

LESSON 8:

APPLE SCIENCE

Students will explore the science behind why apples brown and experiment with how to prevent this chemical reaction.

OBJECTIVES

- Why do apples brown?
- How do you stop apples from browning?
- What chemical reaction occurs?
- What is the evidence that a chemical reaction has occurred?

SUPPLIES

- 4 Gala apples
- Knife to cut apples (for the teacher only)
- Cutting board
- 3 paper plates
- 3 large bowls
- 1 bottle of lemon juice
- 1 mixture of salt water (dissolve 1-2 teaspoons of salt in water)
- 1 bottle of plain water
- 12 pieces of paper and 12 pencils

See Extension for additional supplies

HOOK

🕒 5-10 min

Cut an apple in half for students to see. Watch as it begins to brown. Have students guess how long this will take. Time this to see how long it takes and who was the closest.

HYPOTHESIS

🕒 3-5 min

Discuss with students:

- Why do you think apples brown when cut?

Then, have students draw out the 'Scientist's Worksheet' and make the following predictions:

- Which liquid will delay the apple from browning for the longest?
- Which liquid does not help the apple stop from browning?
- Why does a liquid stop the apple from browning?

EXPERIMENT

🕒 15-25 min

1. Split students into groups of 4.
2. Give group an apple cut into 5 slices (1 per student plus a control) and one paper plate.
3. Make a bowl of each liquid (lemon juice, water, and salt water) and have students submerge one apple slice in each liquid for 1-3 minutes (keep this time consistent for each liquid) and then lay it on their plate next to the correct label.
4. Have students time the apples to see how long they take to start turning brown.
5. Check the apples at 3-5-minute intervals. After 15 minutes, record the results of which apple is the brownest.



CHEMICAL REACTION

A chemical reaction is where different substances (reactants) are changed into a new substance (product)

SIGNS

- change of color
- change of temperature
- change of smell
- production of gas
- production of a solid
- emission of light

KEYWORDS

- Oxidation
- pH
- Enzyme
- Melanin
- Ascorbic acid
- Oxygen

OBSERVATION

🕒 5-10 min

Ask students to discuss:

- Did all the apples brown at the same rate?
- Did the apple that turned brown first turn the brownest overall?

Students should report that the apples browned at different rates. The apple that browned first should have been the brownest at the end of the experiment.

CONCLUSION

🕒 3-5 min

Ask students to share their findings.

- Which liquid stopped the apple from browning the longest?
- Which liquid does not help stop the apple from browning?
- Why do you think liquids stopped the apples from browning?

Students should note that the salt water was able to stop the browning the best. It may be that students do not see much of a difference between the browning of the apples which were in lemon juice and salt water. The plain water was the least effective but was still more effective than the control slice with no liquid. Students may have various explanations as to why the apples have browned but remind them to use their knowledge of chemical reactions to help them make their predictions.



EXPLANATION

🕒 5-10 min

When apples are cut, the inside of the apple is exposed to oxygen. The oxygen makes an enzyme in the apple, called polyphenol oxidase, begin to react, and oxidize, creating new chemicals called o-quinones. The o-quinones then react with amino acids and it produces melanin, which is what creates the brown color you see on the apple.

Different types of apples have various levels of polyphenol oxidase, so may brown at quicker or slower rates. The browning of apples is a chemical reaction because the oxygen and the enzymes create a new chemical, melanin, which changes the apple's color. We know from our learning at the start of the session that one sign of a chemical reaction is a change of color.

To slow the browning process, the idea is to coat the apple in a protective layer that stops the oxygen from reaching the polyphenol oxidase in the apple, so that the chemical reaction does not occur.

The liquid used in the experiment slowed the oxidation process in diverse ways. Plain water coated the outside of the apple and helped prevent the oxygen from reaching the polyphenol oxidase in the apple. However, after a short amount of time, the water was not able to continue to keep the oxygen away from the apple flesh and the apple began to brown.

Lemon juice is well known for preventing apples from browning. Lemon juice works because it contains ascorbic acid and has a low pH (it is very acidic). Ascorbic acid creates a barrier with the oxygen and the polyphenol oxidase. Additionally, polyphenol oxidase reacts best at a pH level of 5-7. Lemon juice is a level 2, which prevents the polyphenol from beginning to react, as the apple has a lower pH level with lemon juice on it.

Salt water was the most effective way of preventing the oxidation of the apple. Salt water contains chloride ions which prevent the polyphenol oxidase from reacting. It also contains water which acts as a barrier between the oxygen and apple flesh. The combination of these two things makes it take the longest for the oxidation process to affect the apple and for the melanin to be produced.

CLEAN UP & DISMISSAL

🕒 3-5 min

Students must then clean their workspace. Liquids and apples can be disposed of safely. Make sure to leave the classroom the way you found it.



SCIENTIST'S WORKSHEET

Tip: Can draw or write the following down on whiteboard!

	Hypothesis - Which will brown the quickest?	Observation - How long did it take to start browning?	Observation - Which was the brownest after 15 minutes?
Lemon Juic			
Water			
Salt Water			

EXTENSION

 5-10 min

If students have time to expand on this experiment, try one of these alternatives:

- Have students repeat the experiment but with other liquids. With their knowledge of pH levels, can they accurately predict which liquids will slow the browning the best?
- Have students choose one liquid (lemon juice or salt water) and repeat the experiment on several different types of apples. Students can then assess which apple type browns the quickest.

Optional supplies for extension:

- 1 can of pineapple juice
- 1 bottle of milk
- 1 bottle of vinegar
- 2-3 apples of different varieties

