Week 12
BIO-1306 - Biology 2 – ICB textbook

Hello and Welcome to the weekly resources for BIO-1306 - Biology 2 – ICB textbook!

This week is Week 12 of class, and typically in this week of the semester. your professors are covering these topics below. If you do not see the topics your particular section of class is learning this week, please take a look at other weekly resources listed on our website for additional topics throughout of the semester.

We also invite you to **look at the group tutoring chart on our website to see if this course has a group tutoring session offered this semester**.

If you have any questions about these study guides, group tutoring sessions, private 30 minute tutoring appointments, the Baylor Tutoring YouTube channel or any tutoring services we offer, please visit our website www.baylor.edu/tutoring or call our drop in center during open business hours. M-Th 9am-8pm on class days 254-710-4135.

Keywords: *Nitrogen fixation, Assimilation, Decomposition, Nitrification, Denitrification*

TOPIC OF THE WEEK: Nutrient Cycling

This week we will be looking at the complexities of the nutrient cycle by going over the nitrogen cycle and organisms involved.

- Nitrogen fixation → Conversion of atmospheric nitrogen (N2) to ammonia (NH3)
- Assimilation → Absorbing nutrients and incorporating them into the body
- Decomposition → Decay through physical, chemical, or biological processes.
- Nitrification → Ammonium to nitrite, and nitrite to nitrate
- Denitrification→ Process of nitrate reduction that produces molecular nitrogen

All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.

HIGHLIGHT #1: Nitrogen Fixation

Nitrogen fixation is usually a process where atmospheric nitrogen (N2) is converted into ammonia (NH3). Nitrogen fixation requires the use of the enzyme, **nitrogenase.** Seneratne and Hardason tried to measure the nitrogen fixation in faba beans, peas, and barley. They did so by measuring subtracting the nitrogen in the soil from the total nitrogen content since any of the excess nitrogen would have come from the atmosphere, and therefore would've gone through the fixation process. The nitrogen in the fertilizer contained the ^{15}N isotope so that the nitrogen fixed from the atmosphere could be differentiated between the nitrogen from the soil.

variable	faba bean	pea	barley
total nitrogen content	113.3	107.9	56.6
nitrogen fixation	83.7	73.4	0
soil nitrogen used	29.6	34.5	56.6
nitrogen conservation	27.0	22.1	—

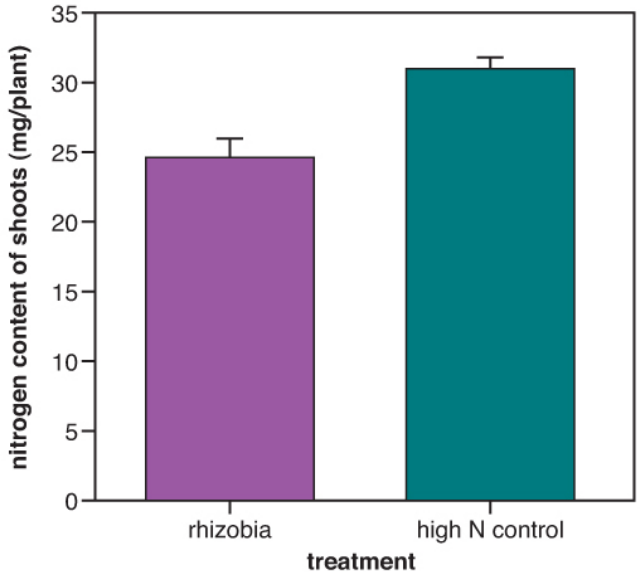
What did they see? Faba beans and peas contained a lot more nitrogen that was fixed, whereas barley had no nitrogen that was fixed. It seems that legume crops are better at fixing nitrogen and therefore have a greater store of nitrogen. This is advantageous for us as we consume more nitrogen from the plants and farmers don't need to use as much fertilizer either.

All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.

HIGHLIGHT #2: Nitrogen Fixation by Rhizobia

Scientists further analyzed the mechanism by observing the nodules in the roots of legumes, including beans and red clover. Scientists found the presence of a bacteria known as ***Rhizobium*.** Researchers proposed that bacteria were **symbiotically associated** with the plants and responsible for the nitrogen fixation observed in Seneratne and Hardason's experiment.

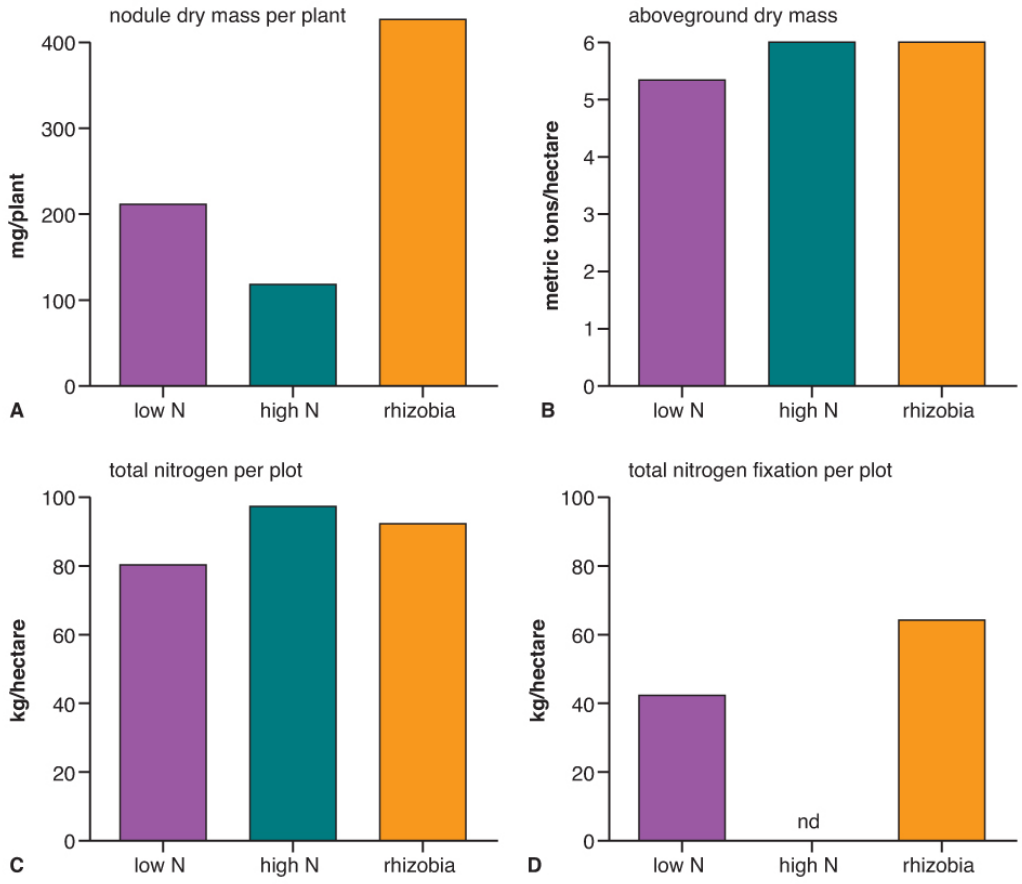
Beck isolated *Rhizobia*, and the seedlings were grown with or without this bacteria. For the seeds grown without *Rhizobia*, a high nitrogen concentration was used instead. The nitrogen concentration of the shoots for both of these conditions were measured and recorded.



What did Beck see? The plants grown with *Rhizobia* had almost as much nitrogen content as a plant just grown with a high nitrogen content. Beck also made sure that the soil had no nitrogen in the *Rhizobia* treatment so that only nitrogen from the atmosphere would be measured and accounted for. Since the plants with *Rhizobia* had almost as much nitrogen, all the nitrogen had to have been fixed from the atmosphere, so this showed that ***Rhizobia* does have the ability to undergo nitrogen fixation.**

All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.

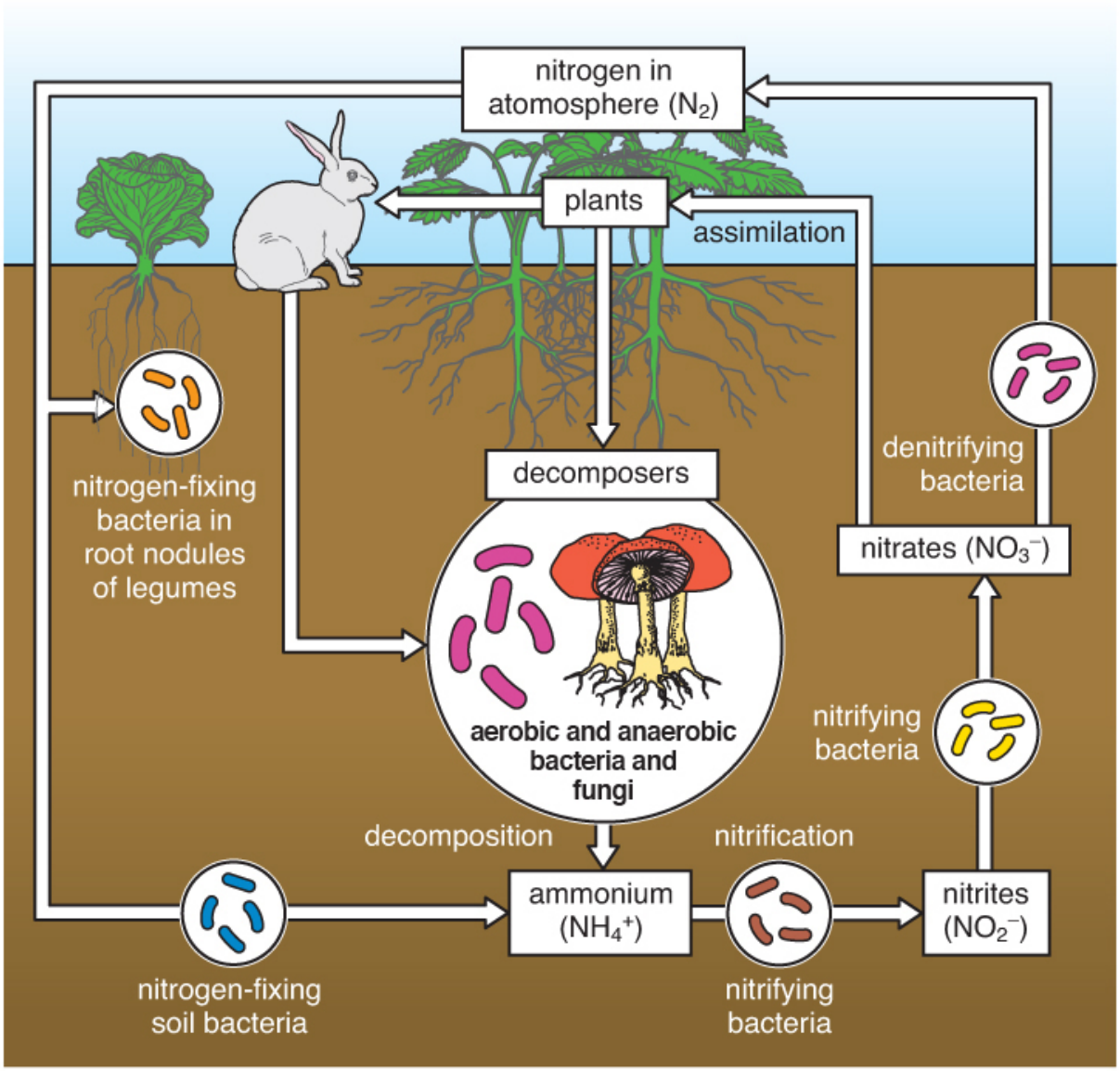
Beck also grew chickpea plants in 3 field conditions: low nitrogen concentration and low *Rhizobia* concentration, high nitrogen concentration, and mid-nitrogen concentration with added *Rhizobia*.



Beck saw that the total nitrogen was high for the plants grown in high nitrogen conditions, but the total nitrogen fixation was close to 0 kg/hectare, as shown in **Graph D**. The plants grown with low to high *Rhizobia* and low nitrogen conditions, however, did go through some nitrogen fixation. Additionally, plants with low nitrogen and high *Rhizobia* had a larger nodule mass than plants in high nitrogen conditions. Beck thought that if there's **high nitrogen, then there's no need for the plants to fix nitrogen from the atmosphere. If they don't fix nitrogen, there's no reason for the plants to have *Rhizobia* and they don't need to grow to accommodate the bacteria in the nodules.** This shows evidence of a **symbiotic relationship** since plants provide a habitat for the *Rhizobia* and *Rhizobia* provides plants with essential nitrogen.

All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.

Rhizobia is only one example of a nitrogen-fixing bacterium. There are many more microorganisms involved in the fixation and the nitrogen cycle as well. The nitrogen cycle is the fixation of atmospheric nitrogen so that it can be used by animals.



All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.

CHECK YOUR LEARNING:

1. What is the anatomical feature often seen in Legumes that represent a relationship with nitrogen fixing bacteria?
2. Between a tomato plant, a chickpea plant, and an oak tree, which one would you expect to increase the amount of nitrogen in soil?
3. What is the name of the process that brings nitrogen back to the atmosphere?

THINGS YOU MIGHT STRUGGLE WITH:

1. It may be tough to memorize/understand the nitrogen cycle so I would suggest drawing it out while explaining it to yourself or someone else. This way you can tell the complete story of how nitrogen is passed around in our ecosystem.

Thanks for checking out these weekly resources!
Don't forget to check out our website for group tutoring times, video tutorials and lots of other resources: www.baylor.edu/tutoring ! Answers to check your learning questions are below

---

Answers

1. Nodules on the roots
2. Chickpea plant
3. Denitrification

All diagrams, tables, and external information included in this document are property of Integrating Concepts in Biology by Campbell, Heyer and Paradise, unless otherwise specific.