Grassland ecology basics

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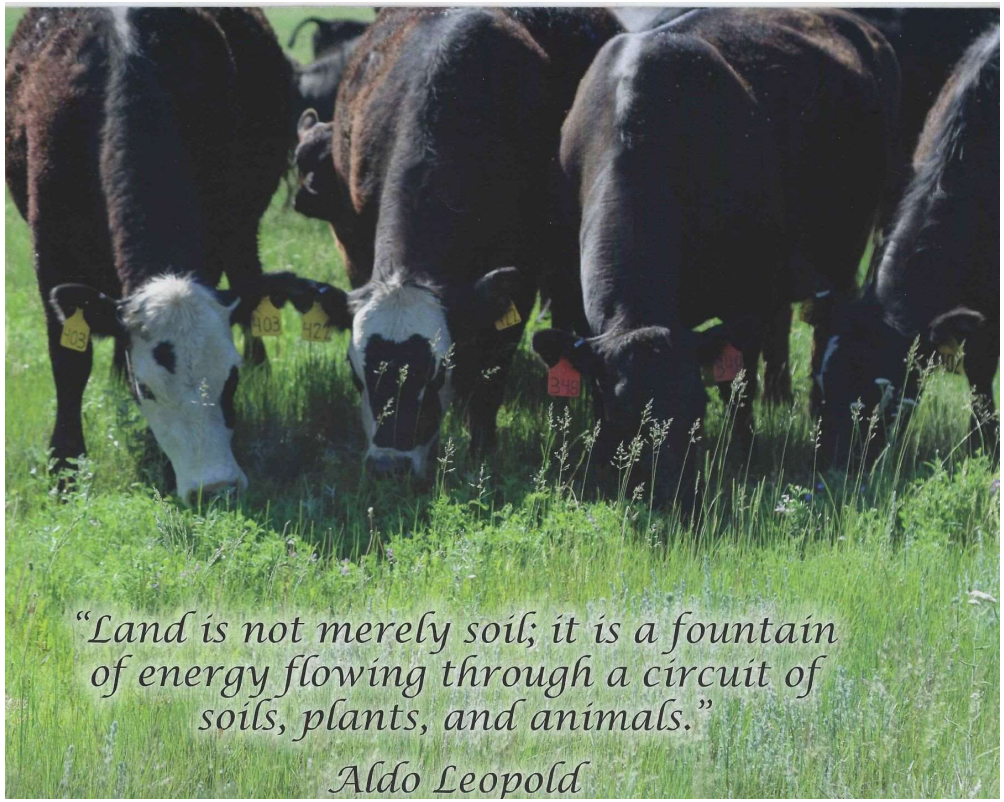
What is an ecosystem?
Assembly of populations that function to support themselves and their environment



OUTLINE

01

Plants, plant associations, ecosystem structure and function

02

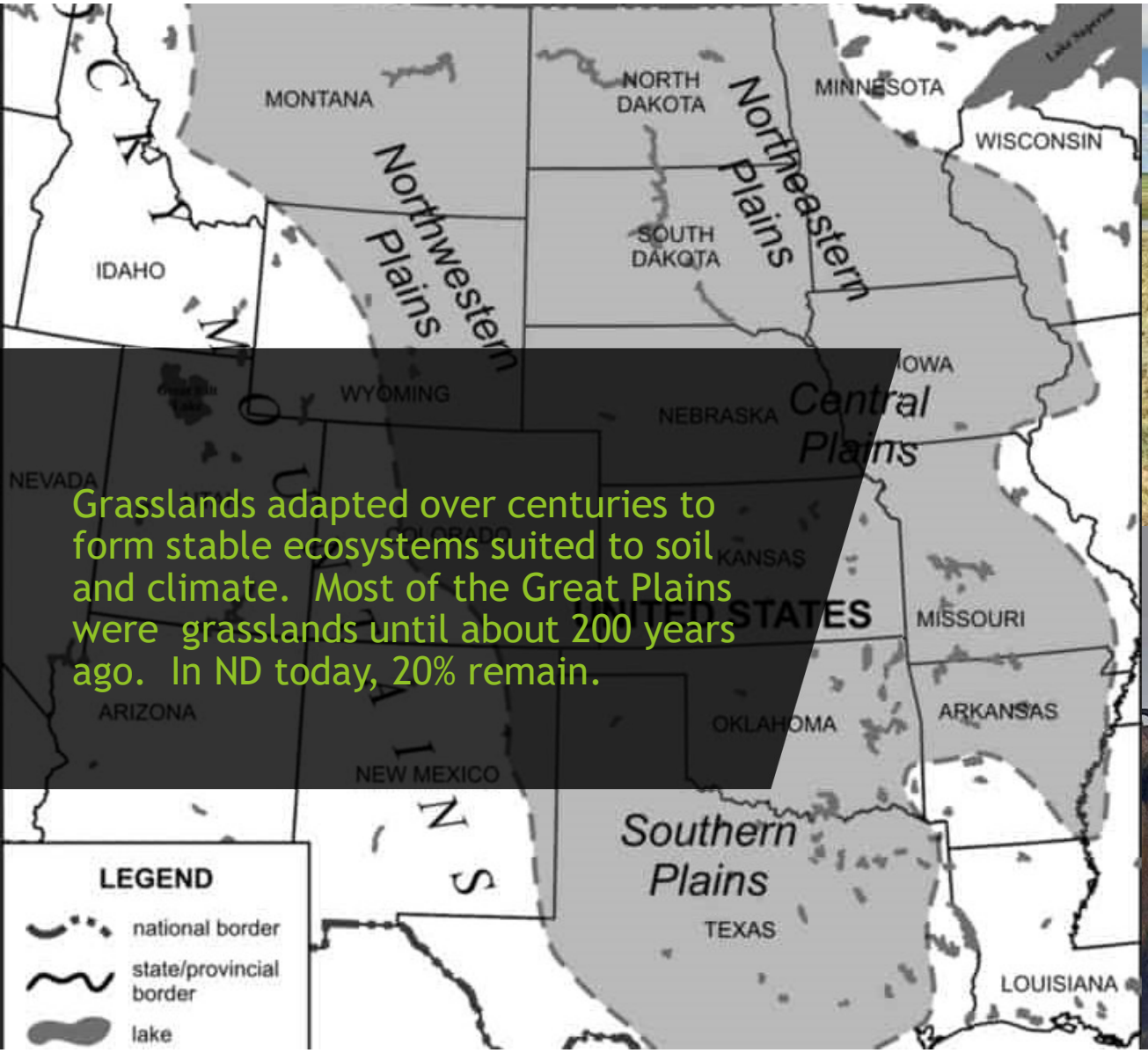
Plants as solar collectors compared to synthetic collectors

03

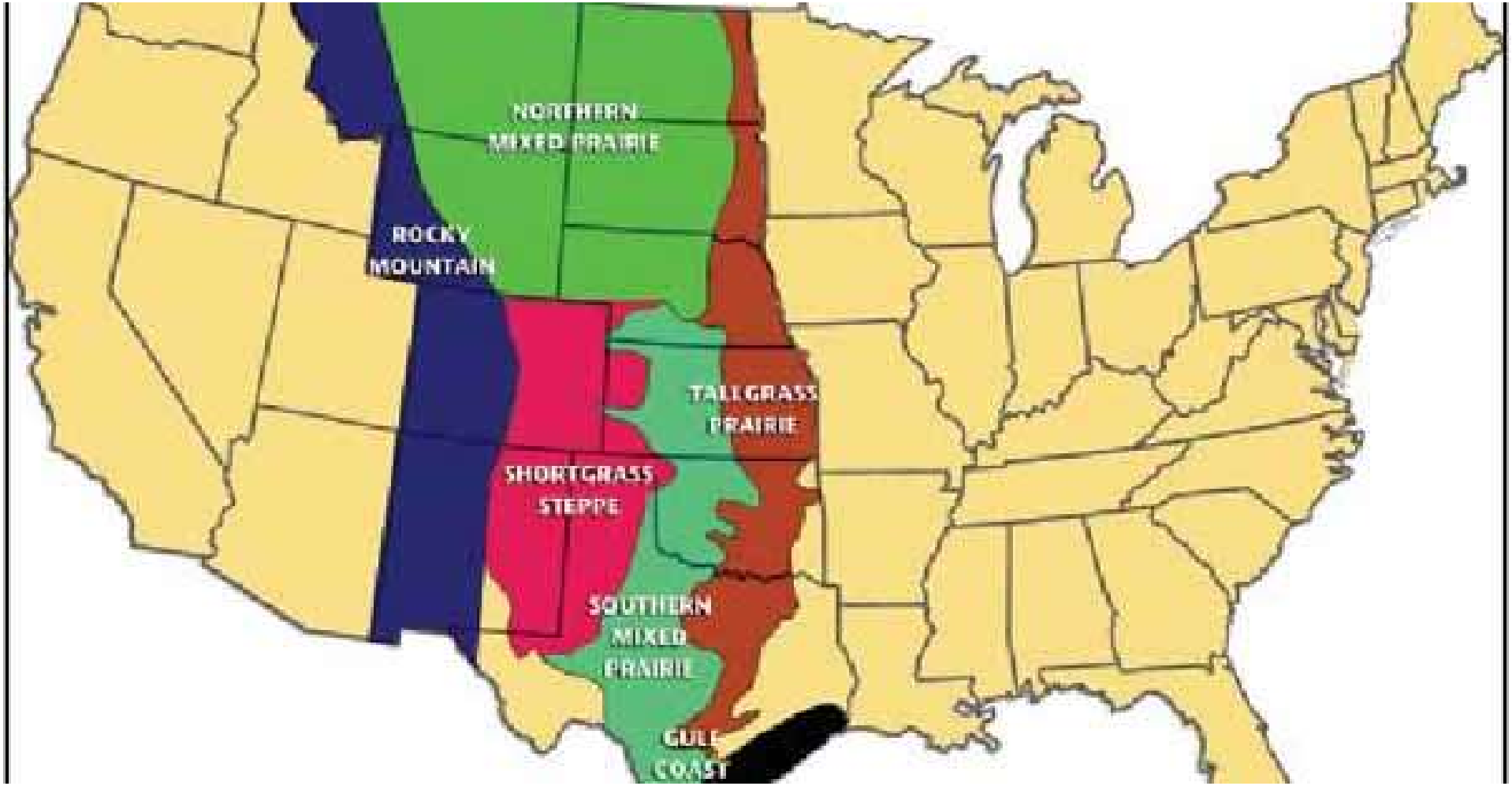
Special project

a) design a multi-purpose plant

b) document your favorite grassland



Grasslands adapted over centuries to form stable ecosystems suited to soil and climate. Most of the Great Plains were grasslands until about 200 years ago. In ND today, 20% remain.


NORTHERN
MIXED PRAIRIE
ROCKY
MOUNTAIN
TALLGRASS
PRAIRIE
SHORTGRASS
STEPPE
SOUTHERN
MIXED
PRAIRIE
GULF
COAST

Grasslands are hidden bastions of biodiversity

https://news.mongabay.com/2016/08/savannas-and-grasslands-are-more-biodiverse-than-you-might-think-and-were-not-doing-enough-to-conserve-them/

Avian habitat

Mammal habitat

Insect habitat

Amphibian habitat

Grassland plants support many habitats

- Plants provide variable structure, e.g. density, height, architecture
- Specific plants support specific organisms, e.g. milkweed for monarchs, flowers for pollinators, forage with specific nutrient contents
- Waste products and exudates feed soil macro and micro organisms, e.g. manure, root exudates, necromass
- Phytochemicals for livestock and human meat nutrition

Plants convert solar energy and feed the soil they need to grow on.

The soil and plants provide a fertile environment for organisms that breakdown nutrients for plants

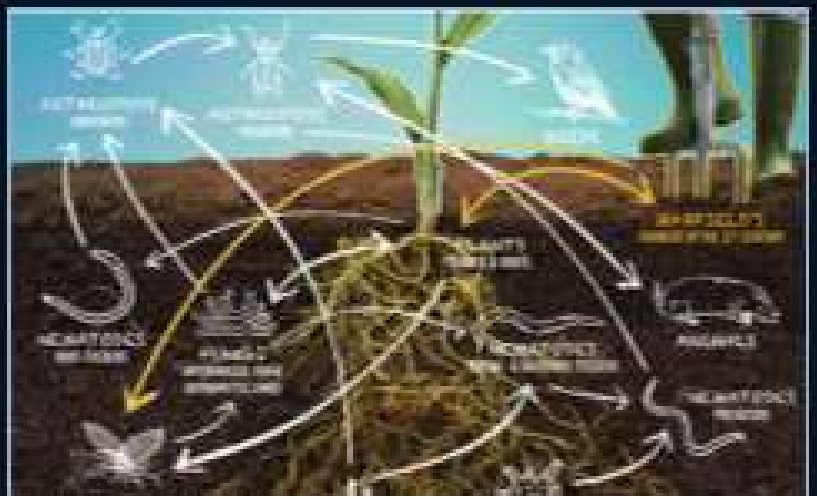
Common Milkweed seed pods.

Painted Lady nectaring on Swamp Milkweed

Landscapes with diverse arrays of plants are nutrition centers and pharmacies with vast arrays of phytochemicals.

Nothing is more important for health through nutrition than...

...landscapes with a variety of foods for herbivores, omnivores, and carnivores above and below ground.



Conversion of solar energy (photons) to chemical energy (electron excitation)

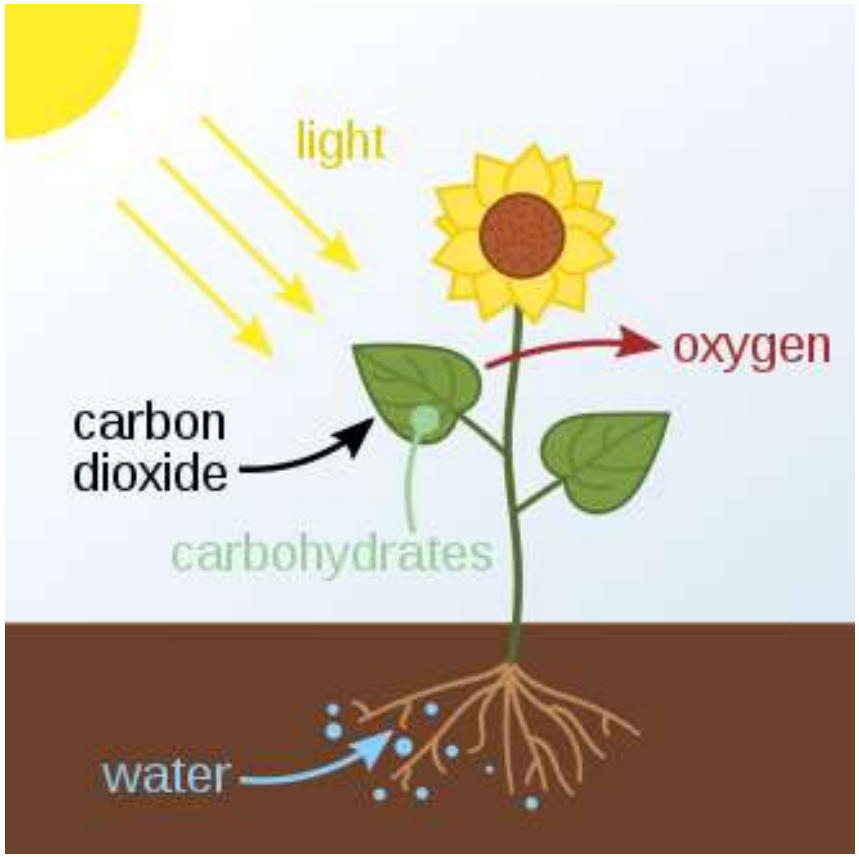
What is fundamental to all ecosystems?
Where does energy come from in grasslands?

Photosynthesis Equation						
Carbon dioxide	+	Water	SUNLIGHT →	Sugar	+	Oxygen
$6CO_2$		$6H_2O$		$C_6H_{12}O_6$		$6O_2$

Grassland plants convert solar energy to chemical energy to feed the rest of the ecosystem

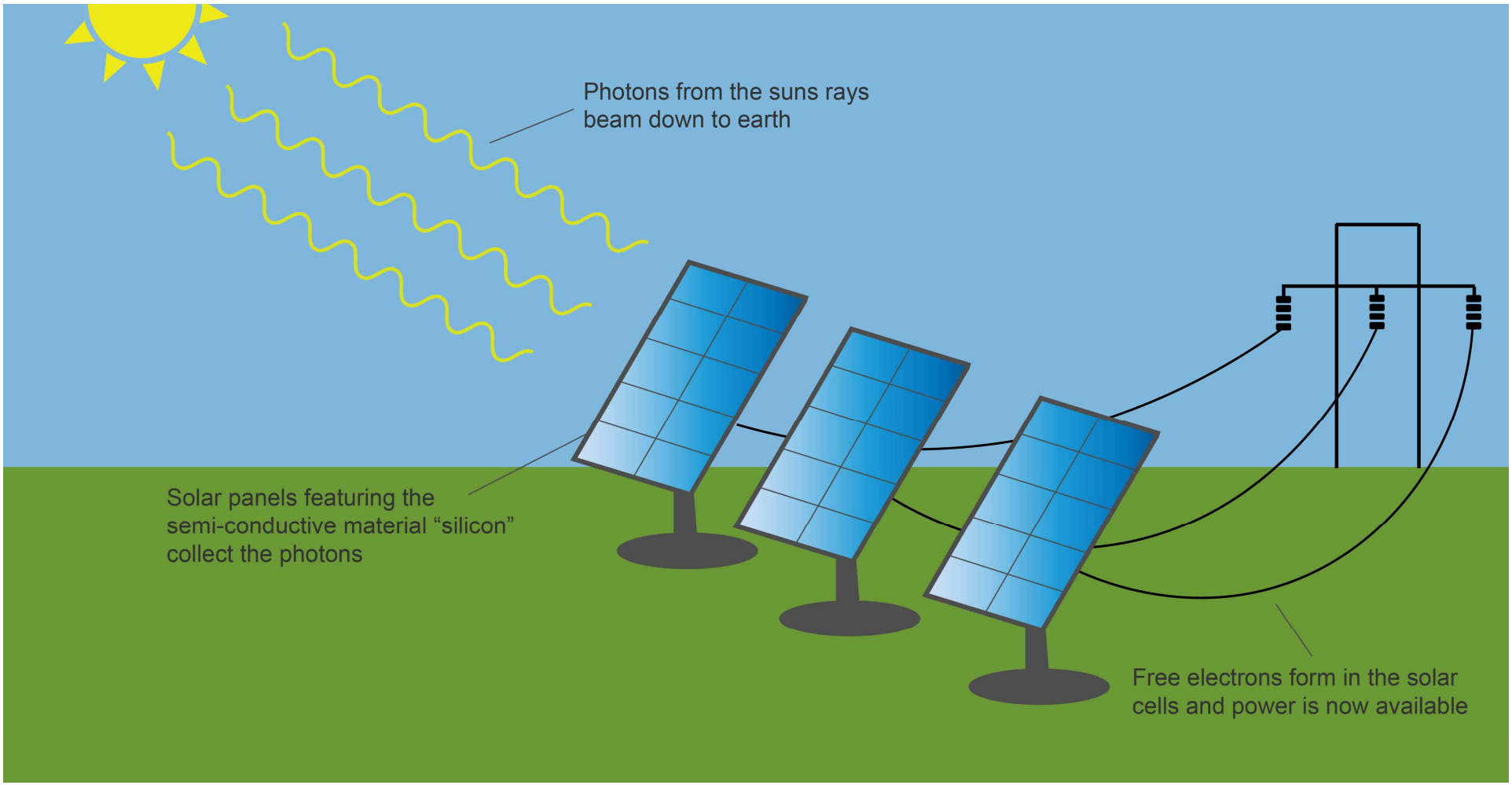
Energy from Sun collected by Leaf

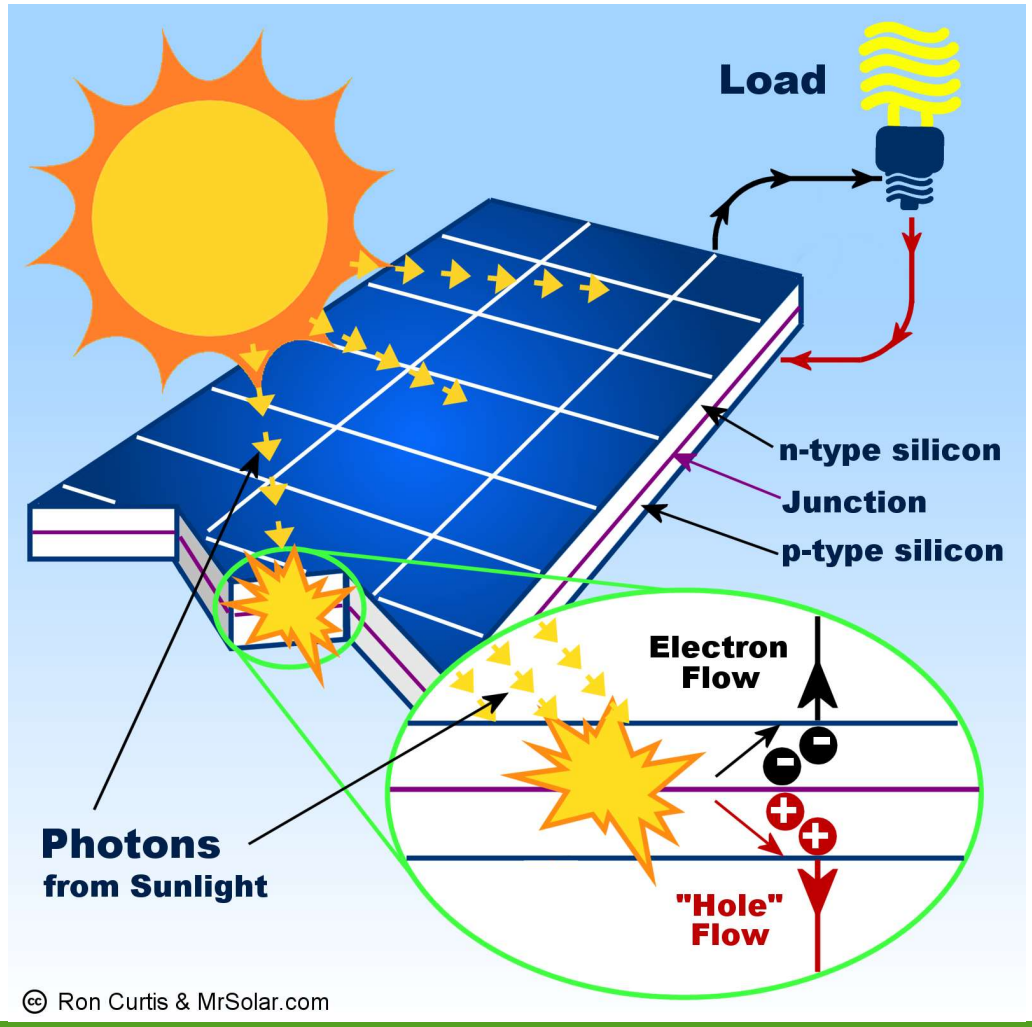
- Solar energy as photons on plant leaf energize electrons
- These electrons are replaced by oxidizing water
- Ions from water create a gradient that flows to generate energy, called ATP
- This energy is used for completion of photosynthesis

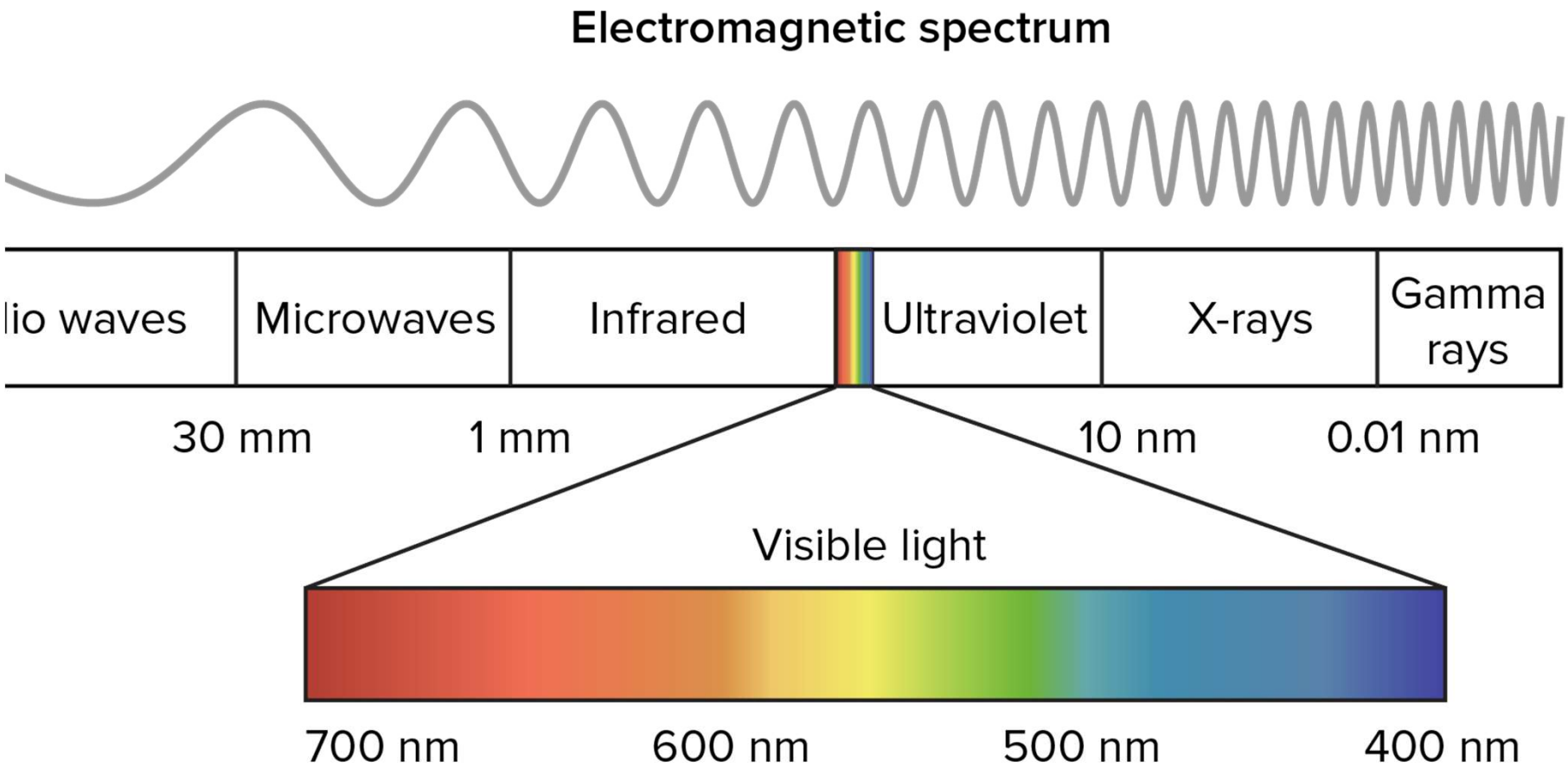


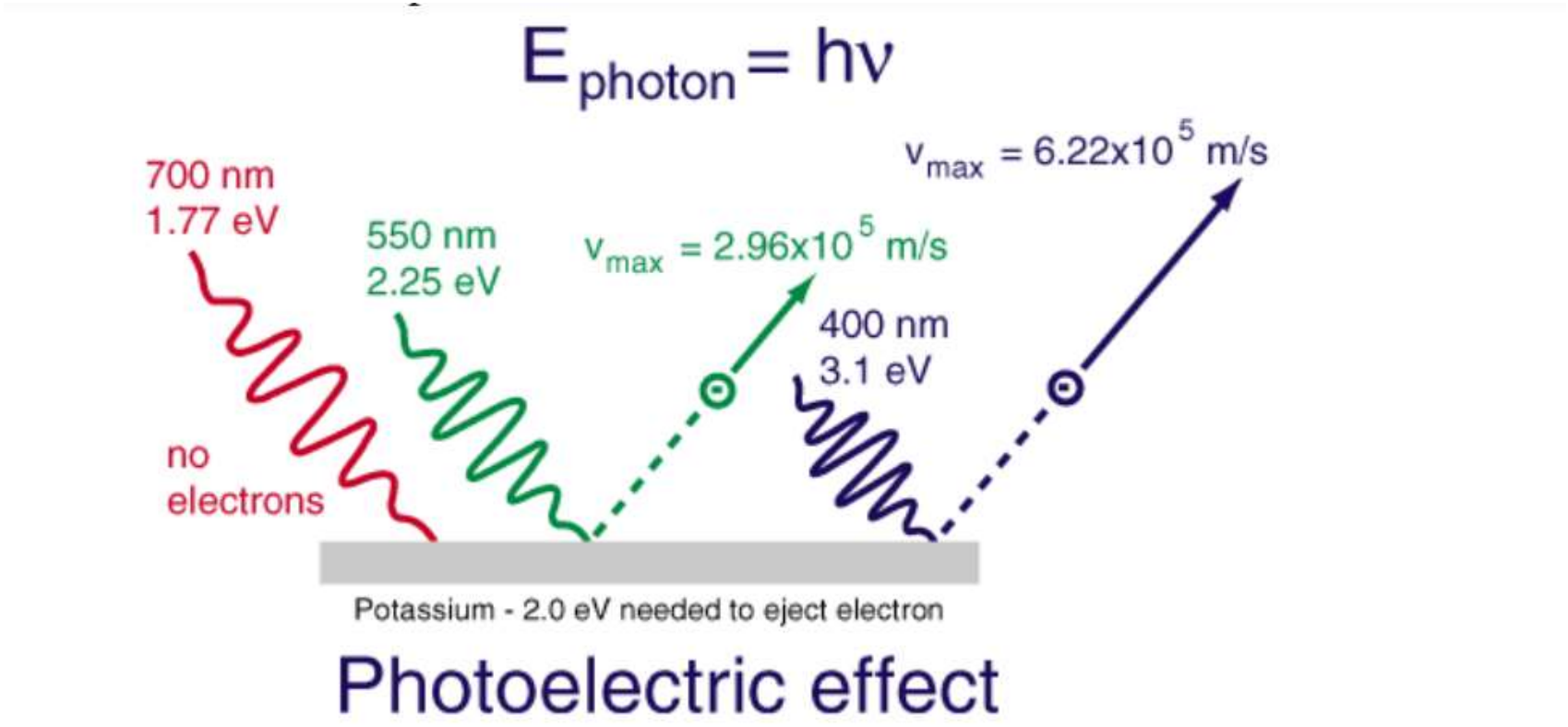
So why should I care about how plants collect solar energy?

Humans collect solar energy, and there are similarities.

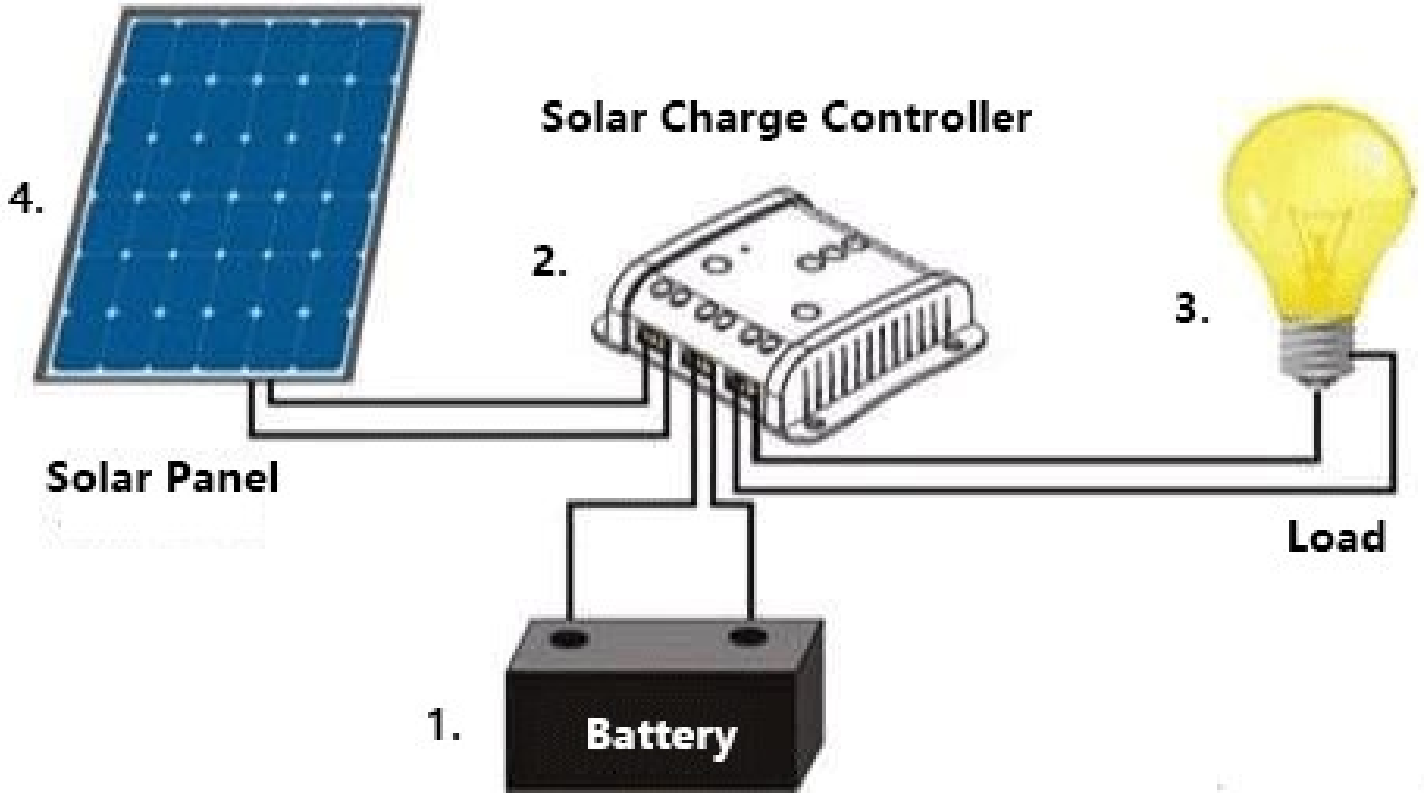

Photons from the suns rays beam down to earth
Solar panels featuring the semi-conductive material “silicon” collect the photons
Free electrons form in the solar cells and power is now available


Load
n-type silicon
Junction
p-type silicon
Electron Flow
Photons from Sunlight
"Hole" Flow
© Ron Curtis & MrSolar.com


Electromagnetic spectrum
lio waves
Microwaves
Infrared
Ultraviolet
X-rays
Gamma rays
30 mm
1 mm
10 nm
0.01 nm
Visible light
700 nm
600 nm
500 nm
400 nm



Photoelectric effect


4.
Solar Charge Controller
2.
3.
Solar Panel
Load
1.
Battery

Special Project I:
How would you design the ideal grassland plant to meet these criteria:

- Optimize solar energy input
- Physical structure for avian, pollinator and wildlife habitat
- Phytochemical nutrition for grazers
- Withstand drought and deluge
- Feed soil macro and micro organisms

Special Project II:
Survey your favourite grassland

- Document observations
  - Plant diversity
  - Potential habitats
  - Insects, pollinators
  - Soil
  - Root zone
  - Microbes
- Map location of observations using GPS
- Link photograph to location

Resources

https://news.mongabay.com/2016/08/savannas-and-grasslands-are-more-biodiverse-than-you-might-think-and-were-not-doing-enough-to-conserve-them/

https://royalsocietypublishing.org/doi/10.1098/rstb.2015.0319

https://c402277.ssl.cf1.rackcdn.com/publications/1359/files/original/PlowprintReport_2020_FINAL_08042020.pdf?1596569610

https://www.worldwildlife.org/projects/plowprint-report

https://news.mongabay.com/2016/12/grasslands-in-us-great-plains-are-being-destroyed-at-alarming-rate/

https://news.mongabay.com/2016/12/grasslands-in-us-great-plains-are-being-destroyed-at-alarming-rate/

https://news.mongabay.com/2020/09/tamper-with-nature-and-everyone-suffers-qa-with-ecologist-enric-sala/