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by
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Holly shows excellent observation and record keeping skills. She realizes that some of the gigantic vegetables that are falling to earth are not products of the seedlings that she sent aloft. She doesn't consider her experiment a failure, but instead wonders where her vegetables have gone?

Vegetables and fruits can be used as natural indicators. An indicator is a substance that indicates or "points to" a change in matter. Indicators can be a certain color in one group of matter, another color in a second group of matter, and a third color when members from each of these groups are mixed together.

The cabbage that lands in Tony Kramer's field is definitely a prize winner. Red cabbage juice is a prize winning natural indicator because it is easy to make, safe to use, and exciting to observe. As an indicator, it can show a change in a most dramatic way.

MATERIALS: red cabbage, white vinegar, baking soda, water, 100 ml measure, spoon, gallon plastic bag, quart plastic bag

ACTIVITY: Step #1. Prepare red cabbage juice indicator: cut a small head into pieces, put pieces in pot, cover with water, bring to a boil and cook gently for five minutes. Pour "red" liquid into bottle, cover, and place in refrigerator. (Keeps for at least two weeks)

Step #2. Put 100 ml of white vinegar into one quart freezer bag.

Step #3. Put 100 ml of water into gallon freezer bag and add 1 heaping teaspoon of baking soda to the bag. Feel the bag as the baking soda mixes with the water. Is there a temperature change?

Step #4. WITHOUT "zipping up" the quart bag containing the vinegar, place the quart bag inside the gallon bag, squeeze out as much air as possible, and "zip up" the gallon bag. Let the contents of the two bags mix together and observe what happens with your eyes, ears, and hands!

Step #5. NOW, repeat steps 2-4 but add 10 ml of red cabbage juice to the vinegar in the quart bag and to the baking soda mixture in the gallon bag. Be a good scientist and record your observations!

EXPLANATION: White vinegar and baking soda mix together to produce a new substance, water, and a gas which fills the gallon bag. The new substance belongs to a group of chemicals called salts, and the gas is carbon dioxide. The reaction or change would happen without the red cabbage juice indicator, but it would not be as dramatic or as easy to see. The red cabbage juice "points out" that white vinegar belongs to one group of compounds (acids), and baking soda belongs to another group of compounds (bases). It "indicates" or classifies the groups of chemicals by changing color when added to each bag. It "indicates" the third group of compounds by changing color when the contents of the quart and gallon bags are mixed together.

EXTENSIONS:
(1) Red cabbage juice paper can be made by students by soaking coffee filters or pieces of paper towels in the leftover indicator juice. When dry, the paper can be taken home and used to test other liquids to see in which group of compounds they belong.
(2) After (or during) the study of plants, make a list the parts of a plant: root, tuber, stem, leaf, flower, seed, and fruit. Include fungi in your list because you will be classifying vegetables. Give your students the following list of vegetables: artichoke, arugula, asparagus, beans, bean sprouts, beets, broccoli, brussel sprouts, cabbage, carrots, cauliflower, celery, chicory, corn, cucumber, eggplant, escarole, garlic, kale, leek, lettuce, morel, mushroom, okra, onion, parsnip, peas, pepper, potato, pumpkin, radicchio, rutabaga, scallion, spinach, squash, sugar snap peas, sweet potato, Swiss chard, tomato, turnip, water chestnut, yam. Divide a piece of paper into 8 columns by folding, and put one part of a plant at the top of each column. Have fun classifying your list!

SOURCE: Indicator demo adapted from *ALChemie* Demo Derby presentation at Purchase College by Elise Hill Levine, May, 1993.

STANDARDS:
BSL: 1.1, 1.3, 1.7, 1.8, 3.2, 4.6, 4.7, 6.1, 11.2, 11.4, 12.1, 12.2, 12.3, 12.6
NCTM: 4d, 4e, 10d
SCS: A1, A2, B1, C1, H2

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