Name \_\_\_\_\_ Date \_\_\_\_\_

## **Exploring the Nitrogen Cycle**

**Part 1:** During this activity you are a nitrogen atom, discovering the different locations that nitrogen exists in ecosystems. For each step along the journey, write down where you start, what happened to you, where you went, and the chemical formula. Each person in the class will follow a different route. Sometimes, you will get 'stuck' at a particular station and you will remain there for one turn. Write down everything that happens so that you have an accurate record of your journey.

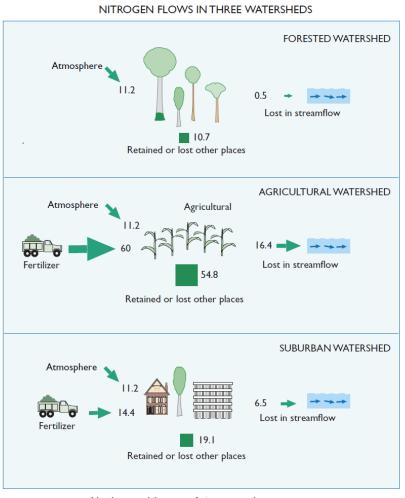
The first line is an example.

Trip	Starting	What happened?	Where you	Formula
	location		went:	and name:
Ex	Dead plants and animals	The wood burned and I was released into the	Atmosphere	N <sub>2</sub> 0
		atmosphere		Nitrous oxide
1				
2				
3				
4				
5				
6				
7				
8				

KE	Y:		
N <sub>2</sub> =	= nitrogen gas	$NH_3 = ammonia$	$NO_3 = nitrate$
N <sub>2</sub> C	) = nitrous oxide	$NH_4 = ammonium$	$NO_2 = nitrite$

## Part 2

- 1. Summarize the processes you took as a nitrogen atom (use the bottom or the back of the next page). It may be helpful to draw your journey as well.
- 2. Using the visual, answer the questions that follow. These data are from sampling sites in and around Baltimore, MD.



Numbers are kilograms of nitrogen per hectare per year

Data are from: Groffman et al. 2004. Nitrogen fluxes and retention in urban watershed ecosystems. Ecosystems, 7:393-403.

- a. Which watershed had the highest amount of nitrogen input? \_\_\_\_\_ Forest \_\_\_\_\_ Agriculture \_\_\_\_\_ Suburban
- b. Which watershed 'lost' the most nitrogen to the stream? \_\_\_\_\_ Forest \_\_\_\_ Agriculture \_\_\_\_ Suburban
- c. Which watershed retained the most nitrogen? \_\_\_\_\_ Forest \_\_\_\_ Agriculture \_\_\_\_ Suburban
- 3. Where did the excess nitrogen come from?

- 4. Are there sources of nitrogen missing from this diagram? Explain.
- 5. Where does the excess nitrogen in a watershed ultimately go? 6. Compare the graphic above from a forest, agricultural field, and suburban area with data from the Hudson River watershed below. INPUTS TO WATERSHED Acid deposition, 10.4 kg N/ha-yr Net Nitrogen Inputs to Watershed 40 -Biological nitrogen fixation, 2.8 kg N/ha-yr Agricultural feed Agricultural N-fixation Hudson Watershed Fertilizer - 05 Ag -Acid Deposition Outputs from Watershed to Estuary Forests Urban unoff Agriculture Animal feed, 1.4 kg N/ha-yr Acid Deposition Fertilizer, 4 kg N/ha-yr Food Sewage Food, 19.2 kg N/ha-yr 0 Raritan Watershed OUTPUTS TO ESTUARY 19 kg of nitrogen per hectare of watershed per year Lower New York Bay Data from C.T. Driscoll et al., 2003, "Nitrogen pollution in the northeastern United States: Sources, effects, and management and Raritan Bay options," Bioscience 53(4): 357-374. Pet foods and N-fixation in forests and wetlands are not included.
  - a. What is the source of the largest input of nitrogen to the Hudson River watershed?

<u> </u>	biological ni	trogen fixation
animal feed	fertilizer	food

b. How is this different from the diagram of the forest/field/suburbia?

C.	What is the source of the largest output from the watershed to the estuary forests urban runoff agriculture acid deposition sewage
d.	In which system is more nitrogen lost, or exported, to the ecosystem? forest agricultural field suburbia Hudson River watershed
e.	Describe how the nitrogen cycle is different in these two places.
Based	on these data and the game, how do people affect the nitrogen cycle?