Species and Their Feces

The Nitrogen Cycle

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Grade Level	9th – 12th Grade	**Time Frame**	5-7 class period(s)
Course	Biology, Environmental Science	**Duration**	300 minutes

Essential Question

How does nature recycle?

Summary

Students will investigate the nitrogen cycle and the flow of nutrients in an ecosystem.

Snapshot

Engage

Students watch a video clip and brainstorm fish tank care.

Explore

Students use ammonia test kits to determine the level of ammonia in the three water samples, then design and test an experiment to determine which water source contains the highest level of ammonia.

Explain

Students share their data from the experiment, then examine the nitrogen cycle and utilize it to better explain why some water samples have more ammonia than others.

Extend

Students analyze the nitrogen cycle in more detail and identify components of an ongoing experiment about nitrogen fixation.

Evaluate

Students analyze the impact of whale feces and hippo feces in certain ecosystems and take an in-depth look at microorganisms. The lesson ends with students authoring a children's book about food webs and the nitrogen cycle.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD304: Determine how the values of variables change as the value of another variable changes in a simple data presentation
SIN301: Understand the methods used in a simple experiment
EMI401: Determine which simple hypothesis, prediction, or conclusion is, or is not, consistent with a data presentation, model, or piece of information in text

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-LS2-4: Use a mathematical representation to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

Oklahoma Academic Standards (Biology)

B.LS2.1.1: Ecosystems have carrying capacities, which are limits to the number of organisms and populations they can support. These limits result from such factors as the availability of living and nonliving resources and from such challenges as predation, competition, and disease.

Oklahoma Academic Standards (Biology)

LS2: Ecosystems: Interactions, Energy, and Dynamics

Attachments

- 1_Experimental Design EXPLORE - Spanish.docx
- 1_Experimental Design EXPLORE - Spanish.pdf
- 1_Experimental Design EXPLORE.docx
- 1_Experimental Design EXPLORE.pdf
- 1_Experimental Design Teacher Key EXPLORE.docx
- 1_Experimental Design Teacher Key EXPLORE.pdf
- 3_Marine_Nitrogen_Cycle_Handout EXPLAIN - Spanish.doc
- 3_Marine_Nitrogen_Cycle_Handout EXPLAIN - Spanish.pdf
- 3_Marine_Nitrogen_Cycle_Handout EXPLAIN.doc
- 3_Marine_Nitrogen_Cycle_Handout EXPLAIN.pdf
- 4_FRAYER Nitrogen Cycle EXPLAIN - Spanish.doc
- 4_FRAYER Nitrogen Cycle EXPLAIN - Spanish.pdf
- 4_FRAYER Nitrogen Cycle EXPLAIN.doc
- 4_FRAYER Nitrogen Cycle EXPLAIN.pdf
- 5_amino-acid-structures-and-abbreviations EXPLAIN - Spanish.doc
- 5_amino-acid-structures-and-abbreviations EXPLAIN - Spanish.pdf
- 5_amino-acid-structures-and-abbreviations EXPLAIN.doc
- 5_amino-acid-structures-and-abbreviations EXPLAIN.pdf
- 6_Amino Acids EXPLAIN - Spanish.doc
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- 7_dna-rna-structure EXPLAIN - Spanish.doc
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- 7_dna-rna-structure EXPLAIN.pdf
- 8.1_Whale Poop EXTEND - Spanish.doc
- 8.1_Whale Poop EXTEND - Spanish.pdf
- 8.1_Whale Poop EXTEND.doc
- 8.1_Whale Poop EXTEND.pdf
- 8.2_What are Phytoplankton EXTEND - Spanish.doc

- 8.2_What are Phytoplankton EXTEND - Spanish.pdf
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- 8.3_Hippo Dung EXTEND - Spanish.doc
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- 9_Book Rubric - Spanish.doc
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Materials

- Ammonia testing strips--these can be found in pet stores or the pet section of most major department stores.
- Spring water sample for all groups in all classes
- River or stream water sample for all groups in all classes
- Livestock pond water sample for all groups in all classes
- Small cups for distributing water to groups
- Colored pencils/markers/crayons for the Frayer Model and children's book
- Computer with internet access, a projector, and speakers
- 1 ream of 8.5 x 11 copier paper (this is enough for all classes)
- Computers to research for children's book (optional)

Engage

Teacher's Note

If you need a refresher on what the nitrogen cycle is, a good place to start this lesson is by watching this tutorial from the K20: k20alt.ou.edu/tutorial/the-nitrogen-cycle It provides both the basics of this lesson and an overview of the nitrogen cycle. Do not begin this lesson by showing the class this video! That can come later, if you choose.

Play the video of Nemo getting clogged the filter in Finding Nemo.

Embedded video
https://youtube.com/watch?v=bHsrZMe4QIQ

Begin this lesson by asking students to think about the two most important aspects of caring for a fish, even if they've never owned a fish personally. Give students a minute or two to think, then ask students to share their answers with the class.

Teacher's Note

The two most popular answers will be "feed the fish" and "clean the tank/bowl." If students have other answers, you can write those on the board too, but the lesson will focus on cleaning the tank. If a student knows the process of cleaning the fish tank, allow them to share, since the ammonia reducer is a big part of this lesson, and a big part of keeping fish safe and healthy. If students don't know what ammonia is, and seem interested, you can share it with them now. If not, it'll be addressed later.

Finish with the question: "Do you think ammonia is present in water sources other than fish tanks?" Allow a few options, then move on.

Explore

- Tell students they are now going to plan an experiment to test nitrogen levels in water from a spring, a river, or stream and a pond location.
- Place students into groups of four.
- Show the students how the test strips work because they will need to include how to test the water in their lab protocol.
- Give students handout "1_Experimental Design." This handout will guide their experimental design. See Attachments for both student and teacher copies of this handout.
- Students need to come up with a plan as a group, then write up their experiment. This can be turned in at the end of the lab and used for evaluation purposes if you need more assessments.

Gauging The Independence

It depends on your students and your level of comfort whether you want to check each group's lab proposal to make sure it is acceptable and that they are testing for varying nitrogen levels in the different water samples or if you want to give them the space to figure out their mistakes on their own.

Lab Preparation

For this lab, you will need samples of spring water, water from a river or stream, and water from an agricultural pond. You'll also need ammonia testing kits/strips. There should be enough water samples for each group to have one sample of each type of water. Be sure to stir the water before distributing it to all the cups; this ensures relatively equal distribution of particulates and/or chemical concentrations in the water samples.

Scientific Practices

Students are still learning how to interact with experimental design, and that's OK. This is a great time to walk around and help students make sure that their plan is clear, but thorough. Also, you will need to emphasize consistency in the controls.

Explain

Once students complete their experiment, pass out the document titled 'Nitrogen Explain' and have students answer the questions in their lab group.

Nitrogen In Cellular Functions

If your students have covered cell theory, proteins, and/or DNA structure/composition, you may want to consider showing the additional handouts (five, six, and seven in the attachments section) that cover amino acids and DNA/RNA to the class. The handouts show how nitrogen is incorporated into the structure of DNA and amino acids.

Extend

In their lab groups still, pass out one article to each group. Have them read the article together, and decide what is most informative. Then, tell students that they are going to create a Two-Minute Documentary over their article to present to the class. Encourage them to use props if they feel like it's needed.

Evaluate

Have students complete a Frayer Model over the nitrogen cycle. When they are done have the students turn it in as a grade.

Resources

- Fish tank cleaning video (from Engage): https://www.youtube.com/watch?v=z8BsjRruEEM
- Ammonia in fish tank (from Engage): http://www.koivet.com/a_ammonia.html
- Phytoplankton and nitrogen fixation by cyanobacteria: http://www.soes.soton.ac.uk/staff/tt/nf/structure/
- Land Nitrogen Fixation Video Link: https://www.youtube.com/watch?v=4NKGS4bj7cc
- Marine Nitrogen Fixation Link: https://www.youtube.com/watch?v=9eEpgSvnMrA
- Nasa website where phytoplankton article came from: http://earthobservatory.nasa.gov/Features/Phytoplankton/printall.php