



## You are what you eat = Nitrogen Leaching

Read each point out loud to the class at least two times. Students need to listen and then draw what you are describing on the worksheet. The number next to the description refers to the picture that students should be working on. At the end of the exercise you can get students to write a short explanation about what is happening in each picture. Or in pairs they can take turns describing what is happening in each picture to check understanding. Questions are also on the student worksheet and can either to be answered during the reading or at the end.

1.	- Effluent is a term that is used to describe urine and poop, draw a big poop and the cow urinating.
	- Within the soil there are microbes and worms that help break down and process effluent and organic material. Add some worms and label them, then add some stars and crosses in the soil to represent the different microbes.

2.	- Label the three of the four plants as ryegrass and add roots going 1/3 of the way through the root zone.
	- The tall plant is called Lucerne and has one long tap root reaching the bottom of the root zone.
	- Draw a poop in the middle. Poop contains nitrogen so draw 5 N's inside the poop to represent this.
	- As the poop <b>slowly breaks down</b> 2 of the nitrogen's are released into the soil. Show this happening on your diagram.
	- The plants are hungry and can absorb the Nitrogen through their roots and they use this for growth. Show this happening in your diagram.

### Questions:

- 1) Which of the four plants are most likely to absorb the nitrogen? The ones closest to the poop.
- 2) Once the plants have used up the nitrogen in their systems what will the plants do? Plants would process the nitrogen they have and then absorb more.



<b>3.</b>	- Draw in the root systems of the three rye grasses and the Lucerne. Draw a stream of urine over two of the plants.
	- Because urine is liquid it soaks into the soil very quickly. Draw a half circle under the soil that encompasses most of the root systems of the two plants to represent the urine soaking into the soil.
	- Urine has lots of nitrogen so add 15 N's to the area where the urine has soaked in. All this nitrogen is available to the plants.
	- The N's that are close to the roots can be absorbed by the plants. But the plants only need three N's before they are full.
	- If it rains, 5 of the Nitrogen's are carried down the soil past the root zone. The rest of the N's stay in the soil and they are out of reach of the other plants.

### Questions:

- 3) **What would happen to the nitrogen over time?** Plants would process the nitrogen they have and then absorb more.
- 4) **Can plants access the nitrogen past the root zone?** No. Different plants have different depth of roots. Lucerne has a longer root so can access resources like nitrogen and water further down.

<b>4.</b>	- Draw a cloud and some rain. Water from the rain makes its way through to soil to the 'water table' where the rainwater and the ground water collects. Draw an arrow to show the flow of rainwater.
	- The 'water table' can be close to the surface and help supply streams, rivers, lakes and springs with water. Label the lake and add in a line for the water level.
	- Draw an arrow showing the flow from the water table to the lake. Some of the rainfall can also runs across the land into the lake add another arrow showing this.
	- Water from the 'water table' manages to go past a soil layer that acts as a barrier through cracks in the soil layer. Add cracks in the soil layer so water can get past.
	- This water pools into a large area which we call an aquifer. This can take 1000's of years for the water to journey from the sky and reach the aquifer. Label the area that you think is the aquifer.
	- Draw in the cow urinating with a large N to represent the high amount of Nitrogen. When there is ongoing rain, the water carries the nitrogen to different places in the environment.
	- In soil this happens easily because nitrogen has a negative charge and soil has a positive charge. This process is called Nitrogen Leaching. Add an arrow to show this occurring and label it 'nitrogen leaching'. The time it takes nitrogen to reach streams or aquifers can be 25+ years.

### Questions:

- 5) **Where is the nitrogen accumulating?** Surface water (streams, lakes and rivers) then aquifers.
- 6) **What season does most nitrogen leaching occur?** When there is heavy rain. Most leaching occurs in winter due to low grass growth (so plants aren't absorbing and processing nitrogen in the soil) and wetter weather.
- 7) **Does riparian planting stop nitrogen entering waterways?** No. Riparian planting helps absorb some nitrogen and phosphorus, helps with sedimentation and run-off. But most of the nitrogen leaching is not in run-off but happening within the soil profile and entering the water table which can be quite a distance from the streams and rivers.

## But where does the cow get all its nitrogen?

<b>5.</b>	- Draw clover leaves on the plant so we know its clover.
	- Draw little circles on its roots and label them nodes. These nodes hold a special type of bacteria, add dots to represent the bacteria. The bacteria feeds off the plant so is interested in helping it grow by providing it with Nitrogen.
	- Air has plenty of Nitrogen, so draw a large N above ground. There is air in the soil and the circles below represent the air. Add N's in all the circles.
	- The bacteria converts the nitrogen from the air into a form that the plants can absorb. In return the plant grows and provides food for the bacteria. Cross out 10 N's in the soil because the plant has absorbed them.
	- The cow then eats the clover and consumes the nitrogen.

### Questions:

- 8) **What is the source of nitrogen?** Clover and cow urine. Fertiliser can be a factor if applied in the wrong conditions. But it's the cow urine in a concentrated spot that is the main problem.

<b>6.</b>	- If the cow consumes lots of clover she also consumes lots of nitrogen. She can use some of the nitrogen for general life functions like growth and milk production. But the rest will come out as effluent (poop and urine). Show this in the last box.
-----------	---

### Questions:

- 9) **How does the cow use the nitrogen?** Personal growth, calf growth, milk and the excess is passed as effluent.
- 10) **Is nitrogen bad?** No because all plants need it to grow. But too much nitrogen in a concentrated area causes problems.
- 11) **How can we decrease the amount of nitrogen in concentrated urine patches?** Change feed, breeding (cows with smaller bladders), standing pads in winter (collect urine), and different plants that can grow in cold conditions, or have longer roots meaning they can access nitrogen further down.
- 12) **Why might the nitrogen concentrations in stream stay high, despite farmers decreasing the amount of nitrogen?** For some streams it can take more than 20 years before the water from the farm makes it way to the stream which is a significant delay. In that time levels may still go up depending on natural events (wet winters), past management or management on neighbours properties.