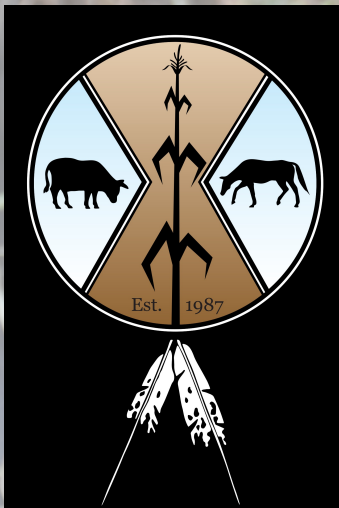


Building Soil: Regenerative Agriculture/ Grazing Practices

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How does regenerative agriculture relate to Traditional Practices?

- Regenerative practices are designed to mimic more natural ecosystem function and use many of the principles that were used traditionally to steward the land
- Regenerative agriculture utilizes many of the same principles of TEK and is in many ways a meeting of traditional practice and scientific experimentation since time immemorial with modern science and understanding all of the microscopic elements and how they work together
- Therefore, it provides evidence that TEK principles are science and brings them back into action on a larger scale to assist in climate change mitigation

Why Regenerative Agriculture?

- Increase water use efficiency, drought resiliency, slowing the water cycle
- Build soil and soil health
- Healthy soil biomes can translate to healthy gut biomes in the people eating the food
- Reduce soil loss/erosion
- Reduce climate change impacts and sequester carbon in the soil
- Improve sustainability
- Reduce the use of chemicals and fertilizer inputs
- Decrease diseases
- Better crop yields
- Overall less impacts to the ecosystem (including the reduction in nitrification of drinking water and dead zones)

Ocean Dead Zones

- <https://oceanservice.noaa.gov/facts/deadzone.html>
- https://www.vims.edu/research/topics/dead_zones/index.php

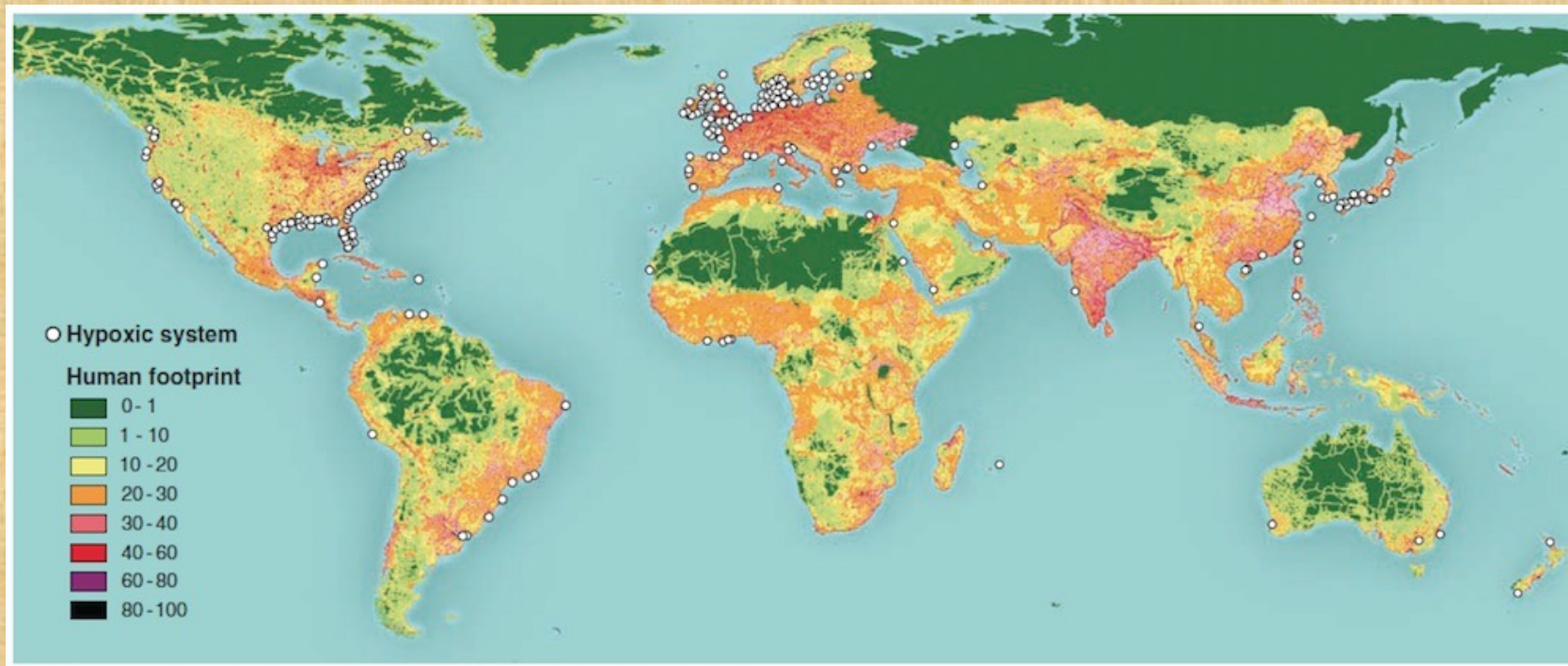


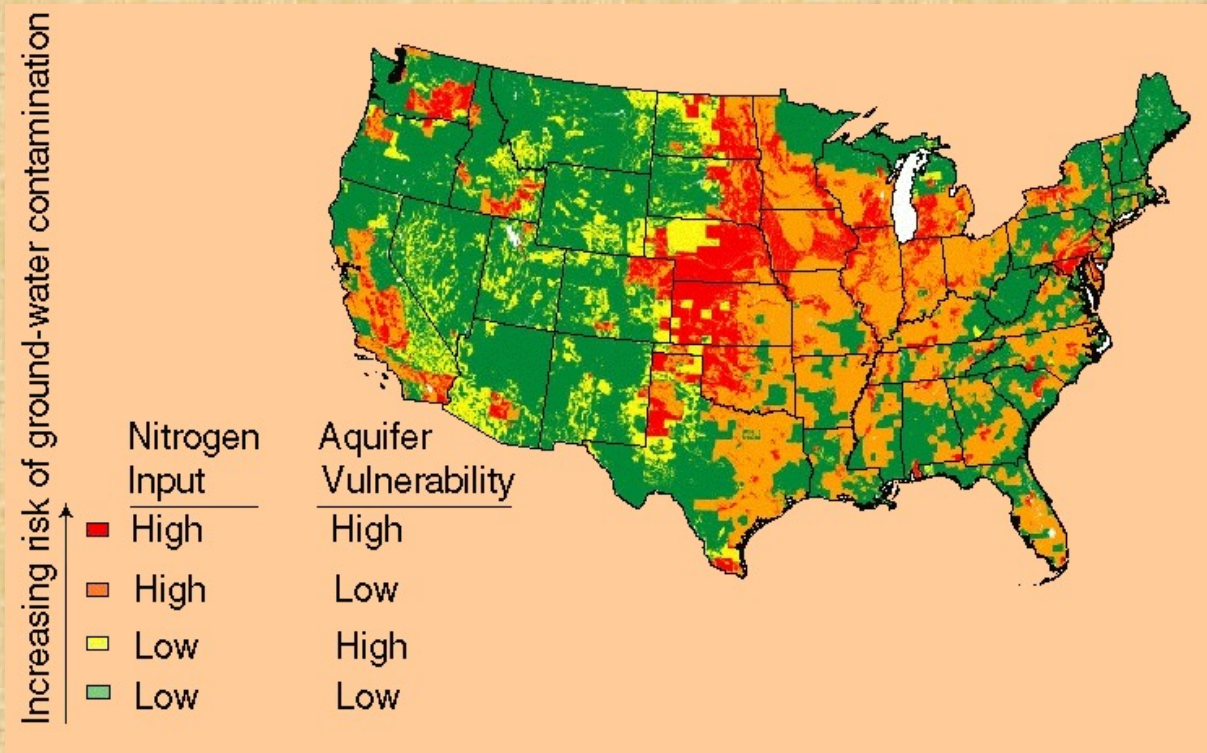
Image from: <https://www.biointeractive.org/classroom-resources/dead-zones-coastal-ecosystems>

Nitrification of Drinking Water

- https://www.usgs.gov/special-topic/water-science-school/science/nitrogen-and-water?qt-science_center_objects=0#qt-science_center_objects
- <https://www.water-research.net/index.php/nitrate>

Image from:

https://water.usgs.gov/na/wqa/nutrients/pubs/wcp_v39_no12/



Important Methods for Regenerative Agriculture

- Crop diversity/ cover cropping
- Minimize soil disturbance/ maintain soil cover
- Maintain living roots (nutrient inputs from living roots are 2-13 times more efficient than added inputs)/ avoid soil compaction
- Integrate livestock
- Holistic Management
- Working to restore the land to more functional ecosystems and mimicking more natural ecosystem function
- Increase use of perennial crops
- Improve soil biome through crop choices, initial inoculation (if necessary), preventing soil compaction, increasing organic material

HE SAPAW

- <https://www.youtube.com/watch?v=M7JPKpO1g2s> (HE SAPAW video by Kelsey)
- H: Humans
- E: Energy
- S: Soil
- A: Animals (both domestic and wildlife)
- P: Plants
- A: Air (top soil loss is a huge contributor to PM 2.5 and PM 10 air pollution as well as losing nutrients and organic matter needed to sustain life, keeping soil cover is so important in protecting this top soil)
- W: Water
- And the E that is left out of the official literature- ecosystem, the importance of full ecosystem function

Regenerative Agriculture (Farming and Grazing) Build Soil and Sequester Carbon

- The net-like layers of silica form the backbone of all sand, silt and clay. The surfaces of these layers have both positive and negative charges, and thus hold the layers together, as well as attract any + or - charged ions. (fine soils with limited organic area, often seen around stream banks, are often held together with capillary forces primarily)
- Sand, silt, and clay are broken from rocks, boulders, and other forms of rock and thus the nutrients held between the layers and within the layers come from the molten rock that cooled and formed the parent material of the continent. All such rock contains the nutrients to grow any plant.

(Information above courtesy of the Soil Food Web School)

- Most rocks are not broken down through weathering, but by microbes that make the nutrients available for plants. The nutrient cycle in the soil is powered by microorganisms, bacteria, fungi, etc. These need to be in balance and work in conjunction with one another in an aerobic environment for healthy soils.
- Aerated soils will help to bring in a balance of the appropriate organisms to help break down the nutrients and fix nitrogen in forms that are bioavailable for the plants. A healthy soil biome helps for a healthy gut biome in the people who eat the food. It boosts plant immune systems and eliminates the need for chemicals. Disturbed soils will not form the food web.

Work with Your Environment



Using coffee cans to protect against wind, evaporation, and keep out rabbits and other pests. Courtesy of Colleen Strawhacker, National Institute of Snow and Ice www.nsidc.org

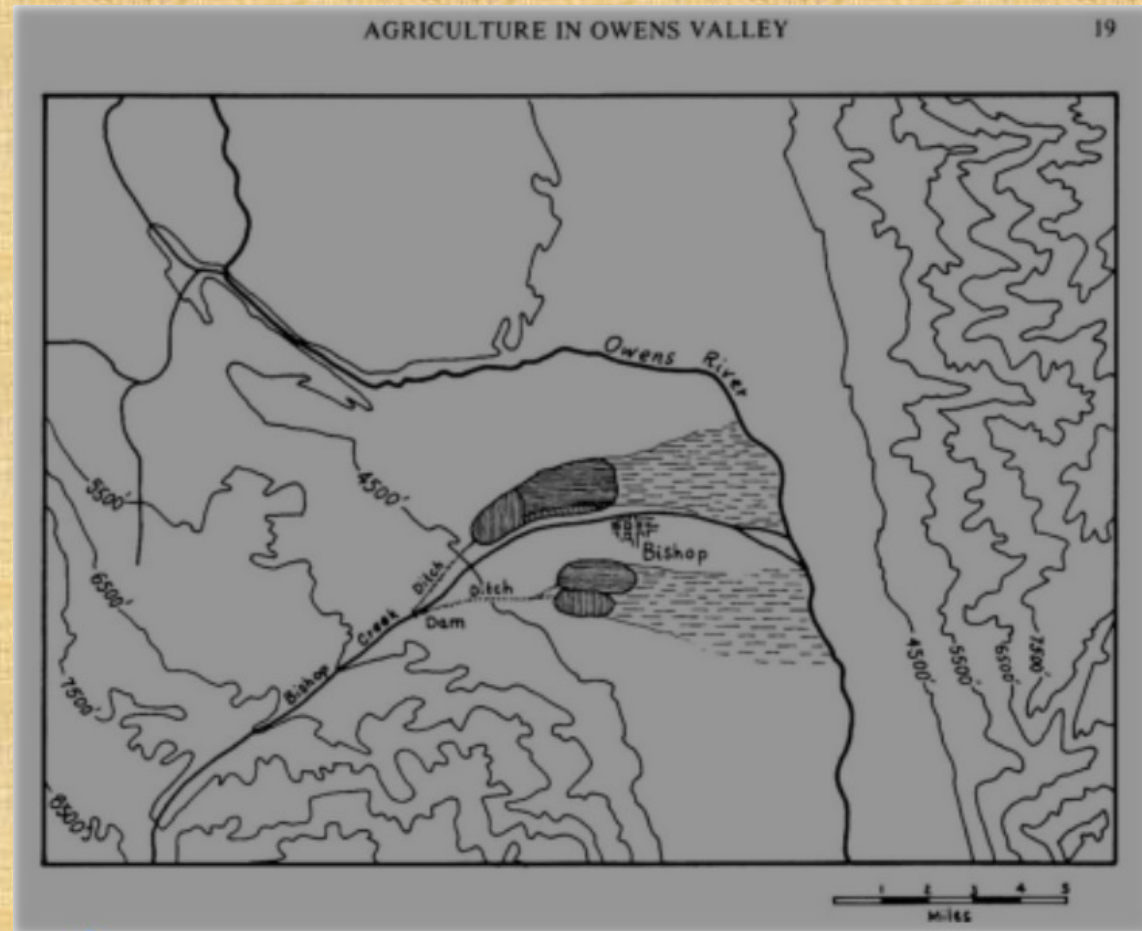
Dealing with Arid Climates and Drought

- Increase organic matter in the soil
- Slow the water cycle and keep as much water on the land as possible
- Look for areas where there is wind erosion/ evaporation protection
- Take advantage of higher altitudes where possible that have more precipitation
- Look for areas where water will pool and flow naturally
- Using organic matter and rock mulch instead of covering all of the soil with vegetation
- Plant deeper
- Use heirloom varieties bred for the climate

Historical Example of Slowing the Water Cycle in the High Desert

- Payahuunadü: Land of the flowing water, Owens Valley & Mono Basin

The ancient Paiute irrigation networks covered 60 miles and included dams and one ditch per plot of land irrigated.



Information
Courtesy of Teri
Red Owl

Building Soil Health in Desert Soils



Cyperus esculentus: taboose (courtesy of Teri Red Owl)

TEK: Changing Paradigms



WESTERN AGRICULTURE

- Ditches are terminal
- Fields are constructed to fit machinery
- Water is transported
- Imported crops grown on imported nutrients
- Profitable

Nüümü AGRICULTURE

- Ditches are directional
- Fields are enhanced to fit plants
- Water is distributed
- Increasing the quality of the endemic plant habitat
- Sustainable (400 years at least)

The Soil Food Web

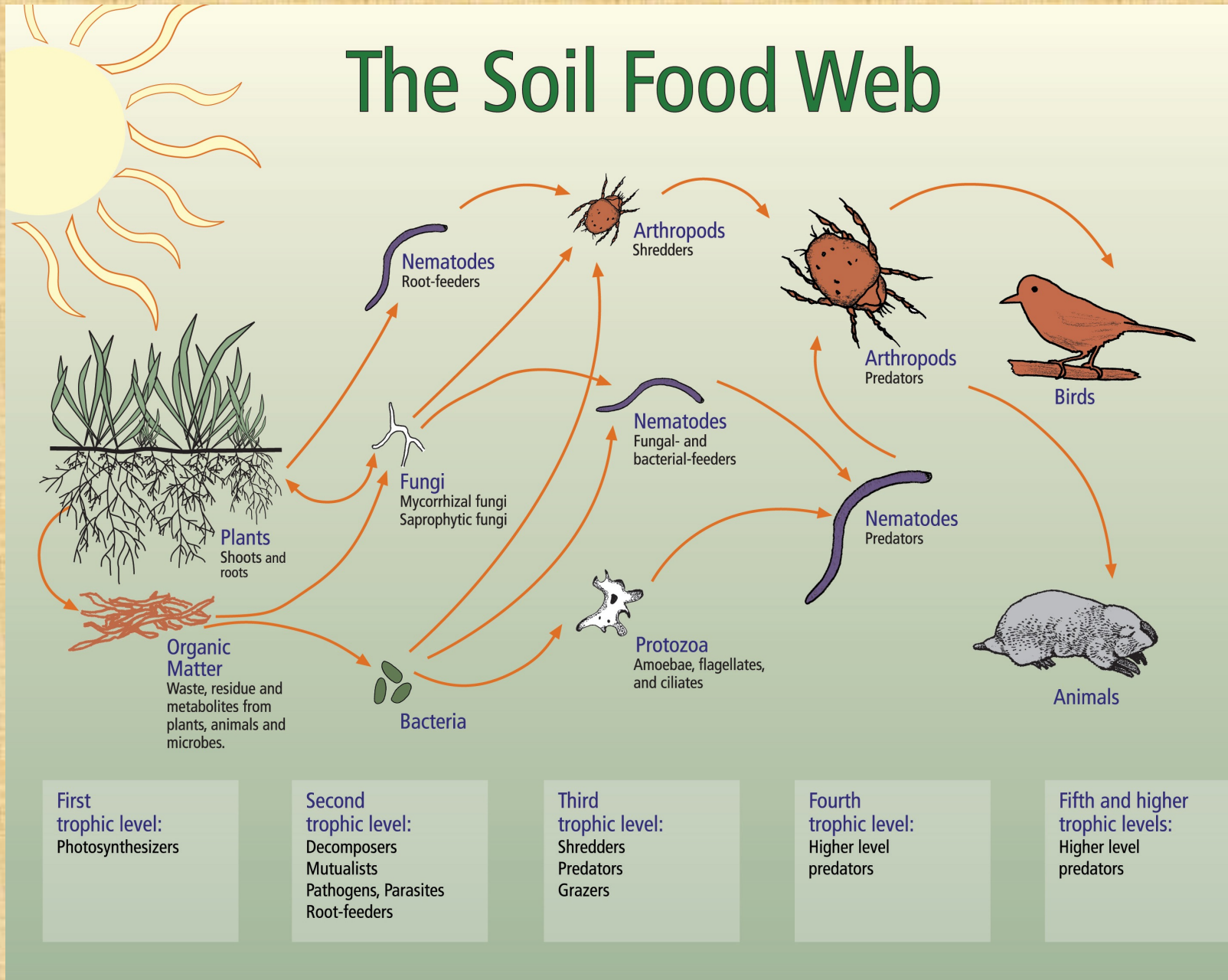


Image from USDA NRCS

Soil Structure

Soil scientists use the capital letters **O**, **A**, **B**, **C**, and **E** to identify the master horizons, and lowercase letters for distinctions of these horizons. Most soils have three major horizons -- the surface horizon (**A**), the subsoil (**B**), and the substratum (**C**). Some soils have an organic horizon (**O**) on the surface, but this horizon can also be buried. The master horizon, **E**, is used for subsurface horizons that have a significant loss of minerals (eluviation). Hard bedrock, which is not soil, uses the letter **R**.

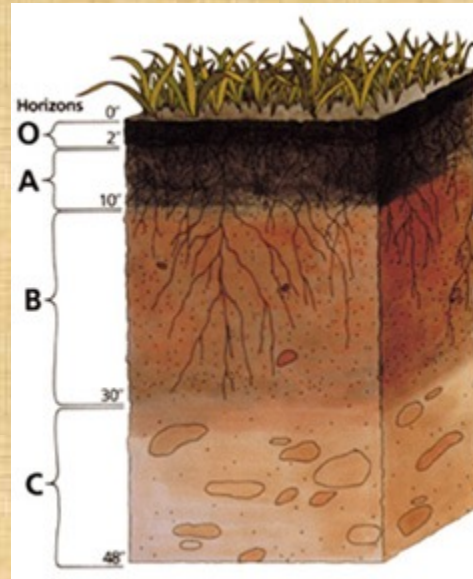


Image and text from USDA NRCS

Soil Comparison

Photo from USDA NRCS



Healthy Soil with High Organic Matter Content



Photo from USDA NRCS

Nutrients in the Soil

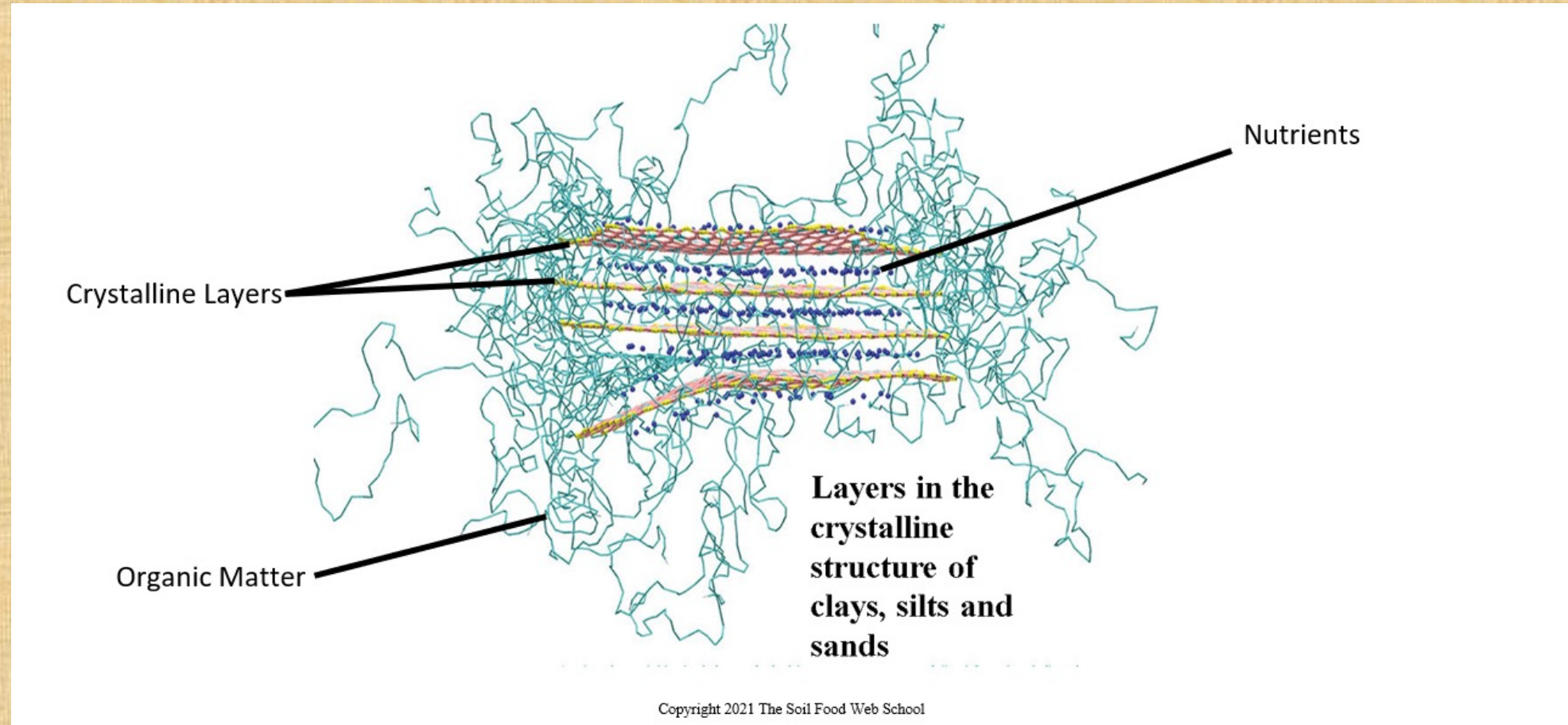
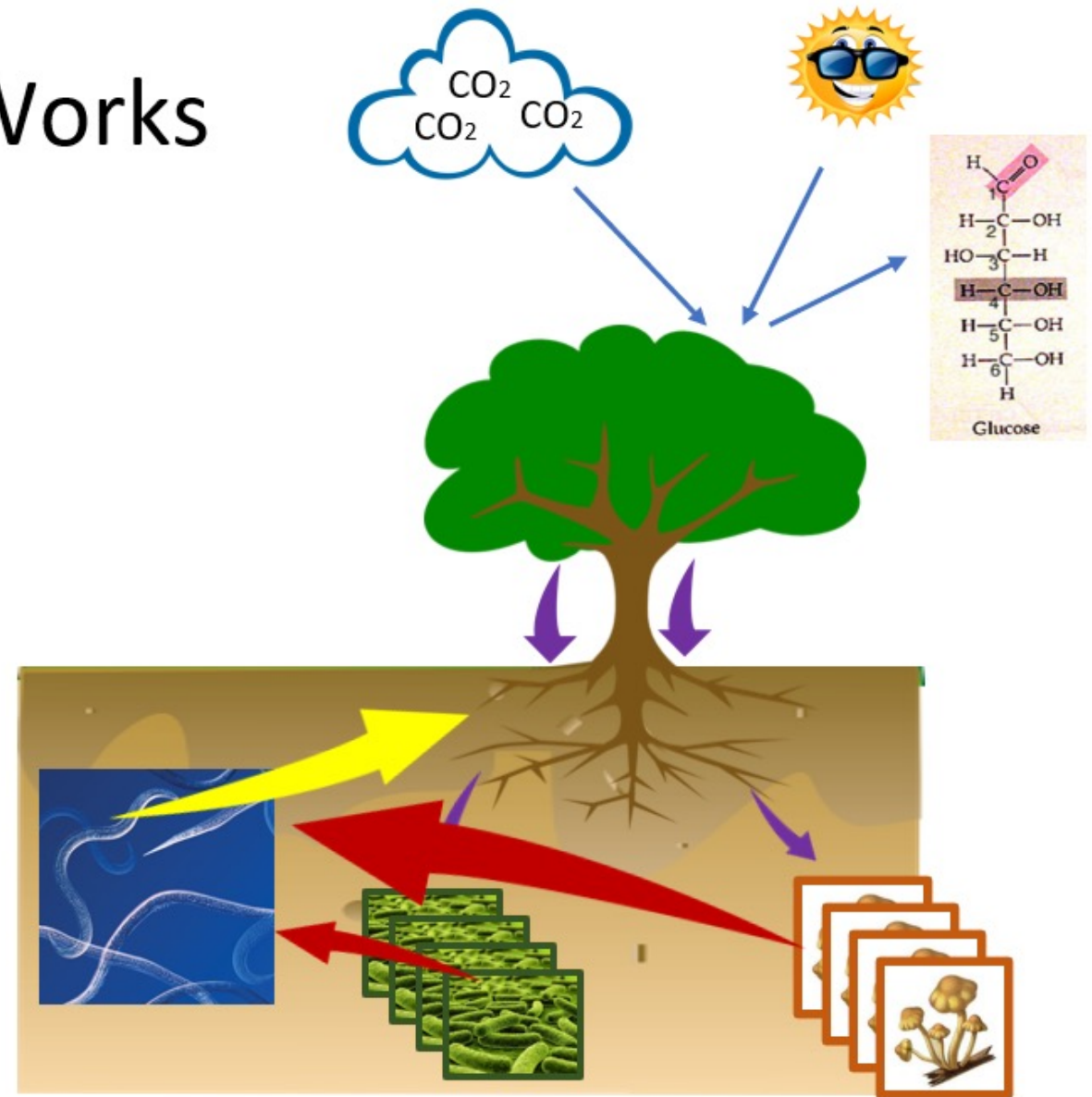


Image and information shared courtesy of: The Soil Food Web School

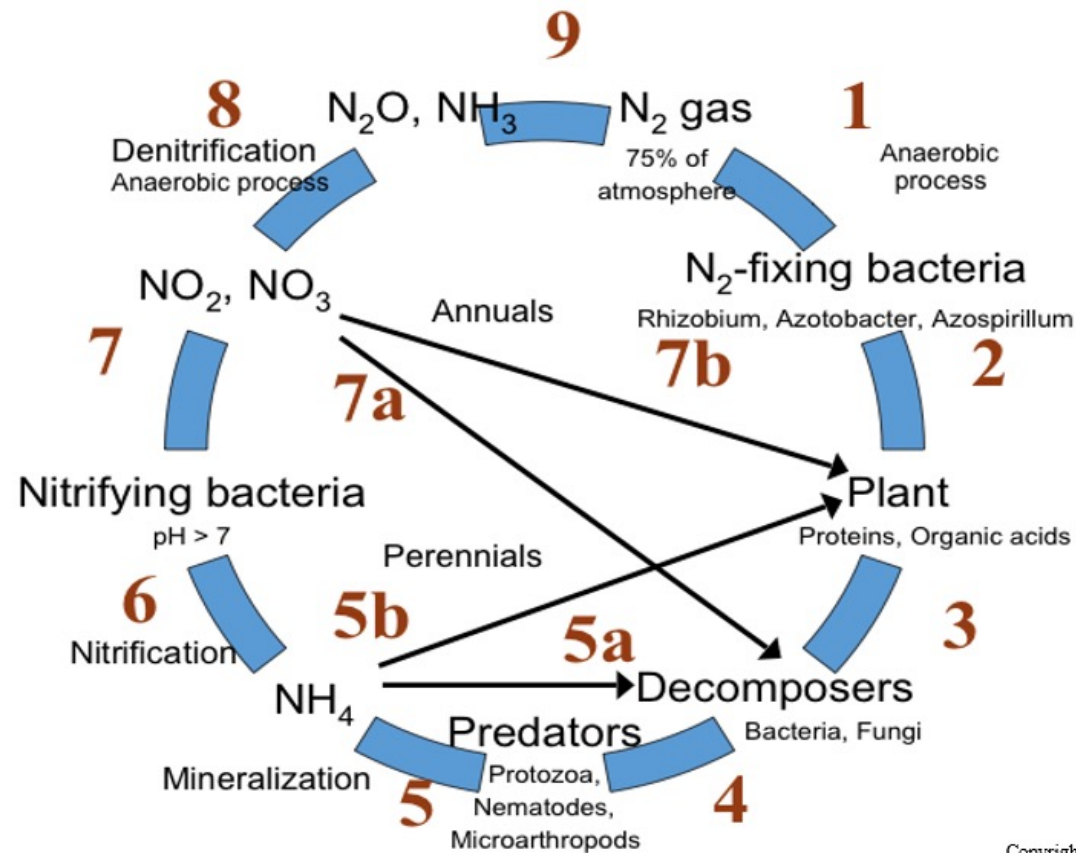
How Nutrient Cycling Works

- Plants produce simple sugars through photosynthesis
- But they need more than this. They need Mg, Fe, Cu, P, K, Na etc...
- Plants **invest** 30-40% of their sugars into the soil – exuding them from their roots in the form of *exudates*.
- Exudates get consumed by *Bacteria & Fungi* which makes them breed and grow – populations explode.
- Bacteria & Fungi consume Organic Matter and *Mineral Particles* – so they become *Nutrient-Rich*
- Predators eat Bacteria & Fungi
- Predator poop – soluble nutrients
- Plants love soluble nutrients!!! So they get a great return on their investment!!



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Nitrogen Cycle



Copyright 2021 The Soil Food Web School

Image and information shared courtesy of: The Soil Food Web School

Nitrogen Fixing Bacteria on Legumes Roots (the Importance of Intercropping with Legumes)

Nitrogen fixing bacteria on the roots of legumes is one of three ways that nitrogen is fixed from the atmosphere and is the most relevant for farming. The other two ways are blue green algae (cyanobacteria), and lightening strikes.



Photo from USDA NRCS

Important principles to Regenerative Grazing

- Use no till methods or minimal till forage
- Use primarily perennial forage, allow the livestock to graze and to trample some of the forage into the soil
- Rotate the livestock when they have foraged no more than 40% of the plant matter. Do not overgraze, and ensure that you allow adequate rest periods
- Know your climate and your field to find out the ideal rotation for pasture to build soil instead of destroying it
- Summary: later turn out for longer rest periods, and higher stock density on
- <https://www.youtube.com/watch?v=zE6xq1hLhPE>

Work with Your Environment



Photo: Desbah Padilla of Sheep Grazing on the Zuni Pueblo

Making the Change

- Building the soil microbiome and organic matter doesn't happen overnight. Two years is about the average time. In this time there may be some drop in yield depending on the condition of the soil when you begin moving to regenerative practices. We can assist you with advice and resources in this phase.
- After the initial period yields will increase.
- When grazing higher animal densities per acre are possible with improved soil health. Animals need to be moved more frequently. Do not overgraze and allow adequate rest periods for each area and productivity will increase.

How do you get started?

- Important guide to rotational grazing:
https://www.google.com/url?q=https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1097378.pdf&sa=D&source=docs&ust=1636527180212000&usg=AOvVaw3LWYhZKDQSgRYfBN09oWE
- Information on a good place to start:
<https://www.google.com/url?q=http://ulster.cce.cornell.edu/resources/rotational-grazing-for-beginners-full-presentation&sa=D&source=docs&ust=1636527180213000&usg=AOvVaw0rwGn6A4egn7f78i7UuvdG>

Links for More Information

- <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcseprd1392625> (NRCS regenerative farm highlight)
- <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/newsroom/features/?cid=nrcseprd1304043> (NRCS rotational grazing highlight)
- <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/newsroom/stories/?cid=nrcseprd1506820> (NRCS featured stories)
- <https://www.youtube.com/watch?v=x9aKKGHRe2Y> (“Regenerative Grazing: Learning from Nature. Stockpiled grass” great video on grazing sheep in Montana with methods and science of regenerative grazing)

More Links with Valuable Information

- <https://rangelandtrust.org/> (California Rangeland Trust, works on preserving rangeland and helping with conservation of that land)
- <https://www.blm.gov/documents/national-office/blm-library/technical-reference/riparian-area-management> (PFC reference guide for Lotic Systems)
- http://rangelands.org/wp-content/uploads/2016/12/OKC_AssessingProperFunctioningConditionLenticAreas.pdf (PFC for Lentic Systems)
- <https://extension.unr.edu/program.aspx?ID=146> (Rangeland Management and Riparian Areas)
- <https://www.nrcs.usda.gov/wps/portal/nrcs/photogallery/soils/health/biology/gallery/?cid=1788&position=Promo> (NRCS photo gallery for soil health)
- <https://www.youtube.com/watch?v=Fy83GZCEHsY> (“Reginaldo Haslett-Marroquin: Building a Regenerative Ag Revolution, 2019 Soil and Nutrition Conference” talks about the colonial mindset and how it impacts agriculture and nutrition- seeds, heritage, traditions, wisdom- talks about decolonizing the mindset is the basis of regeneration not the specific practices)

More Links

- <https://www.youtube.com/watch?v=uZk8j1Lhi6I> (“Indigenous-led Permaculture Brings Resilience And Food Sovereignty to Pine Ridge Reservation”)
- https://www.usgs.gov/ecosystems/climate-adaptation-science-centers/southwest-casc?qt-science_support_page_related_con=3#qt-science_support_page_related_con (Southwest Climate Adaptation Science Center)
- <https://quiviracoalition.org/> (Quivira Coalition)
- <http://sust.unm.edu/partners/food-and-farming.html> (University of New Mexico, Sustainability Studies Program)