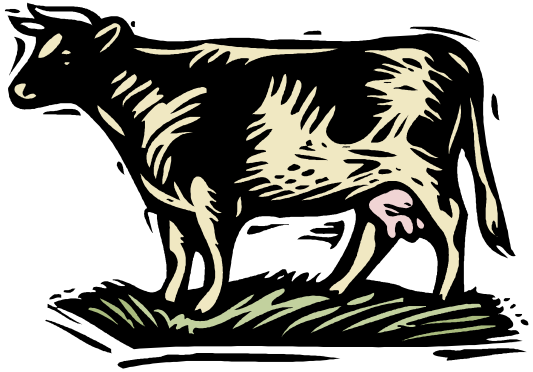
Nitrogen

Does water contain nitrogen?

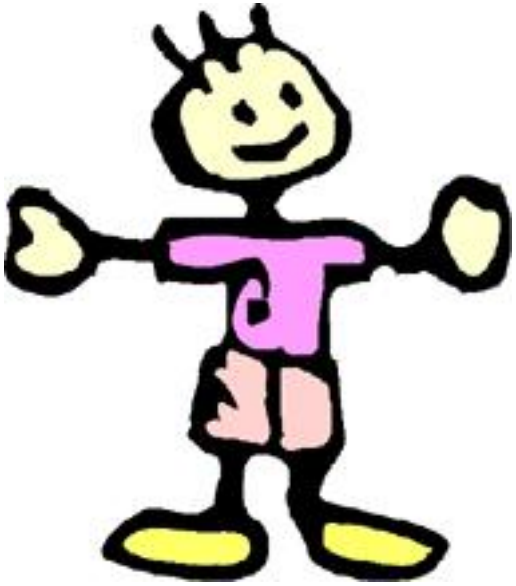
Do plants contain nitrogen?



Do animals contain nitrogen?

Does the soil contain nitrogen?

Do you contain nitrogen?



Does the air contain nitrogen?

Basic nutrient cycle

Decomposition

Soluble Nutrients

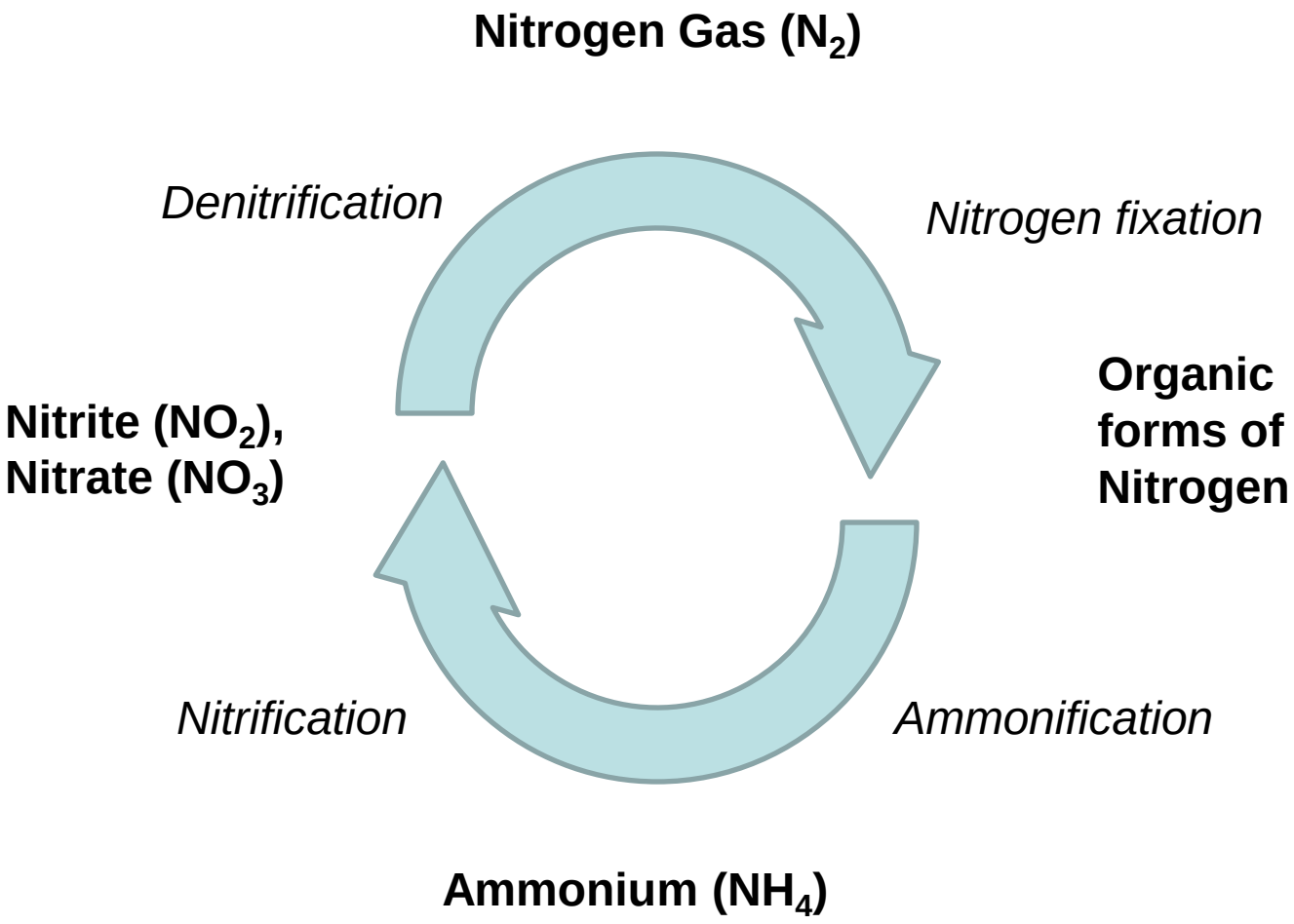
Nitrogen

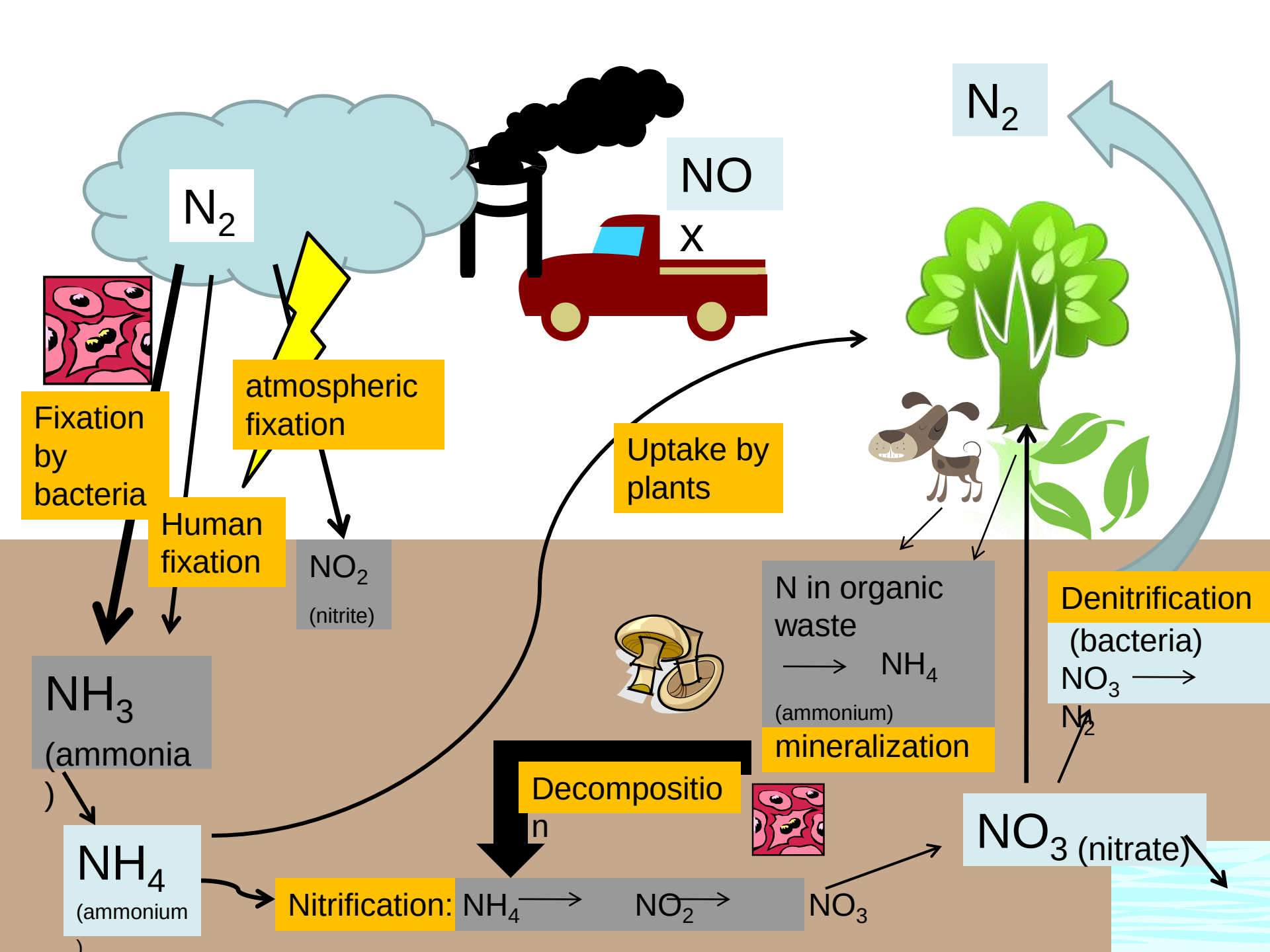
Potassium, etc…

Phosphorus

Living things NEED nutrients

Basic N Cycle

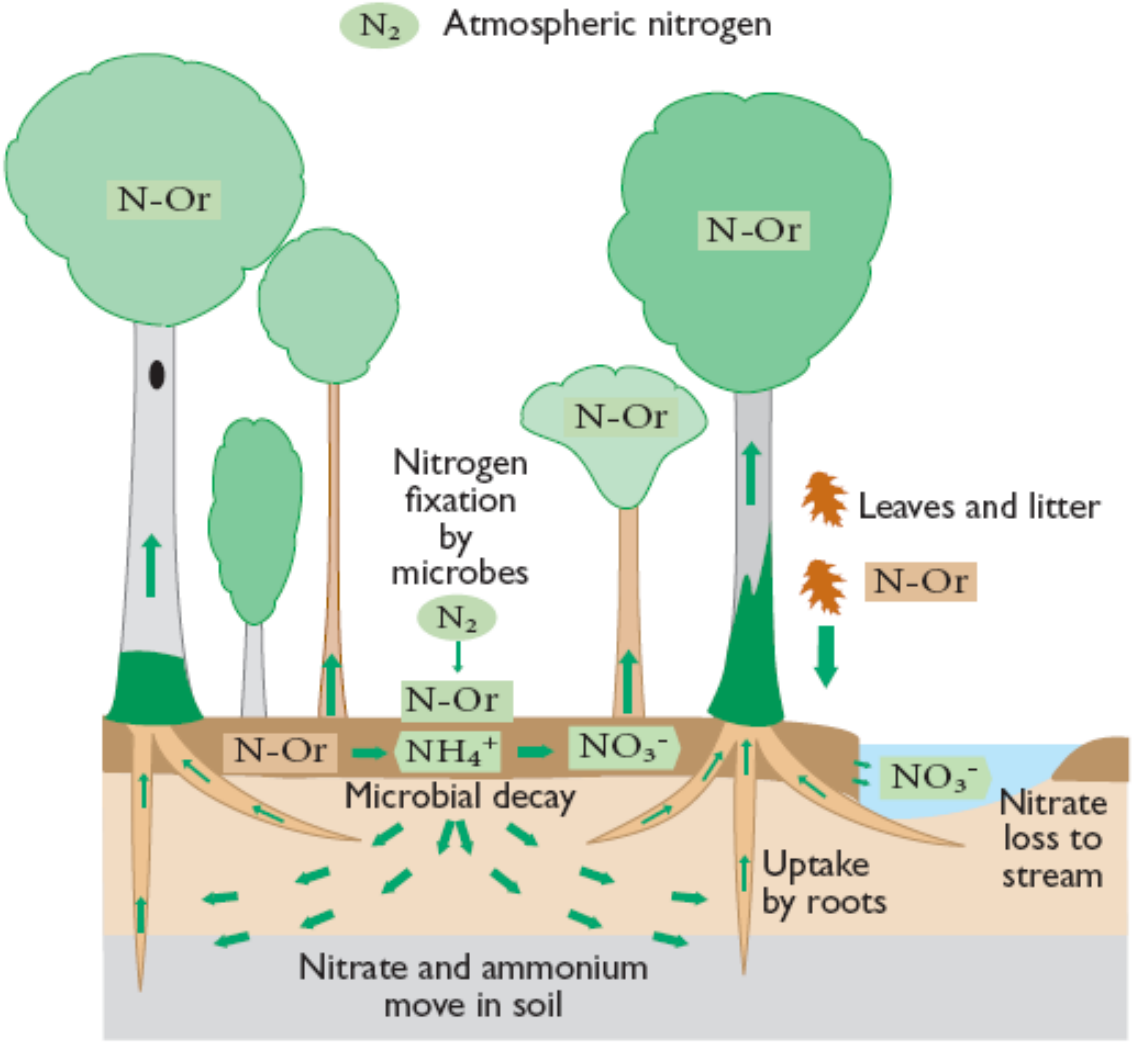



N_2
NO
x
N_2
Fixation by bacteria
Human fixation
atmospheric fixation
NO_2
(nitrite)
Uptake by plants
N in organic waste
NH_4
(ammonium)
mineralization
Denitrification
(bacteria)
NO_3
N_2
NH_3
(ammonia
)
Decompositio
n
NH_4
(ammonium
)
Nitrification: NH_4 NO_2 NO_3
NO_3 (nitrate)

The basics

- The atmosphere is made up of 79% N gas
- This gas is not useable by living things
  - It must be converted to form compounds such as ammonia (NH_4) or nitrate (NO_3) which can be taken up by living things
- There is natural and human fixation of N_2
  - Natural: lightning, bacteria
  - Human: fossil fuel combustion, fertilizer manufacturing

NITROGEN CYCLING IN AN UNDISTURBED FOREST



N-Or Organic nitrogen in living tissue

N-Or Organic nitrogen in dead tissue

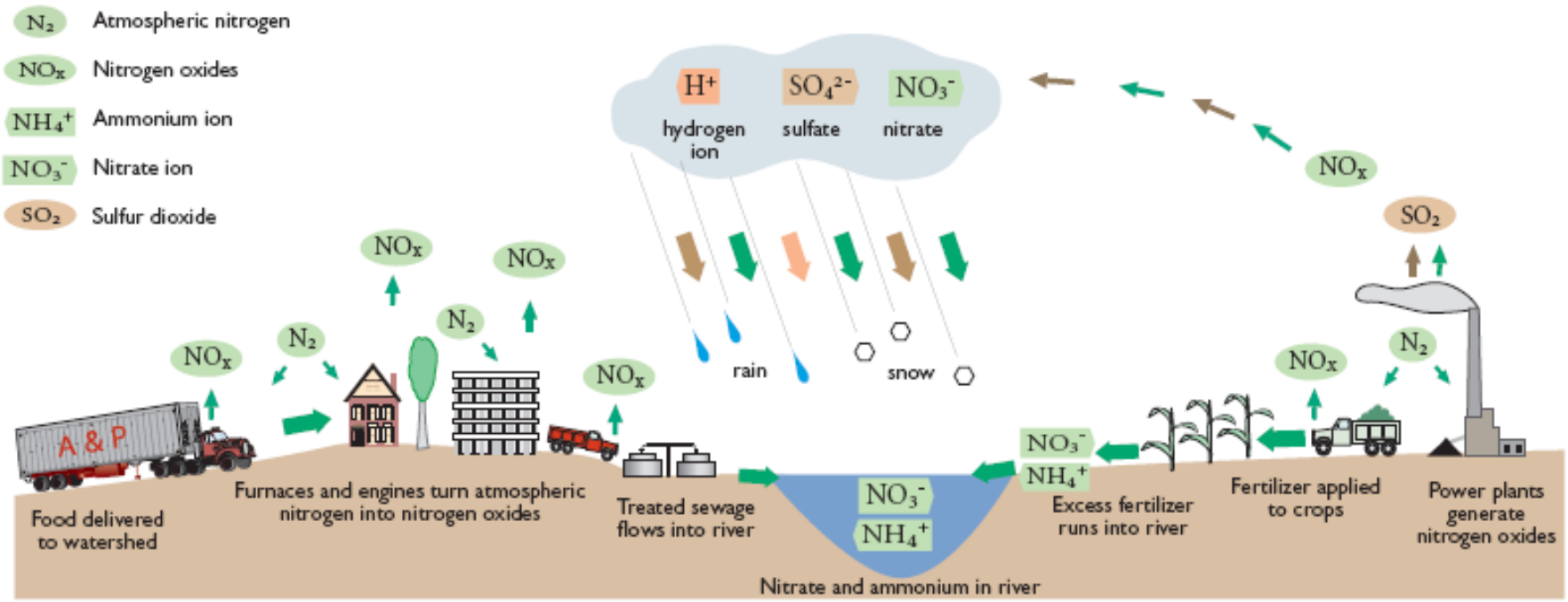
NH_4^+ Ammonium

NO_3^- Nitrate

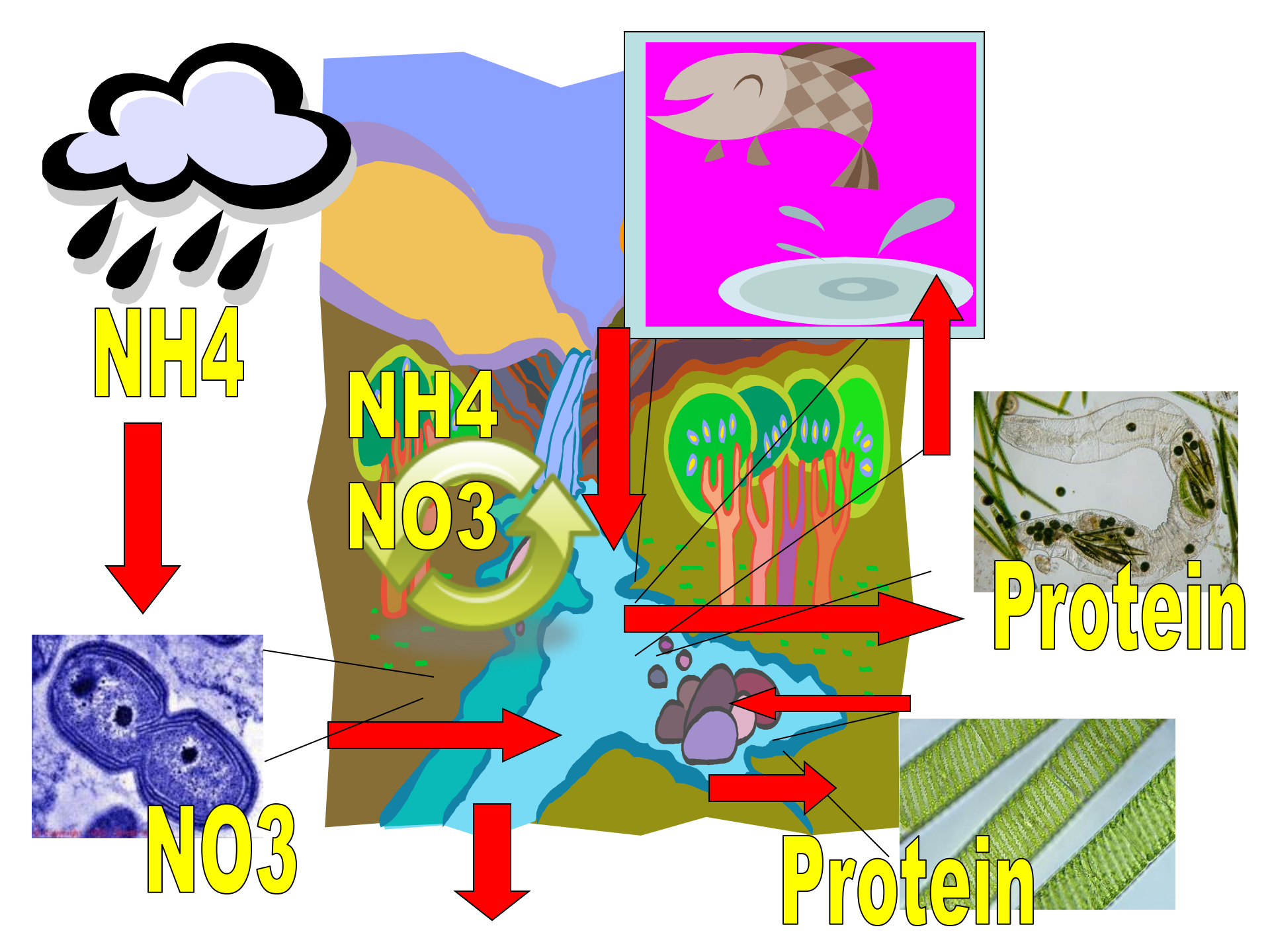
Flow of nitrogen

In an undisturbed forest most of the nitrogen cycles between living plants and dead organic mater in the soil. Plants take up nitrogen through their roots; microbes release the nitrogenfrom dead leaves and branches to the soil. Small amounts enter the cycle through nitrogen fixation, and even smaller amounts leave in stream water.

NITROGEN CYCLING IN A DEVELOPED WATERSHED



Developed watershed import nitrogen in food and fertilizer. They also receive nitrogen from acid rain, which in turn gets its nitrogen from the nitrogen oxides produced by furnaces, boilers, and engines. About half the nitrogen a watershed receives is stored in the soil or in trees or exported as crops. The flows into rivers.


NH4
NH4
NO3
Protein
NO3
Protein

Why care about nitrogen?

We should care because it causes…

- Water pollution (eutrophication which can lead to dead zones)
- Acidic precipitation (rain, snow, fog)
- Climate change (nitrous oxide is a greenhouse gas)
- Air pollution (nitric oxide is the precursor of smog)

Nitrogen cycle…so what?

- Plants and animals *need* nitrogen
- But…there can be too much of a good thing!
- Too much nitrogen results in: eutrophication of aquatic systems

There is both cultural (human) and natural eutrophication

Eutrophication: excess nutrients stimulate plant growth (algal bloom); when these plants die, decomposers use up the available oxygen during decomposition

Source: www.algae.info

Source: http://serc.carleton.edu

Nitrogen in the Hudson

Where does it come from?

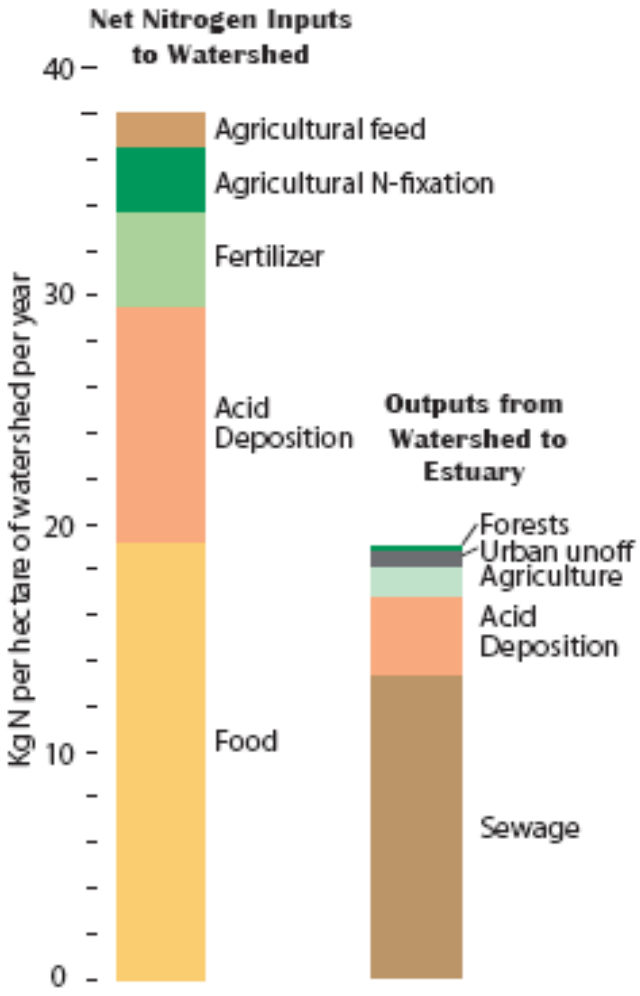
-human waste

-acid deposition

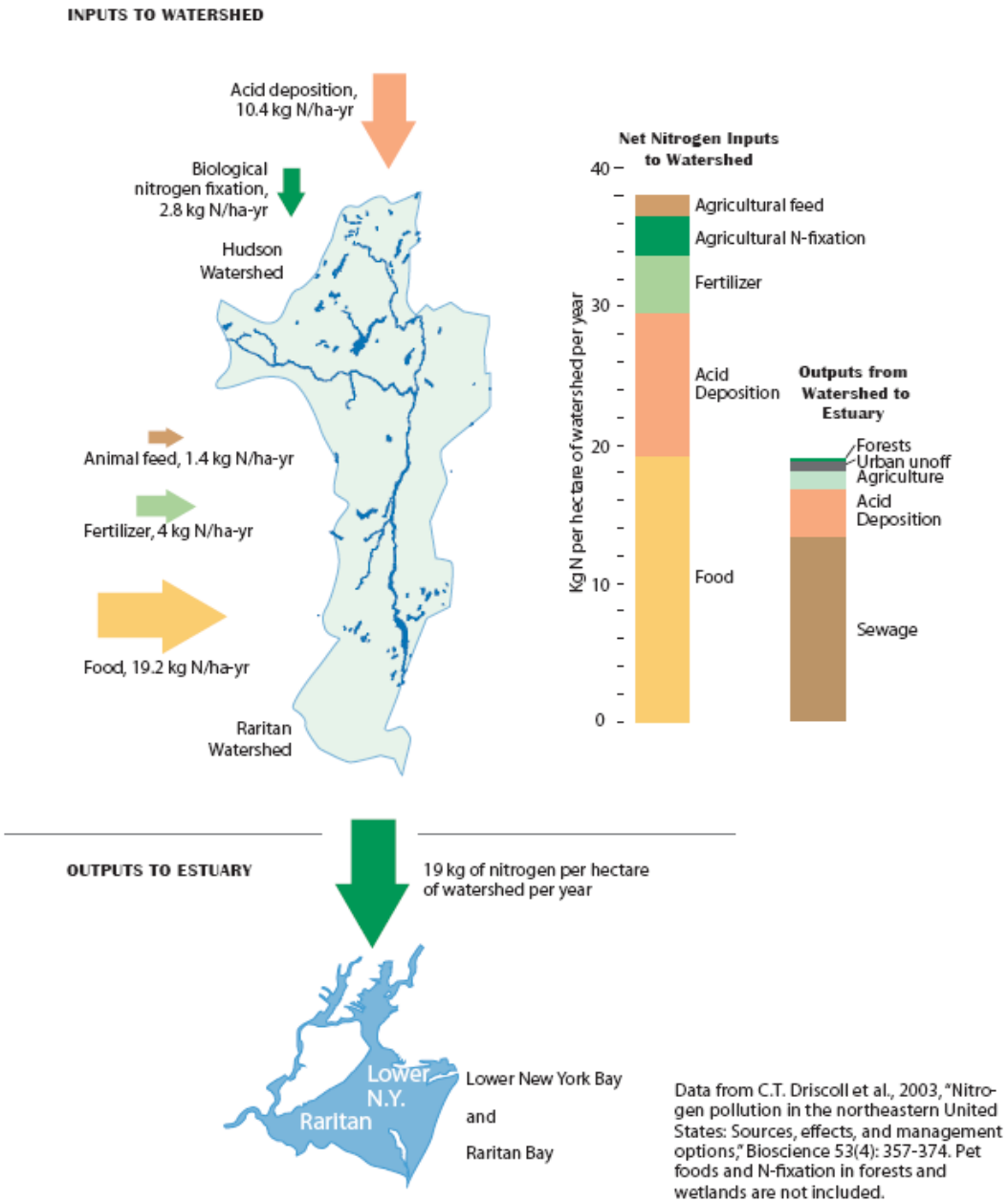
-fertilizer

-agriculture: fixation and feed

Where does it go?

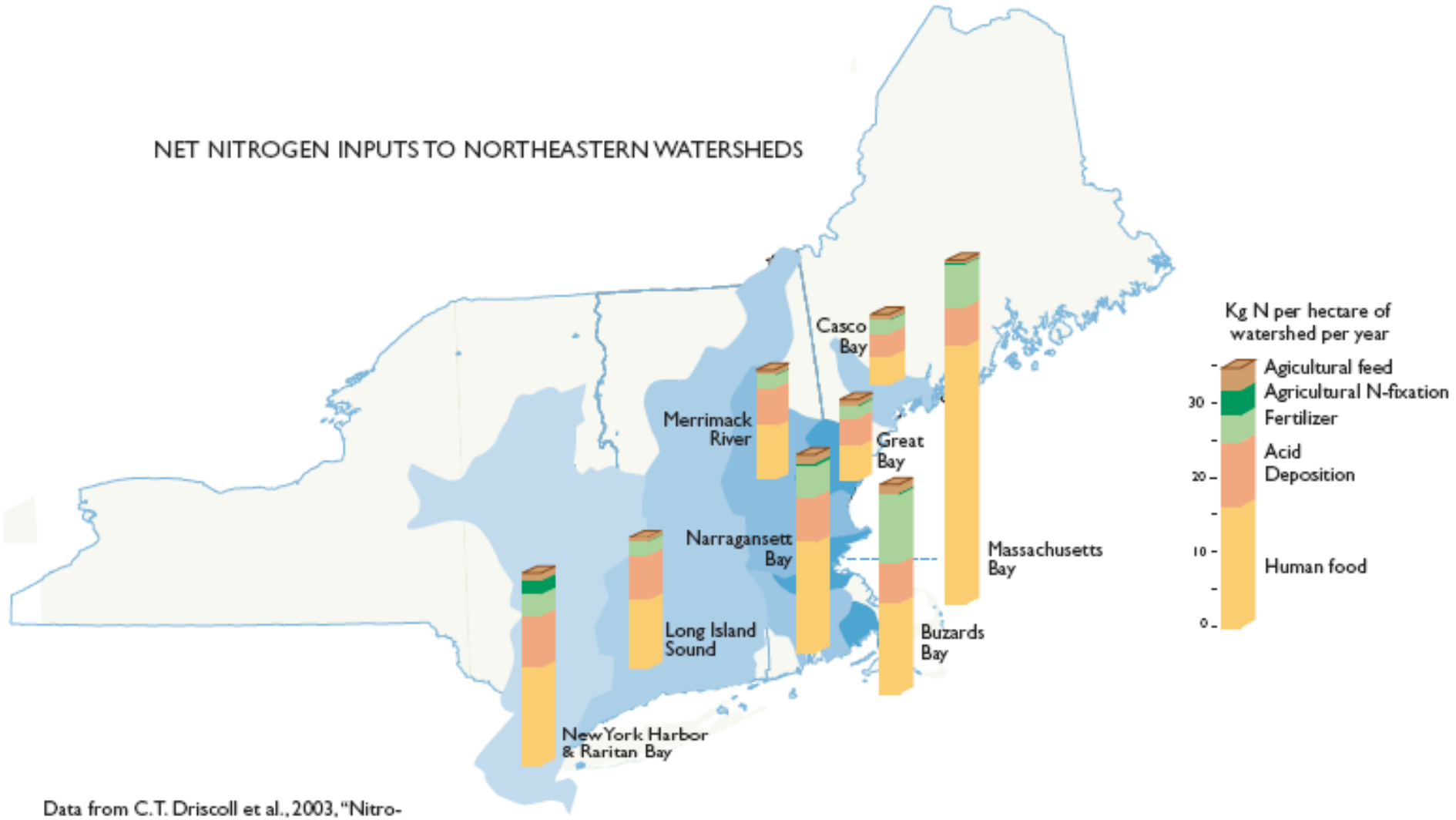


THE NITROGEN BALANCE OF THE HUDSON - WATERSHED



Data from C.T. Driscoll et al., 2003, "Nitrogen pollution in the northeastern United States: Sources, effects, and management options," Bioscience 53(4): 357-374. Pet foods and N-fixation in forests and wetlands are not included.

NET NITROGEN INPUTS TO NORTHEASTERN WATERSHEDS



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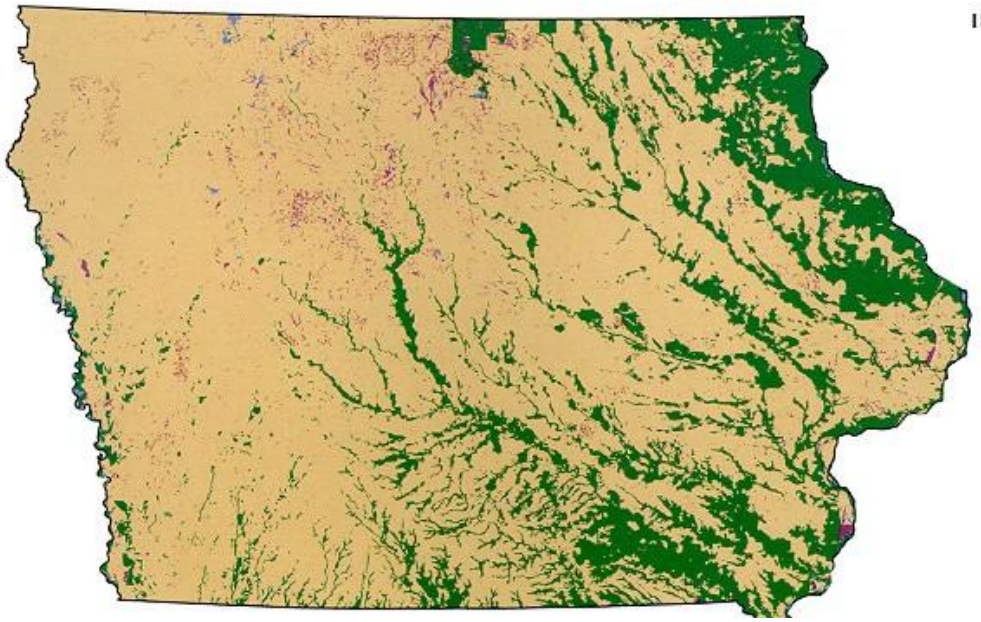
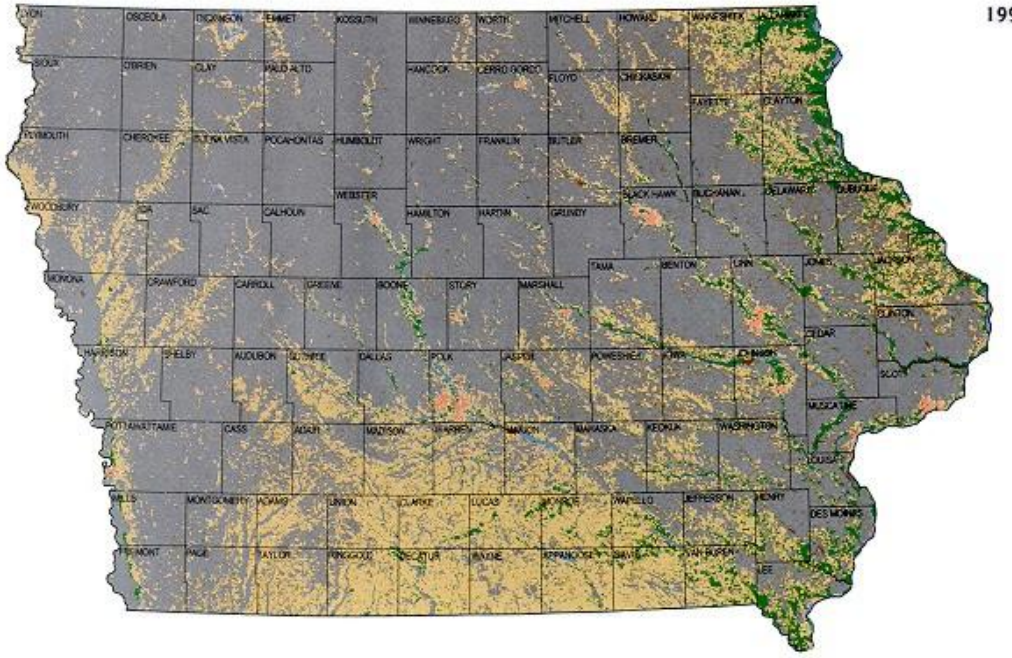


1850s Landcover Map of Iowa

- Prairie
- Forest
- Wetland
- Water



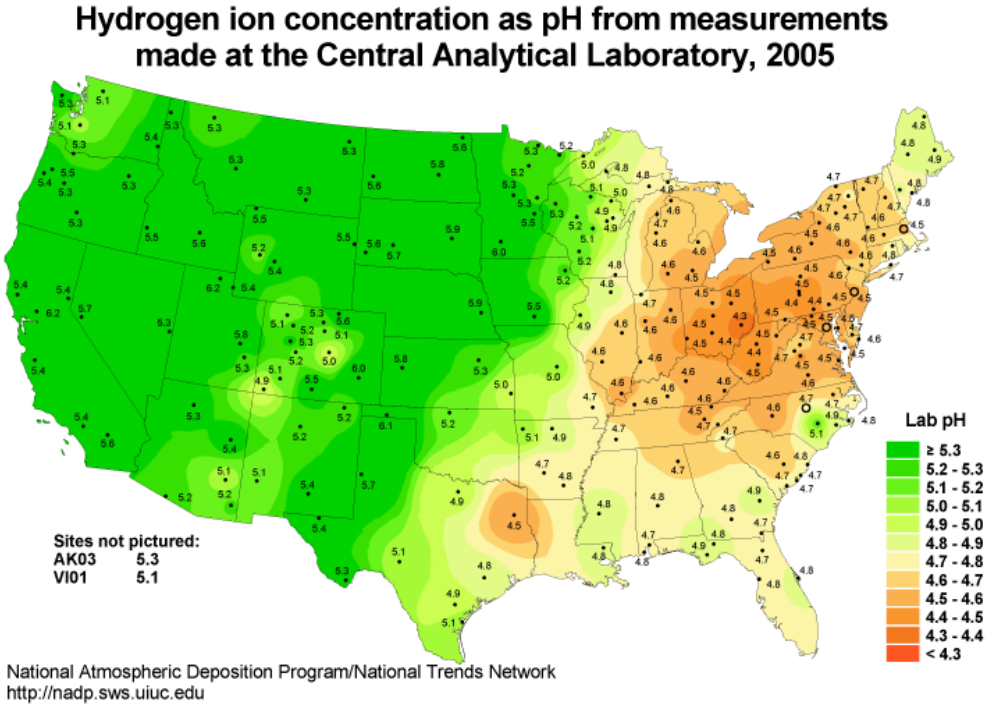
1990s Landcover Ma of Iowa

- Urban / r
- Grassland
- Forest
- Row crop
- Barren
- Water

Source: Compiled from Landsat Thematic Mapper satellite imagery, Iowa Dept. of Natural Resources.

Humans and the Nitrogen Cycle

Last 100 years: humans have more than doubled the amount of fixed nitrogen that is pumped into the atmosphere every year.



The Hudson River

Challenge Question: Why doesn't the Hudson have more algal blooms?