

Fluorides

A Teaching Resource

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Fluoride Committee
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Table of Contents

Introduction	Page 1
Background	Page 1
Tooth Decay	Page 1
Topical and Systemic Fluorides	Page 2
How Fluoride Work	Page 3
Effectiveness of Various Fluorides	Page 3
Suggested Student Activities	Page 4
Factors necessary For Tooth Decay (diagram)	Page 5
The Causes of Dental Decay (diagram)	Page 6
How Fluoride Reaches A Developing Tooth (diagram)	Page 7
Deminerlization vs Reminerlization (diagram)	Page 8

APPENDIX

A. The Fluoride "Eggsperiment"	Page 9
B. Coloring/Activity Sheet	Page 12
C. The Story of Tooth Decay (diagram)	Page 13
D. Fluoride - Its Effect on One's Oral Health	Page 14
E. Community Dental Health Programs	Page 17

Introduction

The following information can be used as a resource when discussing the role of fluorides in the reduction of tooth decay. The actions of both systemic (ingested) and topical (those placed directly on teeth) fluorides will be described.

Background

Fluoride is a common element in the earth's crust, and is present in many minerals and in soil and water. In areas that are rich in fluorine-containing minerals, water from wells may have high levels of fluoride.

Fluorine-containing dusts and gases are discharged into the atmosphere by active volcanoes and by many types of industrial activities. All vegetation contains some fluoride. Some foods such as fish, meat, wine and tea contain higher levels of fluoride.

The relationship of fluorides and dental health was discovered in the early 1900's, but it wasn't until the 1930's that extensive studies began. Since then hundreds of studies have been undertaken.

Fluoride has been proven to be a cost-effective way of preventing tooth decay.

Tooth Decay

Dental caries (tooth decay) ranks among the most prevalent diseases in our society. It starts soon after primary teeth erupt in early childhood and can continue throughout adulthood. Only a few years ago, most people believed that tooth decay was inevitable and had to be endured. Today, we know this disease can be prevented.

Scientists have established that the process of tooth decay requires three factors: (1) a susceptible tooth, (2) certain bacteria (found in plaque) and (3) certain foods (particularly sugars) in the diet.

Figure on page 6.

Plaque is a colorless sticky layer which forms over the teeth. This sticky layer absorbs dissolved food substances, providing nourishment for the bacteria. The acid (formed when food and bacteria combine) dissolves minerals from the surface of the tooth until a cavity is formed.

Efforts to prevent tooth decay attempt to eliminate one or more of the three causative factors by controlling or inhibiting bacterial growth (plaque) on the teeth; by decreasing the acid-forming potential of the diet or modifying eating habits; or by making the teeth more resistant. The ***figure on page 7*** displays the plaque to acid equation.

Methods to inhibit or control bacteria in the mouth include the use of fluoride as an antibacterial agent and mechanical daily removal of dental plaque with a toothbrush and dental floss by the individual.

Teeth can be made more resistant to dental decay by swallowing fluorides during the period of tooth formation as with **systemic** fluoride (e.g.: water fluoridation) and by placing **topical** fluoride directly onto the teeth (e.g.: fluoridated toothpaste).

The benefits of fluoride are not limited to children; adults obtain substantial benefits as well. Older adults are retaining their natural teeth into advanced age, but they generally experience more gingival (gum) recession. Gingival recession results in the root surfaces being exposed and these areas are at a high risk of decay. Fluoride provides the root surface the same benefits as the chewing surface.

Topical Fluorides

Topical fluorides unite with the tooth surface making it more resistant to decay and helps to repair microscopic stages of decay.

The most commonly used method of topical fluoride is fluoridated toothpaste. Other forms include fluoride mouthwashes/rinses, chewable tablets and professionally applied fluoride applications.

Fluoride toothpastes are recommended for all ages. Children 3 and older should be supervised to ensure they use only a small amount of toothpaste (about the size of a small pea). Toothpaste should not be swallowed.

Systemic Fluorides

Systemic fluorides incorporate into the tooth surface during tooth development making the tooth surface more resistant to decay.

Water fluoridation has proven to be the most cost-effective method to benefit a community regardless of age, economic or educational level, individual motivation or the availability of dental manpower.

Fluoridation is the adjustment of the natural fluoride content of a community's water supply to an optimal concentration for the prevention of tooth decay. The optimal range is 0.7 to 1.2 parts per million (ppm).

Some communities in Saskatchewan have optimal **natural** levels. Contact your health region to find out which communities in your area have optimal natural or adjusted fluoride levels.

In addition to the direct benefits, fluoridation has many indirect advantages such as less pain from dental infections, fewer abscessed or missing teeth due to decay, reduced need for dentures, fewer cases of misaligned teeth caused by early loss of baby teeth and fewer less costly dental visits.

Fluoride tablets or drops also offer systemic protection for individuals at high risk of tooth decay. Chewable tablets are preferable to drops as they offer both systemic and topical protection. Consult your dentist or health region public health office for more information on fluoride supplements.

How Fluoride Works

Not long ago teeth exposed to systemic fluorides were thought to develop an enamel with a different structure than those not exposed to fluorides. This "different" enamel was thought to resist the acids produced by bacteria found in plaque. Recent research partially agrees with this theory but also concludes that exposure of the surface of enamel to topical fluorides may be a very important factor.

The **figure on page 8** shows how fluoride reaches a developing tooth. The fluoride that enters the surface enamel makes it more resistant to acids in the mouth once the tooth has erupted.

The **figure on page 9** shows how fluoride helps heal early decay through a process known as remineralization. Exposure to acids demineralize the enamel (minerals in the enamel surface leave). When fluoride is present, the fluoride ions combine with minerals in the saliva and remineralize (rebuild) the enamel surface. This process goes on constantly on the tooth surface and decay occurs when repairs can't keep up with the demineralizing actions.

Effectiveness of Various Fluorides

The effectiveness of different types of fluoride will depend on the frequency and duration of exposure. As most of us will be exposed to different types and quantities of fluorides at different stages of life it is very difficult to estimate individual decay reduction with any one method.

Approximate percentage reduction in dental decay for a few methods is as follows¹:

School Mouthrinse Programs

- 20-50% (through school years)

Fluoride Toothpaste

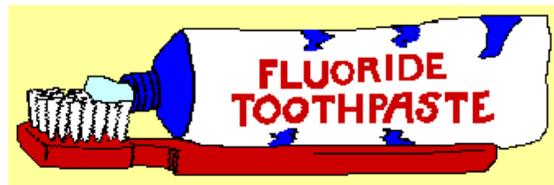
- 20-30% (lifetime)

Community Water Fluoridation²

- 30-60% (less than 8 years of age)

- 20-40% (ages 8 to 12)

- 15-35% (age 14 to senior)



Suggested Student Activities

¹ Horowitz, Herschel S., ed., Achieving Oral Health for the Individual, Family, and Community. the Journal of Health Promotion and Maintenance, Vol. 3, No. 3, November 1980, p. 95.

² Newbrun, Ernest, Effectiveness of Water Fluoridation, Journal of Public Health Dentistry, Vol. 49, No. 5, Special Issue 1989, p. 279.

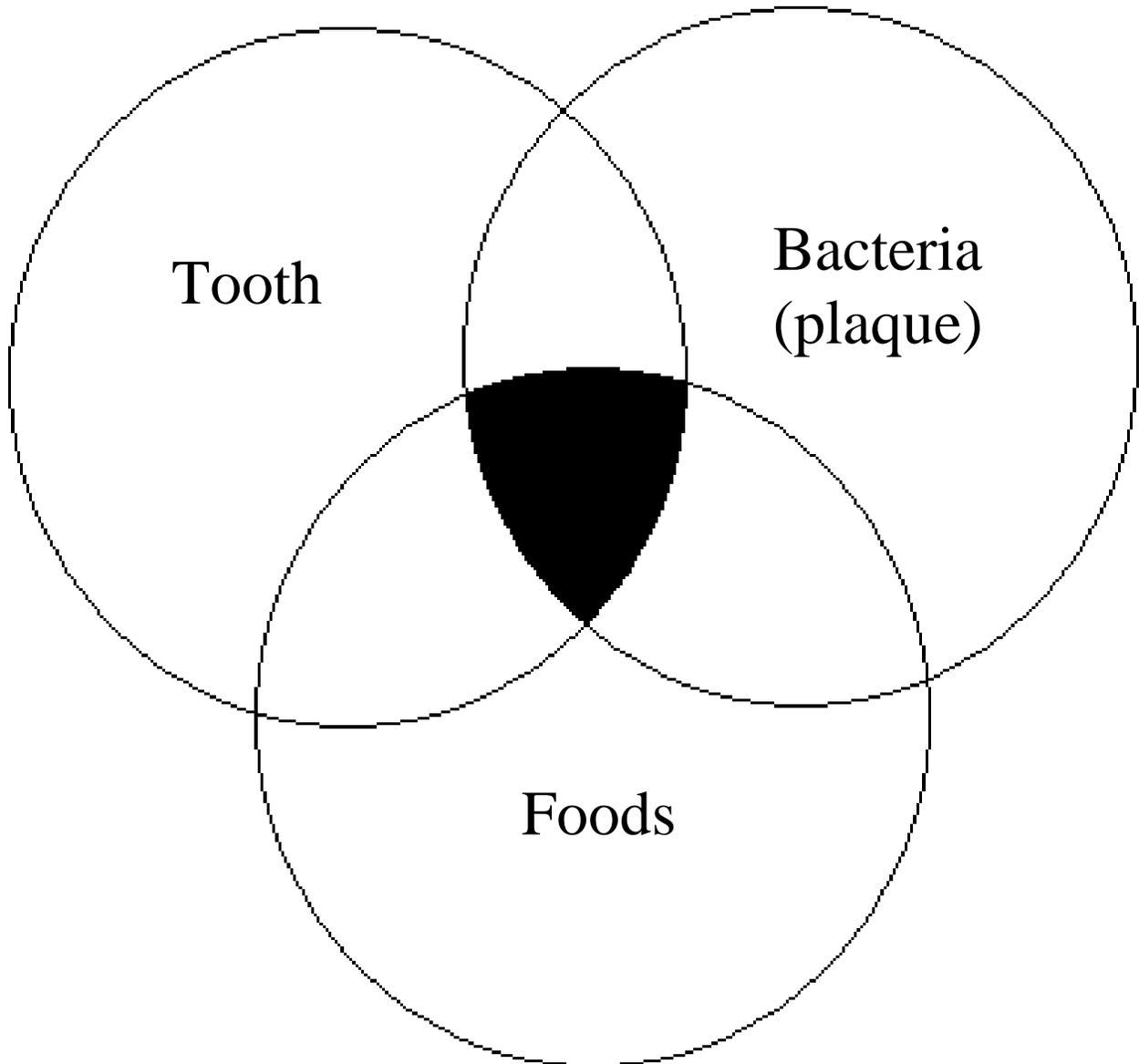
Objective: To make students aware of the benefits, actions and sources of fluorides.

1. Collect names of products that contain fluoride.
2. Make a collage of pictures of products that contain fluoride.
3. Contact your local public health office to find out the level of fluoride in your school water system. Have your school water system tested to obtain the level of fluoride.
4. Have students interview local dentists to discover the cost of dental treatment that could be avoided with the use of fluorides.

Other ideas which are in the appendix are:

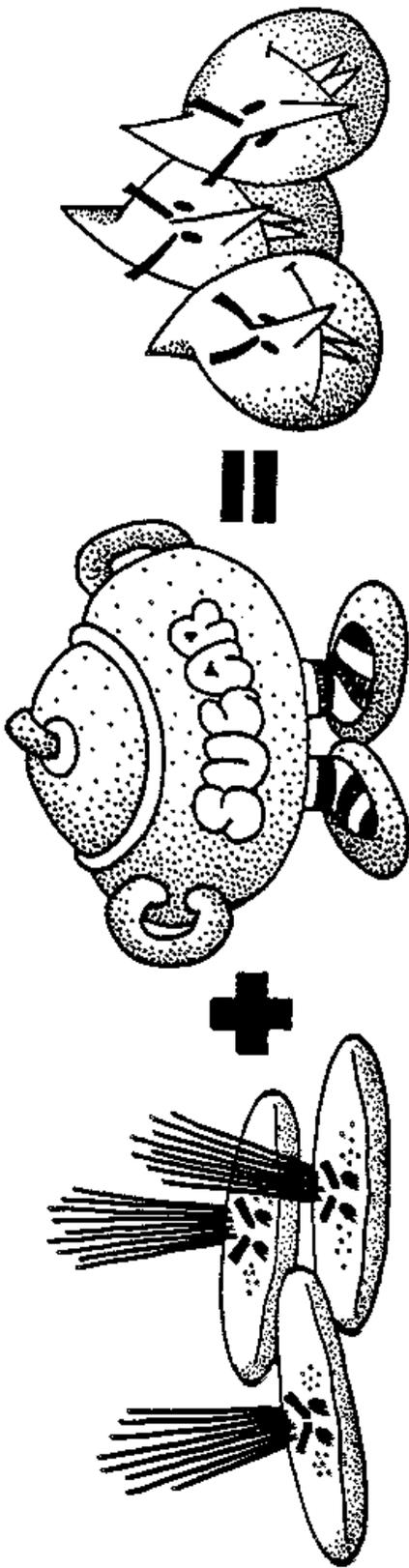
5. Fluoride "Eggsperiment" - Appendix A.
6. Coloring/activity sheet - Appendix B.
7. The Story of Tooth Decay - Appendix C.
9. Fluoride - Its effect on one's oral health - Appendix D.
10. Community Dental Health Programs - Appendix E.

Factors Necessary for Tooth Decay



The overlap in the shaded area indicates the possibility of disease.

The Causes of Dental Decay



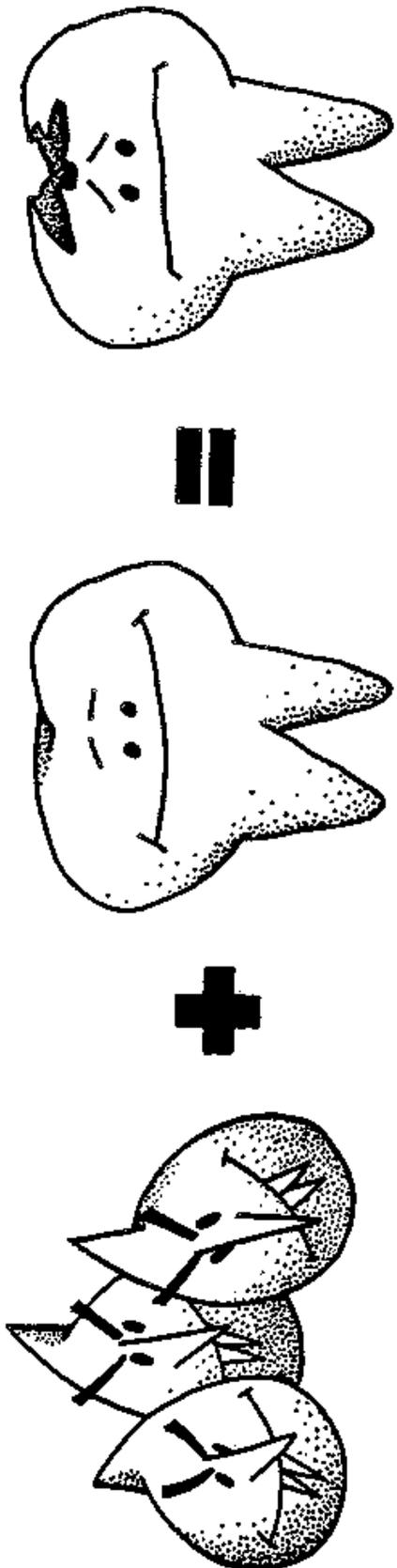
Bacteria (in plaque)

Sugar

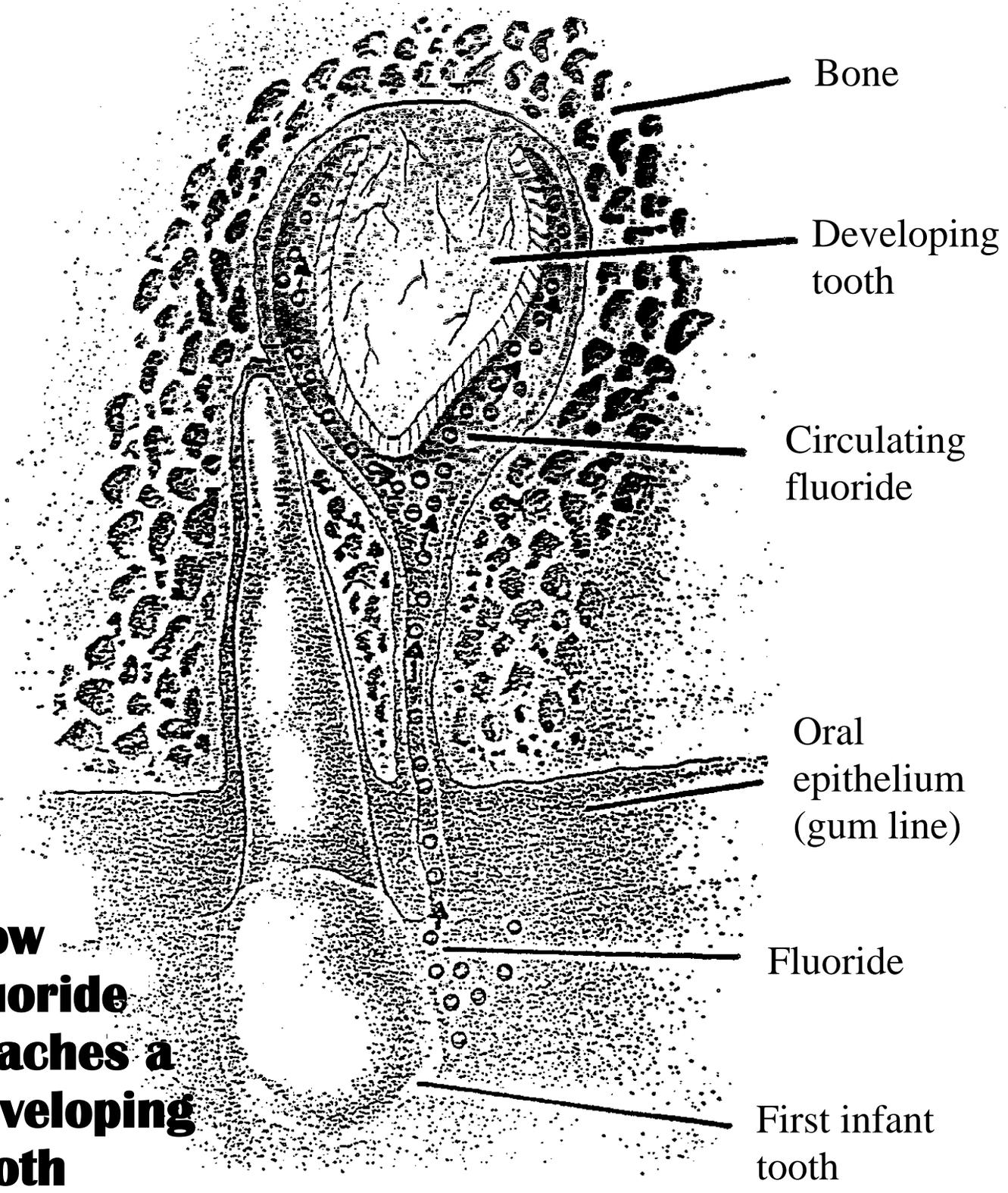
Acid

Tooth

Decay



Acid



**How
fluoride
reaches a
developing
tooth**

Bone

Developing
tooth

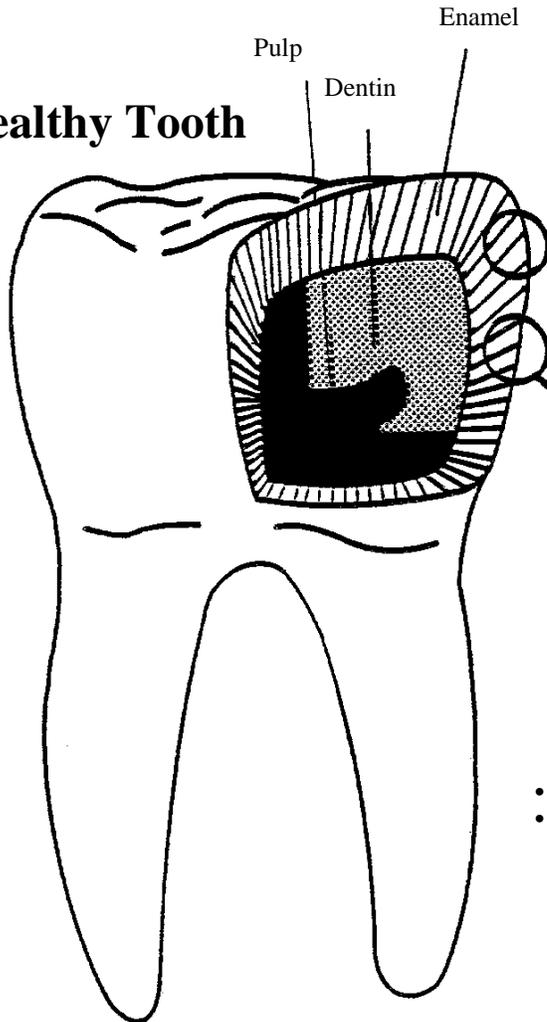
Circulating
fluoride

Oral
epithelium
(gum line)

Fluoride

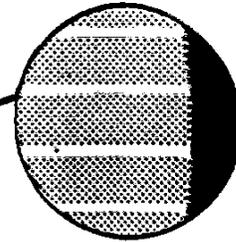
First infant
tooth

A Healthy Tooth



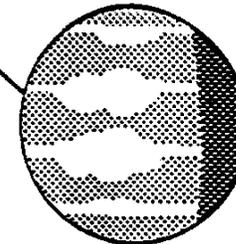
Healthy Enamel

- Extremely hard but porous.
- Made up of many closely packed mineral rods.



Decay Process

- Bacterial Plaque ÷ Carbohydrates = Acids.
- Acids seep down spaces between mineral rods and dissolve them below the surface.
- This is a process called demineralization.

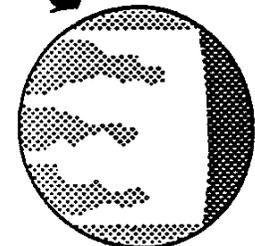
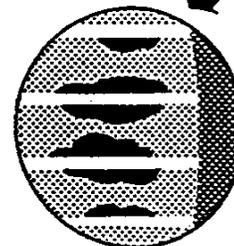


Weakened Enamel

- Continued demineralization can cause an area of many weakened enamel rods.
- May look chalky or whiter than normal.

Remineralization
exceeds demineralization

Demineralization
exceeds remineralization



Demineralization

VS.

Remineralization A Constant Battle

Rebuilt Enamel

- Minerals from saliva (plus fluoride) seep down rods to rebuild them.
- This is a process called remineralization and is enhanced by fluoride.

Cavity

- Surface enamel collapses.
- Cavity requires filling.

Appendix A

The Fluoride "Eggsperiment"

This activity illustrates how fluoride helps make teeth strong to fight acid attack. It is intended for you to do as a demonstration, with the students observing the results in order to understand how fluoride toothpaste protects teeth.

Suggested Lesson Plan

1. Introductory Class Discussion	
Sample Questions For Discussion:	Key answers to prompt for:
a. Why is it important to brush our teeth?	- Toothpaste helps make your teeth strong.
b. What are cavities?	- Acid is natural; we have some in our bodies and it comes in food too.
c. What is acid?	- Acid in our mouths can cause cavities.

2. Comparison: Key Premise for "Eggsperiment"

Point out:

- eggshells are hard like our teeth; they have to protect the egg.
- vinegar is an acid, like the acid in our mouths.

3. Do the "Eggsperiment"

Materials:

- a tube of non-tartar, non-gel, non-baking soda toothpaste that contains .243% sodium fluoride. (Check the small print on the front/side panel of the box).
- a glass measuring cup (2 cup).
- a fresh egg without cracks.
- table vinegar.
- a teaspoon.
- plastic wrap.
- a marker/pen.
- clear nail polish
- paper towel

Note: Try doing a few eggsperiments at the same time in case you accidentally drop one.

Method:

Note: The entire experiment will take 5-6 days. To avoid weekends and late nights start on Thursday or Friday afternoon/evening.

Check the box when each step is completed.

- 1. Let the egg warm to room temperature (3 hours).
- 2. Empty full tube of toothpaste into measuring cup.
- 3. Pat down toothpaste with a teaspoon to make it level and help remove any air bubbles.
- 4. Wash your hands.
- 5. Wash the egg with warm tap water and dry it with the paper towel.
- 6. With a marker or pen, mark one side of the egg with a small X to show the side that will not be covered (protected) by the toothpaste.
- 7. Cover the mark with clear nail polish to protect it from the vinegar.
- 8. Place the egg horizontally into the measuring cup, marked side up, so the toothpaste covers half the egg, making sure the egg doesn't touch the bottom of the cup.
- 9. Cover the cup tightly with plastic wrap and put it in a safe place and leave it at room temperature for 4 full days.
- 10. Four days later, wash you hand then carefully remove the egg with a teaspoon and rinse off all the toothpaste with warm tap water.
- 11. Put the egg on a clean, dry surface and let it dry overnight. Wash the measuring cup.
- 12. The next day, pour enough vinegar into the measuring cup to cover the egg.
- 13. Carefully place the egg in the vinegar with a teaspoon.
- 14. Rest the teaspoon on the egg so the egg remains under the vinegar.



15. Gas bubbles will quickly begin to rise from and form around the unprotected side of the egg. The shell is being attacked by acid and is losing calcium. (Eventually bubbles will appear on the whole egg).

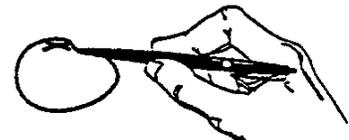


16. Leave the egg in the vinegar until the unprotected side of the shell softens (side with the X). This will take between 7 and 13 hours.

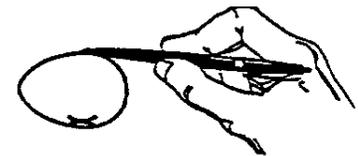
If in 7 hours you are asleep or you won't be around, remove the egg from the vinegar before you leave/go to sleep, wash it with warm tap water and leave it on the counter. Do not leave it out of the vinegar for more than 12 hours. Mark down how many hours the egg was in the vinegar. The next morning or when you return, put it back in the vinegar.

17. After 7 hours remove the egg and check if unprotected side has softened by tapping very lightly with your finger. If it has softened, skip to step #19.

18. If the unprotected side is still hard, put it back in the vinegar. Check it every hour or two afterwards until the egg shell has softened.



19. When the unprotected side is soft, remove the egg and gently wash it with warm tap water. (Careful, it may be really soft).



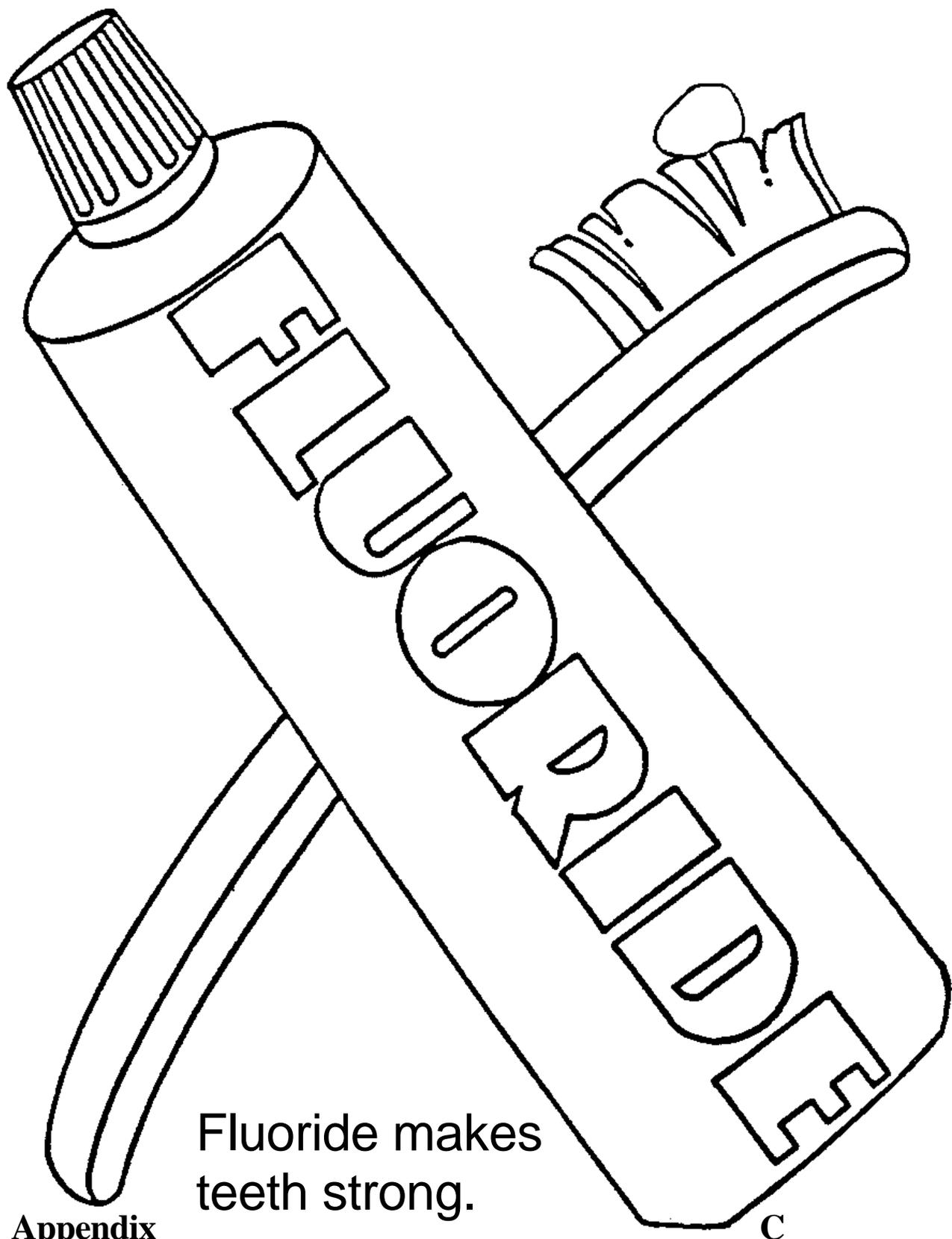
20. Tap the unprotected side (side with the X) with your finger or a pen. The shell should be soft and weak.

21. Tap the protected side. The shell should be hard and strong. That's because the fluoride toothpaste helped lock in calcium on the protected side. The other side had nothing to protect it. In the same way, fluoride toothpaste helps lock in the calcium in your teeth so they'll be strong and protected from cavities.

4. Closing Discussion For Completion of "Eggsperiment": What Did We Learn?

Sample Questions For Discussion:

- a. What happened to the eggshell?
- b. What happened to the part that had been protected by toothpaste?
- c. What does the eggshell represent? What does the vinegar represent?
- d. Why do we need to brush our teeth with fluoride toothpaste?

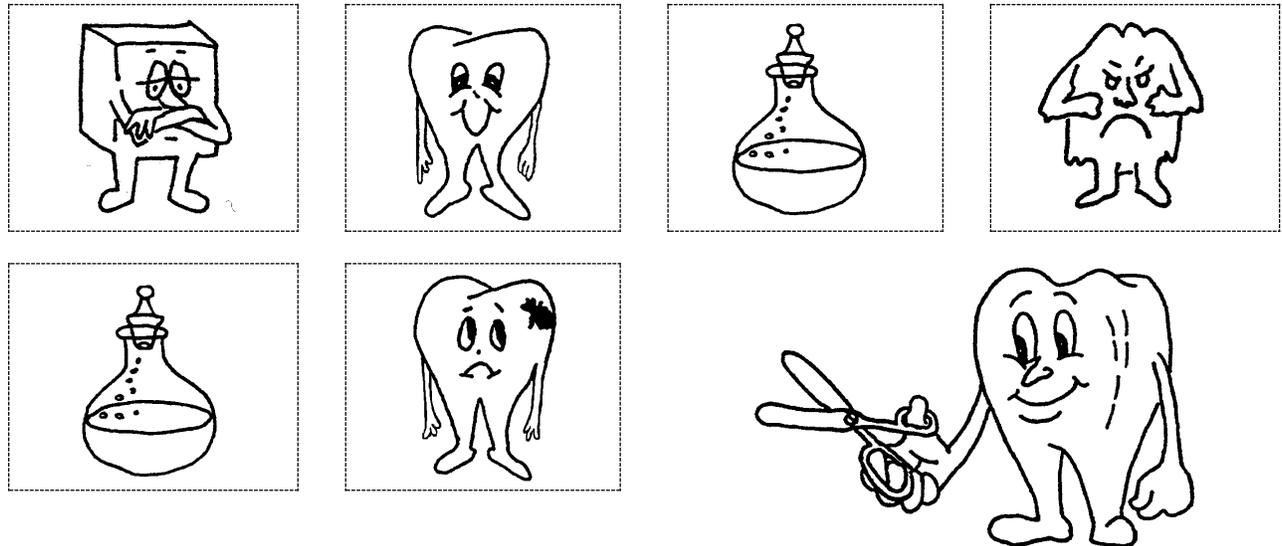
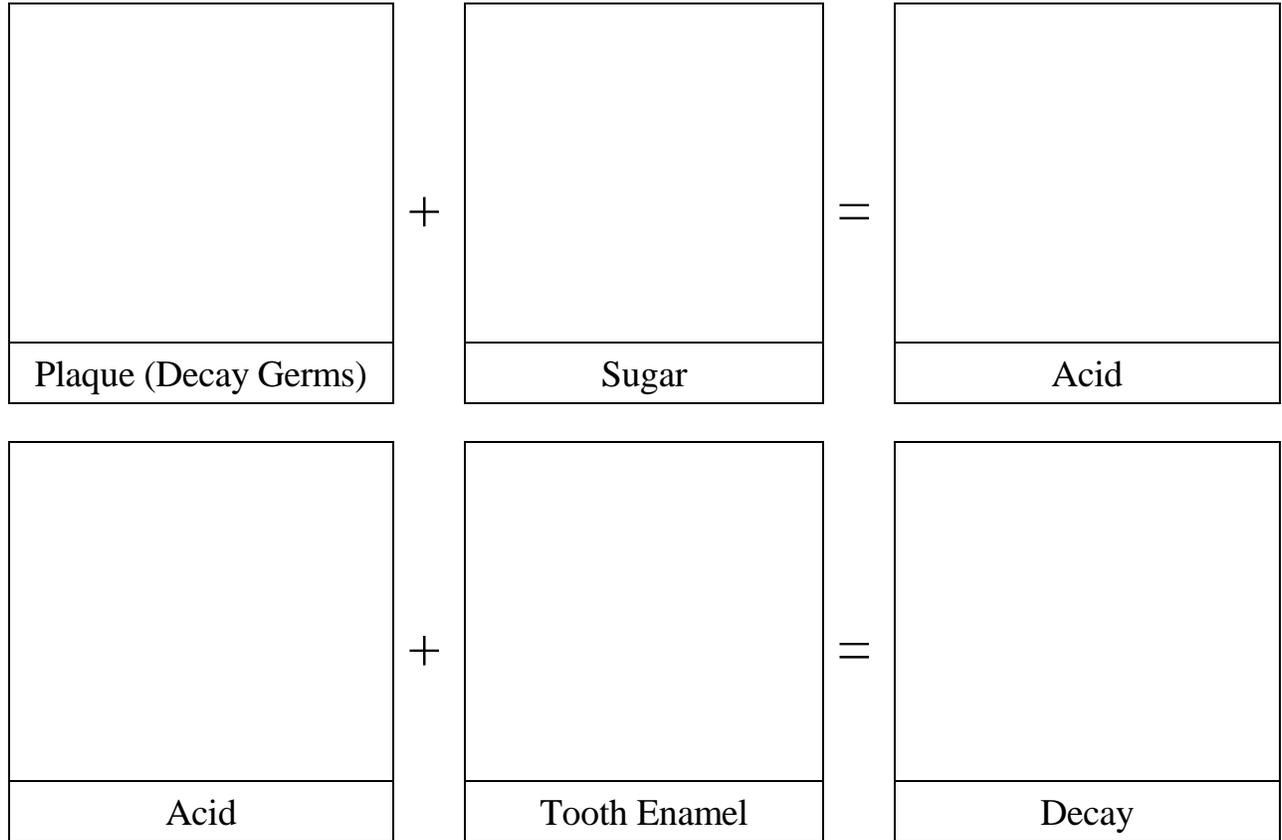


Fluoride makes
teeth strong.

Appendix

C

Instruction: Cut and paste the pictures below in the correct slot to tell the story of tooth decay.



Appendix D

Fluoride - Its Effect On One's Oral Health

Goals:

- To develop an understanding of the effectiveness of fluoride in the prevention of dental caries.
- To develop awareness of the ways in which fluoride may be made available to the teeth.

Behavioral Objectives	Content	Suggested Activities	Related Activities in Other Classes
<p>The student can indicate the extent to which adequate fluoride content in the community water supply can reduce the incidence of dental caries.</p>	<p>Fluoride is a natural substance found in many foods and all water supplies, in various amounts. When the community water supply contains one part fluoride per million parts water (1 ppm) teeth of people who drink it from birth have about two-thirds fewer cavities than those of people drinking water not containing an adequate amount of fluoride. Fluoride is built into the enamel of the teeth so that they become more caries resistant. When the level of fluoride is too low, it can be adjusted by adding fluoride to bring the level to 1 ppm</p>	<p>Have the class study the transparency, "How Fluoride Reduced Caries in a Large U.S. City". Point out the difference between the percent reduction among those drinking fluoridated water from birth, and those receiving its benefits later in childhood. (The difference between 6 and 8 year olds may arise from the former having received the benefits of fluoride during the prenatal period.)</p> <p>Assign a group of students to ask the local health department if the community water supply:</p>	<p>Extra-curricular activities: Prepare an article on fluoridation for the school newspaper. Discuss the benefits of fluoride and why every community should have fluoridated water.</p> <p>Social Studies: If possible, coordinate this activity with the Social Studies teacher and the librarian.</p>
<p>The student can indicate important stages in the history of fluoride's recognition as a caries preventive substance.</p>	<p>History of the recognition that fluoride is valuable to dental health</p> <p>Early 1900s - dentists noted relation between certain stains on teeth and lower rate of caries.</p> <p>1931 - excessive fluoride identified as stain-causing</p>	<ol style="list-style-type: none"> 1. Is adequately fluoridated to help prevent caries? 2. Is adjusted to provide an adequate fluoride level? 3. Has had the fluoride level controlled for a number of years? 4. Was there ever a local 	

Behavioral Objectives	Content	Suggested Activities	Related Activities in Other Classes
	<p>agent.</p> <p>1945 - 10-year study of effects of water supplies having varying amounts of fluoride begun.</p> <p>Late 1940's, early 1950's - establishment of the effectiveness and safety of 1 ppm of fluoride in the water supply, as a caries preventive measure.</p> <p>At present, among the many groups which support fluoridation are the American Dental Association, the American Medical Association, the World Health Organization, the American Public Health Association, and virtually every other major organization in the fields of science and public affairs including the American Association for the Advancement of Science.</p>	<p>referendum?</p> <p>5. Has state legislative action been taken?</p> <p>6. Obtain statistical data about the incidence of dental caries in their community before and after fluoridation has occurred. (Optional).</p> <p>Have class members view the discussion-provoking trigger film, "Is Fluoridation the Answer?" Then assign teams of class members to prepare a debate on the subject, "Adjustment of the Fluoride Content of Our Communities' Water Supply is a Desirable Public Health Measure."</p> <p>If your community is one not having adequate fluoride content naturally in the water supply, study the debate over adjusting the content. What arguments were advanced for and against? By whom? Check back issues of the local newspaper.</p>	
<p>The student can name various ways fluoride may be made available to tooth enamel.</p>	<p>Ways in which fluoride is made available.</p> <ul style="list-style-type: none"> - The community water supply - most effective because it reaches everyone in the community. - The school water supply - areas without community water fluoridation can fluoridate the school's water supply system. This is less effective since it does not reach children from 	<p>Have students check their knowledge of fluoride and its benefits, using the Spirit Master entitled, "Focus on Fluoride."</p> <p>Invite a dentist or dental hygienist to discuss and demonstrate the various ways fluoride may be made available to teeth.</p> <p>Ask the class to collect advertisements about a variety of toothpastes and evaluate the</p>	

Behavioral Objectives	Content	Suggested Activities	Related Activities in Other Classes
	<p>birth.</p> <ul style="list-style-type: none"> - Dentifrice (toothpaste) containing fluoride - some dentifrices containing an effective fluoride compound have been accepted by the American Dental Association Council on Dental Therapeutics as having some caries-preventive effectiveness under certain circumstances. These bear the authorized Council statement of acceptance. - Fluoride topical applications - may be applied directly to teeth by a dentist or dental hygienist. Some dentists prescribe fluoride preparations for the patient to apply to teeth at home. - Chewable fluoride tablets - may be prescribed by a dentist as a dietary supplement. They are most effective from infancy to 8-12 years, when enamel formation is complete. - School fluoride mouthrinse programs - these programs in schools have been proven effective in reducing dental caries, require few materials and supplies, need little time to administer, and can be supervised by non-dental personnel. 	<p>validity of their claims.</p> <p>For a documentary approach to reporting safety, effectiveness, and background information on community water fluoridation, review with students the American Dental Association film entitled "Fluoridation: A White Paper."</p>	

Appendix E

Community Dental Health Programs

Goal: To develop an awareness of various types of dental health programs.

Behavioral Objectives	Content	Suggested Activities	Related Activities in Other Classes
<p>The student can describe dental public health programs operating in the community</p>	<p>School Programs</p> <ul style="list-style-type: none"> • Oral health education. • Screening/inspection for oral disease. • Referral of students to family dentist for examination/treatment with follow-up by school. <p>Adjustment of Fluoride Content of Community Water Supply</p> <p>As previously discussed, community water fluoridation can reduce dental caries up to 65% for children who drink fluoridated water from birth.</p>	<p>Assign groups of students to develop reports for class presentation in the following areas:</p> <ol style="list-style-type: none"> a. What dental health activities are conducted by the local school system. b. Do any of these activities provide follow-up consultation involving parents. c. Assign a small group of students to contact the local dental society directors to obtain information on the current policies of fluoridation within the province. Have them find out when their community's water became fluoridated and how it came about. If the community water is not fluoridated, have students ask officials why fluoridation has not taken place. 	
	<p>Programs for Increasing Access to Dental Care for Special Populations</p> <p>Objectives of these programs are to provide dental care to needy segments of the population (i.e. elderly, handicapped, financially disadvantaged).</p>	<p>Divide the class into two equal groups. Assign the following tasks:</p> <ol style="list-style-type: none"> a. <u>Group 1:</u> What resources does the community provide to assist those unable to afford dental treatment. How many people receive 	<p>Extra-Curricular For the local newspaper, assign the class to inform the public about access programs in their community and where</p>

Behavioral Objectives	Content	Suggested Activities	Related Activities in Other Classes
	<p>These programs are usually supported by one of the following methods:</p> <ul style="list-style-type: none"> a. Supported by private funds contributed by individuals. b. Provided by dental school clinics. c. Supported by public funds. d. Provided by the local dental society. e. Provided by local health department programs. f. Provided by local public welfare department programs. 	<p>public supported dental health services?</p> <p>b. <u>Group 2</u>: How do special population groups such as the homebound/institutionalized, elderly, and handicapped (those unable to be treated in the dental office) receive care in the community?</p> <p>Compare each group's findings.</p>	<p>specific services are provided.</p>