



# Finding Colors



## Challenge:

Can you find five indicator colors (red, orange, yellow, green, and blue) when an acid and a base are reacted together?

## General Description:

Visitors work with an acid, a basic solution, and a pH indicator.

If the acid is neutralized a little at a time, the indicator will show several colors as the pH changes from acidic to basic.

## Objectives:

To show that, as acid and bases, react an indicator can be used to follow the reaction.

To have visitors develop experimental and observational skills.

Careful addition of the acid to the base is required to see all the colors.

## Materials:

### For 5 stations (1 child per station)

- 5 24 well plates
- 5 plastic dropping bottles containing vinegar
- 5 plastic dropping bottles containing washing soda solution
- 5 plastic dropping bottles containing a few ml Bogen universal indicator
- A water wash bottle to rinse well plates
- Paper towels for spills
- A container of clean water
- A safe container to dump solutions into and seal (waste container)



## Activity Preparation (approx. 15 min.):

### 1. Mix up the 2 solutions in plastic bottles, as described below.

About 250 ml of each solution is needed for 5 stations.

(NOTE: This amount will fill all the dropping bottles with the vinegar and the washing soda solution. The solutions keep if the bottles are capped. Visitors will only need a few ml to do the experiment.)

A = store bought white vinegar ( 5% acetic acid).

B = 0.5 molar washing soda solution (add 11.4 grams of sodium carbonate soda to 250 ml of water).

C = Bogen's universal indicator (available from Fischer).

### 2. Each station should have:

- A 24 well plate placed on a paper towel
- A dropping bottle of vinegar
- A dropping bottle of washing soda solution
- A small dropping bottle of indicator

## Directions:

### Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
2. Put 10 drops of vinegar in each of four wells of the well plate.
3. Add 1 drop of Bogen's indicator to each well with the vinegar. The color should be red.
4. Add the washing soda solution to the first well one drop at a time. After each drop observe the color of the reaction mixture. It should turn orange.
5. Add washing soda solution to the second well, counting drop until the solution turns yellow.
6. Add washing soda solution to the third well, counting drop until the solution turns green.
7. Add washing soda solution to the fourth well, counting drop until the solution turns blue.
8. Have visitors repeat the process in reverse starting with five wells with washing soda solutions and adding vinegar 1 drop at a time.

## Clean Up (approx. 15 min):

- Rinse well plates and shake dry over a paper towel.
- Wipe up spills with paper towels.
- All used solutions can go down the drain with lots of water.
- Left over solutions can be saved for the next time.
- Clean goggles with window cleaner and white paper towels.
- Disinfect in goggle cabinet for full 15 minutes.

## Safety Issues:

Participant must wear a pair of safety goggles before beginning!

Goggles must be sterilized before use.

Indicator solutions can stain clothes and hands.

Stains can be washed off hands with soap and water or alcohol.

While all of these solutions can go down the drain, they are irritating.

Clean any spills immediately, and wash thoroughly if visitors get it on their skin.

If solutions get in eyes, flush immediately with clean water.



## Tips For Doing the Activity:

- Explain that the challenge is to find out how many color changes can be seen as the acid is neutralized with the base.
- When participants begin, they can start with either the acid or washing soda solution.
- Caution that adding solution drop-wise is important in order to see all the colors.
- When participants get all the colors, let them to experiment with the solutions.
- The order of colors if starting with vinegar is red, orange, yellow, green, and blue. Various shades of these colors can be seen. The color order is reversed when starting with the washing soda solution.

## Background Information:

### Basic explanation for young children:

Vinegar contains an acid; washing soda solution contains a base. When a base is added to an acid they react to make a chemical called a salt, which is neither an acid nor a base. The indicator changes color as the acid is used up. It is red when there is a lot of acid, blue when there is a lot of base, and yellow when there is almost no acid or base.

### More in depth explanation for older children:

Vinegar is a 5% solution of acetic acid in water. Washing soda is sodium carbonate-- it makes a basic solution when mixed with water. As the two solutions are mixed, the base neutralizes the acid and the pH gradually changes from about 3 to 11.

The pH is a measure of the amount of acid or base in a solution. The lower the pH value the more acid in the solution. Solutions with a pH from 1-7 are acidic, pH of 7-14 are basic and pH 7 is considered neutral.

The Universal indicator contains several dyes that change color as the pH of the solution changes. The color is a useful indicator of the pH of a solution. The approximate color relationship to solution pH is the following: Red is pH 2-3, orange is 4-5, yellow is pH 6-7, green is pH 8-9, blue is pH over 9.

---

## Credits and Disclaimer



Sciencenter,  
601 First Street,  
Ithaca, NY 14880  
607-272-0600

[www.sciencenter.org/chemistry](http://www.sciencenter.org/chemistry)

**Acknowledgments:** These activities were developed by the Sciencenter with a grant from the Camille and Henry Dreyfus Foundation, Inc.

**Copyright Notice:** All information and images presented in this document are deemed to be the property of the Sciencenter. The content presented here may not be used for commercial purposes without the written consent of the Sciencenter. Permission is granted for personal and educational use only.

**Disclaimer:** Reasonable care has been taken in designing the Chemistry Challenge activities. These activities are intended for use with children and adults under direct supervision of qualified adults.

Anyone using this information must follow all the customary and prudent procedures for the safe storage, preparation, handling, and disposal of any potentially dangerous materials mentioned in this document.

Anyone who uses this information, does so at their own risk and shall be deemed to have indemnified the Sciencenter from any injuries or damages arising from such use.