

Ages:

6 to 12

The Chemistry of Color – Tie Die

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Main idea: What is an acid, and what is a base? How is it possible to tell the difference between the two? In the chemistry of color activity kids categorize everyday materials to acids and bases. In addition, they learn how the acidity of solutions changes when acids and bases are mixed together.

Objective: The activity introduces students to acids and bases using the juice of a red cabbage as an indicator. The activity includes testing what happens to the indicator when acids and bases are added, and what happens when acids and bases are mixed. The students test several mystery solutions and guess their identity by testing each with the acid/base indicator. Using different colored dyes from the activity, students finish by making their own tie-die handkerchief.

Materials:

- q Red cabbage juice (Prepare before activity by cutting up a red cabbage into small pieces and boiling for about 1 hour and straining.)

- q Vinegar
- q Salt
- q Baking powder
- q Baking soda
- q Plastic cups
- q Stirring sticks or spoons
- q White cloth or handkerchiefs
- q Zip-lock bags
- q Rubber bands
- q Gloves rubber
- q Mystery Solutions: Pour 2 or 3 liquids such as apple juice, milk, ginger ale or any other into separate cups. (Keep track of which liquid is in which cup so that when kids add solution they can identify liquid as acid, base or neutral.)

Motivator: Use questions below to pique interest.

Questions:

- q Do you know of anything that is an acid or a base?
- ü Acid: Lemon juice. Base: Baking soda.

q How can you tell whether something is an acid or a base?

ü Taste, texture, litmus paper

q Can you guess what will happen when a known base is added to the cabbage juice? What color will the mixture be?

ü Greenish Blue

q Can you guess what will happen when a known acid is added to the cabbage juice? What color will the mixture be?

ü Red

q Can you guess what will happen when a neutral solution is added to the cabbage juice? What color will the mixture be?

ü Will remain purple

Activity:

1. Pour about $\frac{1}{2}$ cup cabbage juice into each of 6 plastic cups.
2. Pour and stir a small amount of the following into each of the cups:

Chemical	Color (pink, blue/green or purple)	Acid, base or neutral?
water		

vinegar		
baking powder		
salt water		
lemon juice		
baking soda		

3. How many different colors are there? Record the color of the cabbage juice for each cup in the table above.
4. Each different color represents an acid (pink), base (blue/green), neutral (purple). Add that information to the chart.
5. Now take some a solution that tested basic (see your chart above) and add it to an acid solution. Does the color change? Try adding acids to bases, as well as adding each to neutral solution. What happens?
6. Pour a small amount of a Mystery Solution in a cup. What does it smell like? How does it feel? Add some cabbage juice to the Mystery Solution. What do you think the mystery solution is: Acidic, basic or neutral?

Learning checks:

Students should be able to identify the Mystery Solution as an acid or base using the cabbage juice test.

Background:

Acids and bases have different effects on the cabbage juice. The cabbage juice is used as an indicator because it changes different colors depending on whether an acid or base is added to it.

Acids change the juice to pink. Bases change it to blue-green.

The anthocyanins in red cabbage are what act as the indicator. When you add acid to anthocyanins, the acid gives the anthocyanin a hydrogen atom, which makes the anthocyanin molecule a little bigger and changes its color to pink. When bases are added, they remove a hydrogen atom from the anthocyanin, making it smaller and changing its color to blue-green.

By the end of the activity, students will understand that many common household items are acids or bases. They will also discover that when an acid is added to a base, the solution becomes neutral and then acidic as more is added. Likewise, when a base is added to an acid, the solution becomes neutral and then basic.

Extensions:

- q Use the dyes, which result from testing acids and bases to make 'tie-die' cloth by dipping white cotton squares in the cups. The cloth can be held together with a rubber band to get the tie-die effect.
- q Try using the same solutions and use red and blue litmus paper to test whether solutions are acidic or basic.