

# Detecting Phosphates in Cola



## Introduction

One of the main ingredients in many cola beverages is phosphoric acid. This chemical helps to preserve the beverage, gives it part of its sweet taste, and provides an acidic solution. Phosphoric acid ( $\text{H}_3\text{PO}_4$ ) ionizes to form hydrogen ions ( $\text{H}^+$ ) and phosphate ions ( $\text{PO}_4^{3-}$ ) in cola. We can use a mixture of magnesium chloride ( $\text{MgCl}_2$ ), ammonium chloride ( $\text{NH}_4\text{Cl}$ ), and ammonia ( $\text{NH}_4\text{OH}$ ) to detect phosphate. When this mixture is added to an acidic solution containing a phosphate ion, a white precipitate called magnesium ammonium phosphate ( $\text{MgNH}_4\text{PO}_4$ ) is formed. In this lab activity, we will test for phosphates where they are commonly found, such as in cola and laundry detergent.

## Materials

cola soft drink  
distilled water  
hydrochloric acid (1.0 M)  
laundry detergent

magnesia mix  
pH paper or red litmus paper  
trisodium phosphate [ $\text{Na}_3\text{PO}_4$ ], solid

## Equipment

pipettes  
test tube rack

test tubes

## Safety Considerations

- YOU MUST WEAR GOGGLES AT ALL TIMES DURING THIS LAB.
- Trisodium phosphate (TSP) is TOXIC. You must wash your hands thoroughly after completing this lab.
- Sometimes chemicals from previous labs still remain in glassware and on other lab equipment; wash all lab equipment before and after performing this lab.

## Procedure #1 - Establish a positive test for phosphate

1. Place 0.5 g of trisodium phosphate (TSP) in a test tube. Fill the tube half full with distilled water and shake the tube until the solid dissolves. This will serve as our control.
2. Use a piece of pH paper (or red litmus paper) to test the solution. It should be basic.
3. Add hydrochloric acid, 1 drop at a time, until the solution is neutral or acidic.
4. Add a pipette full of magnesia mix to the tube.
5. Set the tube aside and observe it carefully. If you see a solid white precipitate slowly form and settle to the bottom of the tube, you have confirmed the presence of phosphate.

## Procedure #2 - Test cola for phosphate

1. Repeat the previous procedure, but use a test tube half-filled with cola instead of TSP and distilled water. The cola may already be acidic, so it may not be necessary to add hydrochloric acid. DO NOT USE TSP AGAIN.

## Procedure #3 - Test detergent for phosphate

1. Repeat the previous procedure, but dissolve a small amount of solid detergent (enough to cover a dime) in a test tube half-filled with distilled water. DO NOT USE TSP AGAIN.

2. Be sure to test the solution with pH paper. It may be necessary to add acid to make the solution neutral.

**Clean-up**

1. Dispose of any extra chemicals in the sink. Rinse the sink with lots of water.
2. Clean all used lab equipment with soap, water and a test tube brush.
3. Return all equipment to its proper location.
4. Wipe down your lab area.
5. Wash your hands before leaving the lab.

**Data Table**

Observations	
Procedure #1 (TSP)	
Procedure #2 (cola)	
Procedure #3 (detergent)	

**Questions**

1. How did you show the presence of phosphate ion in the samples?  

---

---
2. How did the amount of phosphate in the cola and the laundry detergent compare to the amount of phosphate in the control?  

---

---
3. Water tests such as these are very useful for all sorts of applications. Name another water test similar to this one and the job or career that would use it.  

---

---
4. When phosphate ions get into the environment, they cause algae to bloom and deplete the oxygen in local water supplies, killing all fish and other aquatic wildlife. What is one way we can prevent this from happening?  

---

---
5. List one way you could change this lab and describe how your results might be different.  

---

---