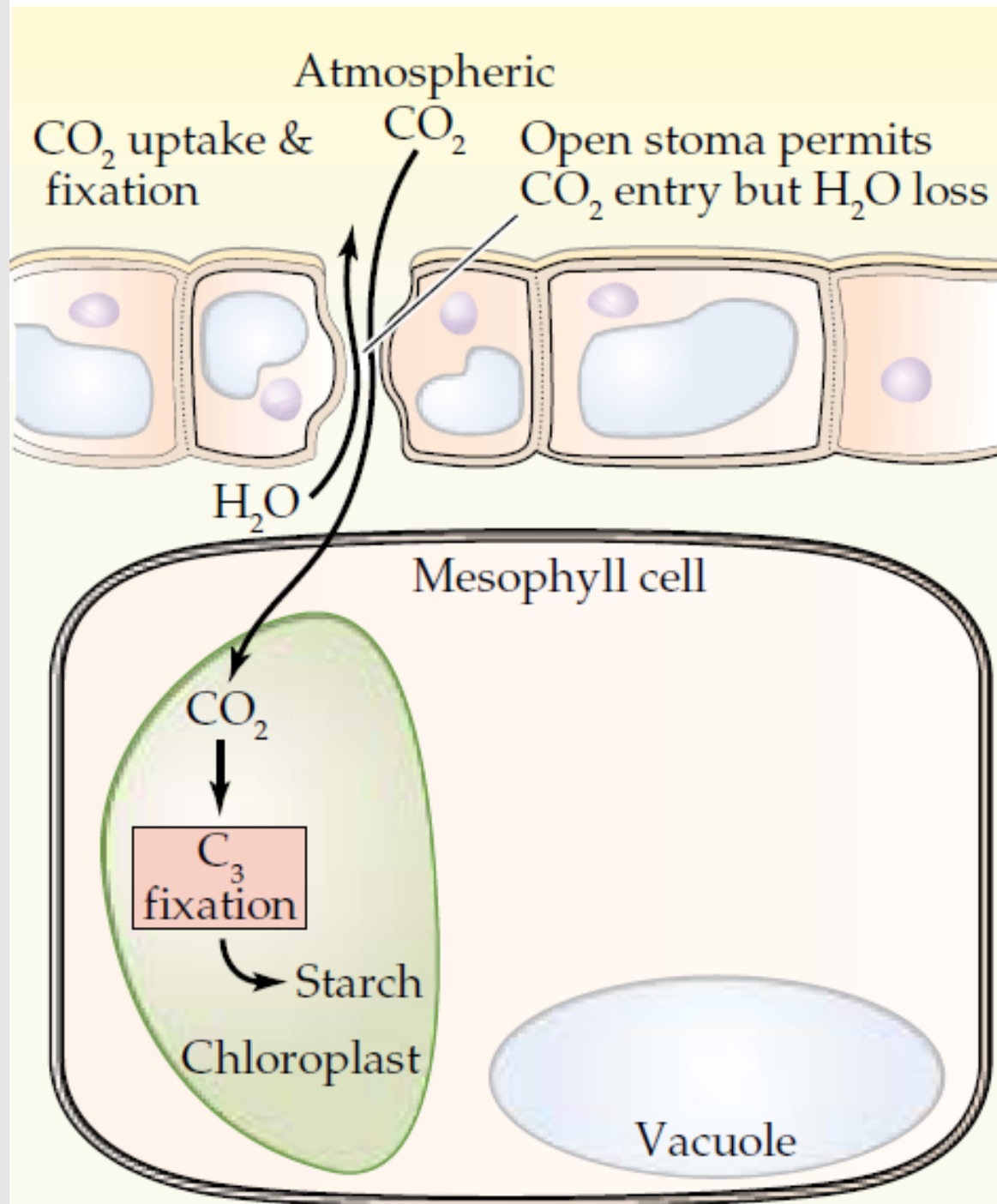
Plants control how wide the stomata open with environmental cues

- Relative humidity
- Light level
- CO₂ concentration
- Soil H₂O availability

Goal: minimize amount of H₂O lost per CO₂ taken in







Most plants lose 500-1000 molecules of H_2O for every molecule of CO_2 they assimilate

–Cacti lose only about 50 H_2O molecules per CO_2 assimilated



Plants and Water



Rising CO_2 concentration will increase the amount of CO_2 assimilated per H_2O lost.

- Plants can decrease width of stomal openings to conserve water but still maintain similar CO_2 concentration
- Or, they can keep the openings the same and lose water at similar rates, but increase CO_2 assimilation

What will plants do?

Need to do experiments!



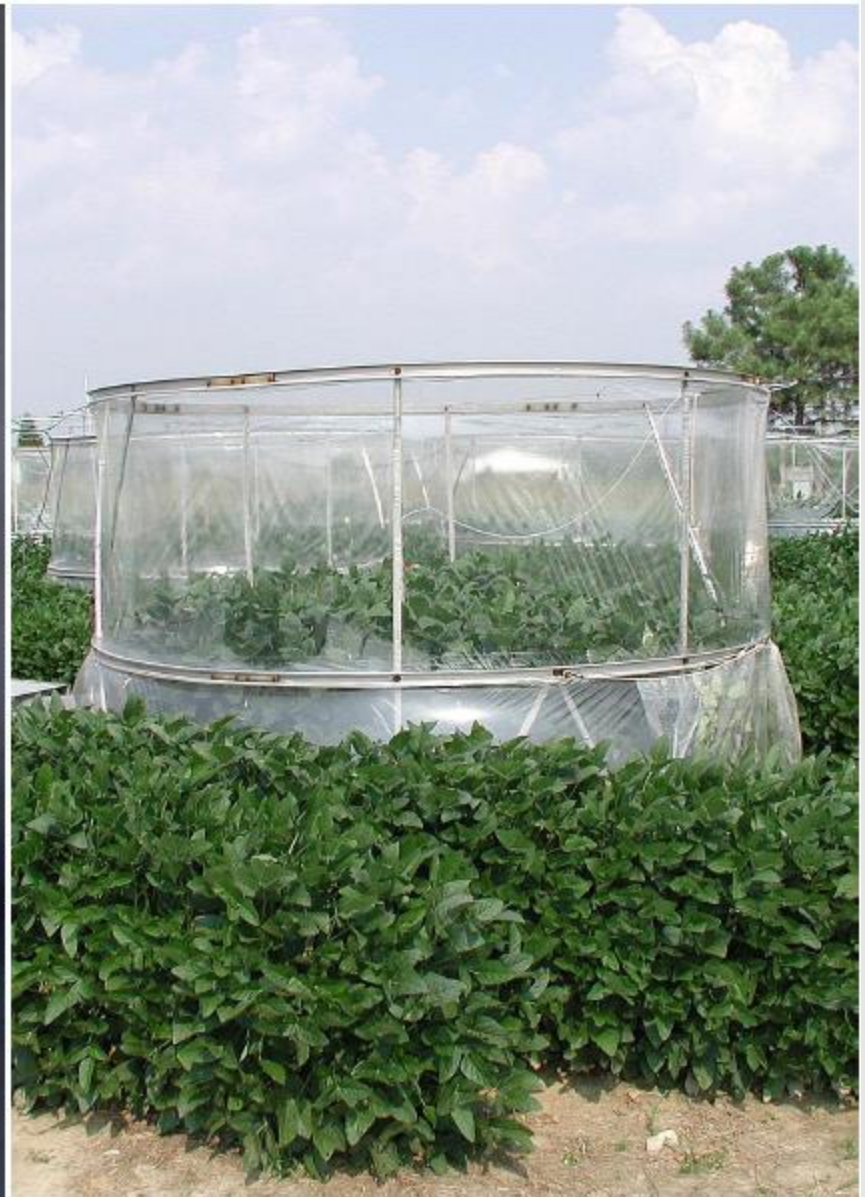
Grow plants in CO₂ enriched environments

- Controlled environment chambers
- Open top chambers
- Free Air CO₂ Enrichment (FACE) plots





Controlled environment chambers



Open top chambers



What will plants do?

They compromise

- Close stomata by 22% to conserve water
- increase CO_2 assimilation, 32% faster



CO₂ Acclimation

Plants in increased CO₂ assimilate CO₂ faster through photosynthesis

–Stimulates faster growth



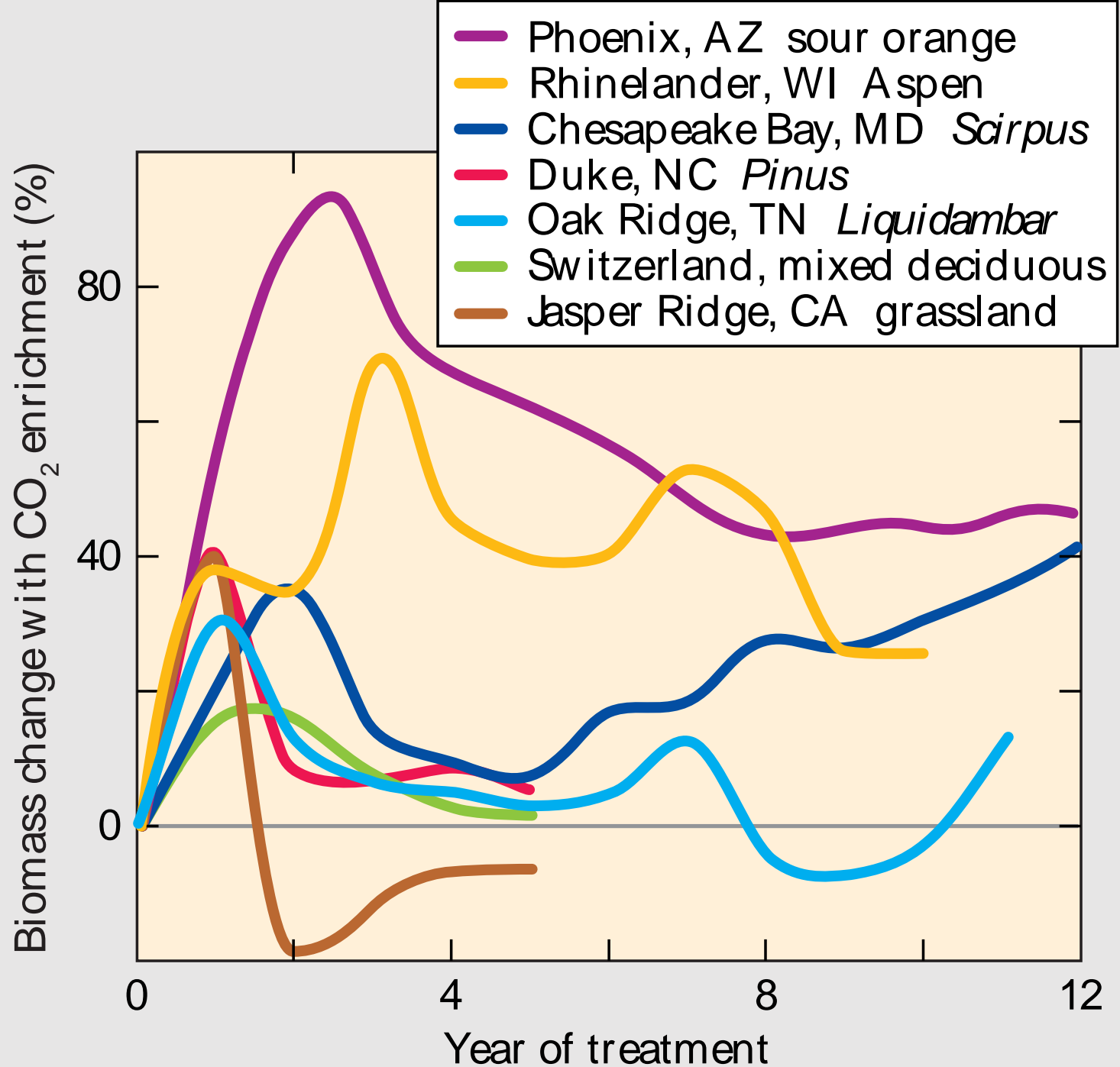
CO₂ Acclimation

After days, weeks, or months of exposure to increased CO₂ levels, net CO₂ assimilation slows.

– In long term, growth rates at elevated CO₂ only 8% faster

The decline of the stimulation of CO₂ over time is called **CO₂ acclimation**

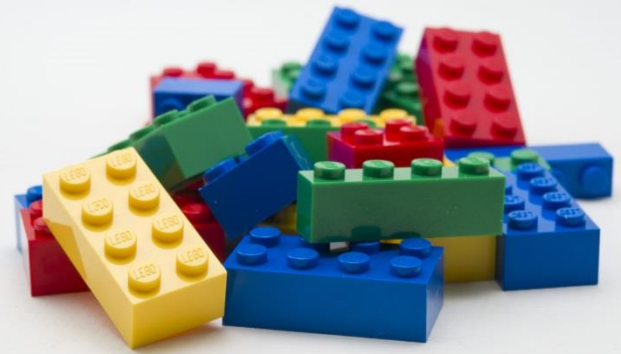




Corporate America and Climate Change 1/25/16

<http://www.bloomberg.com/news/articles/2016-01-26/supply-chain-thwarts-coca-cola-goldman-sachs-action-on-climate>

- Thank you Alyssa Temple!
- Many large companies pledged to take measures to address climate change to contribute to a **United Nations climate agreement between 195 nations sealed last month in Paris.**
- While they're **setting targets** to cut their own fossil-fuel pollution, the report shows **their suppliers, which are responsible for as much as four times as much greenhouse gas emissions, are out of sync.**
- 72% of suppliers said **climate change risks could significantly impact their operations**, sales or costs. Nearly two-thirds said climate policies, such as carbon taxes, posed a risk to their business.
- But **less than half of respondents set a target to cut carbon emissions and only 34 percent reduced emissions in the past year.**



- **"Emissions are not reducing at the rate required to meet the Paris goals, nor are suppliers building the resilience they need to deal with the climate impacts they will inevitably face."**
- Companies should work with suppliers to encourage greater action on climate change.
- **Lego started hosting "innovation camps"** in the hope of creating joint projects with suppliers that could reduce carbon emissions collaboratively. **Other companies have threatened to drop suppliers that fail to comply** with their environmental policies.



Direct Effect of CO₂ on Plants

- Availability of energy
- Availability of water
- Acquisition of nutrients

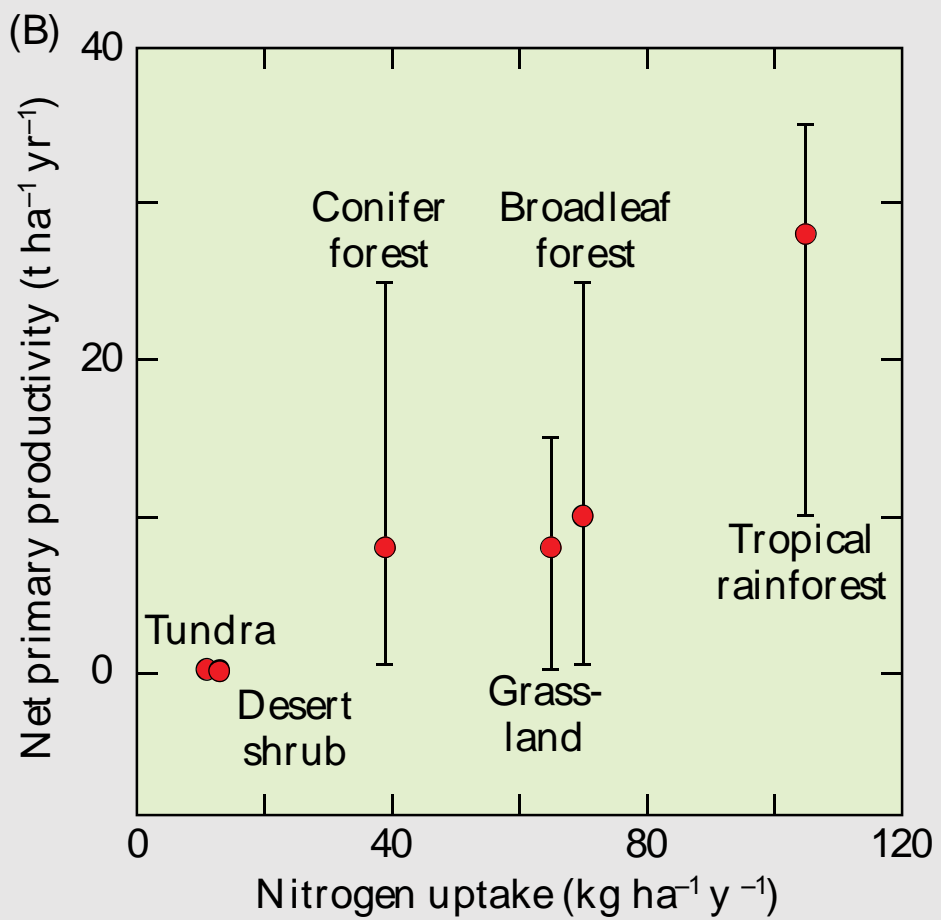
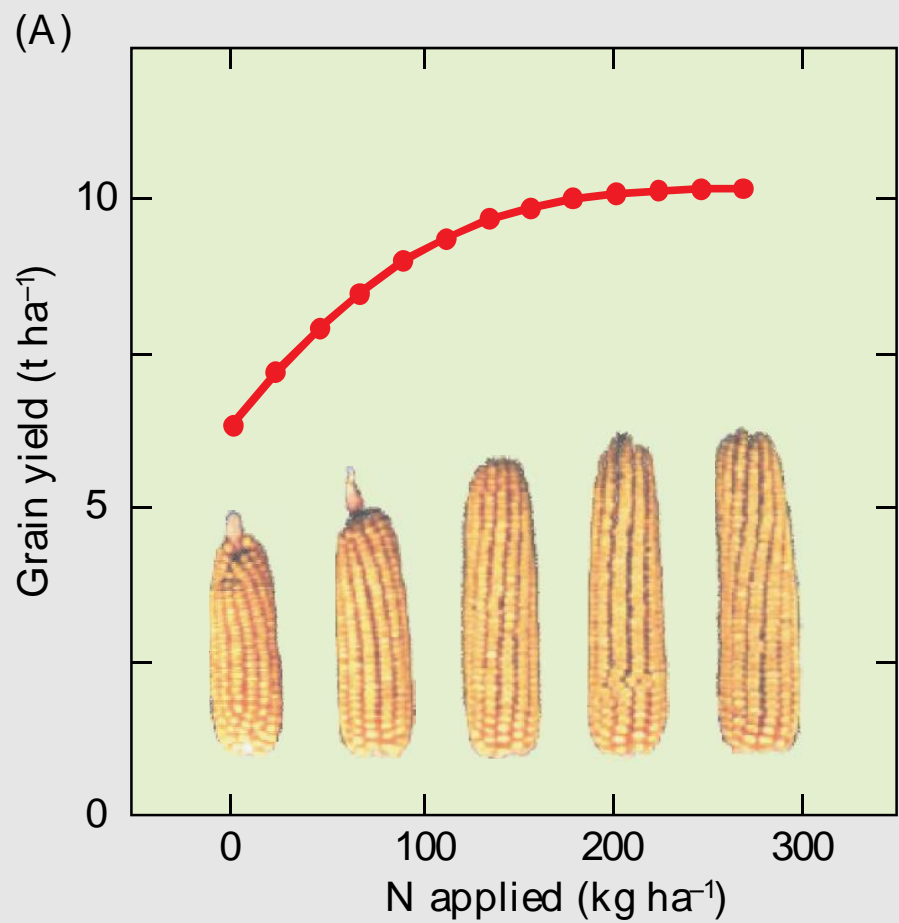


Nitrogen nutrition of plants

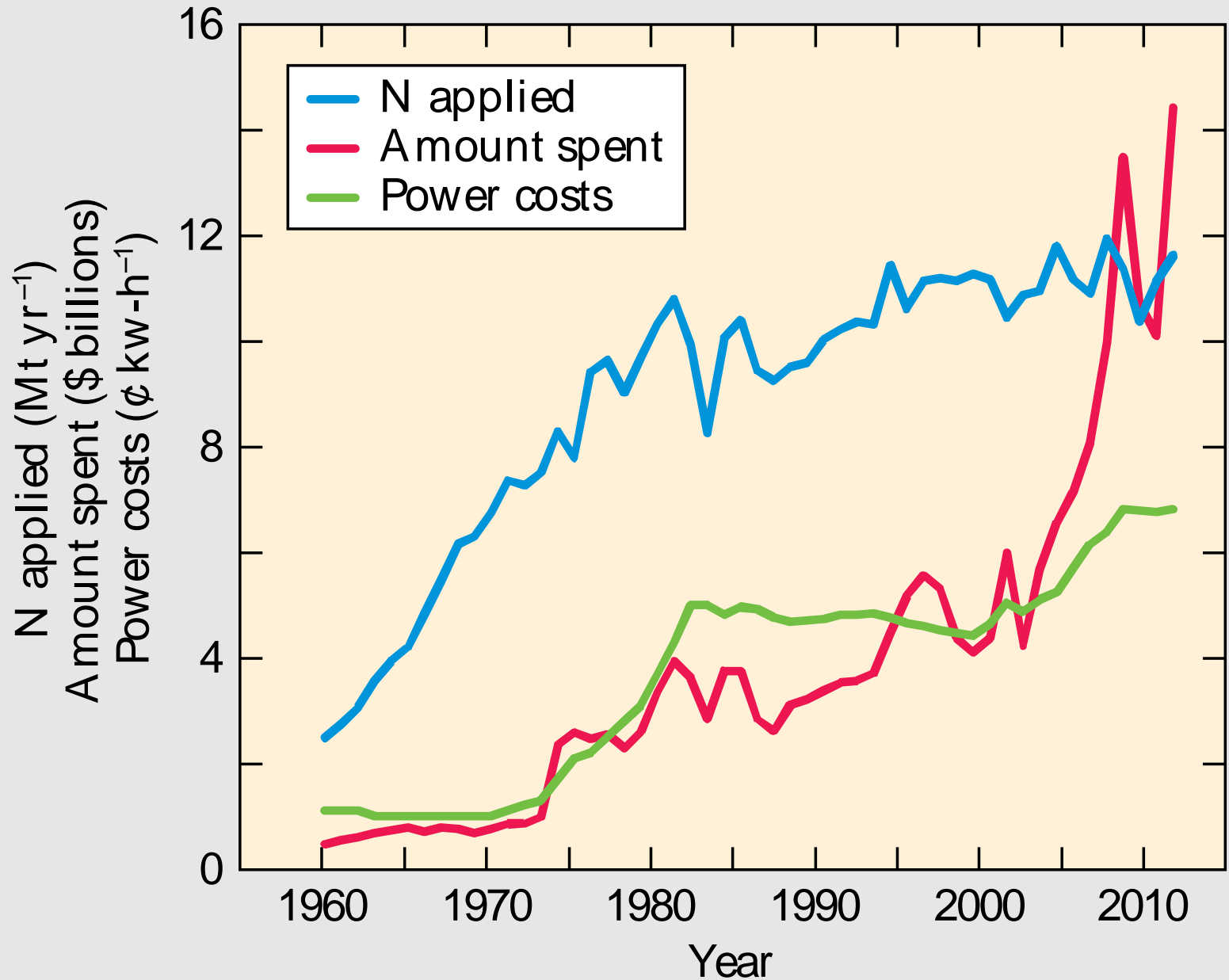
Nitrogen (N) is the mineral that plants require in the greatest amount.

- Nitrogen fertilizers stimulate nearly all agricultural and natural ecosystem growth
- Nitrogen availability is a major limiting factor for plant growth



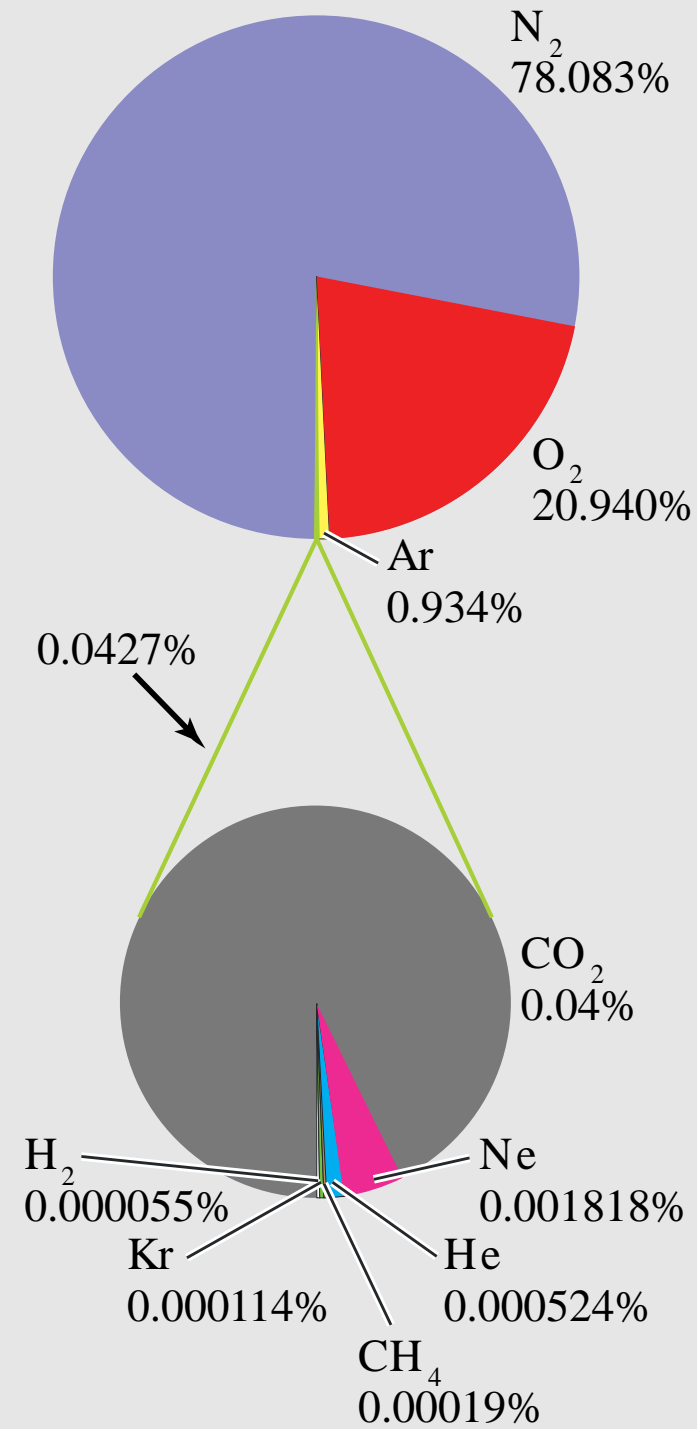
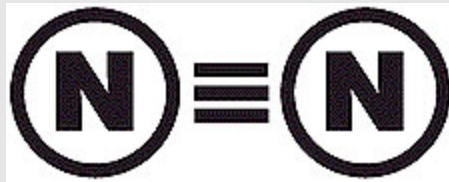


Nitrogen fertilizers applied in the United States



Nitrogen in the atmosphere can not be used by plants

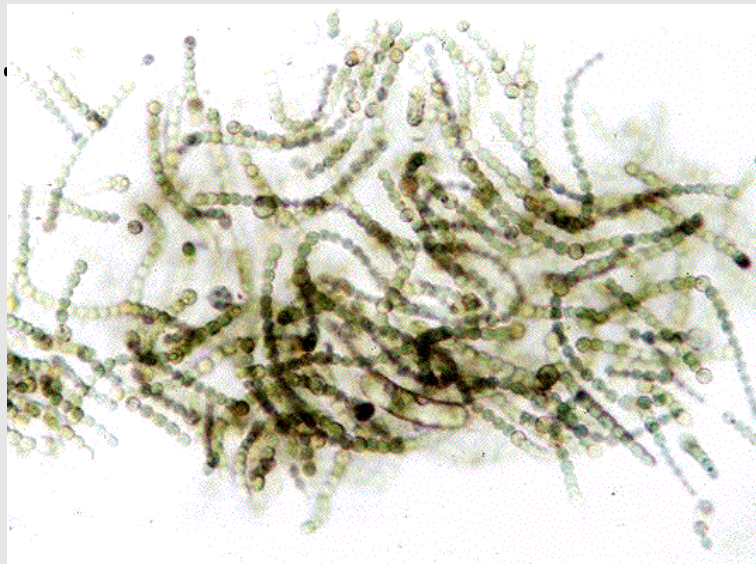
- Bond between Nitrogen atoms too strong to break (inert)



Biological Fixation: some microorganisms in the soil convert N_2 into a useable form: ammonia (NH_3)

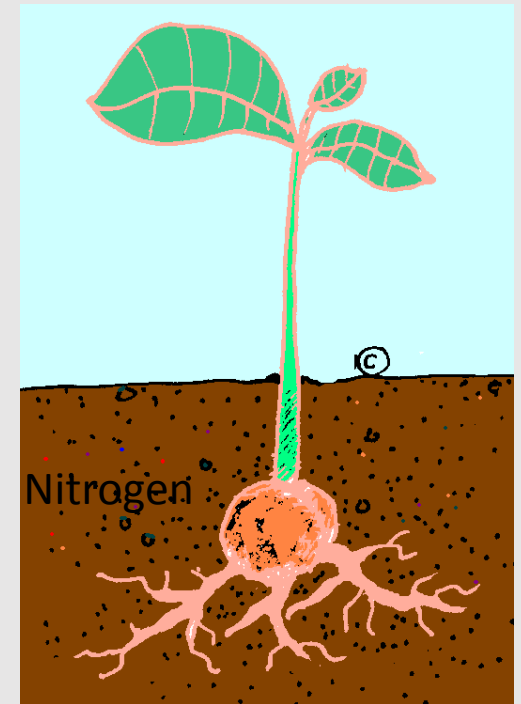
- NH_3 dissolves in water to form **ammonium** (NH_4^+)
- **Nitrate** (NO_3^-) is produced through biological fixation or decomposition in soil

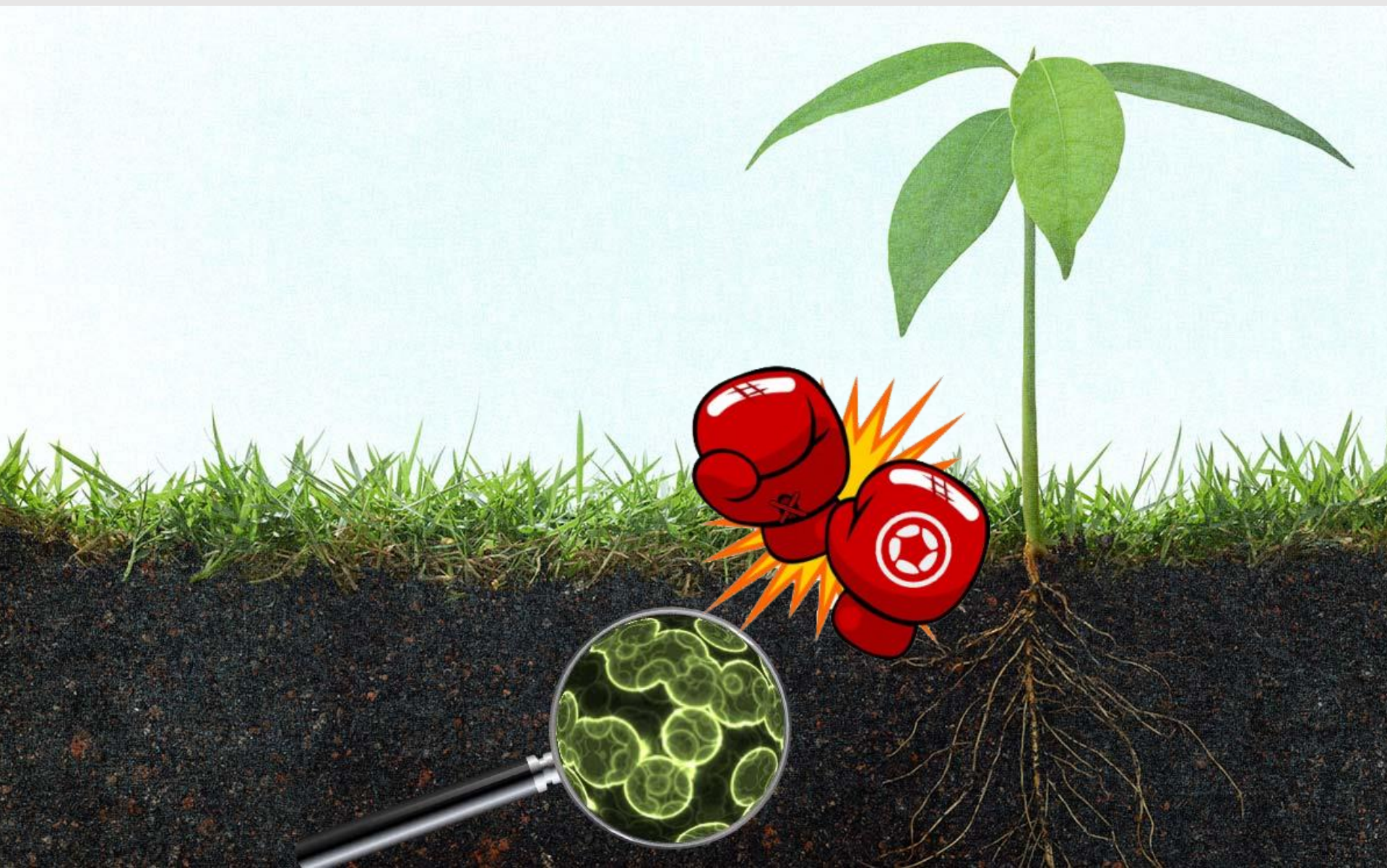
Plants use these forms of nitrogen (ammonium and nitrate) for growth.



Nitrogen nutrition of plants

- Most plants acquire nitrogen through root absorption of ammonium and nitrate.
- Plants convert these forms of nitrogen into amino acids and energy (ADP).



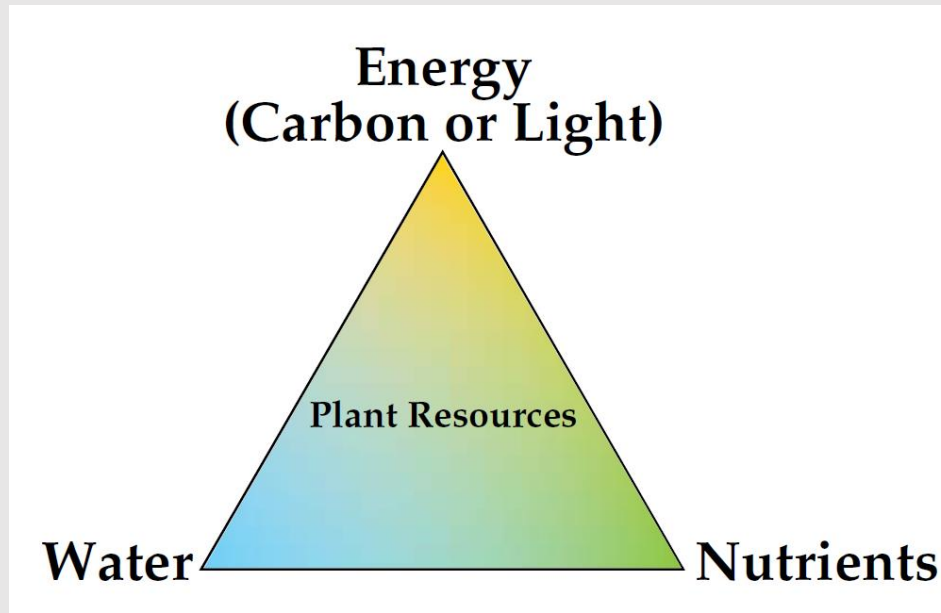


Nitrogen and plants in elevated CO_2

Earlier, we saw that energy and water availability for plants increase with CO_2 concentration

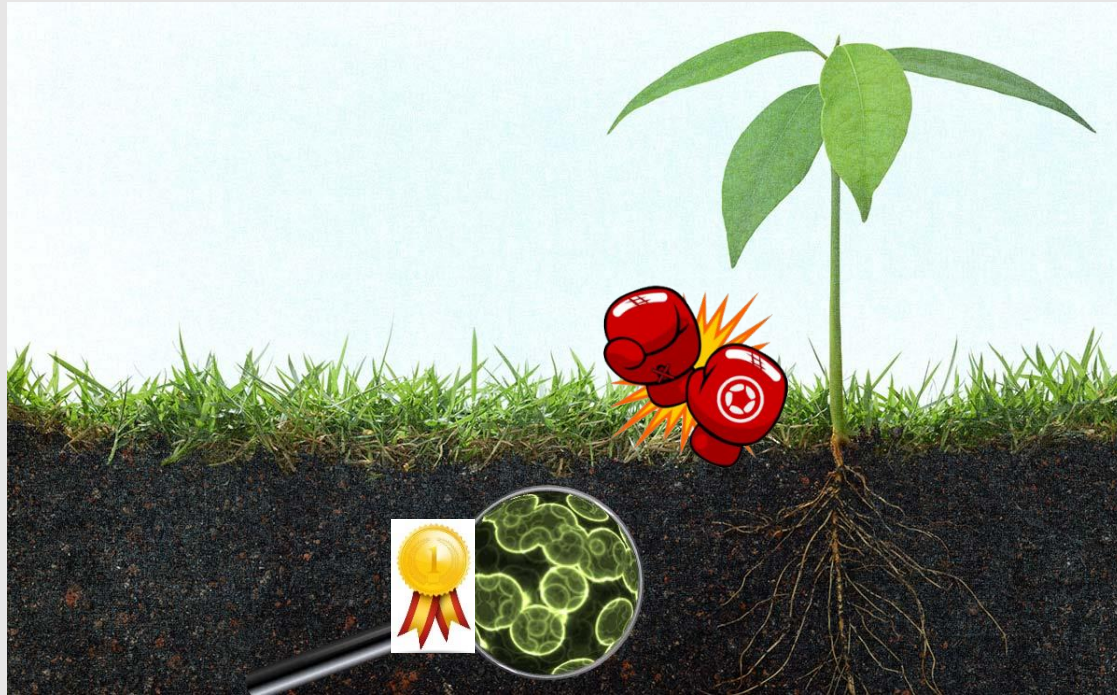
– This stimulates growth.

But, nitrogen availability might not keep up



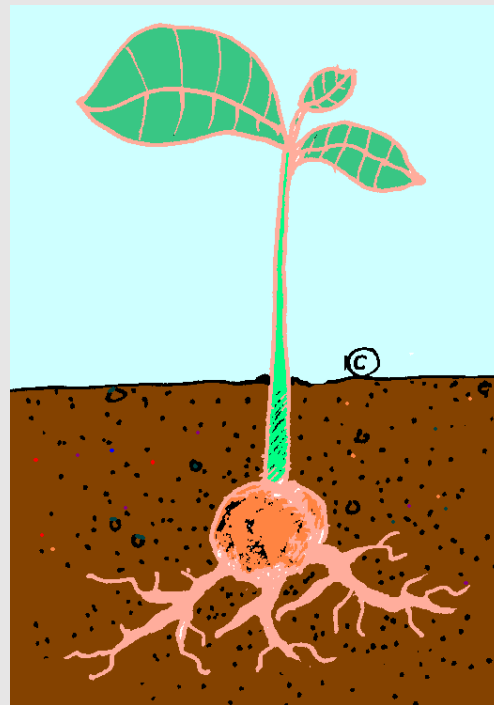
Plants initially grow faster and release more carbohydrates into the soil

- Microorganisms use these carbohydrates and become more active.
 - Respire 18% faster than under normal CO₂ conditions
- As microorganism growth increases, they remove mineral nitrogen and other nutrients from the soil



Nitrogen and plants in elevated CO₂

As extraction of nitrogen from soil by microorganisms increases, nitrogen availability to plants decreases under CO₂ enrichment

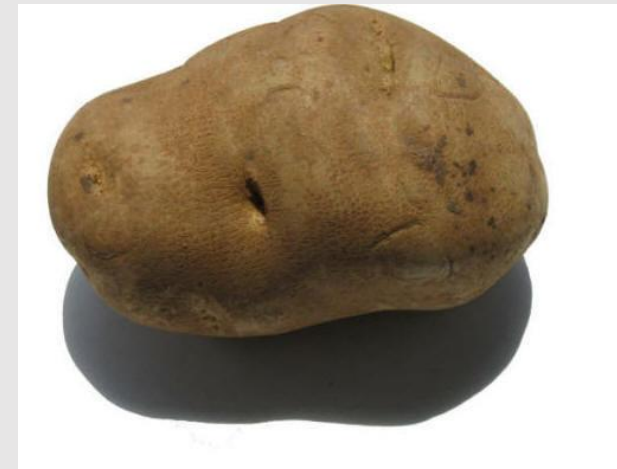


Food Quality

Nutritional value of plant material will decline

- Protein concentrations decline
- Concentration of phenolics increase. Makes plants hard to digest.

Herbivores might have to eat more plants to get the same nutrition



Carbon Dioxide Sensing Organisms

Lots of organisms measure the CO₂ concentrations of their surroundings

Ants, bees, and termites detect location and activity of hives by CO₂ concentration gradients



Mosquitoes, ticks, and tsetse flies find blood meals by following the trail of CO₂ to their prey



Rising CO₂ concentrations will interfere with CO₂ sensing.

Other climate changes may expand ranges!



Climate change will affect the following factors

- Carbon Dioxide levels

- Temperature

- Precipitation

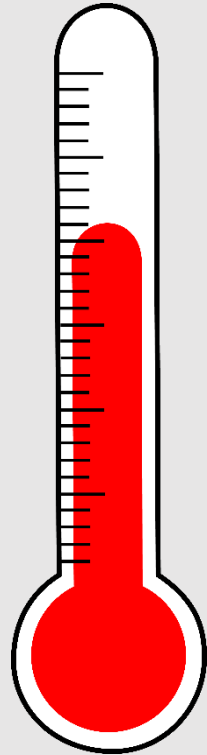
- Salinity

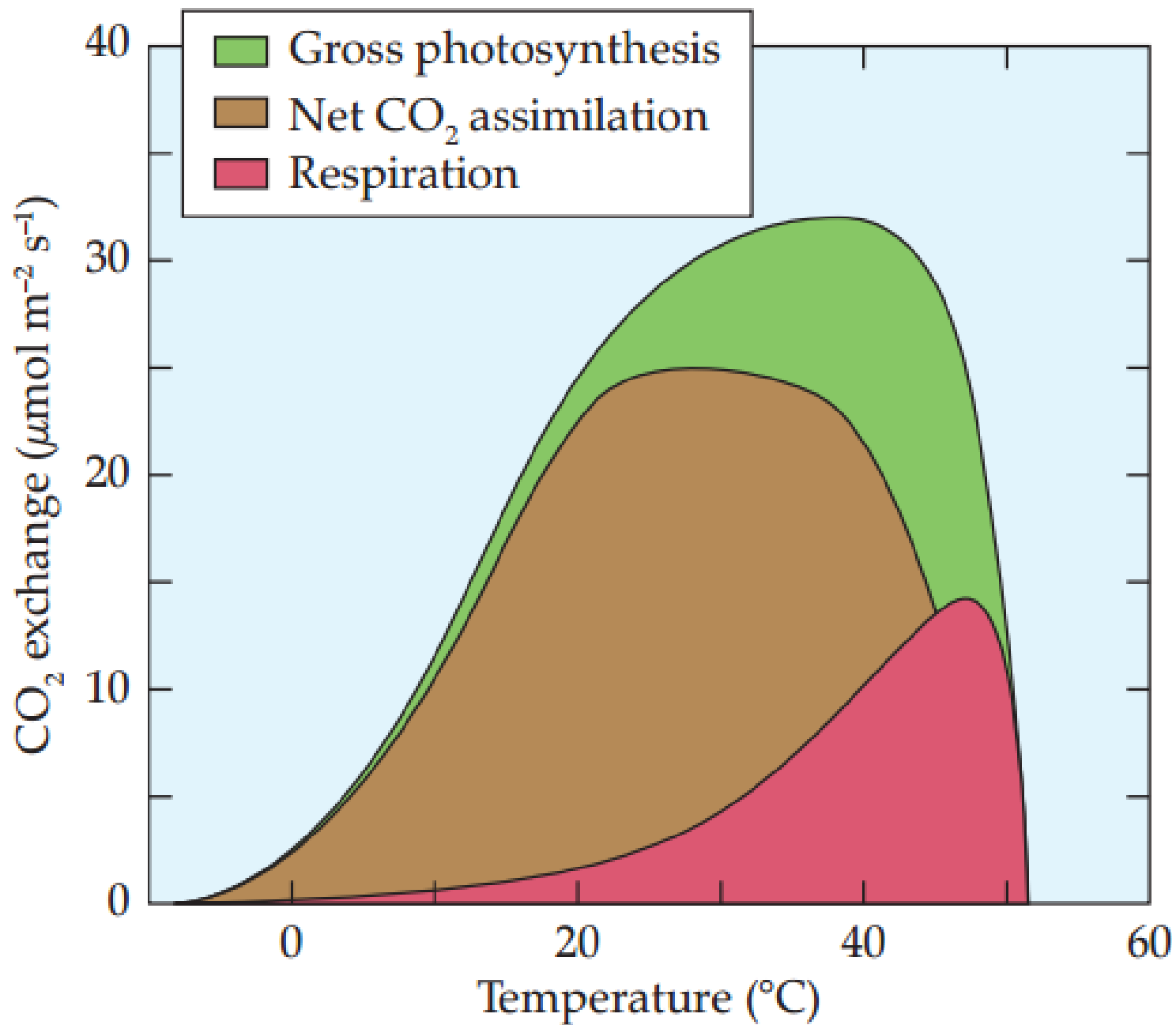
- pH (acid level)

Temperature

Average global temperatures have warmed about 0.6°C over the last 150 years

Likely to warm an additional 2° to 6°C by the end of this century



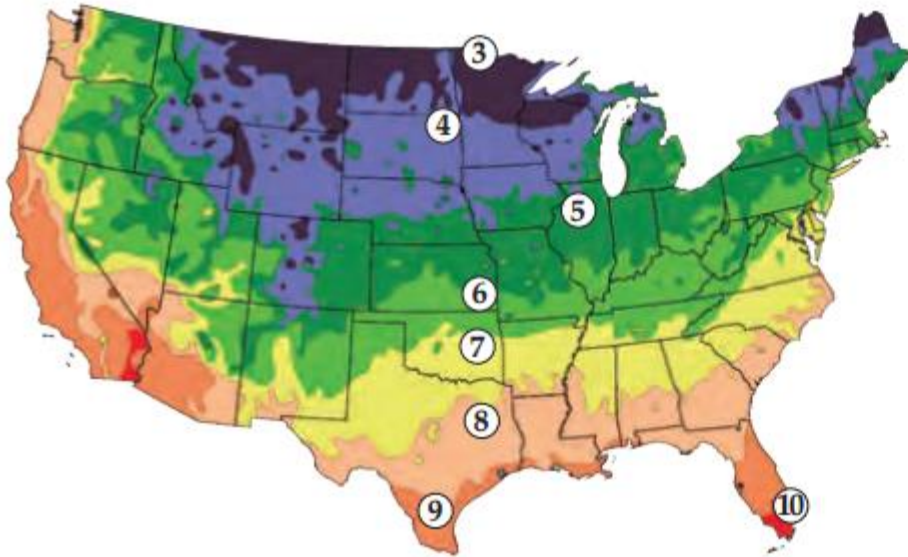


Temperature patterns have changed:
increased nighttime minimum
temperatures

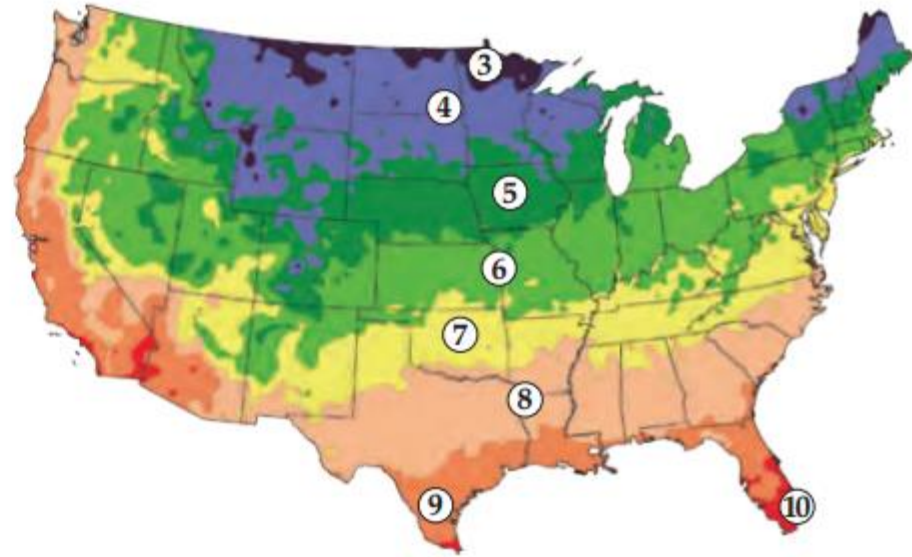
Frost defines the growing season for some
plants



(A) 1990 minimums



(B) 2006 minimums



Zone	Annual minimum (°F)
3	-40 to -50
4	-30 to -40
5	-20 to -30
6	-10 to -20
7	0 to -10
8	10 to 0
9	20 to 10
10	30 to 20

