
Remineralize the Earth
The climate change solution right under our feet
Let's Remineralize!

Soil Remineralization: The Basics

Natural processes return minerals to the soil

- **Glaciers**: crush rocks in their path → rock dust (loess)

→ blows across the globe after ice ages → highly productive agriculture

- **Volcanoes**: erupt, releasing minerals from deep within the Earth
- **Alluvial deposits**: contain minerals → rock weathering → minerals released into soils

We can mimic these processes by adding rock dust (or sea minerals) to soil

- Basalt is a widely available source which contains a wide spectrum of minerals and trace elements

Why Soil Remineralization?

- Enhance soil fertility, yields, and nutrient density
- Reduce agricultural pollution
- Carbon sequestration

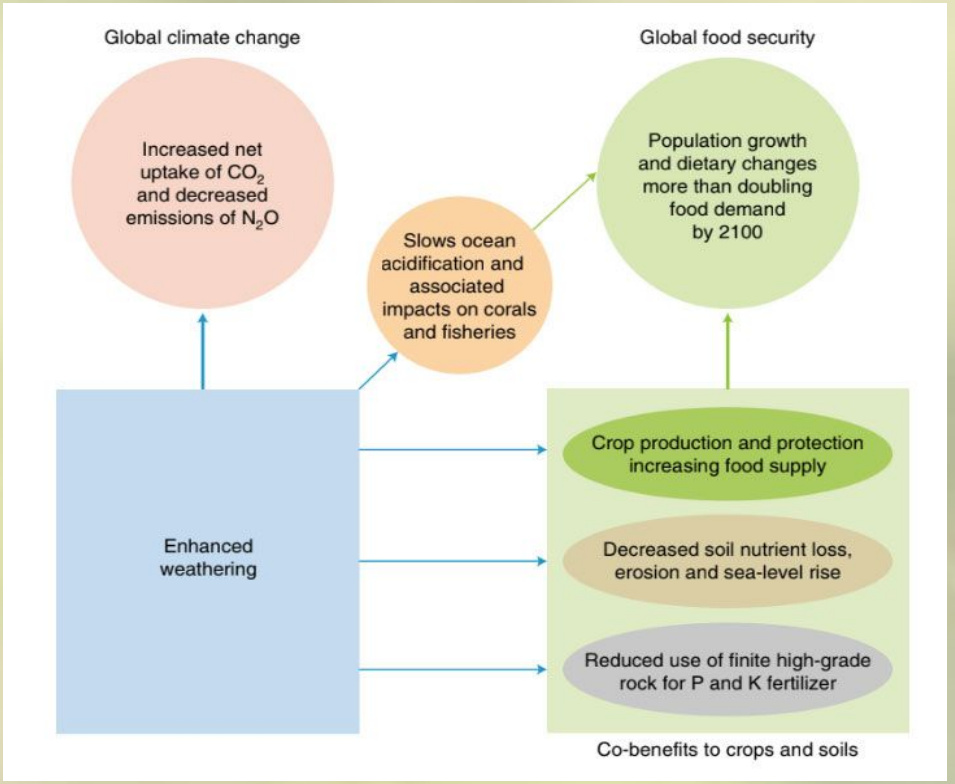
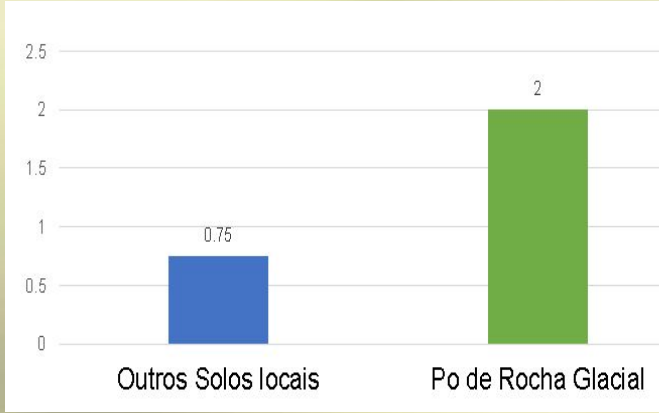


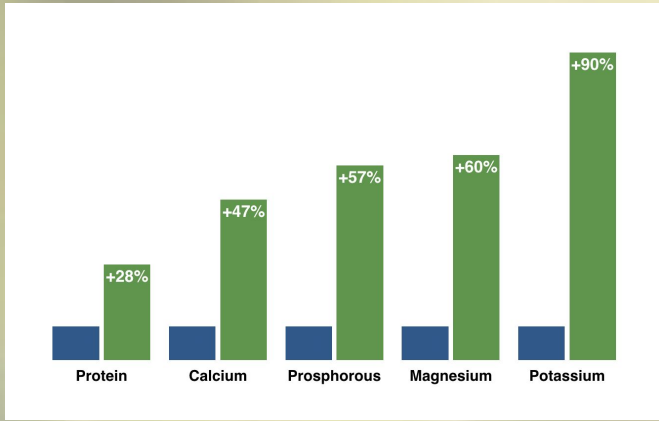
Image credit: Carbon Brief. “How ‘enhanced weathering’ could slow climate change and boost crop yields.” 2018. https://www.carbonbrief.org/guest-post-how-enhanced-weathering-could-slow-climate-change-and-boost-crop-yields. Accessed Oct 2020

Enhance Soil Fertility,

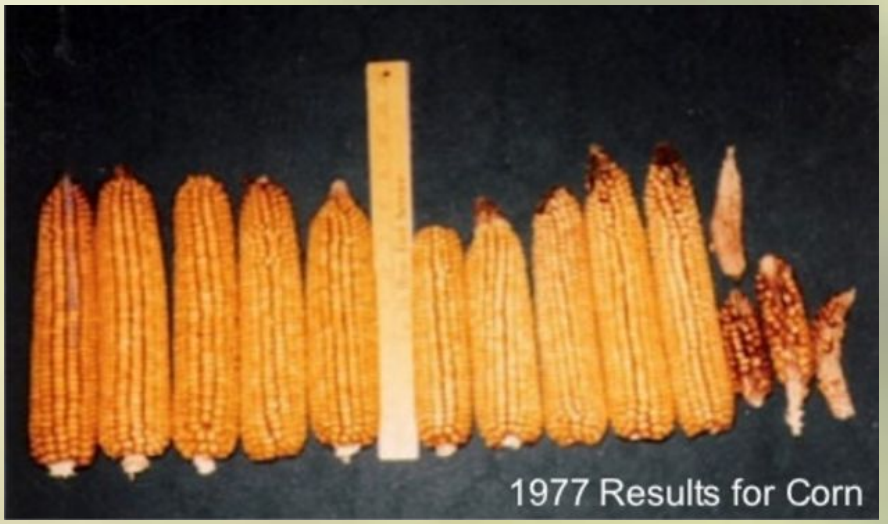
Yields, and Nutrient Density

John Hamaker - Early Trials with Corn (1976-1977)





Glacial rock dust produced **65 bushels** of corn per acre, compared to **25 bushels** per acre from other local farms – with no irrigation.



Source: John D. Hamaker, co-author with Don Weaver, *The Survival of Civilization* Michigan, 1976-1977

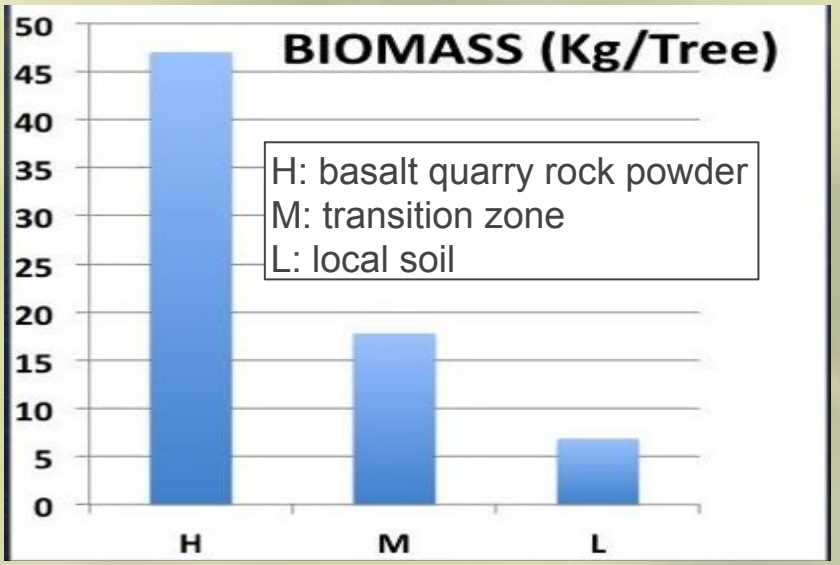
Example: *Acacia Mangium* Panama

Thomas J. Goreau, Felix Lufkin, Carlos A. Arango, Gabriel Despaigne-Matchett, Gabriel Despaigne-Ceballos, Roque Solis, Marina Goreau & Joanna Campe. Chapter 17, *Geotherapy: Innovative Methods of Soil Restoration, Carbon Sequestration, and Reversing CO2 Increase*, 2014, Taylor and Francis Group, LLC

Example: *Acacia Mangium* Panama

Results of 5 year study

- 8-fold increase in biomass
- 2.17 increase in the height of the trees
- 4 times the survivability from the trees on basalt
- The trees on the local soil did not survive



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Goreau et al., 2014

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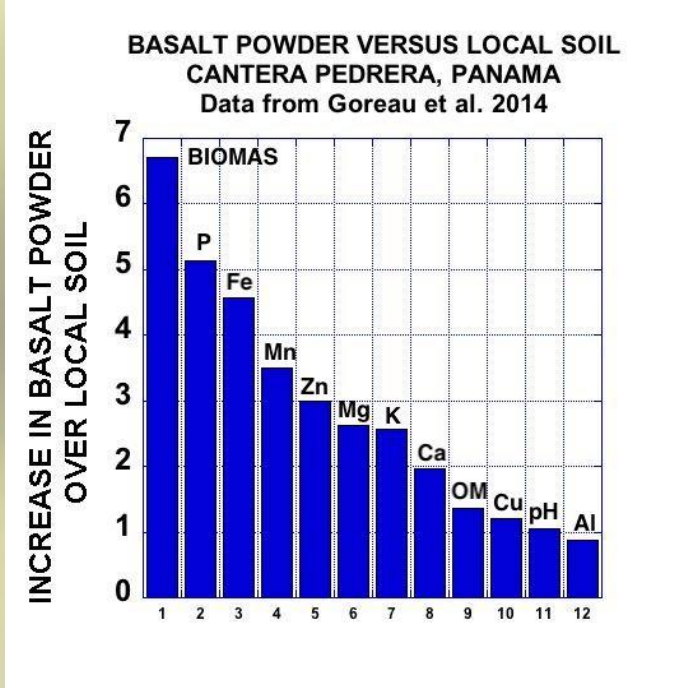

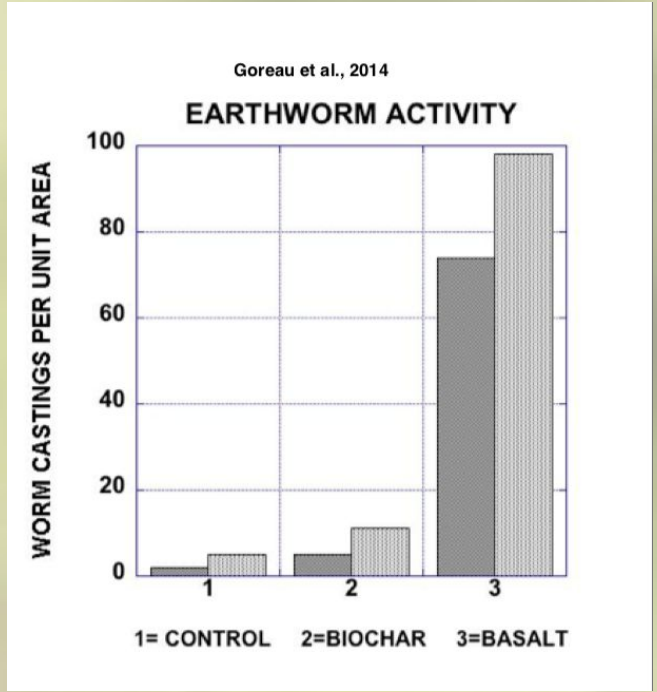

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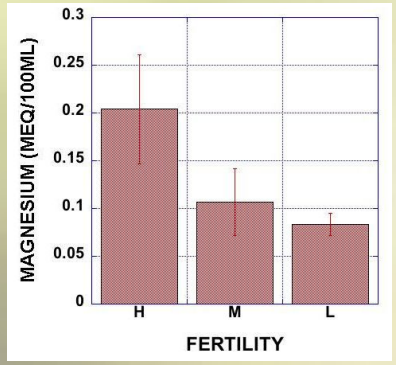

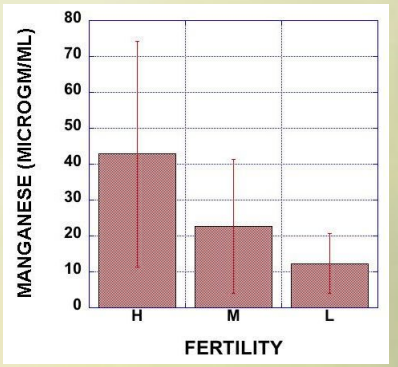

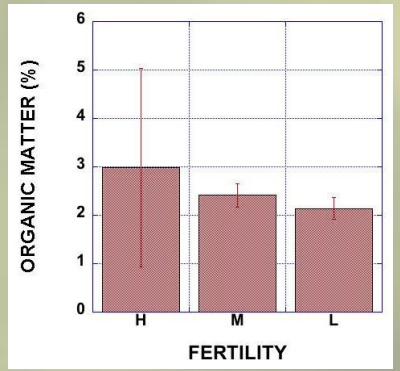

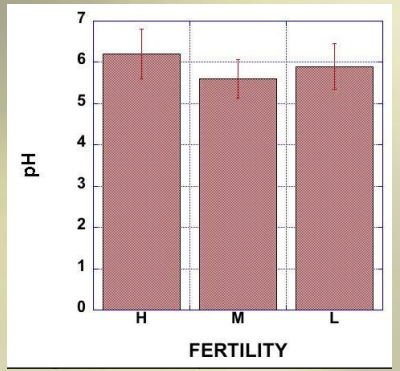

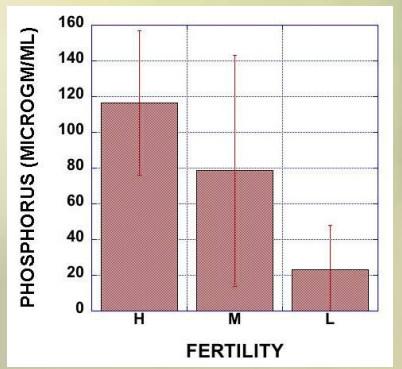

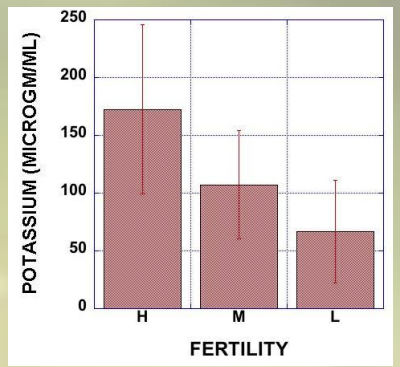

H (basalt quarry rock powder), M (transition zone), L (local soil)

Goreau et al., 2014

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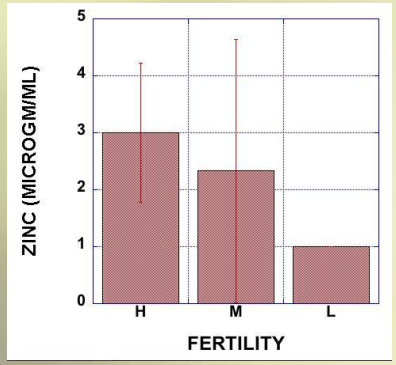

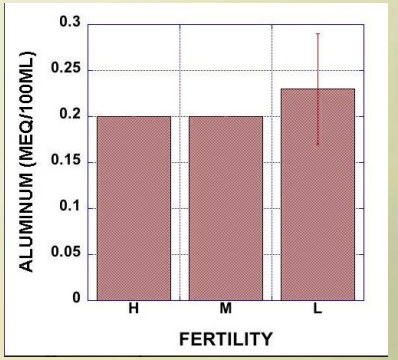

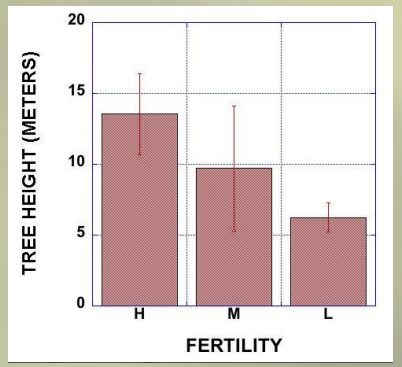

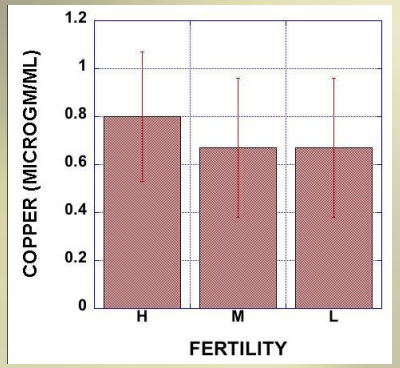

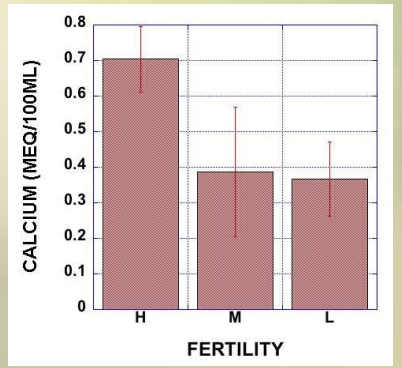

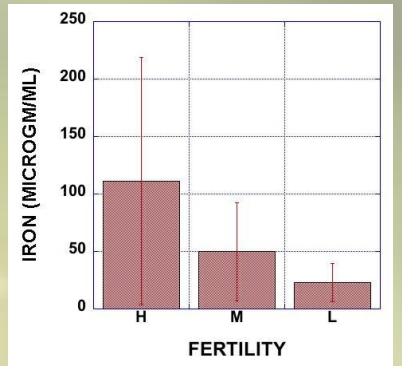

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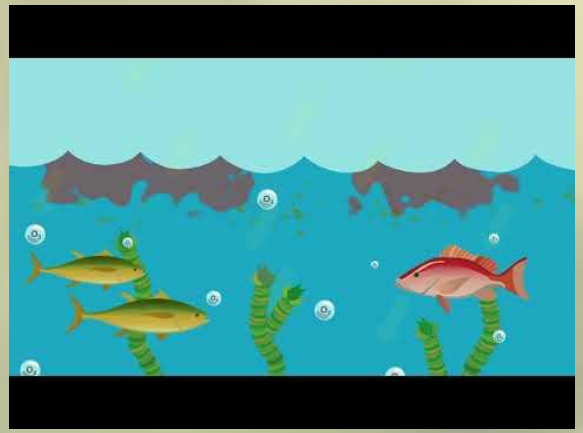
Reduce Agricultural Pollution

The Problem with NPK Fertilizers (Nitrogen, Phosphorus, Potassium)

NPK fertilizers lead to a great loss of soil fertility



- Topsoil loses organic matter creating soil erosion
- 30% of arable land is now barren
- Only 60-100 harvests left

60% of soil ends up in rivers, streams, and lakes

- Contaminates water due to the nitrogen runoff from fertilizers

Creates nutritionally-depleted foods

- Decreased levels of calcium, iron, and vitamins A and C
- Dramatic loss in the nutritional level of almost all minerals and nutrients

Pesticides, Herbicides, and Fungicides

Pesticides, herbicides, and fungicides use chemicals to kill insects, weeds, and fungi

- These chemicals can accumulate in food chains creating toxicity throughout habitats and the environment

Frequently disrupt natural balances in an ecosystem

- For example, in the case of an infestation chemical pesticides destroy the insect population instead of restoring a balance

Using Rock Dust Instead of Chemicals

Rock dust gradually releases 70+ minerals

and trace elements

- Vital elemental plant nutrients are released as basalt weathers
- Calcium, potassium, and magnesium make soils healthier
- Improved pH

Creates soil biological balance and increased soil fertility

Rock dust naturally deters insects, weeds and fungi without disturbing ecosystems

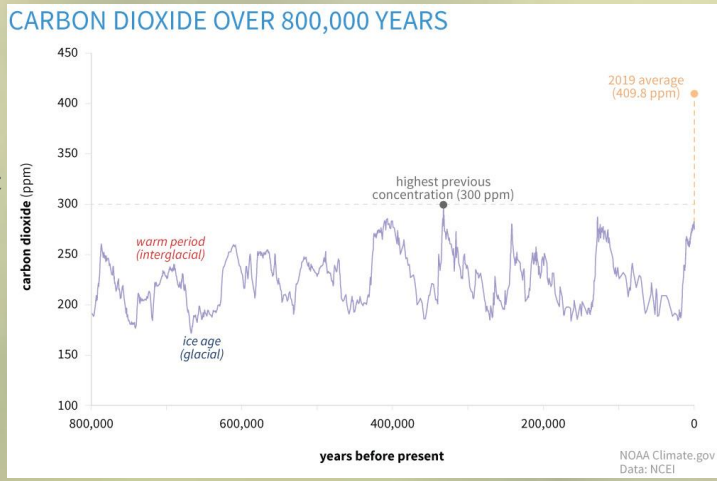
Carbon Sequestration

Putting carbon back in the ground where it belongs!

Carbon Dioxide and Climate Change

Greenhouse gases including CO_2 in Earth's atmosphere trap infrared light (heat) from the sun

- These gases keep Earth at livable temperatures → very important!
- The natural process of adding and removing CO_2 has kept atmospheric concentrations between 180 and 300 ppm over the past 800,000 years



Burning fossil fuels releases CO_2 that used to be stored deep underground into the atmosphere

- More CO_2 added to the atmosphere than taken out → increasing concentrations → more heat trapped in the atmosphere → global climate change

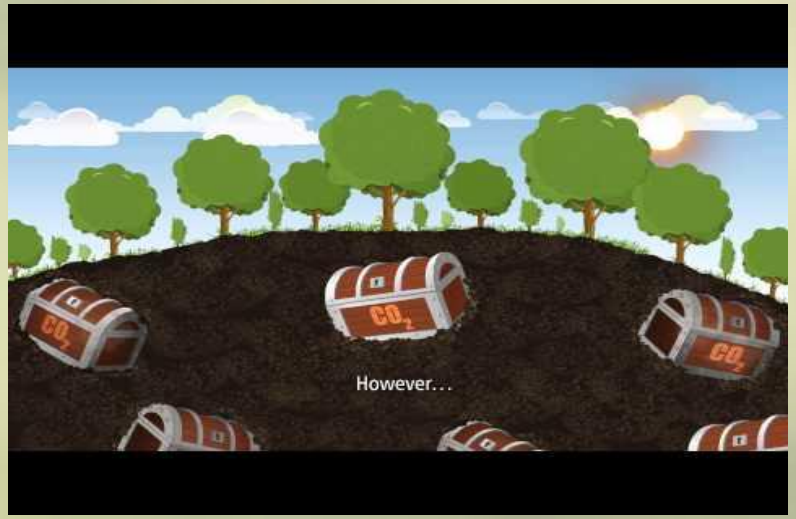
Image credit: NOAA. 2020. Data from NCEI. https://www.climate.gov/sites/default/files/BAMS_SOTC_2019_co2_paleo_1000px.jpg. Accessed Oct 2020;

The Basics of Carbon Cycling

Photosynthesis

- Plants take in carbon dioxide from the atmosphere
- Carbon is stored as organic matter in plants and soils

Organic matter decays and releases CO_2 to the atmosphere



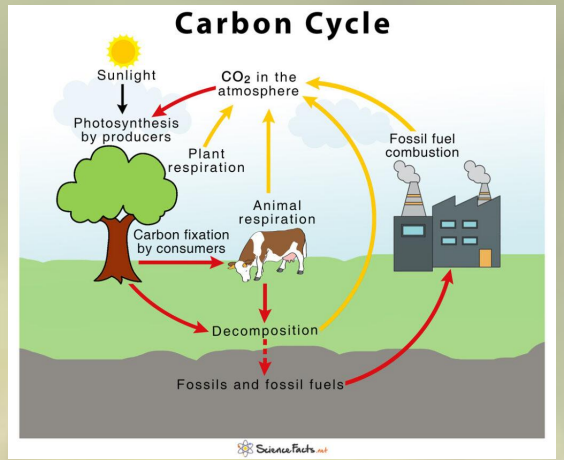


Photo source: https://microbiologyclass.com/carbon-cycle/

Enhanced Rock Weathering (ERW)

Speeds up natural process by applying rock dust to soils

- Finer rock dust → more surface area → faster chemical reaction

Sequesters 0.5 to 2 billion tonnes of carbon dioxide taken out of atmosphere each year

- Equivalent to combined emissions of Germany and Japan
- U.S. released about 5.3 billion tonnes of carbon dioxide in 2018

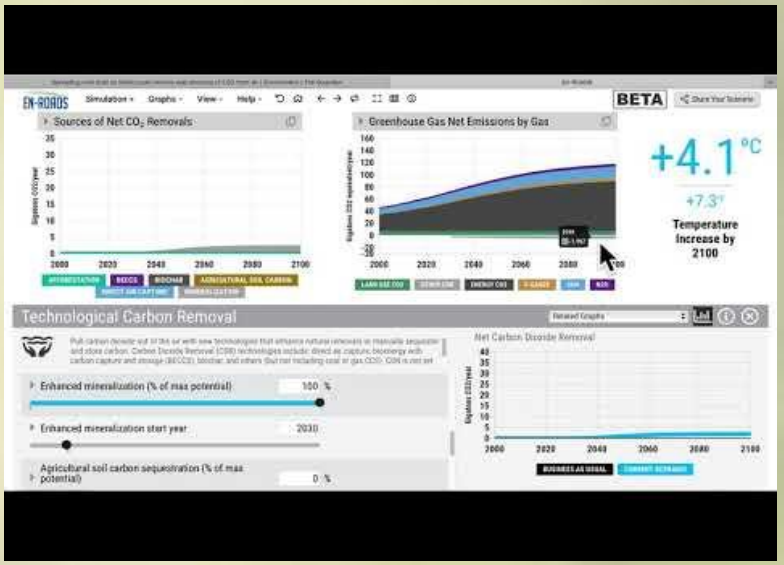
Enhanced Rock Weathering (ERW)

World's biggest polluters/emitters = China, India, and U.S.A.

- Extensive croplands and forests store carbon
- Warm weather → faster kinetics (rate of chemical reactions)

Does not compete or take over land used for growing food or require additional freshwater

How Much of an Impact?



En-Roads Simulator: input behaviors and policies, using the levers to change how encouraged or incentivized such actions are!

https://www.climateinteractive.org/tools/en-roads/

Additional Resources

Beerling, D. and Long, S. How 'enhanced weathering' cold slow climate change and boost crop yields. *Carbon Brief* (2018). https://www.carbonbrief.org/guest-post-how-enhanced-weathering-could-slow-climate-change-and-boost-crop-yields

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