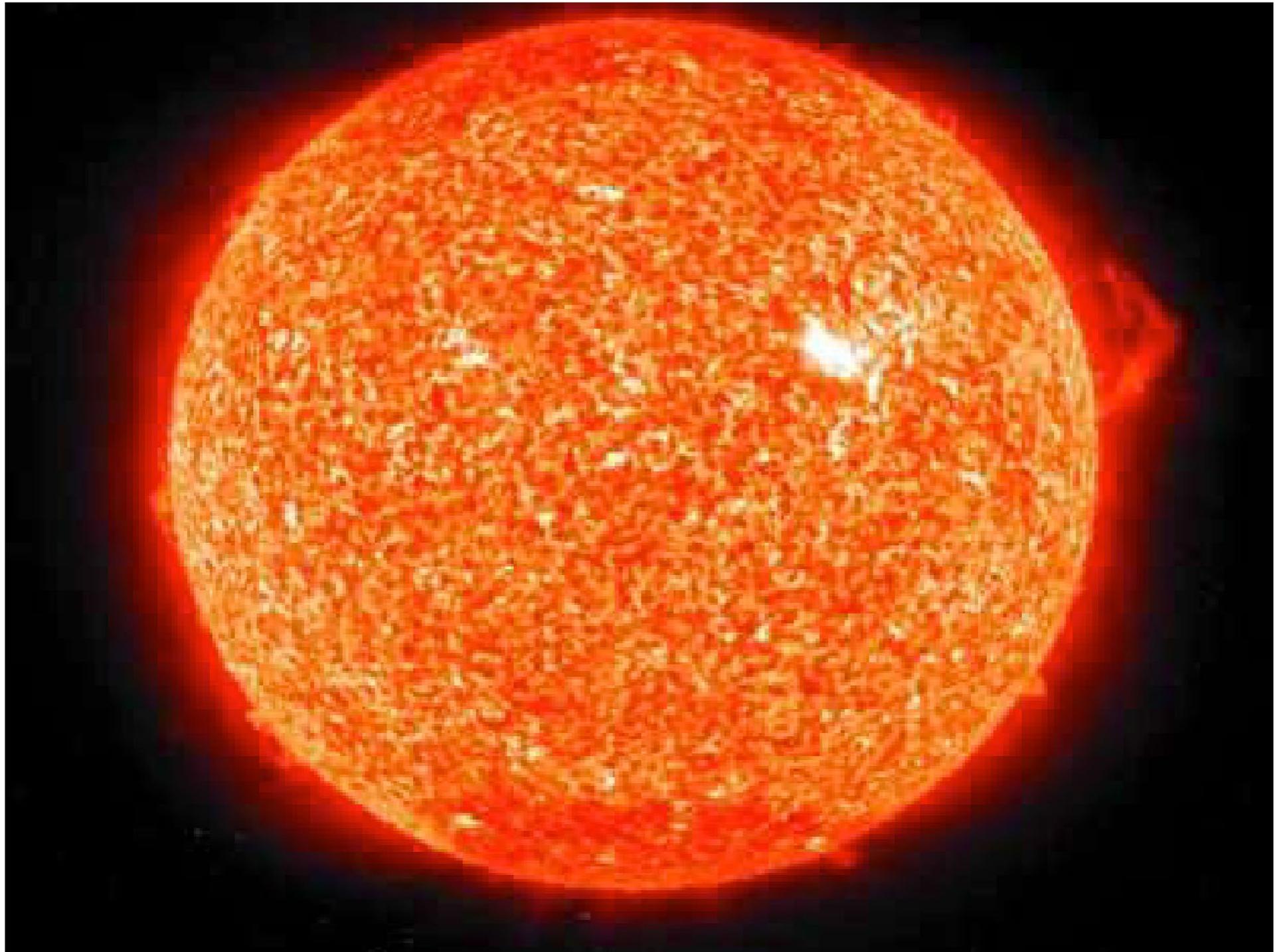
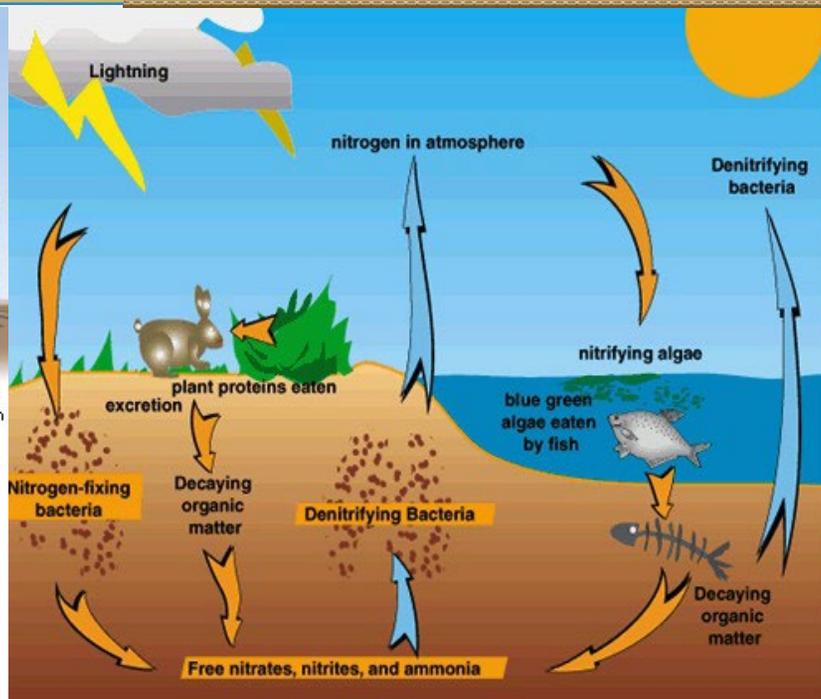
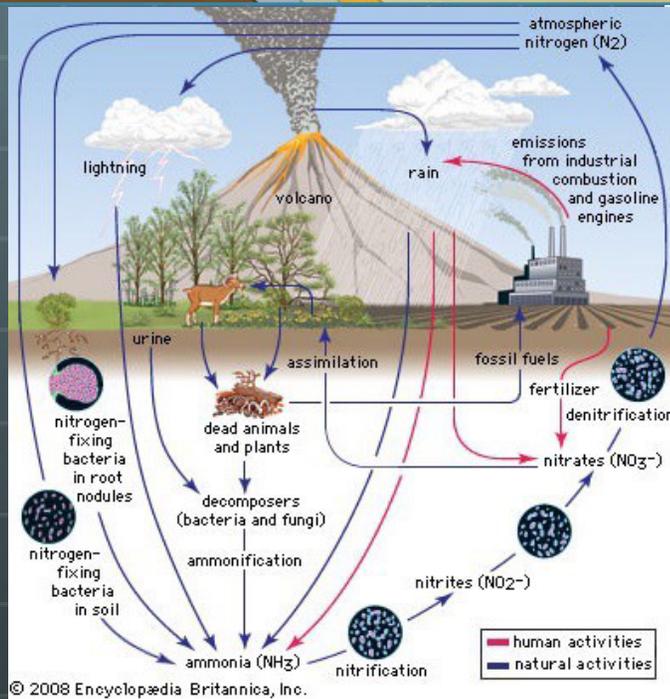
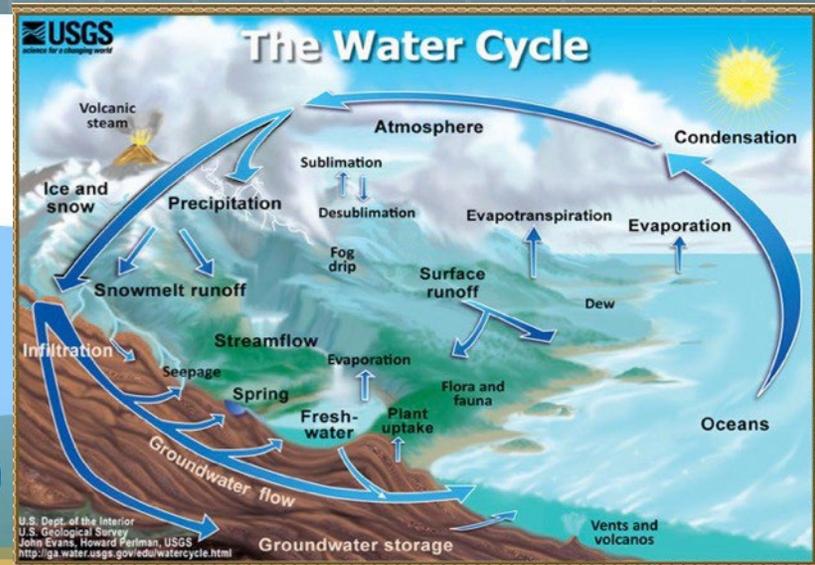


# Hemp Production and Remediation with Biochar



# Natural Earth Cycles



# NOT One-way Farming

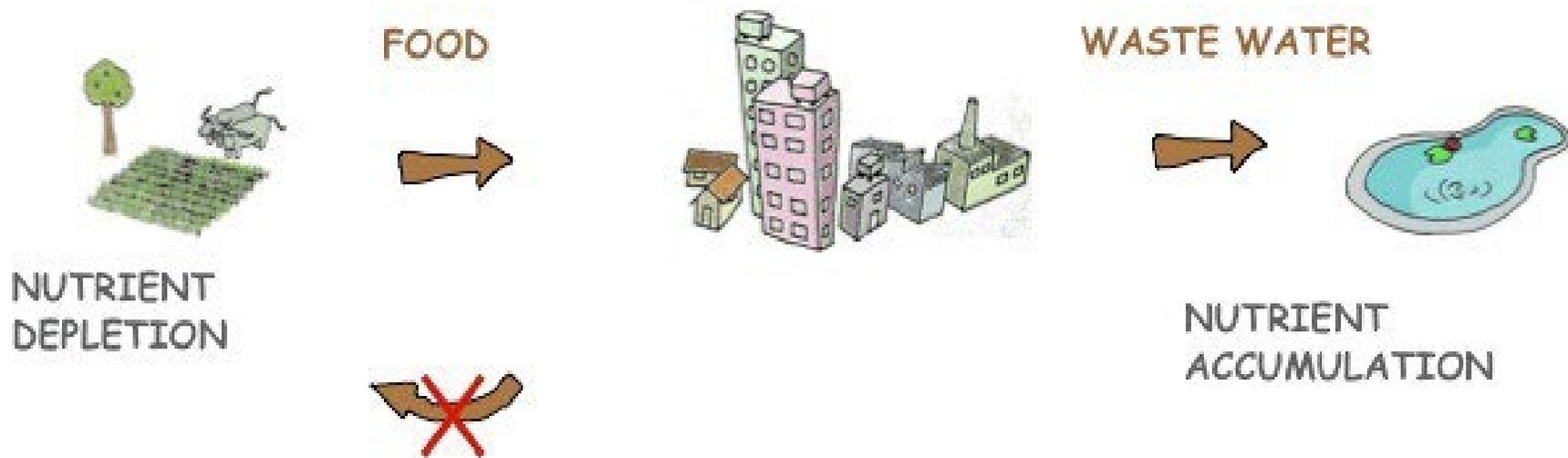


Inputs

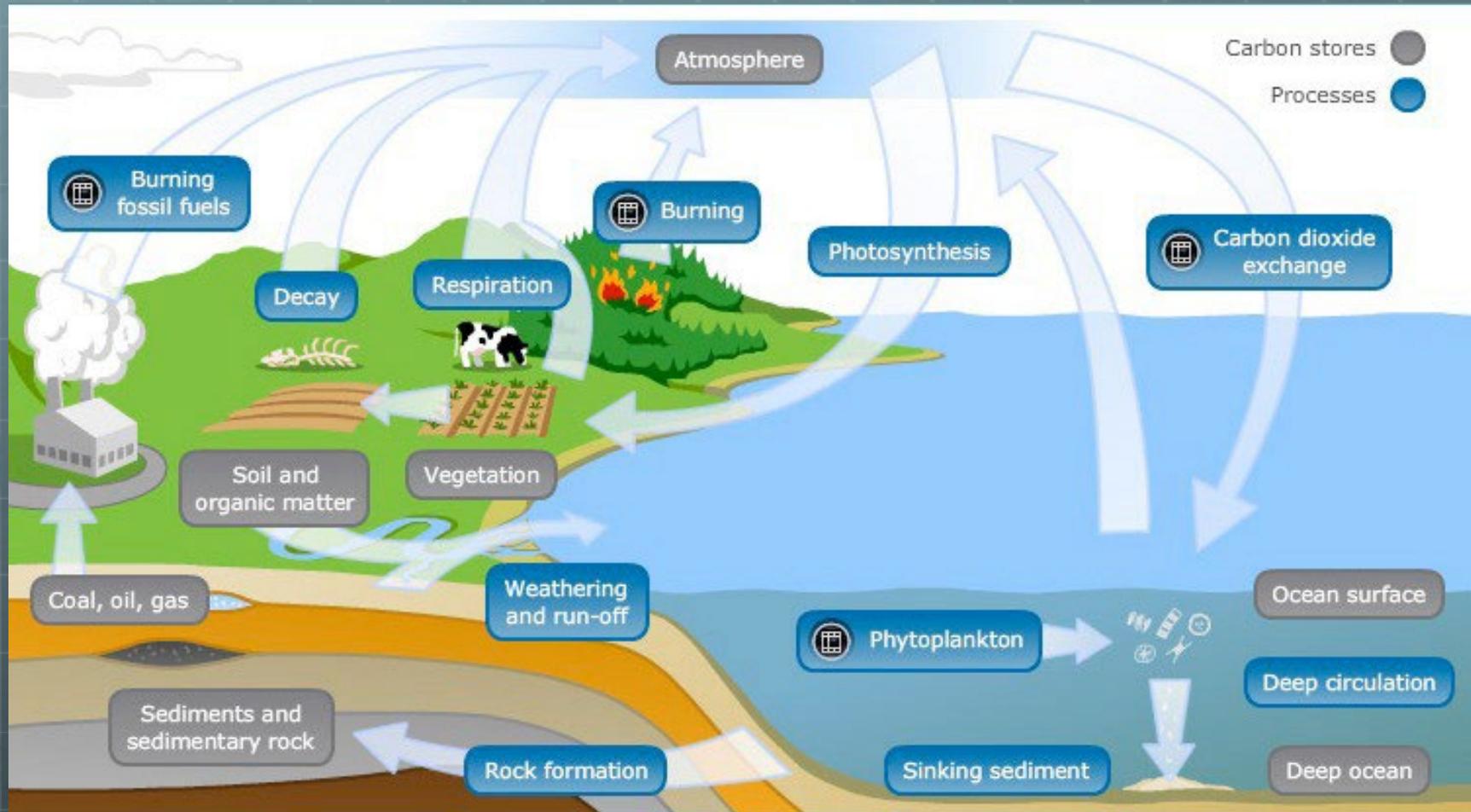
Outputs

# One-way vs Circular Production

→ NUTRIENT FLOW →



# The Carbon Cycle



From University of Waikato, NZ



# Biochar and Sustainability:

## Terra Preta de Indio Soils

(Amazonian Dark Earth)

Terra Preta de Indio Soil



Nearby Oxisol Soil



*Photos:* Julie Majors, Cornell University



# Biochar?

- 🌍 Inspired by Terra Preta, biomass-derived black carbon or charcoal - Biochar - investigated by farmers, researcher, environmental services orgs, and others . . .
- 🌍 **Some Biochar Findings:**
  - 🌍 Beneficial soil amendment
  - 🌍 Increase fertilizer efficiency (esp. organic fertilizers)
  - 🌍 Decreases nutrient loss – decrease N leaching
  - 🌍 Increases Cation Exchange Capacity (CEC)
  - 🌍 Increases crop yields
  - 🌍 Persistent in soils (>1000yrs)
  - 🌍 Improve soil water-holding capacity
  - 🌍 Improves Nutrient Availability
  - 🌍 Avoid and reverse soil degradation



# Biochar Increases Soil Biodiversity

## 5 benefits of soil biodiversity



Healthy soils



Plant growth



Climate change mitigation and adaptation

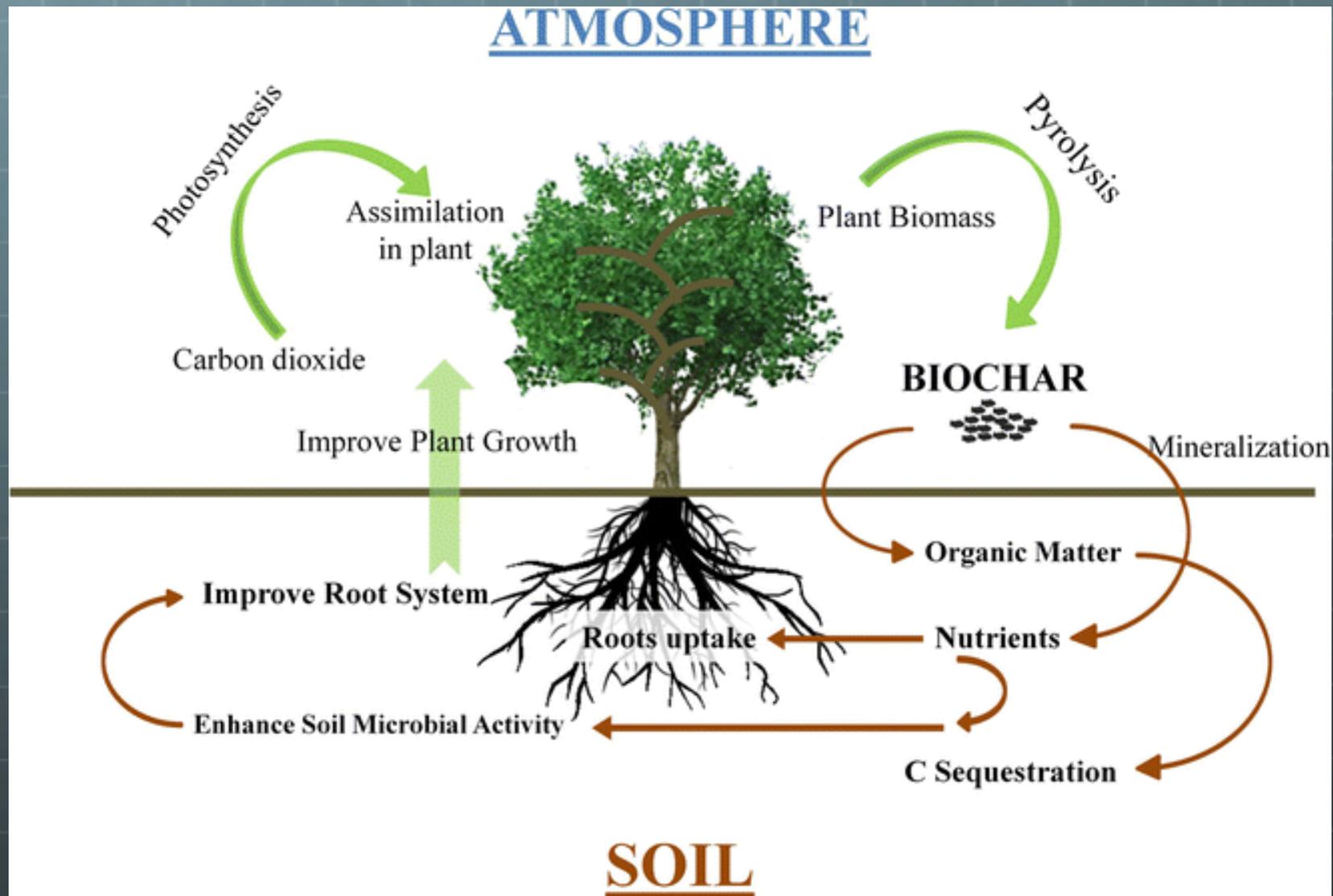


Human health



Water purification

# Creating Healthy Soils



# Increasing Crop Growth



Control



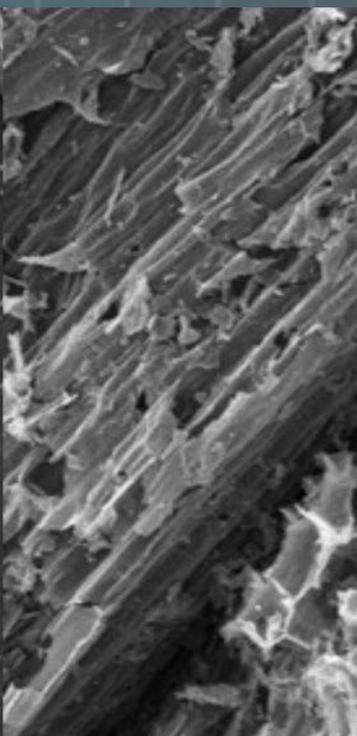
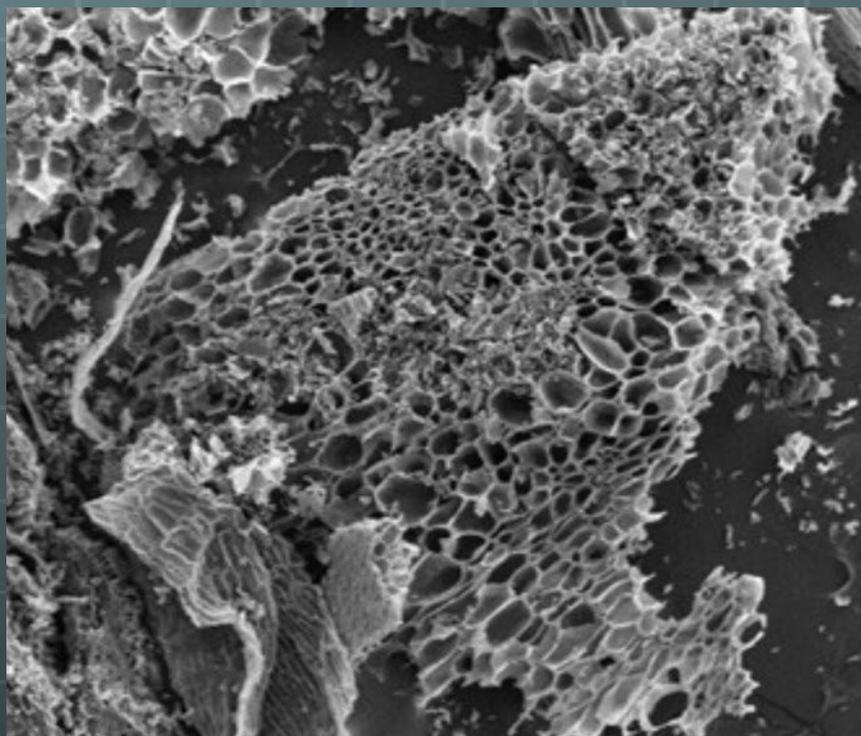
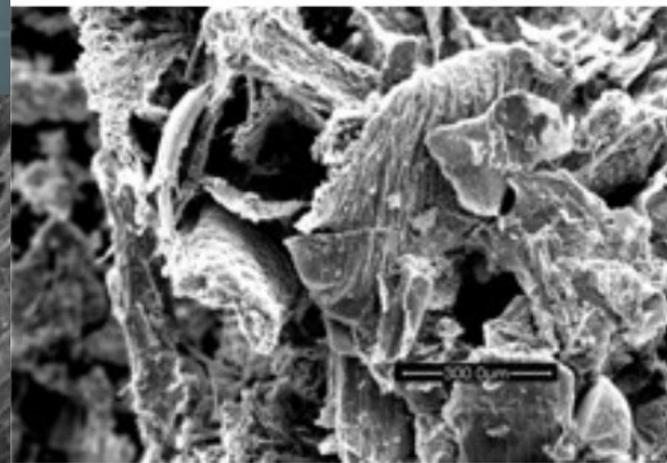
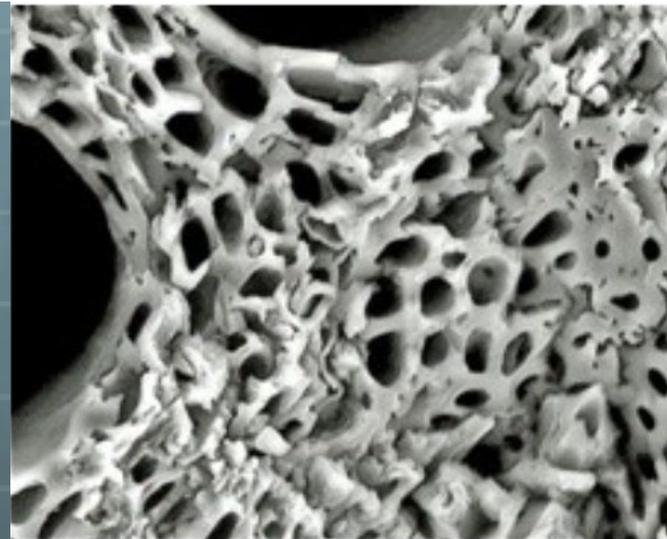
Biochar



Biochar + fungi

Biochar from rice husks in pot trials

# Close-up on Biochar

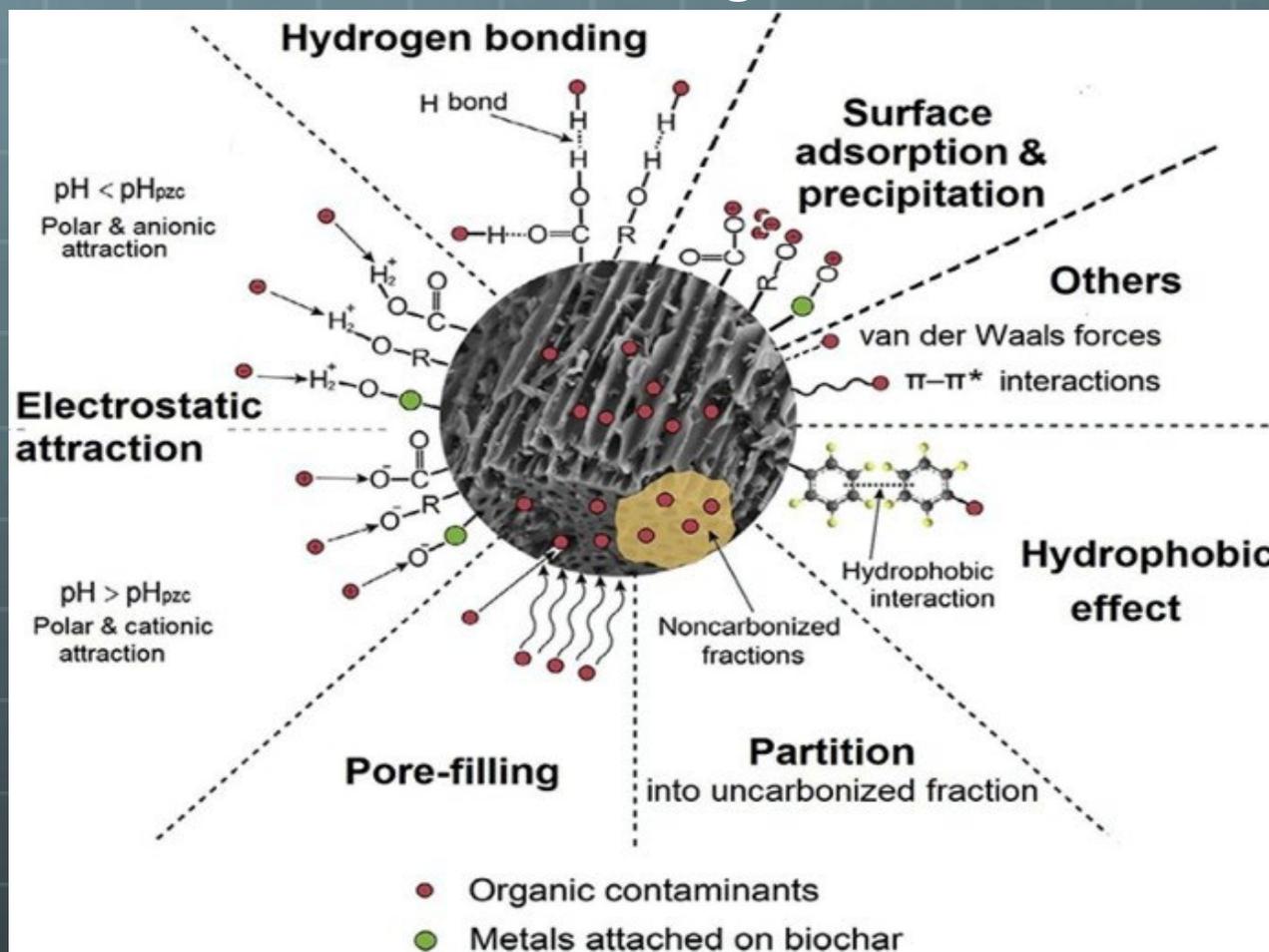


140 x corn cob

280 x miscanthus

# Biochar for Soil Remediation

Major ways biochar stabilizes organic contaminants in soil



Tan, X., Liu, Y., Zeng, G., Wang, X., Hu, X., Gu, Y., et al. (2015). Application of biochar for the removal of pollutants from aqueous solutions. *Chemosphere* 125, 70–85.

# Biochar and Hemp

- 🌐 **Biochar for Soil and Water Remediation**
- 🌐 **Biochar to improve Hemp and other crop production**
- 🌐 **Hemp as feedstock for biochar**
- 🌐 **Hemp as a bioaccumulator for Phytoremediation of Soils**
- 🌐 **Hemp + Biochar for Remediation and Restoration of degraded soils**
- 🌐 **Hemp + other crops (including trees) for phytoremediation**
- 🌐 **Biochar for water remediation**

# Steps Forward: Remediation Research

- 🌐 Funding for core research/remediation
- 🌐 In-field applications and trials
- 🌐 Knowledge building and knowledge sharing
- 🌐 Partnership building
- 🌐 Supply chain development for hemp and biochar
- 🌐 Development of remediation best-practices



Biochar  
Now 

**IND  
HEMP**  
OILSEEDS & FIBER

**OG  
CONTAINERS**  
OG & BULK SUPPLIES



# Why Hemp?

- Hemp is a bioremediating crop
- Hemp production and market development is hot (exciting)
- Captures interest of young and new farmers/entrepreneurs
- Profits (can be) higher than conventional commodities
- Almost limitless opportunities for end-uses
  - Bioplastics, fuel, food, feed, medicine, building materials...



# Hemp in Rotation

- 🌍 Remediation and land restoration sets the foundation for success in multi-year rotations
- 🌍 Other crops such as oilseeds, grasses, legumes, winter covers—and the development of their respective supply chains—is essential in multi-year research and for building regenerative systems



# Forming a long braid



- Not just about connecting links in a supply chain
- The braid is stronger than individual strands
- Interconnectedness of supply chain with threads of deeper knowledge, expertise, education, equity, ecosystem services, job training and job creation, innovation...

***“Humankind has not woven the web of life. We are but one thread within it. Whatever we do to the web, we do to ourselves. All things are bound together... all things connect.” - Chief Seattle***

# Future Generations

- Reconnecting youth & young farmers with the land

- Ancestral knowledge
- Stewardship of sacred lands, water, animals
- Healing generational trauma



- Building economies within native country

- Workforce training
- Ground-up approach to tribal innovation and business development – individual land stewards, tribal communities, tribes/sovereign nations

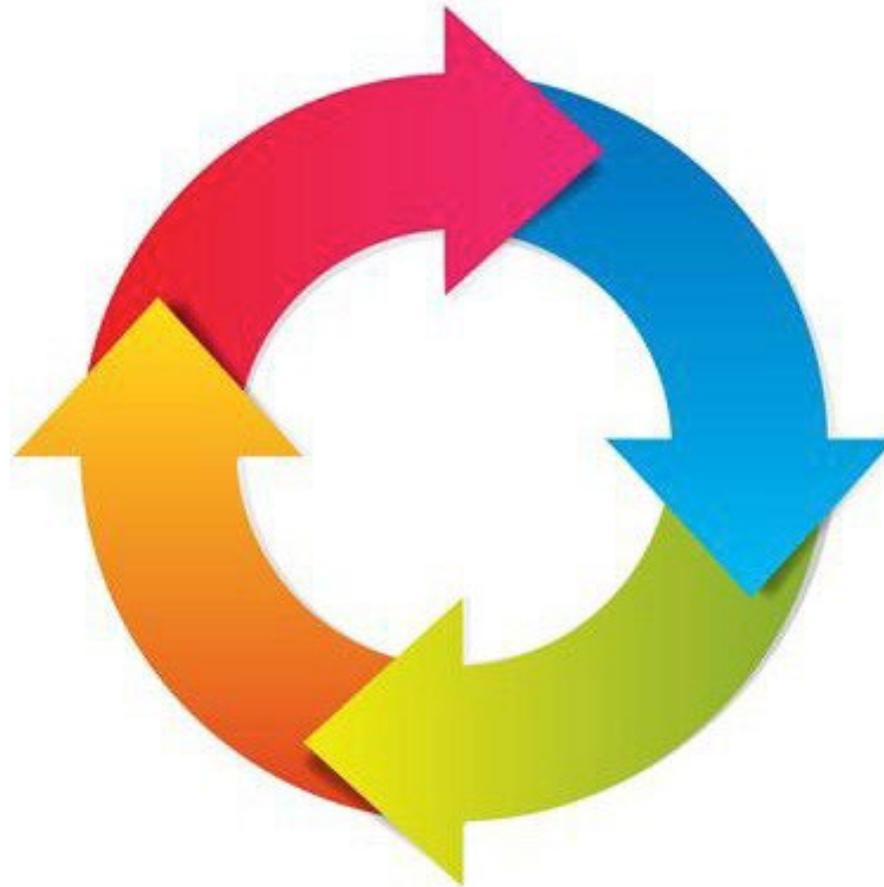
- Intertribal trade

- Sovereignty

- Knowledge
- Land
- Food
- Energy
- Medicine



# Thank you



Janet E. Hawkes, Ph.D.  
Tellus Earth LLC  
janethawkes@gmail.com

Swan Ray, MS SCM  
Native Health Matters Foundation  
swan@nativehealthmatters.com