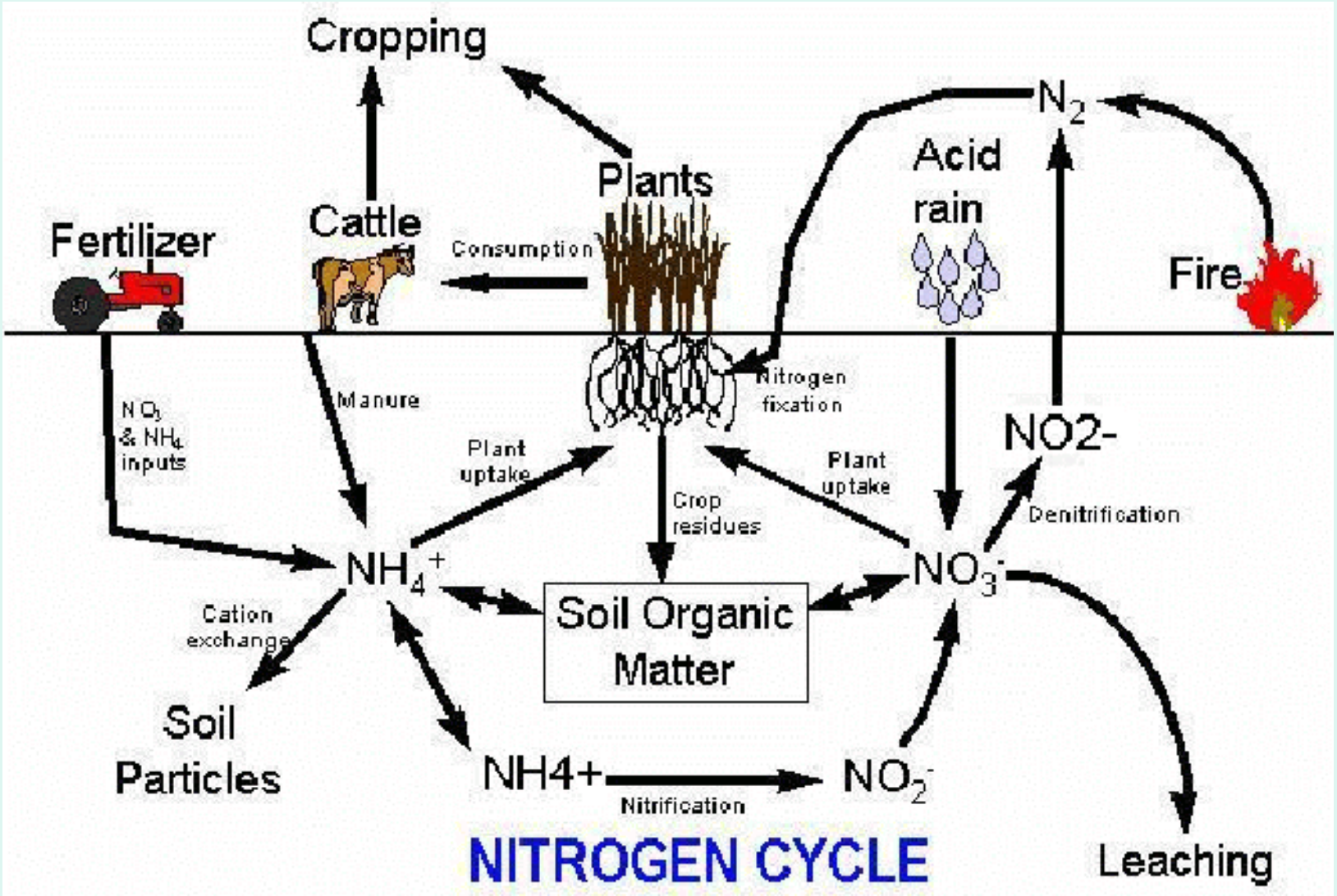

Cropping
Plants
Cattle
Fertilizer
Consumption
N_2
Acid rain
Fire
Manure
Nitrogen fixation
NO_3 & NH_4 inputs
Plant uptake
Plant uptake
Crop residues
NO2-
Denitrification
NH_4^+
NO_3^-
Soil Organic Matter
Cation exchange
Soil Particles
NH4+
NO_2^-
Nitrification
NITROGEN CYCLE
Leaching

Nitrogen Demand

Plants need elements like nitrogen, phosphorus, and potassium to grow (fertilizer)

Nitrogen is required by living organisms.

The Earth's atmosphere is about 80% nitrogen gas,

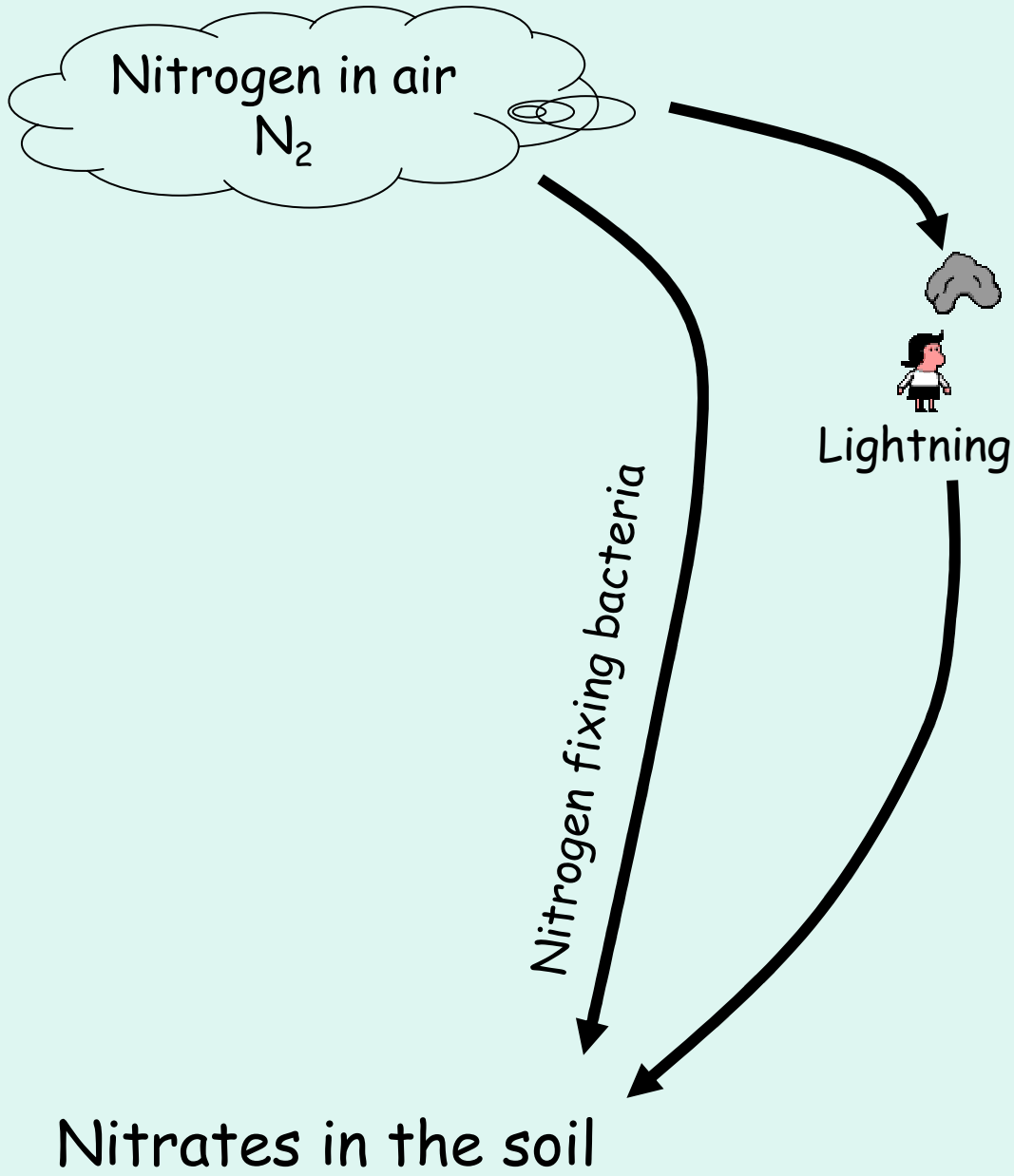
BUT...

Despite its abundance, nitrogen is often the most limiting nutrient for plant growth

Nitrogen fixation

- Nitrogen is available as nitrogen gas (N_2)
- Plants need nitrogen in the form of nitrates (NO_3^-)

- Nitrogen gas can be converted to nitrates, through **nitrogen fixation**, in one of two ways:
  - Lightning
  - Nitrogen fixing bacteria


Nitrogen in air
N_2
Lightning
Nitrogen fixing bacteria
Nitrates in the soil

Rhizobium have a symbiotic relation with legumes:

Roots of a legume plant (peas, beans and clover).

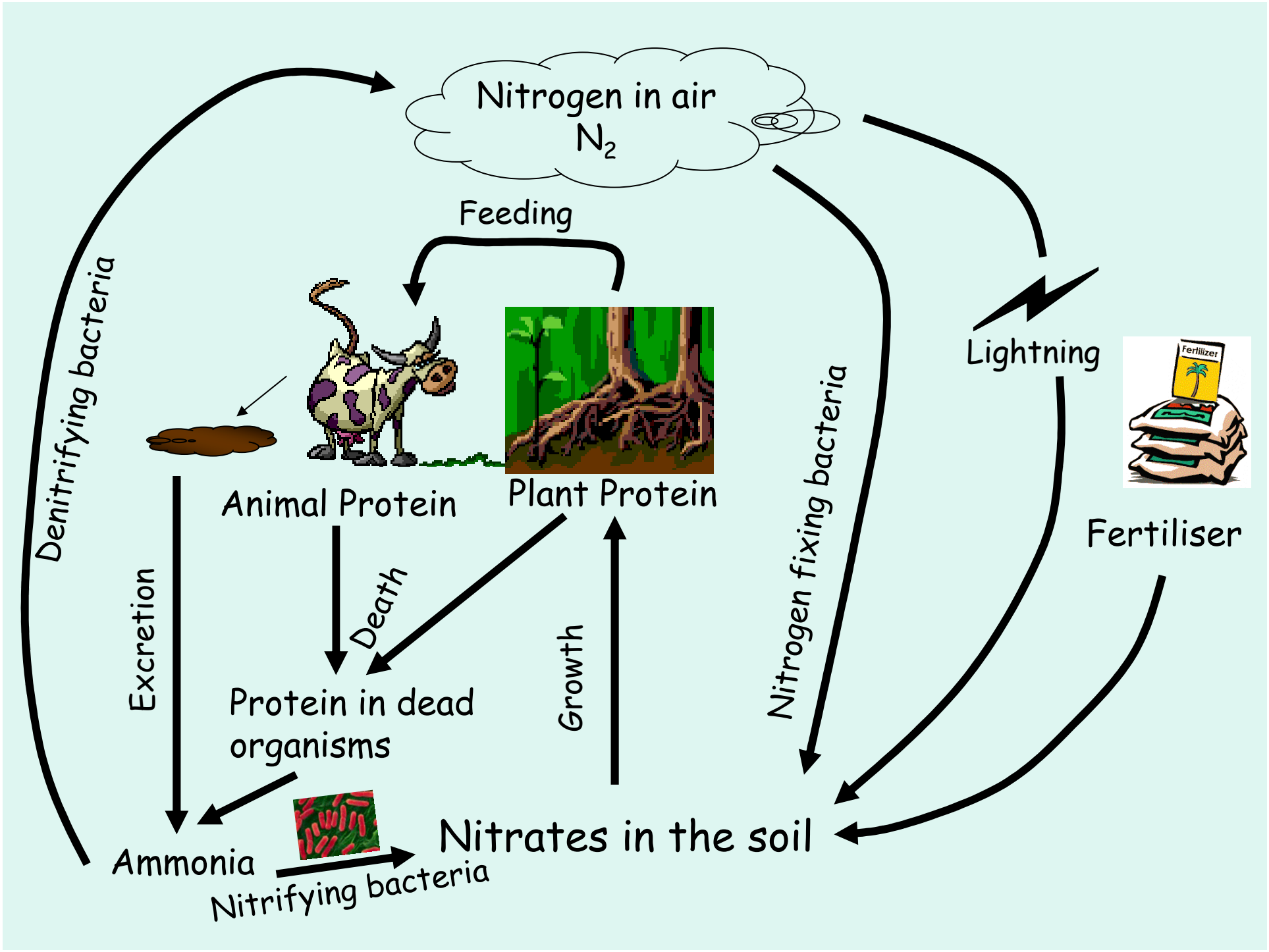
Nitrification

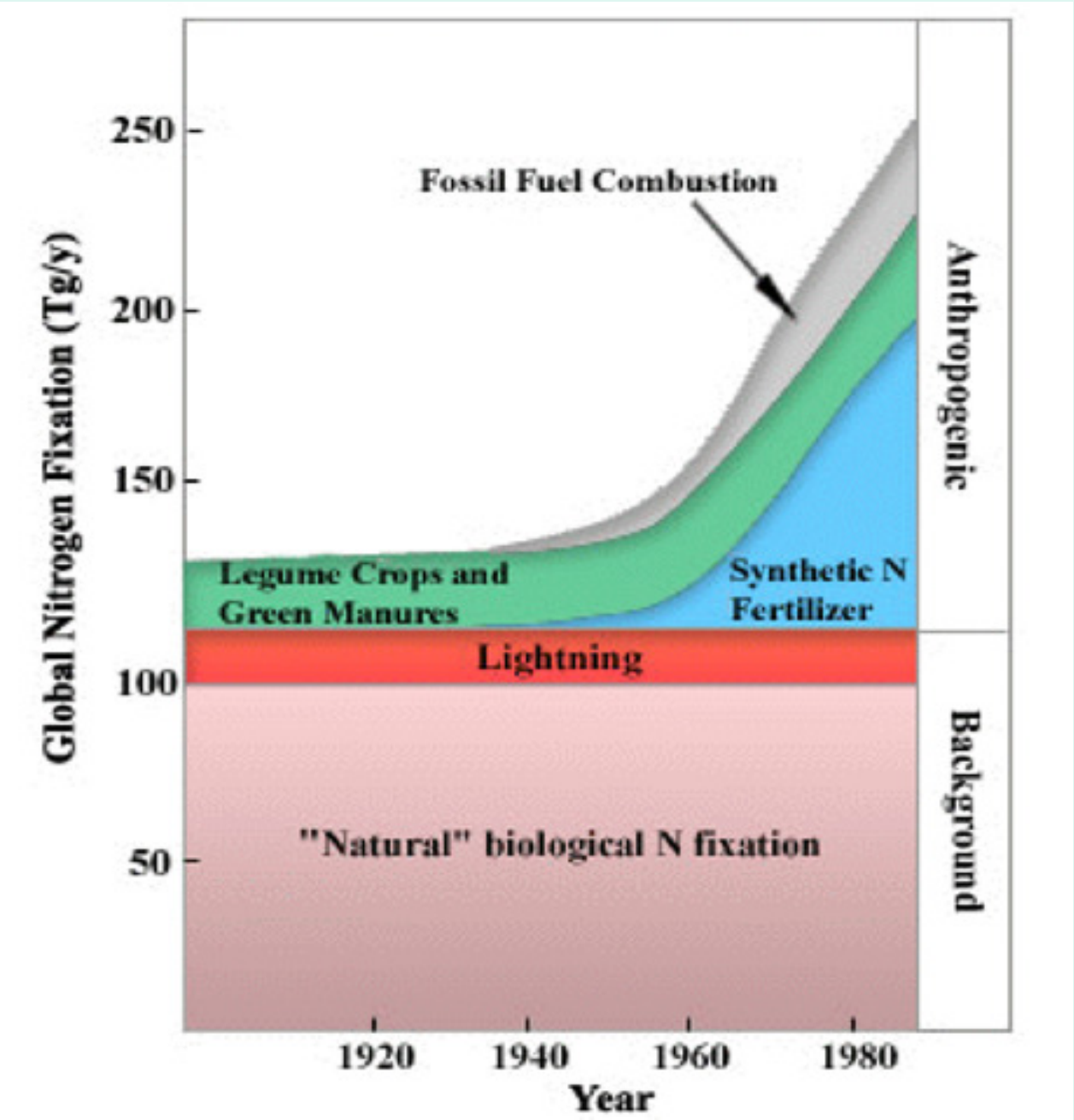
- Animal waste and dead organisms put nitrogen compounds back into the soil through decomposition producing ammonia
- Ammonia is converted back to nitrates via **nitrifying bacteria**, in a process called nitrification.

- Plants can then use this form of nitrogen

Completing the cycle

- Nitrates can also be converted back o nitrogen gas by **denitrifying bacteria**.


Nitrogen in air
N_2
Feeding
Denitrifying bacteria
Lightning
Fertilizer
Animal Protein
Plant Protein
Excretion
Death
Growth
Nitrogen fixing bacteria
Protein in dead organisms
Ammonia
Nitrifying bacteria
Nitrates in the soil

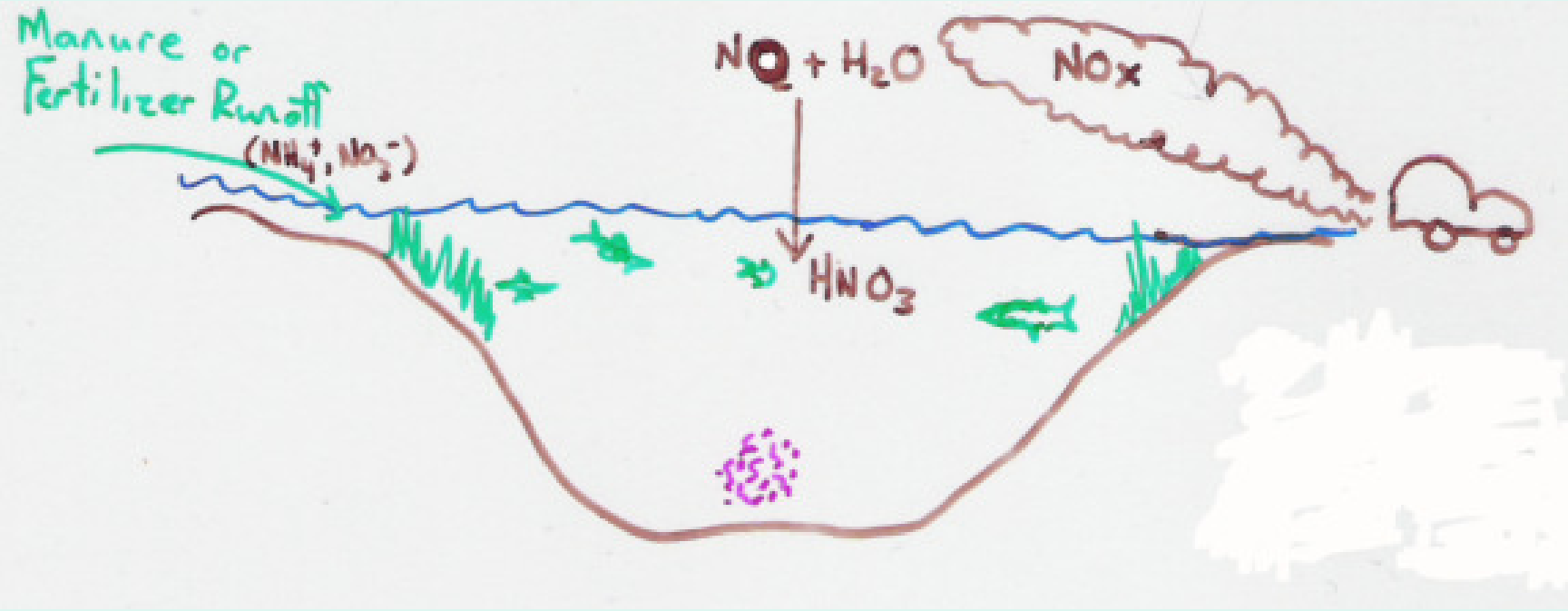

Global Nitrogen Fixation (Tg/y)
250
200
150
100
50
Fossil Fuel Combustion
Legume Crops and
Green Manures
Synthetic N
Fertilizer
Lightning
"Natural" biological N fixation
Anthropogenic
Background
1920
1940
1960
1980
Year

Sources of Nitrogen Pollution

- Dramatic increase in nitrogen fertilizer use
- .Fertilizer run-off from agricultural crops and urban lawns
- Mis-managed manure and sewage handling
- .Acid Rain Nitric Acid (HNO_3)

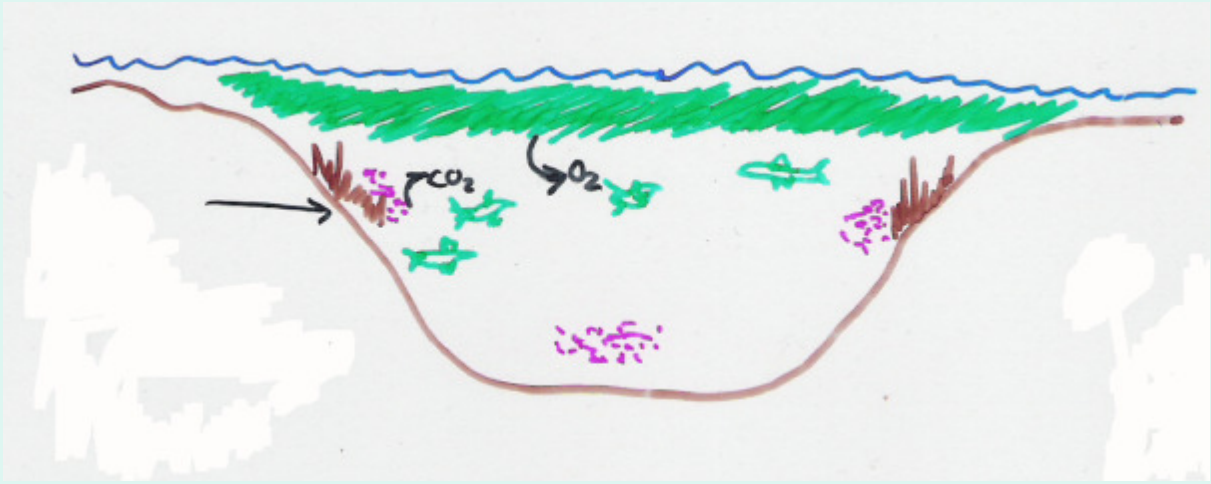
What happens when Humans put too much Nitrogen into ecosystems?

Step 1: Pollution



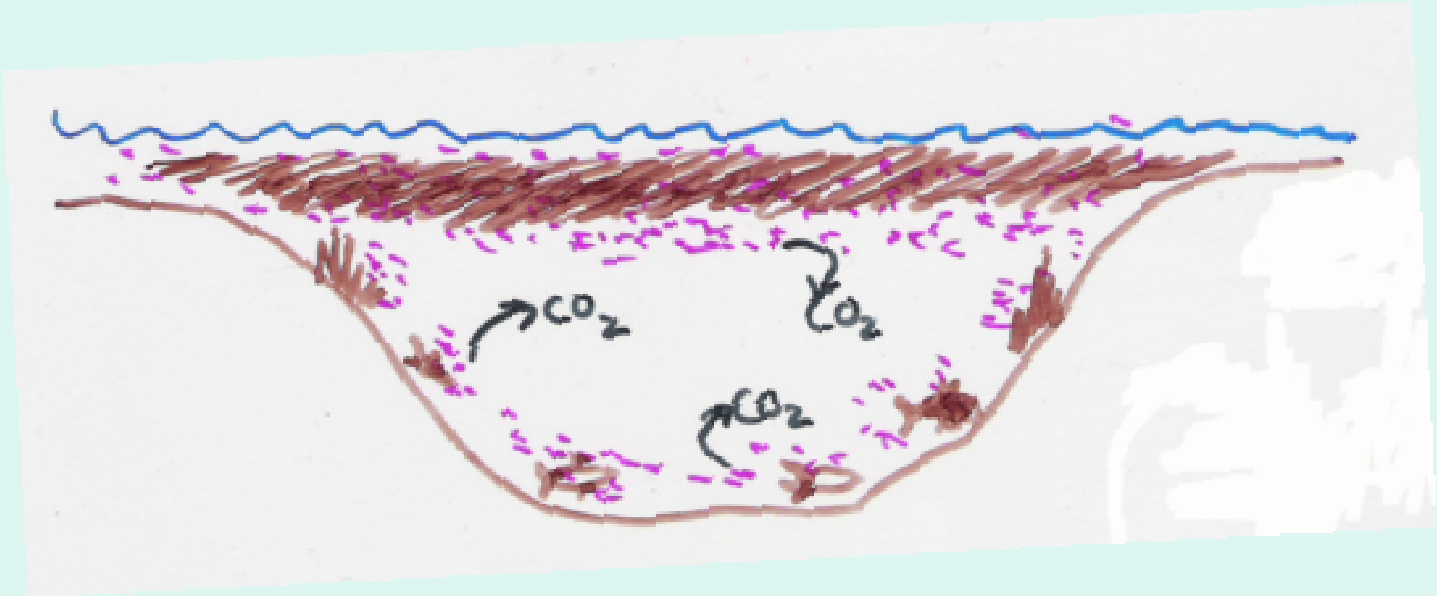
Step 2: Lake Quality Declines

-Algae bloom forms and grows rapidly until the plants run of of nitrates.
-Bottom plants die because all the sunlight is blocked
-Decomposing bacteria increase

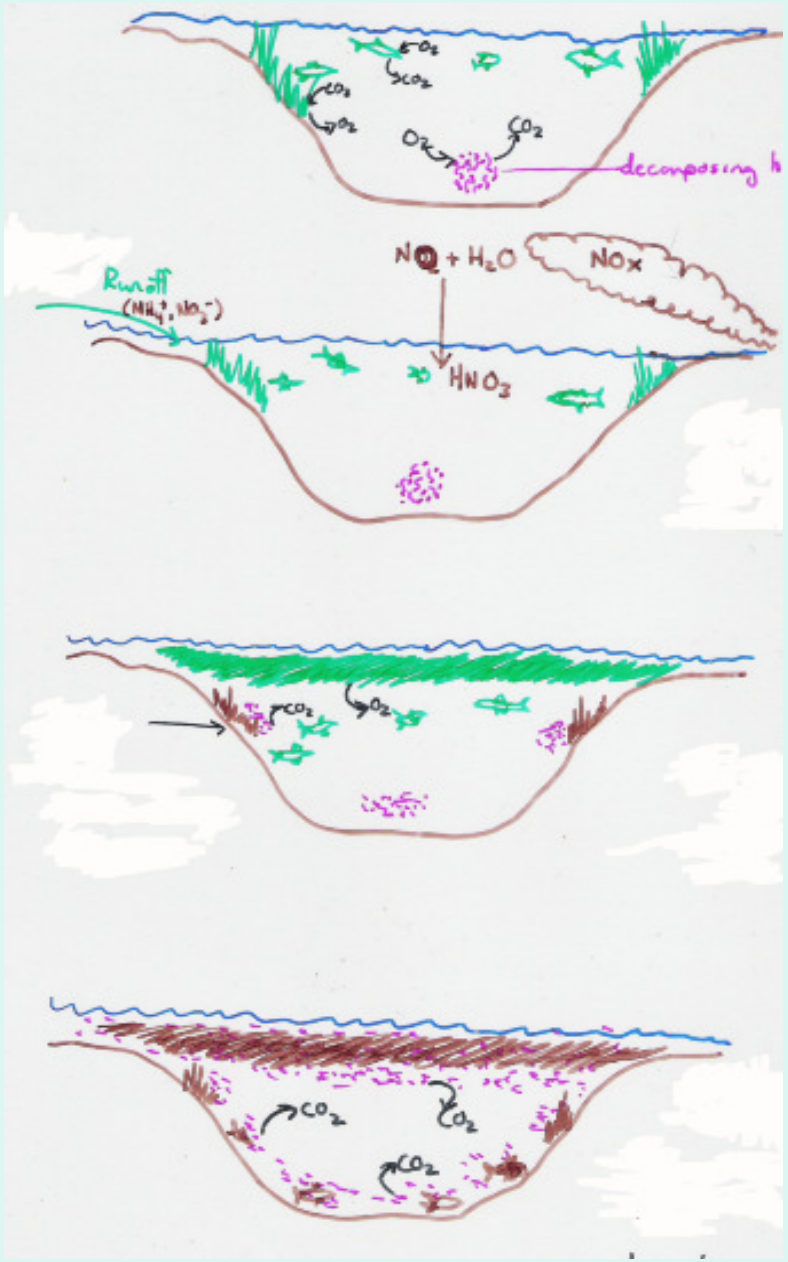


Step 3: The Lake Dies

- Algae dies and decomposes
- Large population of decomposing bacteria removes oxygen from the water
- Little plant or animal life remains



This process is called Eutrophication



Relative Population Numbers of Algae and Decomposers over the course of an Algal Bloom