APPLE TOOTH DECAY: HOW DO CAVITIES HURT YOUR TEETH?

Grade Level: elementary school

BACKGROUND:

In this experiment, students use an apple as a model to investigate tooth decay. Like most models, the apple is not a perfect model for investigating tooth decay; an apple is not a tooth. However, you can use the apple model despite its limitations to help students transfer ideas about the apples to ideas about tooth decay.

Tooth decay (dental caries) is often recognized as a hole in the tooth, or a cavity. A **cavity** is actually the late stage of a dental infection that causes the tooth enamel to lose minerals. The apple model's "hole in the apple" analogy is not entirely accurate because tooth decay begins *under* the surface of the enamel and not as a break or hole in the enamel. If the decay process continues unchecked, a cavity, or hole, eventually appears in the enamel. This, however, is a fine distinction and one that students don't need to make. It is sufficient for students to discuss tooth decay as "cavities" in teeth at this time.

The apple is a good model because it graphically illustrates decay spreading into the apple from a hole in its surface. From this observation, students make predictions about tooth decay that starts from actions on the surface of the teeth. Students don't need to understand details about how the decay process happens yet.

In this experiment, students will ask questions, conduct an investigation, gather data, and communicate their results. Practice with scientific inquiry will help students understand the process of tooth decay and develop the skills needed to understand the world around them.

OBJECTIVES: After completing this activity, students will

- be able to plan and conduct a simple investigation and to share results with others;
- recognize that simple tools, such as hand lenses, thermometers, and balances, provide more information than the students can acquire using only their senses;
- realize that the processes of scientific inquiry can help them ask and answer a question;
- explain that scientists use models when they cannot investigate real things; and
- describe that cavities are the result of a process that begins in the enamel of teeth.

HYPOTHESIS: An apple with a hole poked in it will rot more quickly than an apple without a hole. Other factors (temperature, number of holes, etc.) will influence the amount of rot seen in the apple.

DURATION:

Set-up time: 30 minutes (one class period)

Experiment's run time/data collection: 45 minutes, two days after set-up, for observations, data collection, and discussion

Take-down time: 5 minutes

MATERIALS:

For the class:

- 1 apple, preferably Red Delicious
- 2 or 3 thermometers
- sharp knife to cut apples (for teacher's use only)
- assorted materials for student investigations, such as plastic containers with lids; plastic wrap or small plastic bags; aluminum foil
- sheets of flip chart paper
- markers

For each team of 2 or 3:

- 1 apple, same type as control apple
- 1 hand lens
- 1 sharpened pencil

For each student:

- 1 copy of the Apple Record Page (at the end of this file)
- 1 pencil
- crayons or markers

PROCEDURE

1 EXPERIMENT SET-UP

1.1 Show students an apple. Ask them to compare the apple with a tooth. How is the apple like a tooth? How is it different from a tooth?

1.2 Set the stage for investigating tooth decay by asking students what they think would happen inside the apple if someone used a pencil to poke a hole in its skin. Tell students they will conduct a scientific investigation about an apple with a hole in it.

1.3 Students will plan and conduct their investigations in teams of two or three. Each team will choose a question they think they can answer by investigating. For example, What will happen to the apple if we poke five holes in it and put it in the closet?

*Other examples of questions to study include:

What would happen if

- we poked more than one hole in an apple?
- we made some holes deep and some holes shallow?
- we made some holes larger than others?
- we poked one or more holes in the apple, then put it in a plastic bag and sealed it?

- we poked one or more holes in the apple, then put it in the refrigerator?
- we poked one or more holes in the apple, then put it in a sunny place?
- we poked one or more holes in the apple, then put it in a dark, warm place?

1.4 The team will write its question or have an adult help them write the question.

1.5 The team members will decide who will perform each task.

2 EXPERIMENT EXECUTION

2.1 After teams have confirmed their scientific question and decided who will perform the tasks, distribute one apple per team.

2.2 As a class, determine where to place the control apple. Make sure students know that they should observe the control apple as well as their experimental apple each time they make observations.

2.3 Have students prepare a records page (see Apple Record Page at the end of this example) that addresses the following questions:

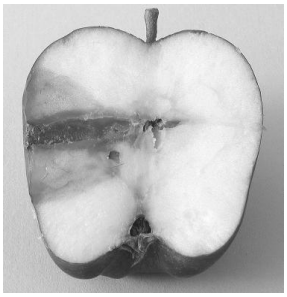
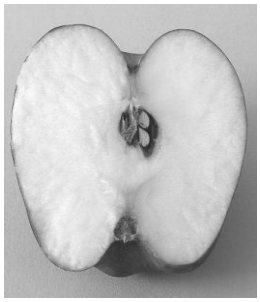
1. What will happen to our apple if... (start hypothesis)
2. Draw a picture of and write what they did to the apple
3. We think our apple will... (end of hypothesis)

2.4 Allow students to poke, treat, and manipulate the apples according to their hypotheses.

2.5 Over the next 5 to 7 days, allow students to briefly observe the experimental and control apples. Because the change is gradual, require students to record their observations only once at the beginning, once in the middle, and once at the end of the investigation. Encourage students to use hand lenses and thermometers to record data about their apple or the environment of the apple.

2.6 After 5 to 7 days (whatever time you designate for the investigation), cut open each team's apple and the control apple. Instruct teams to observe their own apple and to record the results on their record page. Note that the inside of the apples will turn brown quickly after you cut them open. (See Figure 1.)You might wait to cut open the control apple until students have recorded the results from their experimental apple.

Figure 1. Halves of two apples cut open after 5 days of observation: Left, 5 days after poked with a pencil; right, control apple (not poked).

2.7 Display all the team apples and the control apple. Label each apple according to its variables: number of holes, size of holes, in a plastic bag, in the refrigerator, in a closet, and so on. Invite students to observe the results from all the apples.

2.8 Have students complete the sentence: "After __ days, our apple..."

3 EXPERIMENT TAKE-DOWN

3.1 After the results have been documented, the apples can be discarded into the regular trash or compost.

DATA ANALYSIS AND QUESTIONS TO CONSIDER:

1. Review the teams' responses to Question 3 above (We think our apple will...). Discuss whether their responses were accurate and why initial ideas are not always accurate.

2. Discuss the results of their investigation

- What happened inside the apple? The inside of the apple turned brown; it began to decay.
- What made the apple begin to decay? We poked a hole in the skin or peel of the apple.
- What did the hole allow to happen inside the apple? The hole allowed something to get inside the apple and start the decay process. What is your evidence that something got inside the apples that had the holes? The inside of the apples that had holes turned brown. The inside of the control apple did not turn brown.
- Did all apples show the same amount of decay on the inside?
- Which apples showed more decay and why do you think that is?

3. Since this apple is a model for our teeth, why is it important to protect your teeth so that they do not get holes in them?

If the bacteria in your mouth create a hole in the enamel of a tooth, then that tooth will decay, similar to what happened to the inside of the apple.

Remember that the apple is not a perfect model of a tooth. The decay process is not the same, although the appearance might be similar. The inside of the apple will turn brown upon exposure to the air. Tooth decay requires acids produced by oral bacteria.

4. Review the processes that students used to answer their initial question about the apple. Help students compare what they did to what scientists do when they conduct investigations or experiments. Help students realize that they can be scientists.

- Scientists ask a question. (What questions did students ask?)
- Scientists plan their investigation and use a control to try to answer their question. (How did the students plan and conduct their investigations? Did they use a control?)
- Scientists make predictions about what they think might happen. (What were students' guesses?)
- Scientists use their senses to observe and gather evidence or data. (How did the students use their senses?)
- Scientists use tools to help them observe and gather data. (What tools did students use? How did using those tools help them?)
- Scientists record their observations and data. (Where did students record their observations?)
- Scientists share their evidence and data with others. (How did students share their evidence?)
- Scientists use their evidence and data from investigation results to answer their question or explain what happened. (How did students use their evidence to answer their question?)

6. To end the activity, ask students what they would do differently if they repeated their investigation.

7. Congratulate the students on their work as scientists.

CONCLUSION: In our classroom experiment, we saw that poking a hole in an apple speeds up the rotting of the apple.

Apple Record Page

Scientists' Names: _____

_____

1. What will happen to our apple if _____

_____

_____

2. This is what we did to our apple. Draw a picture here.

Write what you did to your apple here.

_____

_____

_____

3. We think our apple will _____

_____

4. This is a record of what happened to our apple:

Date	Our Experimental Apple	The Control Apple

5. After _____ days, our apple _____

_____

_____