Key Stage 4 – Nitrogen recycling

Notes for teachers

At a glance

In this activity students play a game to help them to understand how nitrogen gets recycled throughout the environment. They will become nitrogen atoms and move from compound to compound in different areas of the ecosystem. They then apply what they have learnt to design their own nitrogen cycle and answer questions. The activity is suitable for a first lesson on the nitrogen cycle.

Learning Outcomes

- Students state how nitrogen is recycled throughout the environment.
- Students apply knowledge about the nitrogen cycle.

Each group of three or four students will need

- 1 copy of the pupil worksheet
- Cards cut from each of the sheets C*ards 1-3* (or the sheets printed out and scissors)
- Passports - one each cut from sheet *Passports*
- Counters and dice
- Piece of A3 paper

Possible Lesson Activities

1. **Starter activity**
    - Show the video 'Give peas a chance' to the class.

2. **Main activity: Groups play the game**
    - Ask students to read the section *Why do we need nitrogen?* on the pupil worksheet. Discuss with them why nitrogen is important for all living organisms and why it is vital it gets recycled.
    - Arrange students into groups of 3-4. Groups play the game by following the instructions on the pupil worksheet.
    - The students then work as a group to arrange the cards on an A3 piece of paper to build a nitrogen cycle. They need to add arrows to show the movement of nitrogen. They should be encouraged to be as creative as they like, for example they can add drawings of the places where nitrogen compounds are found. They should add the names of the organisms involved including the four types of bacteria (nitrogen-fixing, nitrifying, decomposers and denitrifying).
    - Show the class an example of a nitrogen cycle diagram and ask them to assess their diagram using this. They can change their diagram in light of this. Explain that this is a simplified version and some processes (such as lightning) and other nitrogen compounds (such as nitrite) also exist in the cycle.

3. **Main activity: Individuals test their understanding**
    - Students work alone to answer the questions on the pupil worksheet, which tests their understanding of the nitrogen cycle.
    - Answers:
        1. Nitrogen-fixing: Convert nitrogen from the air into ammonium that plants can take up through their roots. Found free in the soil or in the root nodules of some plants like peas.
           Decomposers: Break down waste and dead material into ammonium compounds. Fungi are also decomposers.
           Nitrifying: Convert ammonia into nitrate, which is the main form of nitrogen absorbed by plant roots.
           Denitrifying: Convert nitrates back into nitrogen gas.
        2. Denitrifying bacteria can be seen as being detrimental to plant growth because they convert nitrates, which plants can absorb through their roots, into nitrogen gas. However, the process often does not go to completion and nitrous oxide (N_2O) is also produced, which is a greenhouse gas. The presence of denitrifying bacteria in the soil will inhibit plant growth. They carry out this process when living in anaerobic conditions (without oxygen) so one way of reducing denitrification is to make sure soil is aerated and not waterlogged.

3. The legumes have root nodules containing nitrogen-fixing bacteria. The bacteria produce nitrogen compounds for the plant. Legumes are therefore high in protein. When they decay they release nitrogen compounds into the soil. Crops grown on this soil will have a good supply of nitrogen compounds for growth. The practice of crop rotation has been used since the Romans (although they didn't understand how it worked). It fell out of use following the production of artificial fertilisers.
4. The crops will have a good supply of nitrogen containing compounds to build proteins and increase growth and yield. This would result in more food for people.

4. Plenary

- Lead a discussion based on the answer to question 4 which links to the research being done at the University of Oxford: how will improving nitrogen fixation in plants help the global food supply? Why is this increasingly important?

Web links

Web link 1:
https://moodle.beverleyhigh.net/pluginfile.php/7528/mod_resource/content/0/assets/images/ks4/nitrogen.gif

Suitable nitrogen cycle that can be shown to students.

Web link 2:

https://www.classzone.com/books/ml_science_share/vis_sim/em05_pg20_nitrogen/em05_pg20_nitrogen.swf

http://www.picse.net/CD2011/apps/nitrogen-cycle.html

Interactive nitrogen cycles