Nitrogen Cycle Presentation Notes

Materials:

Biome Jars from Waseca

Backyard Biome Tapestry

Felt Tree

Soybeans (optional: provide edamame for children to snack on)

4 boxes with the following felt parts:

1. "Free Nitrogen"
    1. 10 tickets labeled N
    2. 10 tickets labeled O
    3. 10 tickets labeled H

2. "Nitrification Box 1: Atmosphere"
    1. grey cloud

3. "Nitrification Box 2: Terrestrial"
    1. legume stalk and roots with nitrogen fixing bacteria
    2. legume leaves
    3. deer
    4. poop x 2

4. "Denitrification"
    1. green leaves
    2. brown leaves
    3. bones for deer and mole
    4. mushroom and mycelia with denitrification bacteria

adapted from http://eavice.wordpress.com/2012/01/25/nitrogen-cycle-montessori-style/

Nitrogen Cycle Presentation:

Do the Biome Jars from Waseca first and have them available: Sunshine, Air, Water, Soil, Plants, Animals

Lay out the tapestry and put the tree down.

Open Box #1 - "Free Nitrogen." Hold up the Plants jar.

Plants, like all organisms, require a certain number of chemical elements for growth. The story of one of these, nitrogen, is an interesting one. Nitrogen is especially important because proteins are rich in it, and they carry out a lot of the work in the cells.

Take a deep breath. Slowly breathe it out. Hold up the Air jar.

Even though 78% of the air we breathe is nitrogen, plants and animals can't use the free nitrogen. We breathe it back out.

Lay out most of the Free Nitrogen cards in the atmosphere.

Hold up the Soil jar.

And out of the 12 or so elements that a plant must obtain from the soil, only nitrogen can't be obtained directly. It must first be fixed – that is, combined with other elements usually hydrogen or oxygen. This happens in a two main ways. When nitrogen is fixed, it is called "Nitrification."

Lay out the rest of the Free Nitrogen cards in the soil.

Open Box #2 - "Nitrification Box 1: Atmosphere"

The first way nitrogen is "fixed" is in the atmosphere. The catch is that nitrogen will only bond with its favorite elements when there is high temperature and pressure. Where in the atmosphere will you have really high temperatures and lots of pressure?

In lightning bolts!

Set out the cloud and place the H2O tickets in the cloud. (4 H2Os)

Point out raindrops on the tapestry. Move an H2O into the stream of rain.

When the lightening bolts strike the nitrogen bonds with oxygen making nitric oxide (NO).

Point out lightning bolt on the tapestry. Move the first H2O near one branch of the lightening bolt and bring a N over to the H2O, split it apart and allow the H2s out into the atmosphere. Join the N with the O.

Move the second and third H2Os near the second branch of the lightening bolt and bring over a N, split it apart and allow the H2s out into the atmosphere. Join the NO2 together.

When the NO2s fuse this is called nitrogen dioxide. The nitric oxide falls to the ground with the rain.

Hold up the Water jar.

However, not all of the nitrogen dioxide falls directly to the ground. It bumps into some of the H2Os. It then fuses and forms nitric acid (HNO3).

Move the NO2s with waters and arrange them into nitric acid. Make sure all the nitric oxide, nitrogen dioxide, and nitric acid move into the soil.

These three types of fixed nitrogen that are made in the atmosphere are may be used by plants. This is three ways Nitrification takes place in the atmosphere. Move one of the nitrogen dioxides into the trunk of the tree through the roots.

Open Box #3 - "Nitrification Box 2: Terrestrial"

In temperate soils, another types of fixation takes place in the roots of some plants.

Ask the children to name some legumes. Show soybeans. Allow children to snack on edamame. While the children chew, lay out the legume plant.

As these plants grow, their root hairs send out certain chemicals that attract root bacterias. When the bacteria touches the root hairs two things might happen. If it is not the right type of bacteria the root protects itself for it. But, if it is the correct type of bacteria, it is held there…

… and a kind of tube grows from each bacteria into the cells of the tiny root hairs. These bacteria enter into the cells and reproduce causing a swelling called a "nodule" on the root.

Point out the "bacteria" beads on the roots.

This is not an invasion that will hurt the plant. The bacteria and the plant are working together. Do you know the word that is made from the Greek word sym meaning together and the word bios meaning life?

Symbiosis!

The plant provides energy in the form of ATP and the bacteria bring an enzyme that takes the fixed nitrogen and combines it with hydrogen and that makes ammonia (NH_3)!

Move the NO_2 to the plant's roots and combine it with Hs from water to make NH_3.

The ammonia is quickly converted into NO_2 and NO_3. Plants use these as fuel for growth. It is incorporated into many amino acids when are used to make proteins.

Make the NO_2 and NO_3. Lay down green leaves on the legume.

The oxygen from the water is not wasted but used as part of the process and then released. Nitrogen is stored in the leaves, fruit, and roots of the legumes and remember that the fixed nitrogen that was made by the lightning can be used by other plants. This is quite a bit of nitrogen hanging out in plants. But man needs nitrogen, too. How do we get nitrogen to help us grow?

Say a person, a horse, or a deer comes along and sees some tasty soybeans or pulls up a peanut plant and finds tasty peanuts. What do they do? Ahhhhh.

Lay down the deer with him "eating" the legume. Hold up the Animals jar.

Yes, they eat it. Now the fixed nitrogens are inside the deer. I wonder how they might come out?

Lay down the feces. The first at the anus of the animal and the second on the ground where it would fall.

One way is for the animal to excrete waste. The animal might be a tiny cricket or a giant whale. It still extracts what it can from its food; it can't take all of the nutrients and some pass into the feces to be excreted from the body.

Open Box #4 - "Denitrification"

We now begin the process of "Denitrification," of breaking apart the fixed nitrogen into single nitrogen atoms to be used again.

Can you think of another way that the nitrogen trapped in a living thing can be returned to its denitrified state?

This may be difficult for the children to think through. Give a second or two and lay the deer down so his main body is below the soil line. Add the bones to the body. Point out mole on the tapestry. Add bones to the mole.

What about the plants? How does the trapped nitrogen leave the plants?

They will get it and will say that the trees and plants die.

Yes, they do die, but some trees live a very long time. How about their leaves? On most trees, they live only one year and then fall off.

Put the green leaves falling in the air and brown leaves on the ground. Point out layers of dead Autumn leaves on the tapestry.

What creatures have been given the special job of decomposition?

Point out earthworms on the tapestry. Lay down the mushroom and the mycelia and point out the "bacteria" beads.

Take the nitrogen and oxygen in the deer and break it apart and return it to the atmosphere.

Take the nitric acid in the tree and break it apart and return it to the air. Put water back into the clouds and generally reset the cycle.

This important job of denitrification takes death and turns it back into what brings life and growth. The cycle may begin again.

Touch the clouds and walk through the cycle again using the major terms.

Now that you have had this lesson you may do this work. You must be very careful; with so many ways and times that nitrogen fixes, you must be observant and thoughtful to cause the correct nitrification and denitrification at the correct time in the cycle.

FYI:

1. Volcanoes, power plants, and cars also can fix Nitrogen.

2. A byproduct of denitrification is N2O or nitrous oxide, "laughing gas" and is considered a greenhouse gas.

3. The oceans have their own nitrogen cycle which involves blue-green algae and other bacterias without having a symbiotic relationship with plants.

4. Fertilizers and the Haber Process is its own topic and worth research by an upper el student.