# Invertebrates Nutrition Math - Key

Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Earth’s atmosphere is made up of roughly 78% nitrogen in the form of N2. Unfortunately, plants can’t use N2 and need the nitrogen in a different form – either NH4 or NO3. Certain types of soil bacteria can take N2 out of the atmosphere and ‘fix’ it – change it into a different form. N2 is a very chemically tight and stable bond so only a few specialized creatures like these nitrogen fixing bacteria can break that bond and change it.

The bacteria use these nitrogen molecules in their own internal structures. How does the nitrogen then get released into the soil so that plants can utilize it for their own growth?

Nematodes and other microfauna and microorganisms are an important part of nitrogen cycle. Thy will eat the bacteria and excrete or release nitrogen as their waste which is then left in the soil for plants.

**Example:** Bacteria build their cellular structure using carbon and nitrogen in a ratio of 4:1 (four carbon molecules to every one nitrogen molecule. Certain types of predator nematodes build their cell structure using a carbon and nitrogen ratio of 6:1. Let’s assume that a nematode eats three bacteria. From those three bacteria it would get a total of 12 carbon atoms and 3 nitrogen atoms (each bacterium would provide 4 carbon atoms and 1 nitrogen atom). They also use water (H20) in this process and so the resulting nitrogen molecule is NH4.

The nematode would all 12 carbon atoms and use two of the nitrogen atoms to get a ratio of 12:2 which is its required ratio of 6:1. That leaves one extra nitrogen molecule (NH4). The nematode excretes the nitrogen molecule as waste, and it is left in the soil as a plant available nitrogen molecule.

Nematodes actually eat thousands of bacteria each day to fulfill their nutritional requirements, but the basic ratios remain the same. This means that thousands of molecules of nitrogen are made plant-available in the soil through this process.

**Problem 1:** Assume that a species of bacteria has a carbon/nitrogen ratio of 5:1. Protozoa that feed on the bacteria have a carbon/nitrogen ration of 30:1.

1. How many bacteria would the protozoa need to eat to achieve its nutrition for this ratio? \_\_6\_\_
2. How many carbon atoms would the protozoa get? \_\_30\_\_\_\_
3. How many nitrogen atoms would the protozoa get? \_\_6\_\_\_
4. How many nitrogen atoms would the protozoa release and excrete as waste? \_\_5\_\_\_
5. What other organisms will use this excess nitrogen? \_\_plants
6. How do you think the excess nitrogen is transported through the soil? Nitrogen in the soil is water soluble which means it will get absorbed into water droplets and move through the soil profile as the water moves. Plant roots are stationary and nitrogen molecules aren’t always immediately available. Fungi can work in a symbiotic relationship with the plants. Fungi can send out hyphae into the soil to collect these nitrogen molecules and transport them back to the plant. In return for this, the plant will share some of its food resources with the fungi.

**Problem 2:** Assume that a species of fungi has a carbon/nitrogen ratio of 20:1. Nematodes that feed on the fungi have a carbon/nitrogen ration of 100:1.

1. How many fungal cells would the nematode need to eat to achieve its nutrition for this ratio? \_\_5\_\_
2. How many carbon atoms would the nematode get? \_\_100\_\_\_\_
3. How many nitrogen atoms would the nematode get? \_\_5\_\_\_
4. How many nitrogen atoms would the nematode release and excrete as waste? \_\_4\_\_\_
5. Are there any other benefits (or disadvantages) from this predator/prey relationship? One major benefit of this relationship is population control. Without this relationship there would be a possibility of the prey species (bacteria or fungi) becoming too numerous and using up all of the carbon and nitrogen resources in the soil.