NOYCE Summer Institute **Summer 2015**
Cross-Cutting Biology & Mathematics
Tooth Enamel

Learning Objectives

Students will be able to...

- Identify pH levels of common acidic food and drink
- Determine the significance of saliva to the maintenance of mouth pH.
- Compare the relation of acidic beverages to the percentage of healthy enamel.
- Justify the importance for maintaining dental hygiene.

NYS Learning Standards

Crosscutting Concepts:

Stability & Change - For natural and built systems alike, conditions of stability and determinants of rate of change or evolution of a system are critical elements of study.

NYS Living Environment Standards:

-5.1 f Enzymes can affect the rates of chemical change. The rate at which enzymes work can be influenced by internal environmental factors such as pH and temperature

NYS CCSS for Mathematical Practice:

1. Make sense of problems and persevere in solving them - Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution.
2. Reason abstractly and quantitatively - Mathematically proficient students make sense of quantities and their relationships in problem situations
3. Look for and make use of structure - Mathematically proficient students look closely to discern a pattern or structure.
4. Model with mathematics - Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society , and the workplace.

Instructional Resources and Materials to engage students in learning**:**

- Handouts: Food Acidity and Tooth Enamel Student Worksheet, Exit Ticket
- Resources: Smartboard, Audio speakers, Tooth & Sodal Video, 15 Computers, ToothEnamel.NetLogo Model

Instructional Strategies and Learning Tasks that support diverse student needs. (Include what you and students will be doing.)**:**

Lesson Component:	**Activity:**
Engage (5 minutes)	● The instructor distributes a small cup of an acidic beverage (i.e. orange juice, soda,...) to each student based on student choice. Students enjoy their drink! ● The instructor then asks each student to discuss with a partner what they believe is occurring in their mouth as a result. Partners then share their thoughts with the class. ● Students are shown a video of a healthy human tooth placed in soda for 24 hours straight: https://www.youtube.com/watch?v=8ANWDrRd-IQ ● The instructor asks the class if their previous belief has changed.
ToothEnamel NetLogo Activity (30 minutes)	● Students are organized into groups of three based on teacher discretion with the goal of forming optimal learning groups. ● Students work in groups of three to explore the model and complete the corresponding worksheet.
Evaluate (5 minutes)	● Exit Ticket: Using reliable internet resources, determine the effect of sugar content in food on tooth enamel. Make any connection to the day's learning apparent. State your sources. Students may work individually or in their NetLogo groups (teacher discretion).

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Name: _____ Date: _____

Food Acidity & Tooth Enamel Model Activity

1. Model Introduction:
   a. Press the purple **Setup** button in the upper left of the screen.
   b. Make sure you are set to **normal speed** using the slider in the upper-center of the screen.
   c. Have green **saliva?** switch set to Off.
   d. Set green **acidity** slider to 3.0 pH.
   e. Press the purple **Go** button next to the Setup button. To stop the process, press the **Go** button again. To watch the simulation step-by-step, press the purple **Go once** button next to the **Go** button. Once stopped, the model can be continued by pressing either **Go** or **Go once**.
      i. In this model, what is being represented by…
         1. the red circles? _____
         2. the white squares? _____
         3. the varying shades of yellow squares? _____
         4. the black squares? _____

2. Tooth Enamel Erosion:
   a. What is this model showing?

   b. What is meant by complete decay? What would it look like? How would your dentist likely handle such an occurrance?

   c. Observe different acidities by changing the acidity slider. Be sure to restart the model for each change in acidity to see the whole effect. What pattern(s) do you notice?

d. Using reliable internet sources, list one food and one beverage for each whole value pH from 1.0 to 6.0 (total six foods and six beverages).

3. Saliva:

a. Turn the **saliva?** switch to 'On.' Press the purple **Setup** button. Then use the purple **Go once** button to observe the process produced.
   i. What is represented by the blue boxes and what effect are they having?

b. Change the acidity and observe with **saliva?** set to 'On.' Remember to restart the model for every change in acidity by pressing **Setup**.
   i. What do you observe? How do these observations compare to the previous when **saliva?** was set to Off.

4. Rinse:

a. Set **saliva?** to 'Off.' Move the **speed** slider at the top in gray to slower (2-3 shifts to the left). Press **Setup** and then **Go**. After about 5 hours/ticks, press the purple **rinse** button once. The number of ticks is shown in the upper left corner of the small model window.
   i. What did you observe?

ii. Why do dentists recommend rinsing the mouth with water after consuming acidic foods and beverages?

5. Dental Hygiene:

a. The process of brushing the teeth with fluoride toothpaste not only removes acidic molecules from the mouth but also provides some future protection for the enamel from acidic foods.

i. How might the model look if tooth brushing with fluoride was incorporated?

ii. What other dental hygiene procedure do you believe would help reduce the damage of acidic foods and beverages? Explain how.

NOYCE Summer Institute 2015

Acidity (pH scale) of Common Drinks

The pH scale measures the acidity of a solution. The lower the pH, the stronger the acid. The stronger the acid, the more damage that is done to your child's teeth. Therefore, the drinks are listed from best to worst.

Drink Name	ph	% Sugar/Cup
Water	7.0 (neutral)	0
Milk 2%	6.8	4.9
Instant Coffee (black)	5.5	0
Root Beer	4.6	13.1
Diet Root Beer	4.6	0
Tomato Juice	4.5	3.7
7-Up/Sprite	3.7	10.4
Apple Juice	3.4	9.8
Diet Cola	3.4	0
Orange Juice	3.3	8.0
Red Bull	3.3	10.8
Minute Maid	3.2	11.9
Mountain Dew	3.2	13.0
Snapple	3.2	7.6
Propel	3.2	0
V-8 Fusion Energy Drink	3.1	4.2
Sierra Mist	3	11.0
Kool-Aid Jammers	3	12.0
Gatorade	2.9	5.9
Dr. Pepper	2.9	11.5
Hawaiian Punch	2.8	11.8
AMP Energy	2.7	12.3
Powerade	2.7	6.7
Hi-C	2.7	13.1
Monster Energy	2.7	11.4
Coke	2.5	11.0
Country Time Lemonade	2.5	6.8
Pepsi	2.4	11.6
Sunny Delight	2.4	10.6
Rock Star	1.5	12.7
Full Throttle	1.45	12.3
Battery Acid	1	

*The Kids' Dentist does not recommend drinking battery acid, this is just for comparison!

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