



Changing Colors

Challenge:

Can you make the solution go from clear. . . to yellow. . . to blue, . . . then back to clear?



General Description:

Visitors work with 5 solutions that, if added in the correct order, react to change colors.

Objectives:

To show chemical reactions as evidenced by color changes, and to have visitors develop experimental skills by controlling variables in an experiment, systematically evaluating all possible combinations of solutions, and drawing inferences from their observations.

Materials:

For 5 stations (1 child per station):

- 25 60 ml plastic dropping bottles labeled A, B, C, D, E
- Potassium iodide, sodium thiosulfate, sodium hypochlorite, soluble starch, water
- 5 24 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. 35 min.):

1. Mix up the 5 solutions in plastic bottles, as described below.

About 150 ml of each solution is needed for 5 stations.

(NOTE: potassium iodide is the only solution that is stable enough to keep.)

- A = 0.1 molar potassium iodide, KI (add 4.15 grams of KI to 250 ml of water).
- B = 1 molar sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ solution (add 62 grams to 250 ml of water). This should be made up no sooner than 1 day in advance. It is subject to bacterial decomposition.
- C = 50% sodium hypochlorite solution (Clorox™ type bleach, mix 125 ml bleach with 125 ml water). This solution can keep for a week or two.
- D = Soluble starch (made by spraying Niagara spray starch into a container of 250 ml of water) This solution does not keep. It must be prepared shortly before the activity begins and will need to be re-freshed (spray more starch into the container) if the session lasts longer than 1 hour.
- E = Water

Activity Preparation, *continued*

2. Each station should have:

- A 24 well plate placed on a paper towel
- Five dropping bottles labeled A, B, C, D, E for solutions. Each bottle should contain about 10 –15 ml of the appropriate solution.

Directions:

Have visitors do the following:

1. Participant **must** wear a pair of safety goggles before beginning!
2. Combine a few drops of two solutions in one well of a plate to see what happens. Start with solution A and mix it with any other solution. For younger kids, have them add the solutions in order (B to A, C to A, D to A, E to A, then C to B etc).
3. Each time solutions are mixed note what the combination was and what happened (e.g. A+B no color change; A+C blue, etc). Older children can use the chart to note when a color change happens.
4. After two solutions have been found that produce a yellow color, fill several wells with that combination (so that there are several wells of yellow solution). Start adding a third solution to each well until the third solution produces a dark blue or black color.
5. Fill several wells with the dark blue combination and add a fourth solution to find the right solution to make it colorless again.

Clean Up (approx. 15 min):

- Rinse well plates and shake dry over a paper towel.
- Wipe up spills with paper towels.
- All left over solutions except potassium iodide (KI) can go down the drain with lots of water.
- KI solution 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.

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

Clean any spills immediately, and wash thoroughly if a visitor gets 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 to add the solutions together to get the correct order of color changes (clear to yellow to blue to clear).
- When participants begin, tell them to start with solution A and try to put similar amounts of solutions in each well.
- When participants get the correct set of colors, let them to experiment with the solutions.
- The correct combination in order is A, C, D, B, E. The problem is easier if E is not used. The problem is harder if they don't start with solution A.

Background Information:

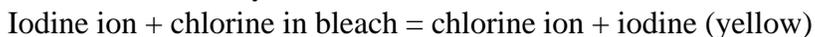
Basic explanation for young children:

When you combine two solutions and you get a color change, it means that the chemicals in the solutions have combined to create a new different chemical.

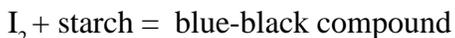
More in depth explanation for older children:

The chemicals that are in the solution break up into parts that are called ions when they are mixed with water. Two of the chemical reactions in this puzzle involve transferring an electron (a piece of the ion) from one element to another.

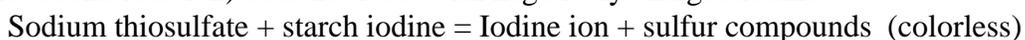
In the first reaction a negatively charged iodine ion transfers an electron to a chlorine atom in bleach and becomes neutral. Neutral iodine is a yellow brown color in solution.



In the second reaction neutral iodine combines with starch to form a blue-black compound.



In the third reaction the neutral iodine gains an electron from a sulfur atom in the compound called sodium thiosulfate and goes back to colorless iodine with a negative charge. It does not turn blue-black again because starch (from the second reaction) does not react with negatively charged iodine.



Credits and Disclaimer



Sciencenter,
601 First Street,
Ithaca, NY 14880
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.



Changing Colors

Challenge:
 Can you make the
 solution go from clear. . .
 to **yellow**. . . to **blue**,
 . . .then back to clear?



	Which combination makes it yellow ?	Which combination makes it blue or black ?	What do you add to make it clear again ?
A + B		AB + C AB + D AB + E	
A + C		AC + B AC + D AC + E	
A + D		AD + B AD + C AD + E	
A + E		AE + B AE + C AE + D	
B + C		BC + A BC + D BC + E	
B + D		BD + A BD + C BD + E	
B + E		BE + A BE + C BE + D	
C + D		CD + A CD + B CD + E	
C + E		CE + A CE + B CE + D	
D + E		DE + A DE + B DE + C	