

2.4) INSTRUCTOR’S GUIDE TO THE NITROGEN AND PHOSPHORUS CYCLES

Overview: The addition of 3 grams of ammonium chloride to one liter of water results in a concentration of about 1 part per thousand of ammonia. Ten milliliters of this solution added to 10 liters of water results in the desired concentration of about 1 part per million. Nitrifying bacteria do not survive desiccation, so drying your biofilter for one week should kill all the nitrifying bacteria in your filter.

It usually takes less than one week for you to be able to detect a noticeable drop in ammonia levels. Aeration enhances nitrification because it is an aerobic bacterial process that consumes oxygen.

Part A: Sample Results (NH₃ ppm)

Date	#1 Active filter, Aeration	#2 Active filter, No aeration	#3 Inactive filter, Aeration	#4 Inactive filter, No aeration
4/28/09	1.00	1.00	1.00	1.00
4/29/09	0.50	1.00	0.50	1.00
4/30/09	0.25	1.00	0.50	1.00
5/1/09	0	1.00	0.50	1.00
5/4/09	0	1.00	0.25	1.00
5/5/09	0	1.00	0.25	1.00

For part B, one option is to use water from an aquarium that has not had its water changed for several months because it should be naturally high in accumulated plant nutrients. The other option is to use dechlorinated tap water and add plant food to the water. The dose of plant food you apply depends on the makeup of the fertilizer. **IMPORTANT:** *Be sure to dilute your plant food solution to make sure that you end up with a starting concentration that does not exceed the range your testing kit can detect.* Maintain consistent water levels by adding distilled water every 2-3 days (mark original level). It may take as long as 3 weeks for you to be able to detect a noticeable drop in nitrate and phosphate levels.

Answers to Questions: 1) Answers may vary. Based on this data aeration alone removes ammonia very slowly. 2) Answers may vary. Based on this data filter activation does not remove ammonia unless there is aeration. 3) Ammonia removal is much faster. 4-8) Answers may vary. 9) Disinfection will kill the denitrifying bacteria. These microorganisms will have to be re-introduced after disinfection. This can be accomplished by adding activated substrate material (such as gravel or foam filters) from other aquaria that do not contain the pathogen. 10) You need a plant that grows fast.

Logistics: Students should take turns measuring ammonia, nitrate, and phosphate levels daily. Start Part A on Monday if possible so that students do not miss important changes over the week’s end. Part A should take less than two weeks. Part B can take up to three weeks.

Degree of Difficulty: 2—This lab relatively easy to organize, though some may find it tricky to adjust nitrate and phosphate levels within the kit’s testing range with plant food.

Product Guidelines: Foam biofilters can be purchased in aquarium stores or pet shops.

Materials: Six 1-liter containers; five liters of dechlorinated tap water; 20 g of ammonium chloride; plant food; 6-10 grams of *Elodea*; and a testing kit that measures ammonia, nitrate, and phosphate.