

PROTECT YOUR TEETH, PROTECT YOUR PLANET | GRADE 5



Overview

In this onsite field trip, students are invited to consider a common household object (the toothbrush) in a new light: using algebraic reasoning, students model the number of toothbrushes deposited annually in landfills across the United States in a visually meaningful way. Later, they encounter sustainability concepts including recycling and sustainable materials science, handle examples of eco-friendly oral health products, and meet one dentist who is working hard in his community to protect Planet Earth—like we all can!

Standards

NGSS 5-ESS3: Earth and Human Activity

- **5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.** Students will encounter grade 5 Earth Science concepts and vocabulary including human impacts on Earth systems, pollution, deforestation, mining, recycling, conservation, and sustainability. Students will also engage with the concept of materials science and hear from a real materials scientist who is working to make dentistry more sustainable.

CCSS.MATH.CONTENT.5.OA: Operations & Algebraic Thinking

- **CCSS.MATH.CONTENT.5.OA.A.1: Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols.** With the guidance of a museum educator, students will pose environmental questions as numerical expressions that can be solved in order to create visual models of human impacts on the Earth. (Students will, for example, create a numerical expression to represent the likely number of years left before their first-ever toothbrushes, used about ten years prior to their visit to the museum, will fully decompose in the Earth's crust.)
- **CCSS.MATH.CONTENT.5.OA.A.2: Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them. For example, express the calculation "add 8 and 7, then multiply by 2" as $2 \times (8 + 7)$. Recognize that $3 \times (18932 + 921)$ is three times as large as $18932 + 921$, without having to calculate the indicated sum or product.** With the guidance of a museum educator, students will pose environmental questions as numerical expressions that can be solved in order to create visual models of human impacts on the Earth. (Students will, for example, create a numerical expression to represent the number of toothbrushes needed to make a one-mile line, then write another expression to represent how many "toothbrush miles" are discarded in the US each year.)

CCSS.ELA-LITERACY: Speaking and Listening

- **CCSS.ELA.LITERACY.SL.5.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.** Students will engage with a museum educator, peers, teachers, and chaperones during collaborative discussions about grade 5 science topics (e.g. human impacts on Earth systems).
- **CCSS.ELA-LITERACY.SL.5.2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.** Students will encounter presentation of information in a variety of media formats, including visual and quantitative presentations throughout the museum, oral presentations from the museum educator, and a video presentation by a working dental professional who is leading sustainability efforts in dentistry. Through various activities, students will determine the main ideas of presented information.
- **CCSS.ELA-LITERACY.SL.5.3: Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.** Students will encounter presentation of information from two speakers, including a museum educator as well as a practicing dentist who has developed a video presentation to address fifth graders studying Earth systems. Students will summarize the points and arguments of the speakers during group discussions and activities.

Exhibitions & Materials

- Featured exhibition: *Branches, Bristles, and Batteries: The Evolution of the Toothbrush*
- Non-exhibit artifacts:
 - 4-5 plastic toothbrushes
 - Bamboo toothbrush
- Graphics and photographs: Epson Pen and projector screen, ruler



The Dr. Samuel D. Harris
**NATIONAL
MUSEUM of
DENTISTRY**

Program Introduction

INTRODUCE: Museum, Museum Educator, and Program

- We are the National Museum of Dentistry. We are located in Baltimore at the University of Maryland, Baltimore because the University of Maryland School of Dentistry is the oldest dental school in the world. Our mission is to celebrate the history and future of oral health.
- Fifth graders can visit our museum to learn about **SUSTAINABILITY**, or the science ideas that some individuals and groups are using to protect the Earth's resources and environment.

PROGRAM FORMAT: In this program, students rotate through two stations. Groups under 25 students may proceed together through Stations 1-2 in order. Groups between 25-50 students may divide in half, with one group starting at Station 1 (proceeding 1-2) and another starting at Station 2 (proceeding 2-1). For groups with more than 50 students, museum staff will determine how best to proceed.

Station 1: Changing Faces Projector

Define & Discuss

WHAT ARE "HUMAN IMPACTS" ON EARTH SYSTEMS? Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.

EXAMPLES OF NEGATIVE HUMAN IMPACTS ON EARTH SYSTEMS:

(Allow students to answer and explain, but the below replies may be discussed as well)

- **POLLUTION:** "Pollution" means putting any kind of substance into an environment that has harmful effects on that environment.
 - **AIR POLLUTION:** Human-made cars and planes send harmful chemicals into the air that lower the air quality for people, plants, and animals.
 - **WATER POLLUTION:** The ocean contains trillions of pieces of plastic garbage that pose threats to aquatic plants and animals.
 - **SOIL POLLUTION:** The presence of toxic materials in soils can cause diseases for plants, animals, and humans.
 - **NOISE POLLUTION:** Excessive noise from traffic, rock concerts, or sports events can cause hearing loss and stress to local wildlife.
- **DEFORESTATION:** When forests are cleared at an unsustainable pace for land and timber products, animals lose their habitats and species of plants can become endangered or extinct.
- **MINING:** When natural resources are mined from the earth, species of plants and animals can lose their habitats and environments become at risk for soil erosion.

HOW CAN INDIVIDUALS AND COMMUNITIES REDUCE THE NEGATIVE IMPACTS OF HUMAN ACTIVITIES ON THE EARTH AND ITS RESOURCES?

(Allow students to answer and explain, but the below replies may be discussed as well)

- **RECYCLING:** Places to dispose of waste products are necessary in human society, but we can reduce the amount of waste we send to the landfill through recycling, or giving old materials new uses.
- **USING SUSTAINABLE MATERIALS:** Some of the Earth's natural resources can be replaced more easily than others. Materials are *sustainable* if the Earth can renew them at an even or faster pace than they are used by humans. By using sustainable materials in our products, homes, schools, businesses, and lives, individuals and communities use materials in a way that respects the Earth's ability to produce them.
- **USING BIODEGRADABLE PRODUCTS:** An object that is biodegradable can be decomposed by bacteria and other living organisms. Objects that are *not* biodegradable stay in the Earth for a very long time, sometimes emitting toxic gasses over time. By increasing our use of biodegradable products, we can reduce the lifetime of waste in landfills.

Define & Discuss

HOW DOES SUSTAINABILITY RELATE TO DENTISTRY?

- **TOOTHBRUSH WASTE:** Every year, one billion plastic toothbrushes are discarded in the United States. That is about three toothbrushes for every single person living in the United States.
 - In some ways, that's a good thing, because it's good for your teeth to replace your toothbrush every 3-4 months. This means that generally, most people in the US are taking good care of their teeth.
 - BUT: toothbrushes are made of a kind of plastic that is very difficult to recycle, and cannot be recycled in regular household recycling. What does that mean? (Toothbrushes go to landfills.)
 - How long does it take for a toothbrush to decompose fully in a landfill? (500 years)
 - This means that every toothbrush you have ever used in your whole life is sitting in a landfill somewhere in the Earth. Every toothbrush *I have ever used* is sitting in a landfill somewhere in the Earth, and I am MUCH older than you.

Activities

INDESTRUCTABLE TOOTHBRUSHES 1 (Supplies: Epsom pen)

- STEP 1 (Educator write numbers on the screen): If toothbrushes require about 500 years to decompose, and most fifth graders started using toothbrushes about 10 years ago, how many years will your first toothbrushes probably still be in the Earth before they fully decompose?

500 years to decompose - 10 years = 490 years left

- STEP 2 (Educator write numbers on the screen): If toothbrushes require about 500 years to decompose, and I started using toothbrushes about 30 years ago, how many years will my first toothbrush probably still be in the Earth before it fully decomposes?

500 years to decompose - 30 years = 470 years left

- STEP 3: How long is 500 years? Let's think about it backwards. 500 years before today:
 - The Lost Colony of Roanoke (1585) hadn't happened yet.
 - The colony of Maryland (1632) didn't exist yet.
 - The first European explorers to visit the Chesapeake were about to arrive (1525).
 - Native Americans lived in this area (Assateague, Delaware, and Piscataway).
 - Takeaway: 500 years is a LONG time.

INDESTRUCTABLE TOOTHBRUSHES 2 (Supplies: Epsom Pen, 4-5 plastic toothbrushes, ruler)

- STEP 1: Let's illustrate the problem of toothbrush waste in another way. (Educator ask a volunteer to measure one of the plastic toothbrushes using the ruler, rounding to the closest inch.)

The average plastic toothbrush in the US is 7 inches long.

(Educator write number on the screen, then ask another volunteer to line up the toothbrushes in a neat, straight line.)

- STEP 2: (Educator write numbers on the screen): If there are 63,360 inches in one mile, how many toothbrushes would we need to line up to make a mile-long toothbrush train? How can we pose this question as a numerical expression?

Inches in a mile/inches of a toothbrush = number of toothbrushes in a mile, OR:

$63,360/7 = 9051$ toothbrushes make up one mile



The Dr. Samuel D. Harris

**NATIONAL
MUSEUM of
DENTISTRY**

Activities

INDESTRUCTIBLE TOOTHBRUSHES 2 (CONT'D)

- STEP 3: (Educator write numbers on the screen): If one billion toothbrushes are discarded in the US each year, how many miles of toothbrush are discarded in the US each year? How can we pose this question as a numerical expression?

One billion toothbrushes discarded each year/number of toothbrushes in a mile = miles of toothbrush discarded each year, OR:

$$1,000,000,000/9051 = 110,485 \text{ miles of toothbrush are discarded each year}$$

- STEP 4: If we were to line up all of the toothbrushes discarded each year, and wrap that line around the Earth, how many times would it wrap around the Earth? How can we pose this question as a numerical expression?

Miles of toothbrush discarded each year/miles of Earth's circumference = number of times the toothbrushes discarded in the US each year could wrap around the Earth, OR

$$110,485/25,000 = \text{the toothbrushes discarded in the US each year could wrap around the Earth 4.4 times.}$$

- STEP 5: Discuss. Is this a surprise to you? How do we feel about this?

Define & Discuss

HOW DOES SUSTAINABILITY RELATE TO DENTISTRY?

- **WATER WASTE:** Did you know that if you leave the faucet running while you brush your teeth, you can accidentally waste as much as five gallons of water? Luckily, there is a VERY simple fix to this: turning off your water while you brush. This is an easy way to practice **CONSERVATION**, or the careful, non-wasteful use of resources.
- This is a good example of a simple truth about sustainability: we can ALL develop more sustainable habits, no matter who we are, how old we are, how much money we have, or where we live. Practicing simple sustainable habits at home can make a BIG difference!

Activity

- **INTRODUCE:** Dr. Rodrick Wiggins Jr., DMD
 - Dr. Wiggins is a real dentist who lives in Brooklyn, New York.
 - When Dr. Wiggins was a student in dental school, he noticed that a *lot* of plastic toothbrushes were going to waste. He was not the leader of the dental school, or even a teacher, but he felt that he should do something about the problem anyway. He started to do some research and discovered a company called TerraCycle that will recycle difficult materials like toothbrushes. He also discovered that large oral health companies, like Colgate and Oral-B, are doing *their* part by paying the cost for companies like TerraCycle to do the recycling work they do to make the Earth a cleaner place.
 - Dr. Wiggins organized a recycling program for his dental school that sent all of the used toothbrushes to be recycled into backpacks and school supplies.
- **PLAY VIDEO:** Dr. Wiggins speaks to NMD Fifth Graders
- **DISCUSS:** Is Dr. Wiggins an Earth scientist? No! Is he a leader of a country or a big business? No! He is a regular person who decided that sustainability was something he could do in his community. What are some ways we can all be more sustainable in our own community--in our homes, schools, workplaces, clubs?
- **EDUCATOR LOOK UP IN ADVANCE** whether visiting school or school district has any sustainability initiatives. Share these with students and teachers/find out if they are aware.



The Dr. Samuel D. Harris

**NATIONAL
MUSEUM of
DENTISTRY**

Station 2: Branches, Bristles, and Batteries: The Evolution of the Toothbrush

Define & Discuss

There is an area of science called **MATERIALS SCIENCE** where scientists and inventors study and design new kinds of solid materials that can be used to make products. These scientists have many kinds of goals. Examples of goals material scientists might have could include discovering materials that are:

- **COST EFFICIENT** (meaning that lots of people can afford to have the product, because it is made of a material that isn't too expensive)
- **SAFE** (meaning that they don't contain any hazardous materials), or
- **SUSTAINABLE** (meaning that the product is made of a material that the Earth can renew faster or at the same pace as humans use it up).

Here in our toothbrush exhibit, we can see examples of the work of materials scientists throughout history.

- **WHICH TOOTHBRUSH IS THE OLDEST IN OUR DISPLAY? (STICKS.)**
 - These are examples of the earliest design and material used for toothbrushes.
 - What need did they meet? (The need to have clean teeth and nice breath.)
- **WHICH TOOTHBRUSH IS THE SECOND OLDEST IN OUR DISPLAY? (BONES & BRISTLES)**
 - These toothbrushes were an improvement on the stick brushes because they had a more effective design, BUT: boar bristles are not very comfortable to have in your mouth.
- **WHICH TOOTHBRUSH IS THE FANCIEST IN OUR DISPLAY? (VICTORIAN SILVER BRUSHES)**
 - These toothbrushes were an improvement on the bone brushes because they had a prettier design, BUT: they were very expensive to own!
- **WHICH TOOTHBRUSHES (BESIDES THE STICKS) ARE THE MOST AFFORDABLE IN OUR DISPLAY? (PLASTIC)**
 - These toothbrushes were an improvement on bone brushes and fancy Victorian silver brushes because they made toothbrushes more affordable, so normal people and families could have them.
 - **COLORED PLASTICS** further improved toothbrush design for average families because toothbrushes could be made to resemble characters, which made toothbrushing fun! If toothbrushing is fun, what are kids more likely to do?
 - BUT: toothbrush plastic is not environmentally sustainable!

WHAT KINDS OF MATERIALS MIGHT WE SEE IN TOOTHBRUSHES OF THE FUTURE THAT ARE MORE SUSTAINABLE? DO YOU HAVE ANY IDEAS?

- Do you have ideas for alternative materials for toothbrushes? How do you think humans in the future might clean their teeth in more environmentally sustainable ways?
- **REAL WORLD MATERIAL:** Bamboo (show example)
- **REAL WORLD MATERIAL:** Biodegradable plastics (like the toothbrushes Dr. Wiggins is working to make!)