



Finding Red



Challenge:

Can you discover which combination of chemicals will produce a red solution when they are mixed together?

General Description:

Visitors work with 4 solutions to find the combination of 2 solutions that produces a deep red color. The visitor then combines 3 solutions and observes the results.

Objectives:

To show chemical reactions as evidenced by color changes, to illustrate the concept of chemical equilibrium, and encourage experimentation and observation. Visitors will systematically evaluate all possible combinations of reagents and draw inferences from their observations.

Materials:

For 5 stations (1 child per station)

- 5 pieces of white paper to provide a colorless background for the well plate
- 5 24 well plates
- 20 plastic dropping bottles
- Dilute solutions of iron(III)chloride, ammonium thiocyanate, tannic acid, and oxalic acid.
- Wash bottle with distilled water
- Paper towels for spills
- A container of clean water
- A safe container to dump solutions into and seal (waste container)



Activity Preparation (approx. 20 min.):

Prepare the solutions as follows:

- Solution A= 0.1 molar Oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$): mix 0.58 grams in 100 ml. of distilled water.
- Solution B = 0.1 molar Ammonium thiocyanate (NH_4SCN): mix 0.76 grams with 100 ml. of distilled water.
- Solution C = 0.1 molar Iron(III)chloride hexahydrate ($\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$): mix 2.70 grams with 100 ml. of water.
- Solution D = 2% tannic acid; mix 2 grams with 100ml. of distilled water.

Each station includes:

- 1 well plate
- Plastic dropping bottles labeled A, B, C, D, and containing about 25 ml of the appropriate solution.
- White sheet of paper

Directions:

Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
2. Pick a solution to start with and place a drop of solution to three wells in the first row on the well plate.
3. Add a drop of any other solution to the first well and observe the results.
4. Add a drop of another solution to the second well and observe results.
5. Add a drop of another solution to the third well and observe results.
6. Choose another solution to start with and fill three wells of the second row.
7. Test with the other solution.
8. Continue the process in other wells until drops from two different solutions yield a very dark red solution.
9. After this, encourage participants to add some of the solution from one of the other bottles to the well containing the red solution. Observe the results.

Clean Up (approx. 15 min):

- Rinse wellplates with distilled water
- 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.

Although none of chemical solutions are very toxic , chemicals spilled on hands or clothing should be washed off with soap and water. All the colors can stain hands and clothing. The solutions may be disposed of by rinsing down the drain with lots of water.



Tips For Doing the Activity:

- If possible have all visitors start at the same time.
- Encourage visitors to put only one or two drops of chemical in each well.
- The red color can be very intense and may look black. Tilt the wellplate to show the color, or add a little bit of water to the well.
- After the red color combination has been found encourage participants to try combinations of three or more solutions. Adding an excess of A and D will change the color from red to either yellow or black. The adding more B will change solution back to red.

Expected Results:

Solution Combination	Color
B + C	red
A + C	yellow
D + C	black
All others	colorless

Background Information:

Explanation for younger children:

Solution C contains iron in solution. The other three solutions contain compounds that combine with the iron. Solution A contains a chemical that forms a yellow color with iron, solution B has a chemical that forms a red color with iron, and solution D contains a chemical that forms a black color with iron. If all three color-producing solutions are mixed with the iron solution, the color that forms depends on which solution is present in the greatest amount.

More in depth explanation for older children:

Metals like iron can form many compounds that dissolve in water. When they dissolve, positively charged iron atoms called ions form. The ions can react with negative ions to form other compounds of iron that are colored. In this experiment the ions come from oxalic acid (solution A), ammonium thiocyanate (solution B), and tannic acid (solution D). In this set of reactions, adding a large amount of color producing solution will pull the iron ion away from the first colored compound to form the colored compound using the ion that was added.

Questions

1. Which solution made the red color?
2. What happens when you mix other solutions?
3. How can you make the red color disappear?
4. How can the mixture turn yellow, then red, and then black?

Credits and Disclaimer



Sciencenter,
601 First Street,
Ithaca, NY 14850
607-272-0600
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.