



Chemical Magic

Overview: *Students will use red cabbage juice as an indicator dye to identify acids and bases.*

(Note: This lesson may be spread over two days.)

Materials

- safety goggles for students (See page 48, Delta Education)
- 1/4 head red cabbage
- 1 oz. clear plastic cups (available at stores which supply restaurants)
- dropper bottles or droppers (dropper bottles are available at Delta Education)
- white vinegar
- pure ammonia (without soap)
- Chemical Magic Data Charts (page 44)
- 6 oz. (178 mL) cups for cabbage indicator dye (one per group)
- vials of pH paper with color code (one per group). (See Carolina Biological in Resource section.)
- 3 small glass test tubes and rack

Lesson Preparation

Follow the recipe below to make about a pint of cabbage indicator dye.

Red Cabbage Indicator Dye

Materials: 1/4 head red cabbage chopped into small pieces water, glass bowl, microwave

Directions: Chop the cabbage into small pieces and place them in the bowl. Add just enough water to cover the cabbage and bring it to a boil. Boil for 3–4 minutes more. Pour the contents into a strainer and drain off the liquid into a container. Refrigerate until ready to use.

Label the 6 oz. (178 mL) cups “cabbage indicator dye” and fill them about 1/2 full. Place a dropper in each of these cups.

Pour the vinegar and ammonia into dropper bottles and label them. Give each group a set.

(Note: *Ammonia can not be in an open container, due to the fumes. If droppers are used, fill the droppers 1/4 full, and give one to each group.*)

Fill the test tubes 1/2 full with the dye and set them in the rack. **Optional:** Use inverted paper or Styrofoam cups with a hole in the bottom just large enough to hold the test tube.

Activity

1. Begin this lesson with a “Magic Show”. Place the test tubes with the dye in them where all students can see them. Have ready a vial of pH paper with the color code, and a bottle of ammonia and vinegar with the label concealed. Tell the students you are going to perform a magic show that they are to watch and be ready to write an explanation of what they saw. Follow the steps below.
 - Show the students the test tubes with the blue dye in it and have them note the color.
 - Into one of the tubes place three drops of vinegar and shake it. Let the students observe the color changed from blue to pink (or red).
 - Drop three drops of ammonia into another tube and shake it. Have the students observe that the color of the blue dye is now green.

Chemical Magic *(cont.)*

Activity *(cont.)*

- Have each student write and draw what they think caused the color change. When they finish this, discuss it with them.
- Introduce the students to the pH paper and show them the color code inside the bottle. Explain that this is a special paper which changes color to show if something is an acid or base.
 - Take one of the pH strips and place the lower half into the dye with no additives in it. Show the students the color change and hold the paper against the color code to match it. Write the pH number on the board and show that it identifies this as a neutral substance. Repeat this with the other test tubes, showing the dye with vinegar is acid and the ammonia a base.
- Provide each group with a cup of the dye, three 1 oz. (30 mL) cups, ammonia and vinegar bottles, and a copy of the data chart (page 43). Have them use the dropper to fill the small cups just enough to cover the bottom of it. Tell the students to follow the #1 chart and conduct the tests on the substances. Explain that they should only use one or two drops of the vinegar and ammonia and then, record the results on the chart as they work.
- Review the results the groups have recorded.

Closure

- Repeat the same tests, but this time provide students with a mystery liquid to test. This should be either an acid or base made by adding a few drops of vinegar or ammonia to 1 oz. (30 mL) cup of water. Do not provide the same mystery liquids to all groups so some will find it a base while others find it an acid.
- Students should use a dropper (or half of a straw) to transfer a few drops of the mystery liquid into the dye. They may use the pH paper dipped into the mystery liquid to get its value.
- After they have identified the mystery liquid as acid or base, reissue the dropper bottles of vinegar and ammonia to them. Have them add drops of the opposite type of liquid to their mystery liquid and test it again.
- Let them repeat this test again, but this time they use the dropper bottle with the matching acid or base as the mystery liquid was originally. **Note:** The groups should use the same container of mystery liquid throughout these tests.
- Discuss their results, all will not be the same. Let them see that as they add the opposite (base or acid) to their mystery liquid, it begins to approach neutral.

Extenders

- Let the students continue adding drops to the mystery liquid to achieve neutral if they can. Their pH paper will be the best identifier for this test.
- Send home the recipe for cabbage indicator dye along with a note to explain what the class has been doing. Encourage the parents to make the dye with their children and repeat the tests, using household items such as tea, shampoo, crushed and liquefied Tums™. Provide a time for the students to report their results to the class.

PH Value Range											
1	2	3	4	5	6	7	8	9	10	11	12
strong acid		weak acid			neutral		weak base			strong base	
Cabbage Indicator Dye											
orange		red	pink	purple	blue	blue green		green	yellow		
strong acid		weak acid		neutral		weak base				strong base	

Chemical Magic *(cont.)*

Chemical Magic Data Charts

To the Teacher: Make copies of these data sheets for each group to have one set.

Group Members			
1. Substances	Cabbage Dye	pH Value	Identify liquid (Circle your answer below.)
water	color:	pH	acid neutral base
vinegar	color:	pH	acid neutral base
ammonia	color:	pH	acid neutral base
2. Substances	Cabbage Dye	pH Value	Identify liquid
mystery liquid	color:	pH	acid neutral base
	color:	pH	acid neutral base
	color:	pH	acid neutral base

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