

Reading the Carbon Loop, Drawing the Nitrogen Loop

Learning target: I can read a cycle diagram as reservoirs connected by processes, explain what each arrow means for a single atom, and build my own labeled model of a nutrient cycling through a field.

Diagrams and models

About 40 min

Individual

MS-LS2-3 · assesses

MS-LS1-6 · supports

visual modeling

independent practice

Name _____

Date _____

Period _____

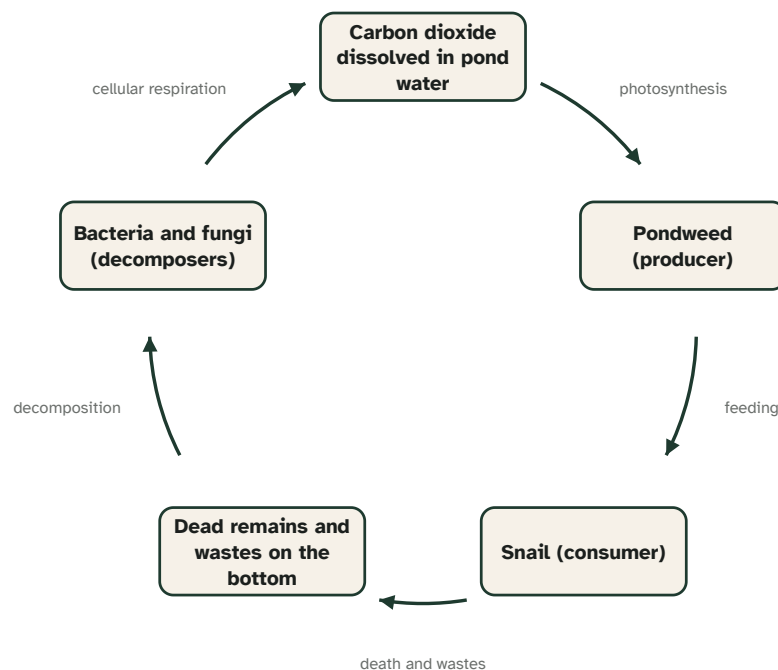
Directions

Part A gives you a finished carbon-cycle model of a pond. Read it the way a scientist does: every box is a reservoir where carbon is stored, and every arrow is a process that moves carbon from one reservoir to the next. Answer the questions about it. In Part B you will build your own model of the nitrogen cycle in a peanut field, then answer questions about your own drawing. Use a pencil so you can revise.

You will need: This worksheet, Pencil and eraser, Ruler, Two colored pencils for the extension

Part A: Read a model of carbon in a pond

The main carbon loop in a pond (read clockwise from the top)



Boxes are reservoirs; arrows are processes. The loop shows only the most common route; see the second figure for the routes it leaves out.

Four routes the simple loop leaves out

Air above the pond

Carbon dioxide passes both ways across the surface, between the air and the water.

Respiration by pondweed and snail

Producers and consumers also release carbon dioxide through cellular respiration, not only decomposers.

Pond-bottom mud

Remains that decomposers never finish can stay buried for a very long time.

Burning nearby

A wood fire or a car engine beside the pond adds carbon dioxide to the air above it.

1. Which arrow in the loop moves carbon from a **nonliving** reservoir into a **living** one? Name the process and the two reservoirs it connects.

2. Which arrow or arrows return carbon from living things to a nonliving reservoir? Use both figures, and name every organism that carries out this process.

3. When a carbon atom is 'in the snail,' it is part of a molecule. Name two different kinds of carbon-containing material in a snail's body that the atom could be part of, and say what each is for.

4. Suppose every decomposer in the pond died and none returned. According to the model, what would happen over the following year?

- ☐ **A.** Carbon would be destroyed, so the pond would slowly run out of carbon.
- ☐ **B.** Dead remains and wastes would pile up on the bottom, and less carbon dioxide would be returned to the water for the pondweed.
- ☐ **C.** The snails would take over the decomposers' job and the loop would continue unchanged.
- ☐ **D.** Photosynthesis would stop immediately because it depends on decomposers.

5. Now imagine the whole pond is sealed inside a giant glass dome that lets light and heat through. Is the dome a closed system for **matter**? For **energy**? Explain each answer in one sentence.

6. Describe two **different** paths a single carbon atom could take, each starting as carbon dioxide dissolved in the water and ending as carbon dioxide again. Use both figures. Each path must name every reservoir and process in order, and the two paths must differ in at least two stops.

7. The first figure is a model, not a photograph. Name one thing it shows well and one real feature of a pond it leaves out or simplifies. Use the second figure to help.

Part B: Build a model of nitrogen in a peanut field

A peanut field has air above it, soil below it, peanut plants with nitrogen-fixing bacteria in their root nodules, people who eat the peanuts, and decomposers in the soil. Build a model of how nitrogen moves through this field. Your model must include **all** of the following: nitrogen gas in the air; nitrogen-fixing bacteria in root nodules; ammonium in soil; nitrate in soil; nitrifying bacteria; proteins in the peanut plant; a consumer (a person or an animal); decomposers; denitrifying bacteria; and a dashed line showing the boundary of your system. Every arrow must carry a label naming the process.

-  Draw your nitrogen model here. Boxes = reservoirs (write what form the nitrogen is in). Arrows = processes (write the process and, where it applies, the organism that does it). Draw a dashed line around the system you are modeling and label at least one arrow that crosses it.



8. Count the arrows in your model that depend on **bacteria**. List them, and explain what would happen to the peanut plants if the nitrogen-fixing bacteria alone disappeared.

9. The farmer decides to spread nitrate fertilizer made in a factory. Add this to your model with a new arrow. Does the arrow start inside or outside your system boundary? What does that tell you about where the extra nitrogen came from?

10. A nitrogen atom in a peanut plant's protein could end up back in the air in two different ways. Trace both using your model.

Build it in three passes

Pass 1: draw only the boxes (reservoirs) and write the form of nitrogen in each: nitrogen gas, ammonium, nitrate, plant protein, consumer protein, wastes and remains. Pass 2: add one arrow at a time, asking 'What moves nitrogen from this box to that one?' and writing the answer on the arrow. Pass 3: draw the dashed boundary and check that every box has at least one arrow in and one arrow out. The carbon loop in Part A is a pattern you can copy: a producer, a consumer, remains, decomposers, and a nonliving reservoir that starts the loop again.

Merge the two cycles

Carbon and nitrogen meet inside living things: a protein molecule contains both. Redraw your nitrogen model and add the carbon loop from Part A on top of it, using a second color. Mark every reservoir that holds both elements and every process that moves both at once. Then write a paragraph explaining why textbooks draw the cycles separately even though, in a real field, the atoms travel together.