Apples Please…No Brown Ones!
Teacher Guide

Overview
This activity explores the relationship between the acidity/basicity of a substance and its effect on the browning of apple slices.

Materials (per group of 2 – 3 students)
5 fresh apple slices
¼ cup lemon juice
¼ cup vinegar
¼ cup water
¼ cup baking soda solution
¼ cup diluted antacid solution (such as Milk of Magnesia)
5 clear, plastic cups
Measuring cup
Marker
Masking Tape for labeling cups

Getting Ready
- Prepare the baking soda solution by adding water to the baking soda. Add enough water that all of the baking soda dissolves.
- Prepare the diluted antacid solution. A 1:1 ratio of water to antacid will work but the ratio is not important. The key is to simply dilute the antacid so that it flows more readily.

Procedure
Students are quick to notice that an apple left out at room temperature will brown fairly rapidly. However, many grocery stores and fast food chains now offer pre-cut apple slices that are often prepared and packaged days ahead of when the apples are sold. How do these apples maintain their original color? This activity will help students to answer this question.

Begin by showing students the materials and allow a few minutes for them to predict what effect, if any, the different liquids will have on the browning of the apple slices. Let students know that they will submerge an apple slice in each of the different liquids and observe the results.

Each team should gather their 5 cups and label each cup with the name of the liquid that will be in it (water, lemon juice, etc.) To the cup, students should add ¼ cup of the correct liquid as noted on the label. Once the students have their cups prepared, you will need to cut the apples and give each group five slices. Have students immediately place one apple slice in each of the cups and swirl the liquid and apple around to ensure that the entire apple has been coated with the liquid. Note: It is important to cut and distribute the apples when they are freshly cut to minimize any

Procedure (continued)
initial browning. Have students make observations of their apple slices immediately upon placing them in the liquids so that they have a baseline observation from which to compare future observations. Students should make observations at 1 hour and then again at 3 hours and note any changes. The final observations should be done the following day. All observations should be recorded on the Student observation sheet.

Results
The apple slices soaked in the acidic substances (lemon juice and vinegar) should show less browning than those soaked in the other three liquids. The apple slice in the water should be intermediate in browning while the apples in the basic substances (the baking soda and antacid solutions) should show the most browning.

Explanation
Apples, and many other fruits, contain an enzyme that reacts with oxygen from the air, turning the apples brown. When you cut the fruit, you damage the cells of the fruit which allows more oxygen from the air to react with the enzyme. The more oxygen reacting with the enzyme in the fruit, the browner the fruit gets.

There are ways to slow down the browning of the fruit. In this activity, students should be able to see that more acidic substances, like vinegar and lemon juice, slow down the browning process more so than basic substances (baking soda and antacid). Bases contain more oxygen and therefore actually speed up the browning of the apples. Other techniques, such as blanching, are effective at reducing the browning of fruit. If you choose, you might ask your students to explore some other factors that affect the browning of their fruit and continue the discussion!

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Student Observation Sheet

Name: _____

Time	Observations				
	Water	Lemon Juice	Baking Soda Solution	Antacid Solution	Vinegar
Immediately After Placing in Liquid					
1 hour					
3 hours					
The next day					