

Student Guide

Paper & pH Activity

Introduction:

Many paper materials including historical documents, prints, and drawings are worth preserving. Paper is defined as a matted sheet of cellulosic fibers, and wood pulp is the most common source of cellulose for modern paper. Previously, paper was made from linen and cotton fibers, which are longer than the fibers of wood pulp. Over time, cellulose fibers break down. Acidity is a key agent of fiber deterioration because it catalyzes hydrolysis, a process that severs the chains of paper molecules. Higher quality papers have less inherent acidic components like lignin, and therefore they do not degrade as quickly. However, these papers can still become acidic through environmental exposure. Conservators often bathe acid-damaged paper in water to remove acidic discolorations, reestablish broken hydrogen bonds, and help prevent further damage. In this lab, students will explore the acidity of different papers and test the aqueous treatment process.

Objectives:

- To examine the acidity of different types of paper and understand the use of acid-base properties in aqueous treatment baths

Supplies:

various paper types (newspaper, construction paper, notebook paper, printer paper, archival paper, cotton rag paper, etc.)

acid identifier pen

page from a yellowed paperback book

filter paper (large)

scissors

tweezers

pH test strips or pH meter

test tubes (large)

laboratory film

beaker, 100 mL

graduated cylinder

microspatula

weigh boat

calcium carbonate (CaCO_3)

Safety:

Safety goggles and gloves should be worn when handling acidic and basic solutions.

Procedure:**Part I**

1. Obtain small pieces of filter paper, old book paper, and at least 2 other papers.
2. Using an acid identifier pen, make a mark on each piece of paper and record your observations. Compare qualities, such as paper's color, thickness, texture, translucency, flexibility, etc.

Part II

1. Obtain a page from an old, yellowed paperback book. Cut strips that are thin enough to fit in a test tube, and cut these strips into $\frac{1}{2}$ inch segments. You will need 20 scraps.
2. Obtain 2 sheets of large filter paper. Cut strips that are thin enough to fit in a test tube, and cut these strips into $\frac{1}{2}$ inch segments. You will need 10 scraps.
3. Obtain 3 test tubes. Place 10 scraps of book paper in one test tube. Label this tube #1. Place 10 scraps of filter paper in the second test tube. Label as #2. Leave the third test tube for your blank. Label #3.
4. Add approximately 5 mL hot water to all 3 test tubes. Your paper scraps should be submerged, but excess water makes the results difficult to interpret. Record the pH.
5. Cover each tube with laboratory film and allow to sit, occasionally agitating or swirling the tubes. Record pH after 10 minutes and again after 20 minutes.
*optional – pH testing can be repeated every 5 minutes and graphed to illustrate acid diffusion, eventually reaching equilibrium.
6. While the test tubes are sitting, obtain a 100 mL beaker. Using a graduated cylinder, measure 10 mL of distilled water and add to the beaker.
7. To make a saturated solution of CaCO_3 , weigh 0.1g of the solid and add to your beaker. Stir with microspatula. Some solid will remain undissolved at the bottom of the beaker. Record the pH.
8. Add your remaining 10 scraps of book paper to the beaker. Agitate gently to soak the strips. Cover with laboratory film and allow the solution to sit for 10-20 minutes.
9. Use tweezers to remove the 10 strips of book paper from the CaCO_3 solution in the beaker. Place the strips on a paper towel and pat dry.
10. Transfer these book paper strips to a fresh test tube. Label the tube #4. Add 5 mL hot water. Record the pH.
11. Cover tube #4 with laboratory film. Allow the tube to sit, occasionally agitating or swirling the tube. Record the pH after 10 minutes and again after 20 minutes.
12. Compare the acidity of the solutions in tubes #1 (book paper) and #4 (book paper soaked in CaCO_3 solution).

Clean up:

Return supplies and dispose of solutions as directed by teacher.

Student Name _____ Date _____ Period _____

Paper & pH
Answer Sheet

Part I

Paper Type	pH reading from Pen	Physical Properties

Part II

	Initial pH	pH after 10 mins	pH after 20 mins
Test Tube 1 (book paper)			
Test Tube 2 (filter paper)			
Test Tube 3 (water control)			
Test Tube 4 (book paper + CaCO ₃)			

What is the pH of the saturated calcium carbonate solution?

Compare the pH readings for test tubes #1 and #4. What is the effect of soaking the acidic paper in a alkaline bath?