

Team Green

Environment & Sustainability

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- 1. Recycling Plastics***
- 2. Fighting Against Red Tides***
- 3. Soil Conservation***





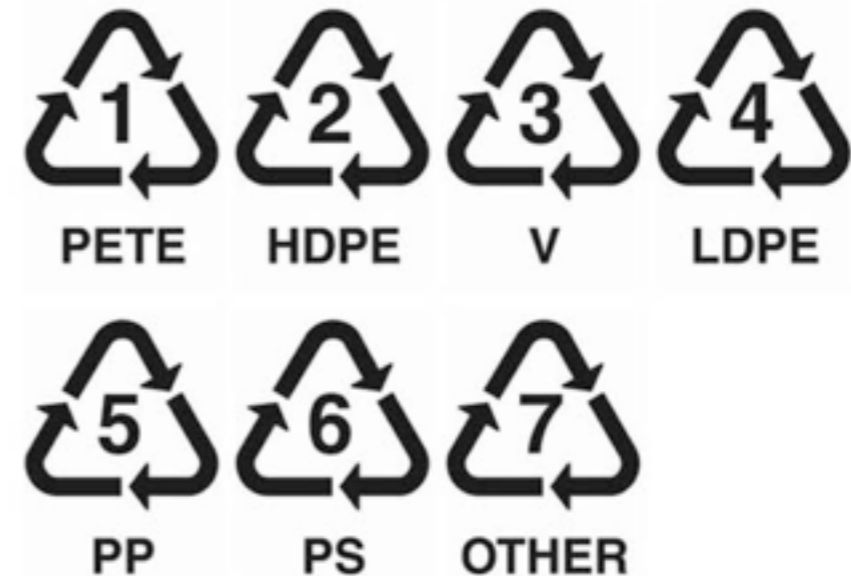
RECYCLING AID

Goal: Engineer organisms to quickly break down mixtures of non-biodegradable plastics, increasing recycling capacity and reducing waste.

IMPORTANCE

Recycling Plastic...

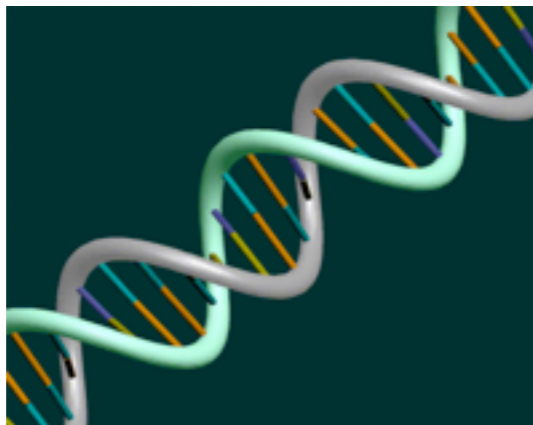
1. Limits Environmental Contamination
2. Reduces Green House Gas Emissions
3. Reduces Costs & Dependency on Foreign Oil
4. Maximizes Landfill Space



IMPACT

A Biotechnology Approach Would...

- Lead to the recycling of plastics that are currently overlooked by the industry
- Increase the accessibility of recycling technology
- Reduce the amount of required processing, increasing recycling efficiency.



COMPETITION

Mechanical Recycling Industry

- Very effective at breaking down specific types of pure plastic
- Cannot process all kinds of plastics due to limitations in sorting/ separation technology and prohibitive cost
- Requires a large plant and lots of energy

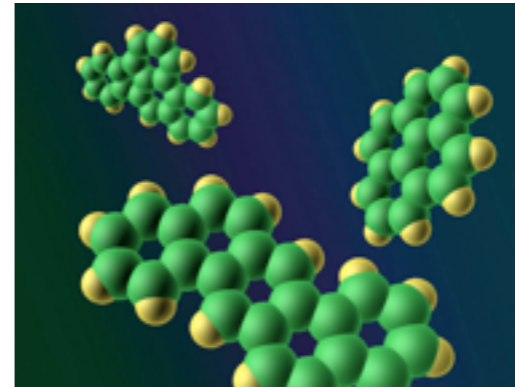
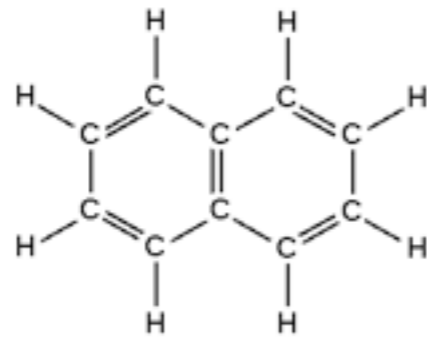


Chemical Recycling Industry

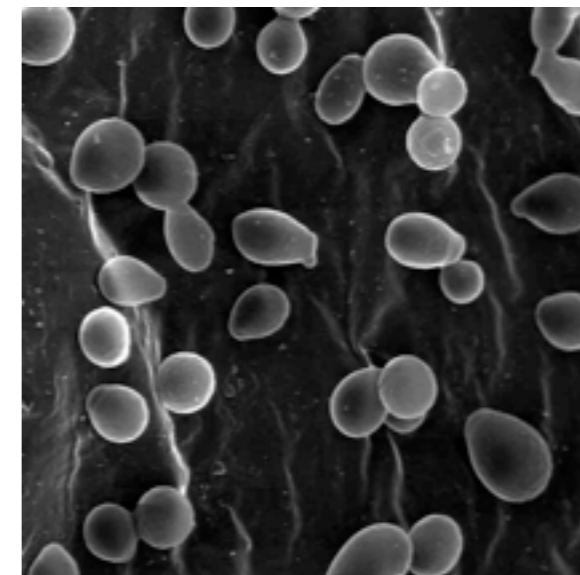
- Successfully breaks down specific types of plastic into component elements
- Requires an even larger, more specialized plant

KNOWNNS

Most plastics are polymers, composed of chains of aromatic hydrocarbons.



Varieties of Fungi, Eubacteria and Yeast all have the natural ability to break down different types of hydrocarbon polymers.



UNKNOWNNS

Breakdown Reaction Dynamics

Cost

Feasibility

Scale



Byproducts

Properties of New Organism

FIGHTING AGAINST RED TIDES

- **Goal: To engineer bacteria to kill algal blooms (red tide) without hurting the environment**

IMPORTANCE

- Many organisms can accumulate toxins in their body - harmful to humans
- Blocks sunlight and oxygen reaching depth - many fish killed
- Algae compete for nutrients by other organisms ocean ecosystem.



IMPACT

- Keeps marine organisms from accumulating toxins in their body/saves them from death
- Reducing risks for human health
- No more economic losses in fishery & beach tourism



COMPETITION

Silver-doped TiO₂ nanoparticles

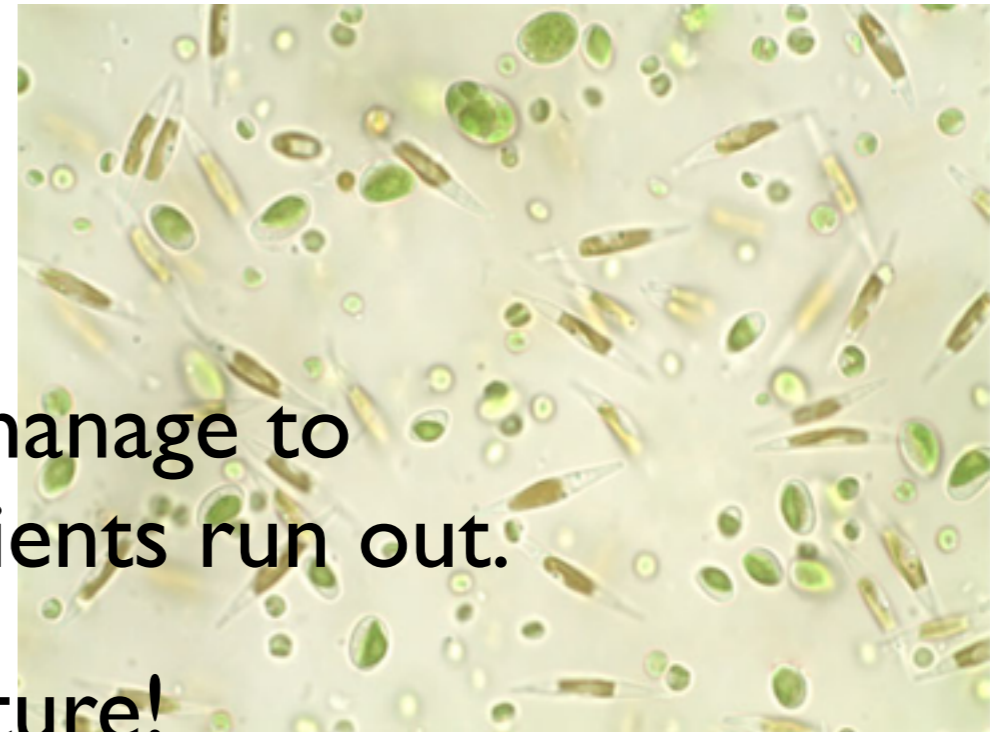
- Using chemicals to contain the red tide
- TiO₂ is a dangerous chemical (carcinogenic)

Organoclay

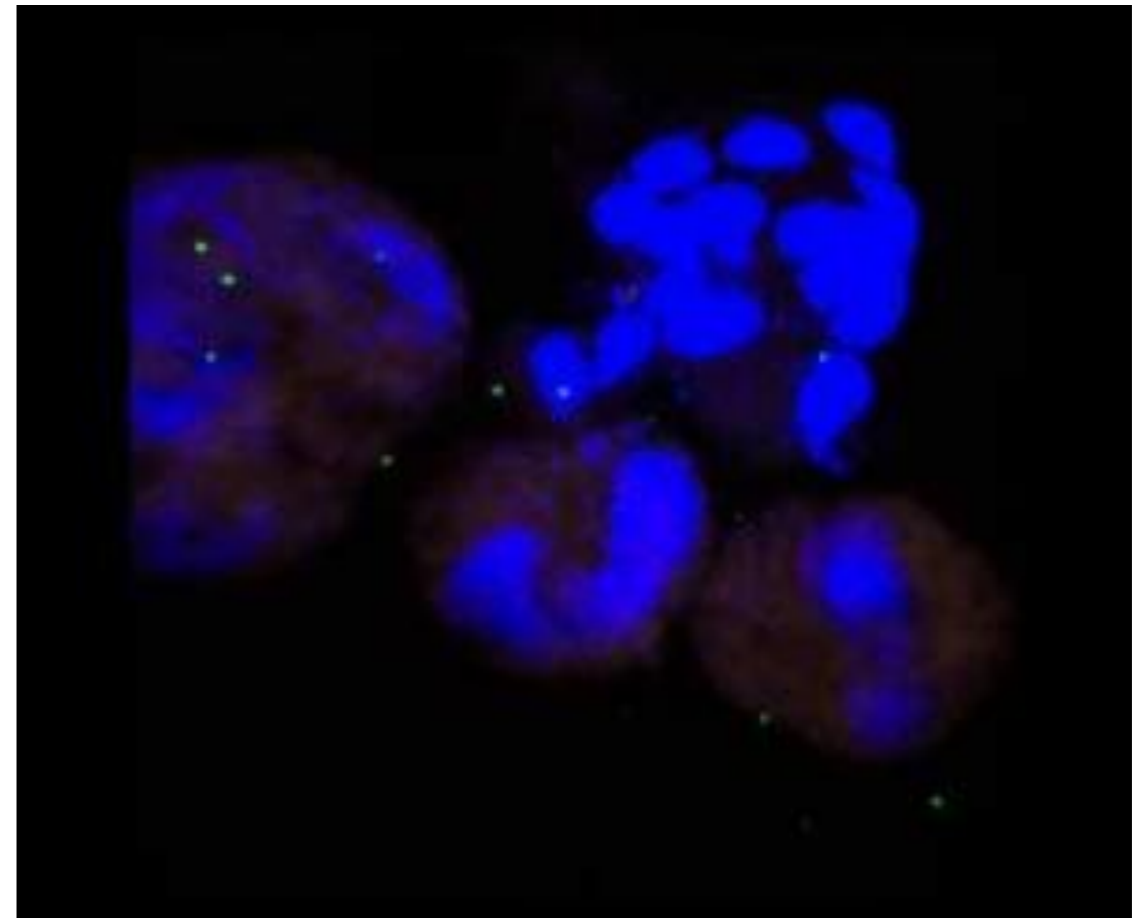
- Sinking planktons to the ocean bottom
- Toxins can still smother other organisms at the bottom



KNOWNNS



- How phytoplanktons grow and manage to keep their population when nutrients run out.
- Algae-killing bacteria exists in nature!



- People are afraid of releasing genetically modified organisms in the sea



UNKNOWNNS

- We don't know how red tides start or go away in nature.
- Only very little is known about RCA Bacteria - ecological roles? what makes them to kill phytoplanktons?



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- **Goal: To engineer bacteria to increase nitrogen in soil**

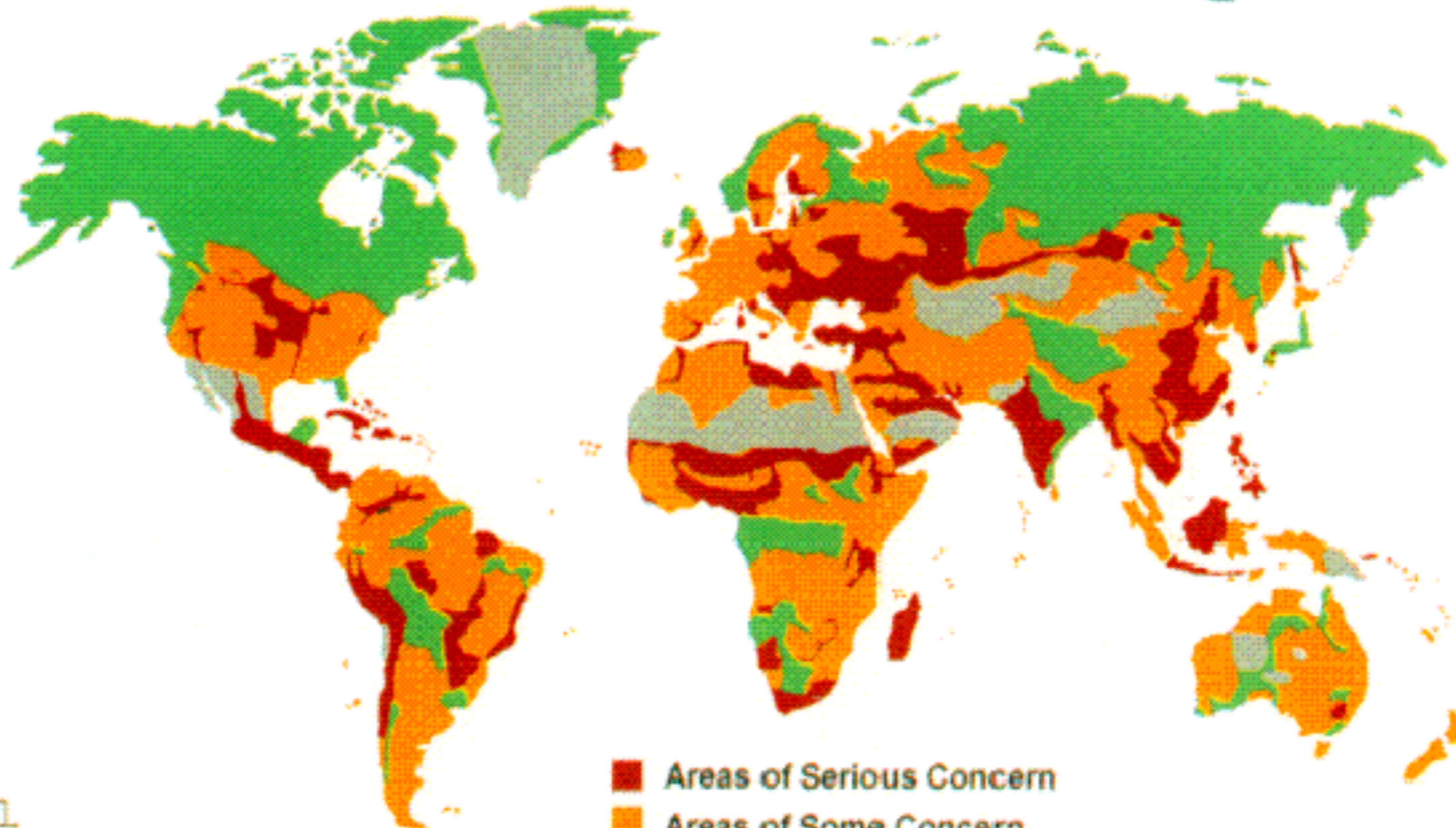
SOIL CONSERVATION

IMPORTANCE

- Humanity has degraded and eroded more than a third of all arable land.
- There will be more than 9 billion people to feed.
- Conventional ways of fertilizing the soil require a lot of energy and have reduced native soil fertility.



Areas of Concern for Soil Degradation



- Areas of Serious Concern
- Areas of Some Concern
- Stable Terrain
- Nonvegetated Land

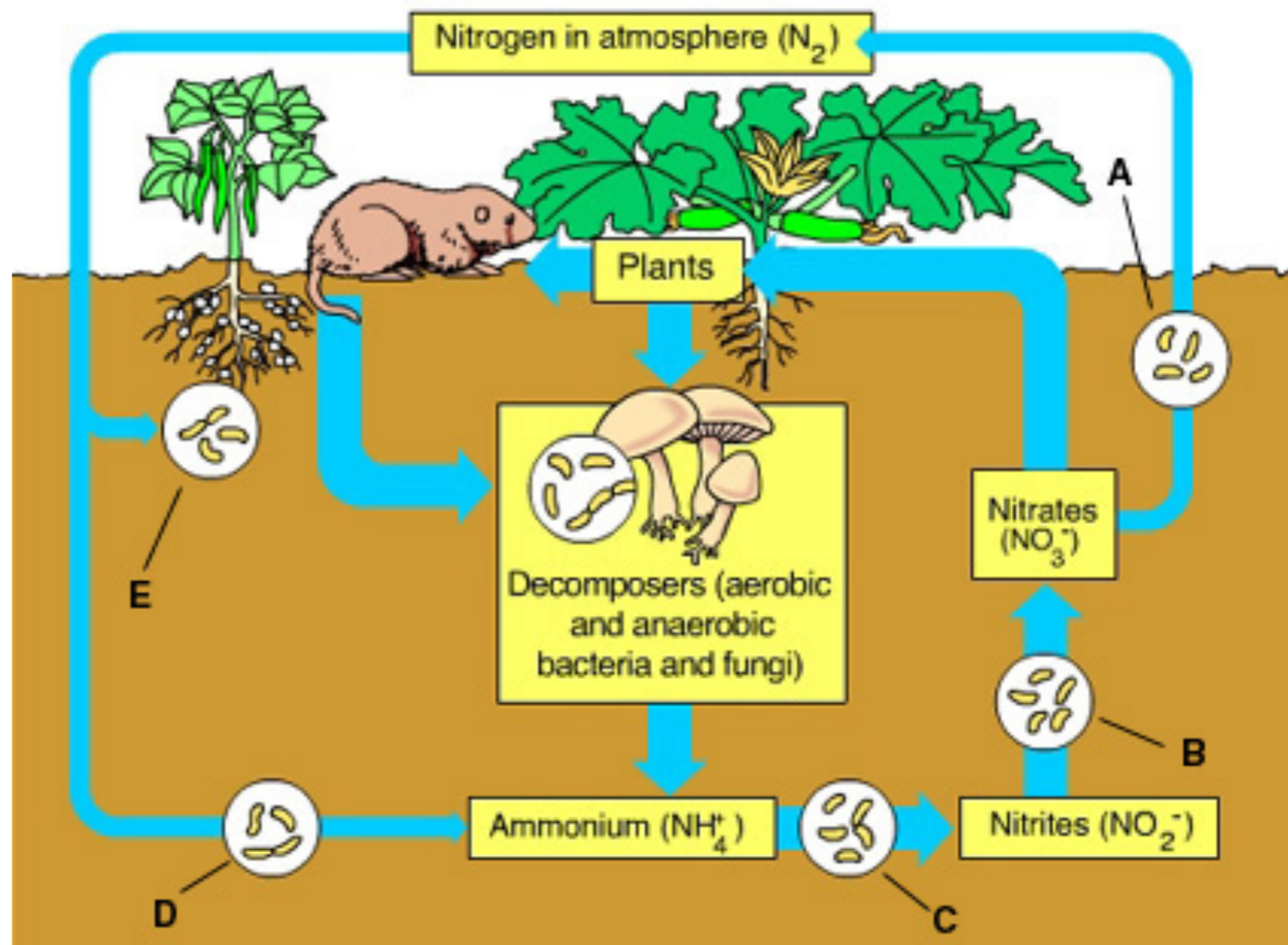

World
Resources
Institute

Source: International Soil Reference and Information Centre, unpublished map
(Wageningen, the Netherlands, 1990)

IMPORTANCE

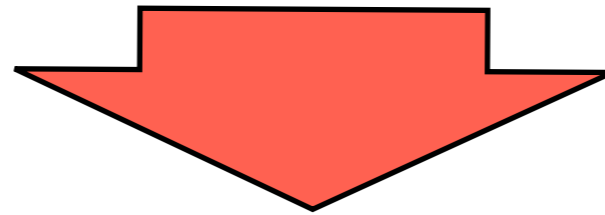
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- The main nutrients for plants are nitrogen, phosphorus, and potassium. Availability of fixed nitrogen is often the limiting factor in crop productivity.
- We need to find an organic method to restore and sustain soil fertility by developing an efficient nitrogen-fixing process by bacteria.



IMPACT

- Prevent soil from being eroded or chemically overused
- Increase soil fertility

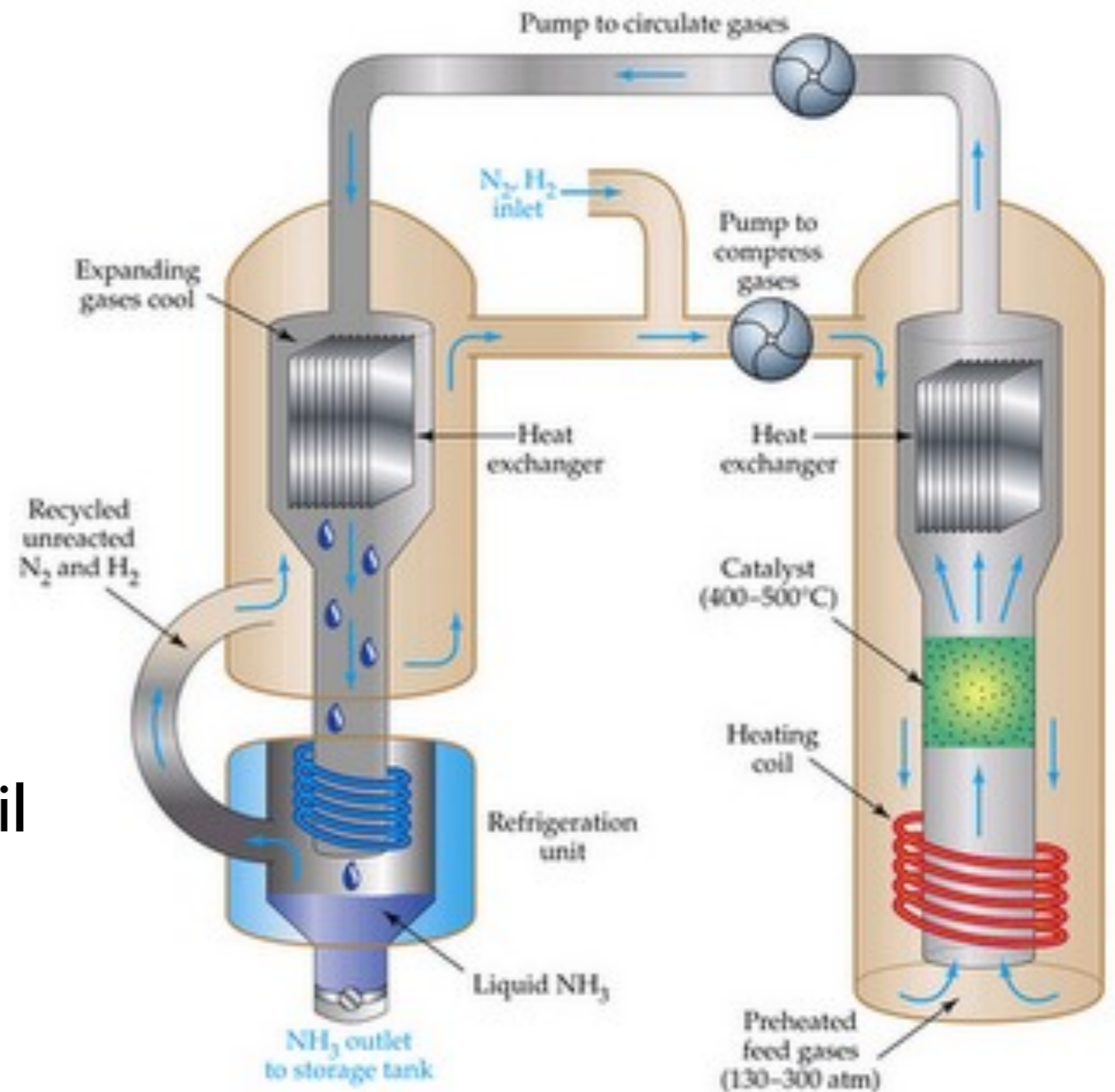


- More available land for farming (food production) and biological organisms (plants, trees) to grow.

COMPETING TECHNOLOGIES

Haber-Bosch Process

- Used to create the ammonia in commercial fertilizer
- Sustains one-third of the earth's population
- Cons: high energy consumption necessary for chemical process.
- Runoff of fertilizer-treated soil into water, excess nitrogen causes algae bloom.



COMPETITION

(Continued)

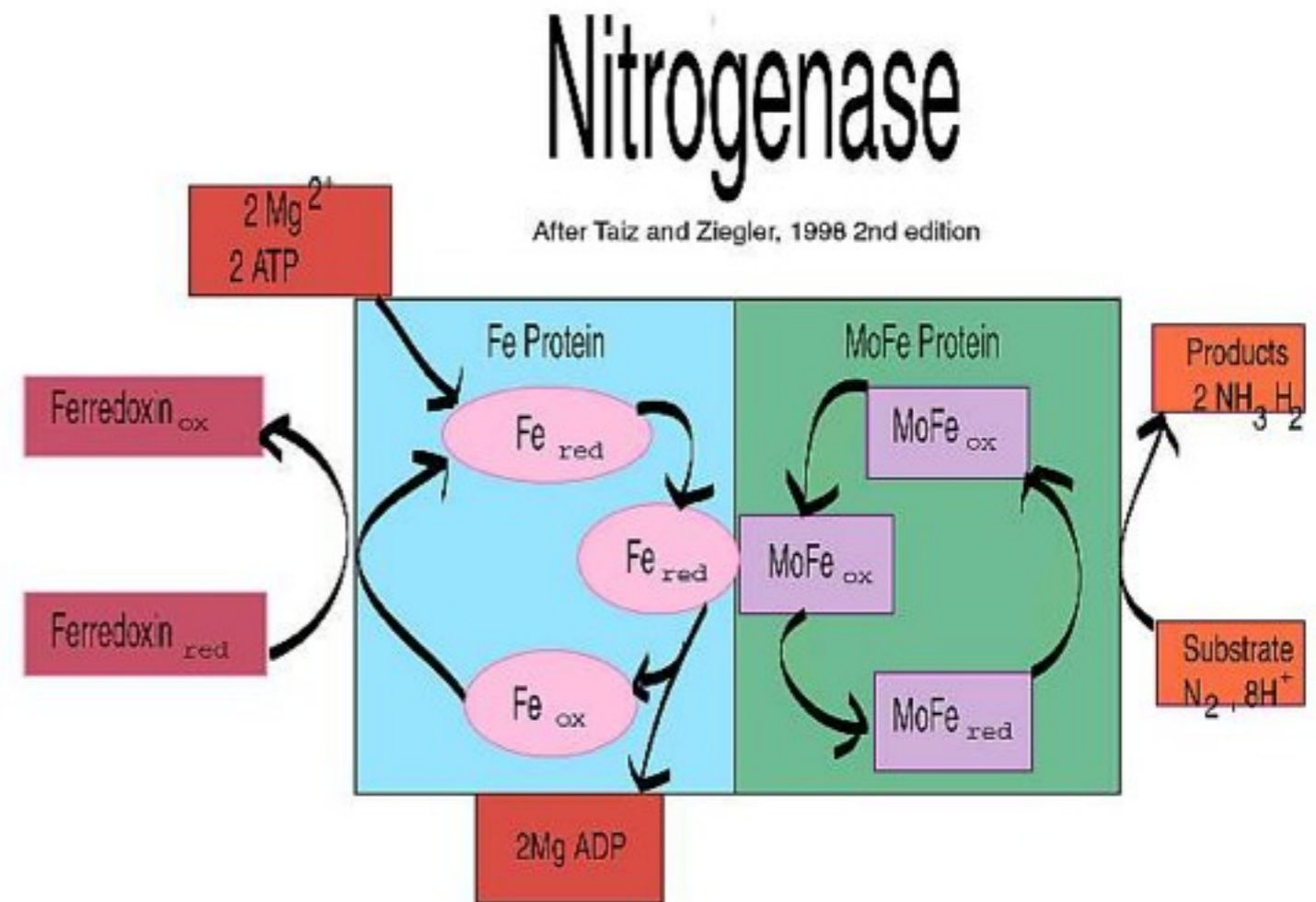
Genetically Modified Crops

- Same final goal as our idea, i.e. increasing crop yield
- Genetically modified crops have already been implemented, with some success
- Cons: impact on human health is unknown
- Potentially adverse impact on environment; cross-pollination with other plants, reduction of biodiversity



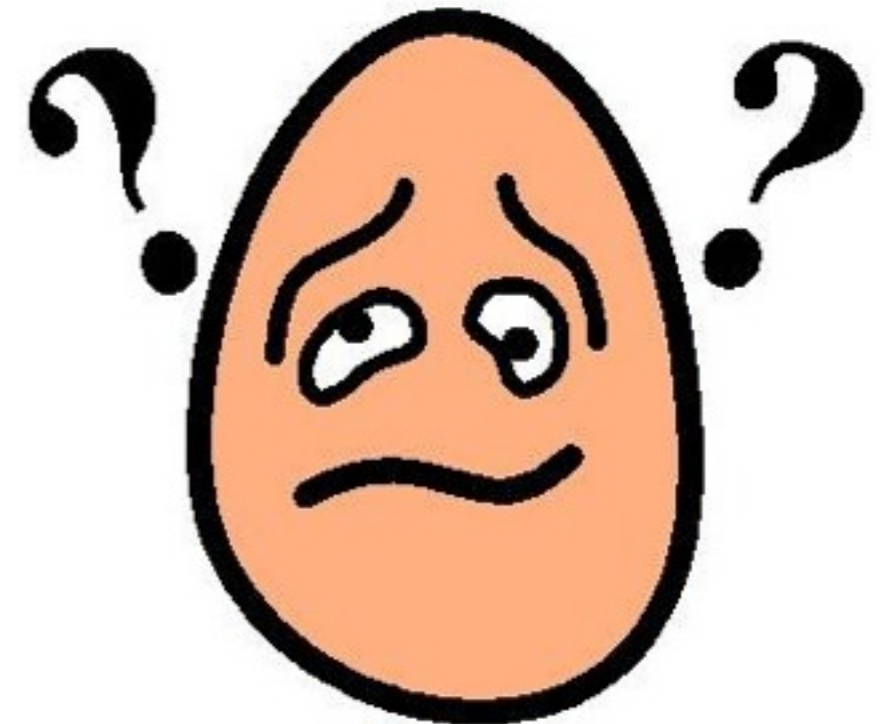
KNOWNNS

- Fixed nitrogen is often the limiting factor in crop yield.
- The nitrogenase enzyme complex is the primary pathway responsible for the ability of certain bacteria to fix nitrogen
- It is important to be able to control/predict the amount of nitrogen produced.



UNKNOWNNS

- Implementation: might be difficult to introduce this design on a wide scale level
- Nitrogenase enzyme complex highly sensitive to environmental cues (oxygen sensitivity, temperature, etc.): is it possible to get around this?
- Not all steps in the pathway are understood by scientists
- Possible environmental consequences?





Recycling Aid



Fighting Against Red Tides



Soil Conservation

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