Allergy*

Lesson 10 – Brushing up on Definitions

Overview

This lesson is about the science concept of **operational definitions**. Operational definitions define variables by how they are measured or produced. Operational definitions are important for scientists because they define a variable very specifically so that the variable means the same thing to another scientist. Operational definitions help scientists replicate or repeat experiments in exactly the same way (see upcoming Lesson 15 on replication). They describe concepts that may be vague (e.g., happiness) in a way that is concrete and measurable (e.g., specific facial expressions) and, therefore, allow for the variable to be studied.

To learn about operational definitions, UQUEST scientists will operationally define how to brush teeth by practicing on hard-boiled eggs and a model mouth. After comparing their operational definitions, UQUEST scientists will learn the dentist recommended approach for brushing teeth by practicing with the model mouth.

Science Objectives:

UQUEST scientists will:

- understand that some variables need operational definitions.
- operationally define teeth brushing by how the variable is produced.
- state an operational definition in terms of how a variable is produced.

Health Messages:

- For healthy teeth, brush your teeth with fluoride toothpaste twice a day for two minutes each time.
- Avoid sugary beverages and snacks that can wear down teeth over time.

Reinforcement of Previous Messages:

- Observation (Lesson 1) - Observing is fundamental for experimentation.
- Variables (Lesson 3) - Variables can be observed and classified.

Vocabulary

- **Operational definition** - Defining a variable by how it is measured or how it is produced or created.

Materials

- UQUEST kit
- Camera
- ~6 teeth-gum models; (one per team)
- ~30 Hardboiled eggs; one per UQUEST scientist *

- ~2 bottles each of soda for soaking eggs (alternatives: soda, cranberry juice, coffee)
- ~30 reusable plates; one per UQUEST scientist
- ~6 Plastic water cups; one per team
- ~30 manual toothbrushes; one for each UQUEST scientist to take home
- ~30 electric toothbrushes
- ~6 tubes of Toothpaste; one tube per team
- ~6 floss; one for each team
- ~30 rulers; one per UQUEST scientist

Preparation

At home (UQUEST Leader):

- Boil all of the eggs (for soaking, as well as one white hardboiled egg for comparison per team).

At UM:

- Soak hard boiled eggs for three hours in soda (or other substance).

At OYC:

- Place paper plates, stained eggs, toothpaste, water basin with water, and toothbrushes at each table (one per UQUEST scientist).

Introductory Script (~3 mins):

Welcome UQUEST scientists.

Remember the lab notebook is an important tool that scientists use to record their observations and the results of their experiments.

Let's open up your lab notebooks to the second page. Like all scientists, UQUEST scientists pay attention to the world around them. They create an environment that helps them to learn about the world. They listen to each other. They communicate with each other. And they treat each other with respect.

***Let's review the values of a UQUEST scientist. E*ach UQUEST scientist reads OUT LOUD one value.**

1. **Pay attention** when others are talking.
2. **Speak in a low voice**. Do not scream.
3. **Respect each other.** Do not push or shove each other.

****Be sure to praise scientists when they do well****

Relaxation (~2 mins)

Before we begin the lesson, we'd like to start off by doing a relaxation activity. When scientists are relaxed, they do better science.

For today's relaxation activity we will practice belly breathing.

- Guide the UQUEST scientists, through some belly breathing for ~1 minute.

Instructions for UQUEST Guides

1. **Introduction (~10 mins)**
    a. *Today's quest will be about **operational definitions**.*
    b. ***Operational definitions** describe variables by how they are measured or how they are produced. That may sound complicated, but in some of our other quests, we have already used operational definitions to describe how variables are measured!*
        i. *Variables are the characteristics of objects or people that can differ among them.*
        ii. *For example, in lesson 3, when we described UQUEST guides in the "Guess the Guide" game, we observed a variable - a characteristic of each guide that differed. They differed in the color shirt they were using, length of their hair, whether or not they wore glasses etc.*
    c. *Variables are defined by how they are measured.*
        i. **Example:** *How would you measure how good a dancer is?*
        ii. *You may have a judge rate them on a scale from 1 to 10 (10 meaning they are an awesome dancer and 1 meaning they don't dance well)*
            1. *This is our operational definition for measuring how good of a dancer a person is. We measure them on a 1-10 scale.*
            2. *Another way we could have measured how good a dancer someone is may be by simply rating them as "Good dancer" or "Bad dancer." This would be another operational definition.*
            3. *In both cases, we are measuring someone's dancing skills but HOW we measure this differs (either 1-10 rating or "good" vs. "bad" dancer).*
    d. *It is important to have an operational definition because if someone wants to repeat an experiment, for example, they will know exactly what we did and how we measured our variable!*
    e. *For example, let's say you make a peanut butter and jelly sandwich. You want your friend to re-make a peanut butter and jelly sandwich THE SAME WAY you did. To be able to get a replica of your sandwich, you need to provide your friend with EXACT instructions on how you made your sandwich.*
        i. *Example: How much peanut butter did you use? How much jelly? What flavor jelly? Crunchy or creamy peanut butter? What type of bread? Did you put the jelly on the bread first or second? Etc.*
        ii. *By providing your operational definition for what the peanut butter and jelly sandwich you make is like, you can make sure that others can replicate it in the future!*
    f. *What would happen if scientists all used different operational definitions when they are trying to answer research questions?*
        i. *They might get different results! Trying different operational definitions may be an exciting part of the scientific process.*
        ii. *BUT, if you are trying to repeat or replicate another scientist's experiment, then it will be important to use the same operational definitions.*

2. Activity (~20-25 mins)

a. *Today we will be learning about operational definitions!*
   i. *Operational definitions for our* variables *can tell us <u>HOW to do something</u>.*
b. *Today, we will come up with a set of instructions for brushing teeth!*
c. *If you were a UQUEST scientist last year, you may remember we came up with operational definition for brushing teeth with a manual toothbrush.*
d. *Today, the instructions we will come up with will be the team's **operational definition** for brushing teeth with an ELECTRIC TOOTHBRUSH.*
   i. *Our operational definition will define HOW to do something-- how to brush your teeth. It's important to know HOW to brush your teeth because it is one way that you can try to keep them healthy!*
e. **Give instructions for hard-boiled egg brushing activity.**
   i. *When you brush your teeth, you are often brushing away bits of food and drinks that stay in your mouths after you eat. Many times, beverages that we drink can stain our teeth if we don't brush our teeth well enough.*
   ii. *So, to practice brushing our teeth and brainstorm instructions to keep them clean, you will be practicing on these hard-boiled eggs!* **Point to the eggs on the table.**
   iii. *Each one of you will brush a hard-boiled egg that has been stained with soda.*
f. **Show difference between stained and non-stained eggs.**
g. *Before we get started brushing, let's take a picture of our eggs so that we can compare how our brushing methods changed them.*
   i. **Using the UQUEST camera, take a picture of the eggs before scientists start brushing them to compare with post-brushing**
h. *Pretend your egg is a very large tooth that you need to scrub white again. You will use a toothbrush and toothpaste to brush until the stains come off your egg.*
i. *On page 10B in your lab notebook, you can see dentist's recommended operational definition for good teeth brushing with a manual toothbrush.*
j. *You will use an electric toothbrush and see if the operational definition for teeth brushing is different with an electric toothbrush.*
k. **Show mouth model**
   i. *When you are brushing your egg, you will be pretending to brush a tooth.*
   ii. *However, it may be helpful to look at the model mouth to see if your egg brushing strategies will work on a regular mouth with MANY teeth, too!*
   iii. *While you are brushing your egg "tooth," talk to the rest of the team about instructions that are working for you.*
   iv. *At the end, we will each share our instructions with the entire team. The instructions will be our OPERATIONAL DEFINITION for teeth brushing with an electric toothbrush.*

g. UQUEST guides distribute one stained egg per UQUEST scientist.
h. Begin brushing
   i. Scientists can use a cup of water to rinse off your toothbrush.
   ii. *<u>Reminder:</u> Do not put these toothbrushes in your mouth; they will be re-used and are not clean enough for you to use on your own teeth!*
i. **UQUEST guides engage in and facilitate discussion for each team.**

i. **Observe what they are doing, describe what you notice and ask them questions about their instructions:**
    1. *I see that you are moving the brush side to side. Is that working well?*
    2. *How long have you been brushing that spot?*
    3. *How long do you think you need to brush a whole mouth, like the model mouth here?*
    4. *What' the difference between brushing with an electric versus manual toothbrush?*
    5. **(Say this next sentence only if it happened in your group)** *You brushed so hard the eggshell cracked a little, imagine how that might feel on your gums!*

ii. **What scientists should take note of while brushing:**
    1. *Brushing up and down vs side to side vs in a circle vs holding in place, brushing for 1, 2, 3, 4, or 5 minutes, amount of toothpaste, how hard to brush, etc.*

iii. **Engage in discussion related to juice/soda:**
    1. *After you drink juice/soda, do you typically spend this much time brushing your teeth? What do you think happens to your teeth?*
    2. *If you drink juice/soda and forget to brush your teeth, your teeth may get stained over time. It will also become harder to get the stains out if you don't brush frequently.*

j. Revisit the model mouth.

i. *Now that you have brushed your egg "tooth" clean, let's think about whether your instructions will work well in a mouth with more than one tooth.*

ii. *Let's practice the operational definition for tooth brushing on our model mouth.*
    1. *You all are going to work in pairs to practice brushing your mouth model. While one person brushed the other holds down the mouth model so that it doesn't move. Then, you switch.*
    2. **Distribute model mouths**
    3. *Show me your ideas for how you would recommend someone brush their teeth using the model mouth.*
        a. **Take away mouth model and tooth brushes when done to reduce distractions.**

k. **UQUEST scientists document their operational definitions.**

i. *Open up to page 10C in your lab notebook so we can write our operational definition for tooth brushing with an electric toothbrush.*

ii. *The instructions we came up with is our operational definition for HOW to brush teeth with an electric toothbrush.*

iii. *On page 10C of your lab notebook, we will write if we should use a lot or a little bit of toothpaste, how many minutes to brush our teeth for on this line, whether we brush our teeth hard or soft, and which way we should brush our teeth in.*

iv. **Each UQUEST scientist will share what they wrote in their lab notebooks.**
    1. **Example (modify what is said here based on what scientists in your group said):** *I recommend: 1) using a lot of toothpaste, 2) brushing*

for five minutes, 3) using our toothbrush softly, and 4) and brushing up and down.

3. Activity 2 – optional (if time permits) - (~5-10 mins)

l. What else can you do to take care of your teeth?

i. You can also floss! When you're done brushing, it's time to floss to remove food and plaque from in between teeth and along the gum line. Do this every night at bedtime.

ii. **UQUEST guide demonstrates how to floss using the model mouth:** *When you floss, wind 18 inches of floss around your pointer finger, hold the floss tightly between your thumbs and your fingers. Glide the floss between your teeth using a rubbing motion, don't snap it. When it reaches the gum line, curve it into a c-shape against one tooth and holding tightly gently move the floss upward away from the tooth.*

m. Let's practice flossing on the model mouth!

n. Distribute floss and a ruler. Distribute model mouth.

i. Use your ruler to measure 18 inches of floss. Remove an 18-inch piece of floss.

ii. You will work in pairs again to practice flossing your mouth model. While one person flosses, the other holds down the mouth model so that it doesn't move. Then, you switch.

4. Documentation (<5 mins)

a. UQUEST scientists will compare eggs BEFORE and AFTER the tooth brushing activity.

i. They will document this by taking pictures of the eggs before and after.

5. Discussion (~10 mins)

b. Now let's discuss what we did today. I will ask some questions, and if you answer, you get a sticker. At the end, the stickers can be traded in for a special prize. Let's GO!

i. **Award sticker for every question answered.**

ii. **Note: below are example questions. You can ask additional questions not listed.**

c. Did everyone brush their egg "tooth" the exact same way? Did every UQUEST scientist come up with the same operational definition -- instructions for brushing teeth?

i. *No. Everyone's operational definitions were different.*

d. ***So, if you tell someone "Brush your teeth" do you think they would brush their teeth exactly like you?***

i. Engage in brief discussion. *It would be important to provide an operational definition for what YOU mean by "brush your teeth." Your operational definition may be different than another person's!*

e. What is an operational definition?

i. Operational definitions tell us how variables are either measured or produced.

ii. The instructions we came up with were our operational definition.

f. How did we come up with our operational definition?

i. *We defined how to produce clean teeth by coming up with instructions for teeth brushing. Each UQUEST scientist's operational definition tells us HOW to brush our teeth.*

g. **Take a look at pages 10B and 10C in your lab notebooks. How is the operational definition for teeth brushing with an electric toothbrush different from the operational definition for teeth brushing with a manual toothbrush?**
   i. **Discuss**
   ii. **Example:** *Brushing in circles is recommended when using a manual toothbrush, but some UQUEST scientists found that brushing in place removed the stain with an electric toothbrush.*

h. Why is it important to have an operational definition?
   i. *It is important to have an operational definition because if someone wants to repeat what we did, they will know exactly what we did!*
   ii. *Sometimes scientists want to repeat experiments to see if they get the same results. If we just said, "brush your teeth," they might take different approaches, just like we all did today.*

i. What would happen if scientists all used different operational definitions when they are trying to answer research questions?
   i. *They might get different results! Trying different operational definitions may be an exciting part of the scientific process.*
   ii. *BUT, if you are trying to repeat or replicate another scientist's experiment, then it will be important to use the same operational definitions.*

j. *In science, there are usually teams of scientists doing exactly what we just did. They decide how they are going to measure their variables. They brainstorm different operational definitions.*
   i. *In fact, scientists have come up with an operational definition for brushing teeth. Although we came up with different sets of instructions today, it is important to follow the instructions that scientists have come up with for teeth brushing.*

k. *Scientists have tested many different ways of brushing teeth and have come up with the best way to remove plaque and keep your teeth clean.*

l. What is the best way to brush your teeth?
   i. *Scientists recommend brushing your teeth in a circular motion* (**demonstrate with toothbrush)** *and for at least 2 minutes, twice a day!*
   ii. *We want to brush with a little pressure and hold on each tooth for 3 to 5 seconds on the inside and outside of our teeth! We also want to brush the tongue from back to front.*

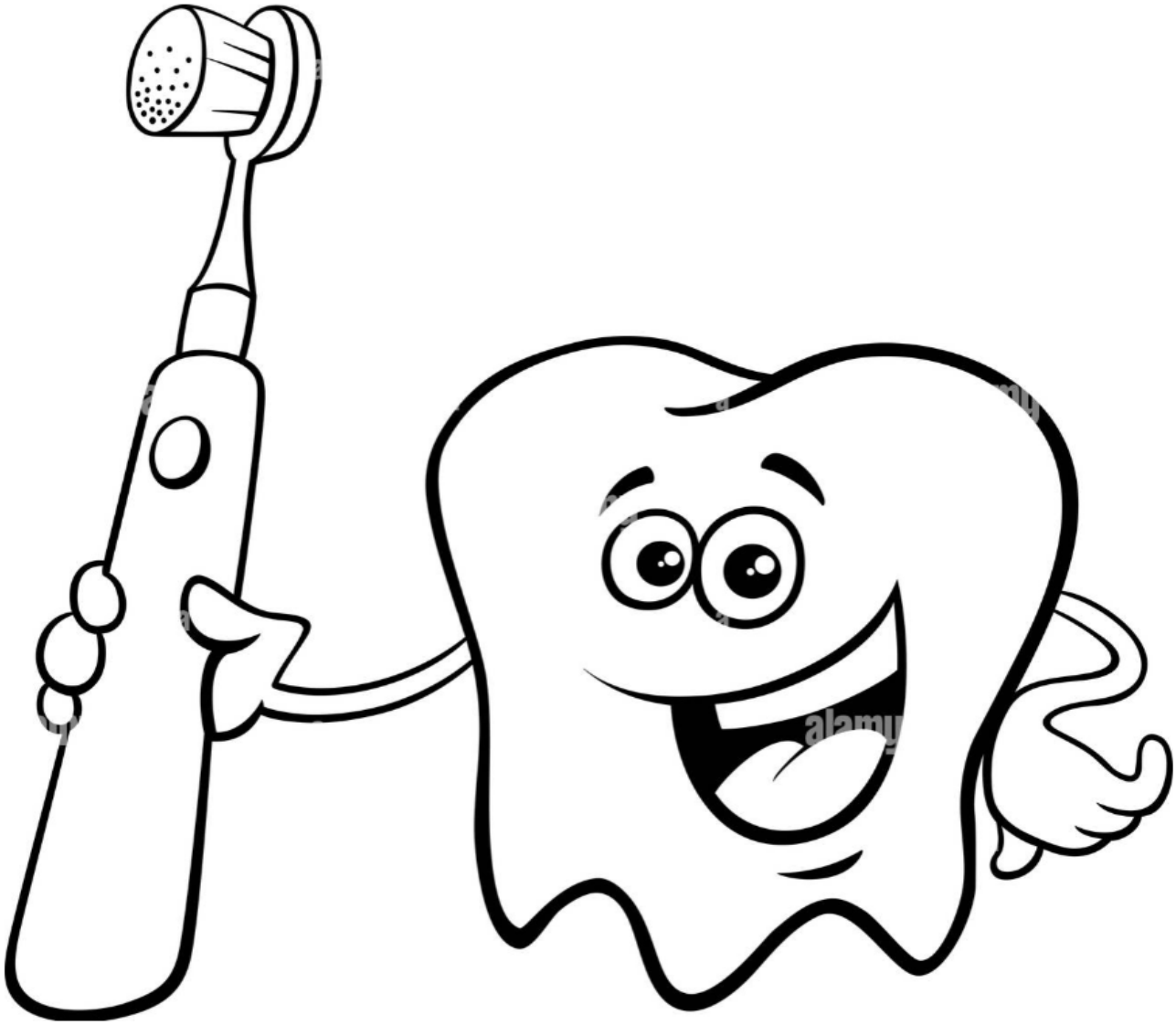
m. Why is brushing your teeth important for your health?
   i. *Keeping your teeth clean is important because the health of your teeth and gums affects the health of other parts of your body like your heart and your stomach.*
   ii. *It is recommended to try to avoid sugary beverages and snacks that can also wear down your teeth over time.*

Wrap-up

n. *What did you learn today? Write that down on the lines on page 10D.*

o. *How much did you like today's lesson on scale from strongly agree to strongly disagree?*
p. **Award prize at the end based on number of stickers.**
    i. **Distribute new toothbrushes to UQUEST scientists.**

Lesson 10
Brushing Up On Definitions



Date: _____

Operational definition for manual toothbrush

Make sure you:

Use a pea-sized amount of toothpaste.

Brush your teeth for at least 2 minutes.

Brush your teeth softly.

Brush your teeth in circles.

Date: _____

Operational definition for electric toothbrush

Make sure you:

Use _____ of toothpaste.
(a lot / a little bit)

Brush your teeth for _____ minutes.
(1 / 2 / 3 / 4 / 5)

Brush your teeth _____.
(hard / softly)

Brush your teeth _____.
(up and down/in circles/side to side/by holding toothbrush in place)

Date: _____

Lesson 10

What did I learn today?

_____

_____

_____

I liked this lesson (circle one):

Strongly Agree	Agree	Disagree	Strongly Disagree