

Community in the Classroom Presentation Plan

Lesson Name: *Microorganisms: Good or Evil?*

Presenters: UC Berkeley Graduate Students from the Cate/Doudna Lab Groups

Grade Level: 4

Abstract:

The goal of our visit is get students to look at microorganisms in a new light. What are they? Do they help or hurt us? When we think of microbes, we usually think of the bacteria & viruses that make us sick, but microbes are much more than disease-causers. One of their most important functions is digestion: for example, millions of microbes live inside of us and help us digest our food. They actually keep us healthy! The goal of our experiment is to look at one particular microorganism (yeast) and investigate what substances it can digest (sugars, artificial sweeteners, juices?) What if we could get microbes to digest unwanted substances like waste? That is the goal of a lot of current research at Berkeley now.

Materials:

What you'll bring with you:

Mini lab-notebooks for each student

Yeast

0.5L plastic bottles

Balloons

Rubber bands

Graduated cylinders

Sugar sources: regular soda, diet soda, decaffeinated soda, red bull, apple juice, sugar water, splenda water, coffee, decaffeinated coffee

What students should have ready:

Pencils & brains

Classroom Set-up:

7-8 groups of 4. Each group should have a "station" consisting of a table or couple of desks pushed together.

Needed: a class source of hot water, 5 minutes of set-up time to place materials at each station and 5 minutes for clean-up.

Classroom Visit:

Personal Introduction: 5 minutes

The 3 of us will introduce ourselves as Berkeley graduate students in biology; mention briefly what got us interested in science when we were kids and how it's really more than memorizing facts in a text-book.

Topic introduction & assessing prior knowledge: 10 Minutes

What are **microbes**? What are some common examples? Hand out tons of color photographs of microorganisms—what are their characteristics? They look pretty scary, right? We usually think of microbes as dangerous, but they can also help us. What are examples of “good” microbes? Examples include bacteria used to make yogurt,

microorganisms that live in your body and help you digest food, and, of course, yeast used to make bread rise!

Yeast accomplish all this by doing one thing: digesting stuff. What is **digestion**? Digestion is the process by which yeast convert nutrients into energy. Yeast break down their energy sources to make carbon dioxide gas. You can measure how much yeast like a specific nutrient by how much carbon dioxide is made. In our case, we will trap all the carbon dioxide in a balloon. How big the balloon gets will tell us how much digestion is going on.

Just like you might prefer certain things to eat, yeast prefer certain energy sources to digest. What do you think yeast might like to digest? What might they hate? What if we could get microbes to digest other things—things we don't want around anymore? Garbage, paper, metal cans, food waste? Let's take one microbe—yeast—and find out what it can and can't digest.

Vocabulary:

microbe, hypothesis, digestion, control

Learning Experience:

Starting experiment: 20 minutes

Lab book:

*Record what sugar sources you are testing. Make a prediction or **hypothesis**: which sugar source will the yeast prefer? How will you measure **digestion**?*

Take initial observations of just the yeast powder: Does it look alive?

Add yeast (the **microbe** of choice) in plastic bag to bottle. Measure out 150 mL of your sugar source and add it to the yeast. Shake. Put balloon on the top of the bottle & secure air-tight with rubber band. Note time. (Each student puts a unique sugar source in a bottle; each group tests 4 different sugar sources)

Lab book:

Take observations upon mixing yeast with sugar source: Note any immediate changes. Do you see bubbles?

Also, talk with graduate students about how you made your hypotheses. What other things might affect yeast digestion—temperature? light?

After 5 minutes, take more observations. Look at both the balloon & the yeast.

Discussion: 10 minutes

What is one flaw in our experimental design? What would you change about the experiment? One possible thing: the lack of a “no yeast” control. What is a **control**? What are other controls we could have done? A big part of science is examining experiments and results critically after.

Lab book:

Take observations again: how has the amount of bubbles changed? What about the size of the balloon? Measure its circumference using measuring tape and record it.

Wrap-up: Sharing Experiences and Building Connections Minutes:

Write your findings on the board.

Compare the actual rankings to your own predictions. Are you surprised? Do the results make sense to you?

Lab book:

Suggest other sugar sources to try.

If you could engineer a microbe to digest anything—anything at all—what would it be?

This kind of research is happening right now at Berkeley.

Close & Follow-up – After Presentation

Write us a letter or email! You can suggest other sugar sources for us to try with yeast or share your own experimental results after trying another sugar source at home. Also, think about what problems could be solved using microbes. What would the perfect microbe be able to digest? Could microbes be used by doctors? Against pollution?