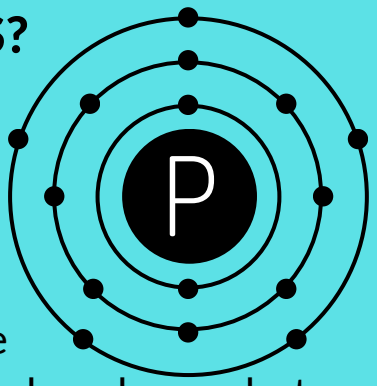
TOTAL PHOSPHORUS

Community Science Institute
Partnering with Communities to Protect Water

WHAT IS TOTAL PHOSPHORUS?

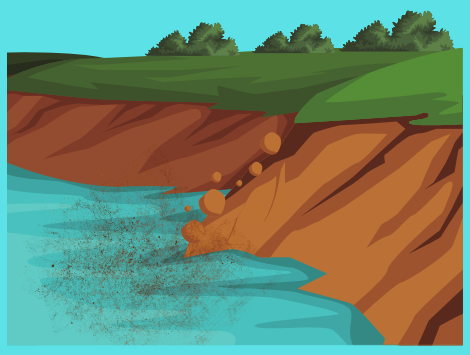
Phosphorus is a naturally-occurring nutrient that can be harmful at excessive levels in aquatic ecosystems.**Total phosphorus** includes both particulate phosphorus (phosphorus bound to particles such as clay or soil) and dissolved phosphorus (phosphorus not bound to particles). Total phosphorus represents *all phosphorus* in the water sample, regardless of its form.

WHY DO WE MEASURE TOTAL PHOSPHORUS?



Phosphorus is a nutrient that is essential to life, but too much phosphorus can lead to ecological degradation by contributing to excessive growth of aquatic plants, algae, cyanobacteria and other photosynthetic organisms.

Total phosphorus is a useful indicator as it includes (as the name implies) all forms of phosphorus: not only dissolved phosphorus, but also particulate phosphorus. Dissolved phosphorus is considered more "bioavailable" than particulate phosphorus, meaning it is easier for algae to consume and use it. Dissolved phosphorus is more likely to be associated with runoff from fertilizers or manure spreading.



Particulate phosphorus is more likely to be associated with soil erosion. Particulate phosphorus can become more bioavailable over time through complex nutrient cycling processes within a lake system. Because it gives a sense of all phosphorus present in an aquatic system, total phosphorus is an important indicator of water quality.

In New York State, total phosphorus levels are regulated by a *narrative* water quality standard that states “none in amounts that will result in growths of algae, weeds and slimes that will impair the waters for their best usages.” Total phosphorus levels are not regulated by a numeric standard. However, a statewide guidance value of 20 µg/L is suggested for ponded waters like lakes and reservoirs that used for swimming or drinking.

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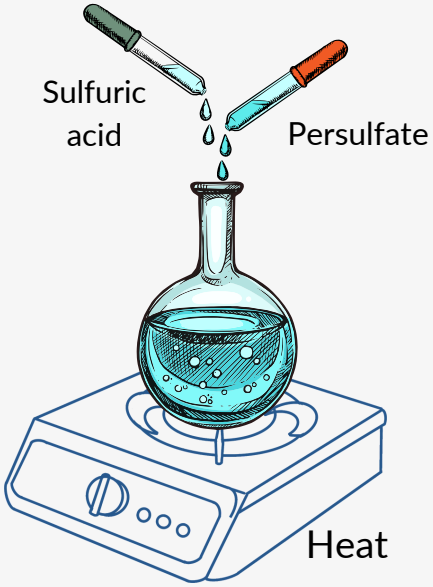
HOW DO WE MEASURE TOTAL PHOSPHORUS?

Because total phosphorus measures all phosphorus in a water sample, no filtration is required for the total phosphorus test. Instead, the sample is "digested" then tested using a process called "colorimetry."

First, the water sample must be "**digested**." Like digestion in the human body, digestion in the laboratory involves adding acid and applying heat.



CSI chemists first add sulfuric acid and persulfate. Then they add heat. This causes the **particulate phosphorus** in the water sample to break down into **soluble reactive phosphorus**, which can be measured by colorimetry.

Next, the colorimetry process begins.

Another acid, ascorbic acid, and a compound containing the mineral "molybdenum" are added to the digested sample. Molybdenum generates color in the presence of phosphorus in an acidified sample.

It takes 40 minutes for the color change to occur.

A square vial (a "cuvette") containing the now-blue water sample is placed into a machine that measures how light interacts with it.

The amount of light the sample absorbs at a given wavelength (the "absorption") is directly proportional to the concentration of phosphorus in the sample.

In other words, a sample that absorbs *more* light (a bluer sample) has a greater concentration of phosphorus than a sample that absorbs *less* light (a less blue sample).