

Aquarium Test Kit Accuracy

It is entirely possible that test kits will not show ammonia, nitrite or nitrate.

By Stephen M. Meyer

Q. I have a tiny pond in my backyard here on Long Island New York. It is 18 inches deep, holds about 60 gallons and is home to seven 4-inch comet goldfish. Around Thanksgiving I remove the biological filter and do a large water change of about 40 gallons. (The filter consists of a 10-inch hexagon block of foam with a small pump attached to a fountain.) The fish have overwintered for two years without a problem (I open a hole in the ice daily).

The last weekend in March I did another large water change and put the filter back into the pond. Because the weather was warm I began feeding the fish once a day. The pH at this time was 7.2 and there was no trace of ammonia, nitrite or nitrate. It is now mid-May, the fish have been fed daily for the last eight weeks and the water has a slight hint of brown to it (no chemical filtration).

Now for my question. After eight weeks of water temperatures averaging in the upper 40s to mid 50s (Fahrenheit), the pH is still 7.2 and there is still no trace of ammonia, nitrite or nitrate. I can understand a functioning nitrogen cycle will leave no ammonia or nitrite, but where is the nitrate? The test kit I use is new and gives me readings when testing my aquariums, so we can rule out a defective kit.

A. This does indeed seem like a mystery. You are right, nitrogen — either in the form of ammonia, nitrite or nitrate — has to be somewhere. Let's do a back-of-the-envelope calculation to see what the numbers should look like.

Your pond has seven 4-inch comets. Let's assume that each of these fish weighs about 10 grams. Under normal feeding conditions during the prime summer months each fish will produce about 2.5 milligrams (mg) of ammonia per day (250 mg per kilogram of mass).

During the spring, however, when feeding rates are lower than normal, water temperatures are still fairly low and the fish are rebuilding body mass, I would expect them produce maybe half that amount per day. So, seven comets would produce about 10 mg of ammonia per day.

A 60-gallon pond holds about 225 liters of water. Now, after 45 days the fish would have produced a total of 450 mg of ammonia. Assume for the moment that all of that ammonia was converted directly to nitrate and remained in the pond water. That would yield a total concentration of nitrate around 2 mg or 1 part per million (ppm). (Keep in mind that given all the uncertainties, I am rounding these numbers.)

Most of the nitrate test kits available to hobbyists measure in increments of 10 or 20 ppm. So, unless you spent big bucks for a professional nitrate test kit I doubt you would get an observable reading even if the nitrate level was substantially higher.

We also need to factor in the brownish tinge to the water, which is caused by species of planktonic algae. Those plants are consuming the ammonia before it is converted to nitrate. Therefore, it is probably the case that the actual nitrate concentrations are below 2 mg/l (per liter).

Then, too, you don't say whether there are water plants in your pond. If there are, they are certainly taking up ammonia and nitrate from the water. And your foam filter may have some anaerobic areas in it where denitrification is taking place. This releases some nitrogen into the air. Similarly, gravel or soil on the pond floor will act as a substrate for denitrifying bacteria.

The bottom line is, the nitrate is there but invisible to your test kit. More to the point, unless you have nitrate levels over 200 mg/l — which in a pond I think is virtually impossible — you have nothing to worry about and should not bother testing. Hope this clears up the mystery.