

Fishable and Swimmable in 7 Years

Lesson 4 - Elaborate

Overview

Bioremediation is the use of microorganisms to take care of a problem. Students will be making mud balls, called Genki Balls, as a form of bioremediation. Genki Balls contain microorganisms to digest the sludge in the canal and fend off some of the pathogens.

Goal

Students know that they can apply technology to address a problem.

Essential Question

How can we encourage others to care?

Enduring Understanding

Problems can have more than one solution.

- There are multiple ways to address the Ala Wai Canal's pollution
- There are multiple ways to encourage people to care.

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Lesson 4 - Elaborate

| Materials | |
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| Materials for 60 Balls | Tools |
| <ul style="list-style-type: none">● Topsoil (½ cubic ft)● Rice Bran, 800 grams● Molasses, ½ cup● Water● EM solution, 1 liter<ul style="list-style-type: none">○ See note on next page.● Aluminum Pans (9" x 13"), 5 pans● Underbed container, 1 container | <ul style="list-style-type: none">● Sifting pans ¼"● Container(s) to scoop soil● Graduated cylinder● Beaker● 5 gallon bucket● Newspaper● Container(s) for water to wash● Tarp● Food service gloves |
| <p>Considerations:</p> <ul style="list-style-type: none">● You will need to multiply the supplies in the left column depending on how many Genki Balls you want to make in total. Most students make around 2 to 4 balls each.● Work area<ul style="list-style-type: none">○ Normal = Ideally you would want to work outside, on tables.○ Alternative = If indoors, you may want to use a tarp to cover the tables and floor.● Washing hands<ul style="list-style-type: none">○ Normal = The container of water is to remove most of the soil from the students' hands before washing their hands in a sink.○ Alternative = If students don't want to get their hands dirty, you can provide food service gloves. | |

Lesson 4 - Elaborate

Notes on the EM Solution

Insight:

- If you are making more than one bag (more than 60 balls) it can get costly since each bag requires 1 liter of EM solution.
- There is a cost-effective way of making “activated EM,” which will give you about 20x the amount, but you need to prepare this solution 2 weeks in advance.

Materials:

- 1 bottle of EM
- Water
- Molasses, 1 liter
- 7 one gallon containers.
- 1000 mL beaker
- Chopstick to stir with

Procedure:

1. Pour 850 mL of water into the beaker.
2. Add 150 mL of molasses into the same beaker.
3. Use the chopstick to stir.
4. Pour this solution into an empty 1-gallon container.
5. There will still be some molasses stuck to the beaker.
6. Add 1000 mL of water into the beaker.
7. Use the chopstick to stir. This will remove more molasses from the beaker.
8. Pour this 1000 mL solution into the same 1-gallon container.
9. Pour 850 mL of water into the beaker.
10. Pour 150 mL of the EM solution into the same beaker.
11. Use the chopstick to stir.
12. Pour this solution into the same 1-gallon container.
13. Close the 1-gallon container, and shake the mixture.
14. This is 3 liters of activated EM. Repeat for the other empty 1-gallons.

Lesson 4 - Elaborate

Lesson Time = Varies - 45 minutes to 1 hour

Setup (Before)

1. You may have to alter this setup depending on the amount of materials you have access to.
2. On a table, place:
 - a. The large underbed container.
 - b. The sifter(s)
 - c. The container of water (to wash hands)
 - d. 1 liter of the EM solution
 - e. The rice bran
3. Near the table, on the floor, place:
 - a. The opened bag of soil.
 - b. Place the scooper into that bag of soil.
 - c. Place the 5-gallon bucket near the table.
4. Prepare the aluminum pans.
 - a. These are used to store the Genki Balls for 2 weeks.
 - b. Place two sheets of newspaper in the middle of the pan, so that half of the newspaper is in the pan, and half of it is hanging out.
 - c. Place another sheet of newspaper on top of those, in the middle of the pan.
 - d. Each pan can hold about 12 balls. Prepare as many as necessary.
 - e. Place the pans near the Genki Ball making area.

Lesson 4 - Elaborate

Making the Genki Balls (45 minutes - 1 hour)

Sifting the soil.

1. Students should hold the sifters over the large underbed container(s).
2. Others should use the smaller container(s) in the soil bag to scoop soil and pour it onto the sifters.
3. Students should shake the sifters so that the smaller particles fall into the large container on the table.
4. The leftover rocks and twigs remaining in the sifter can be disposed of in the 5-gallon bucket on the floor.
5. Repeat this process until all of the soil is sifted.
6. Mention that the purpose of the soil is to hold everything together.

Adding the rice bran.

1. Mention that the purpose of the rice bran is to provide a surface for the microorganisms to thrive on.
2. Rice bran is the outside part of rice. You can have the students feel it before adding it to the soil.
3. Add all of the rice bran to the soil.
4. Students should mix the rice bran and soil thoroughly. Have them check the corners of the container - the rice bran tends to pile up there.

Adding the EM solution.

1. Mention that these are the effective microorganisms that will be used to digest the sludge.
 - a. Yeast - same as in bread, but this time it's helping the lactic acid bacteria thrive.
 - b. Lactic acid bacteria - same in our digestive system, but it's helping decrease the pathogens in the water.

Fishable and Swimmable in 7 Years

Lesson 4 - Elaborate

- c. Phototrophic (photosynthetic) bacteria - "photo" - uses light to digest the sludge.
 - d. All of these are non-toxic, in fact, people drink the solution to help their digestive system.
2. Either:
- a. With normal EM solution:
 - i. Pour 1 liter of the EM solution evenly over the soil/rice bran mixture.
 - ii. Mix 50 mL of molasses with 1 liter of water.
 - iii. Pour this molasses and water solution over the soil/rice bran as well.
 - b. With activated EM, pour 2 liters evenly over the soil/rice bran.

Mixing the ingredients.

1. Distribute gloves, if necessary.
2. Students should mix the liquid and the soil/rice bran thoroughly.

Making the Genki Balls.

1. Grab some soil and compact it together into a ball.
2. The Genki Ball should be the size of a tennis ball.
3. Students should focus on compacting the soil well.

Insight: Students may be quick to want to add more water, but refrain from doing that in the beginning. The Genki Balls will be too mushy if too wet. However, if the Genki Balls do not look as smooth, add water, a little at a time.

Fishable and Swimmable in 7 Years

Lesson 4 - Elaborate

4. Completed Genki Balls should be placed in the aluminum pans.
 - a. Each pan should have 12 Genki Balls or so.
 - b. Make sure the Genki Balls are not stacked on one another.

Clean up.

1. Students should use the container of water to remove most of the soil from their hands first. Then they can go to a sink and wash their hands as normal.
2. We are not using the sifted out rocks, twigs, and larger soil particles for our Genki Ball purposes, so you can decide what to do with it. Some people use them in their gardens. You can also ask your custodians if they can use it around school.
3. For the completed Genki Balls, fold the newspaper over them to shield them from light while they dry. You can use tape if necessary.

Genki Ball Storage (2 weeks)

1. It takes about 2 weeks for the Genki Balls to fully dry.
2. You may have to switch out the newspaper the next day if it's too wet.
3. Check the balls in a few days, some white fuzzy stuff may be growing.
 - a. It is not toxic.
 - b. Have the students rub that into the Genki Balls' surface to prevent black mold from growing.

Student Reflection (5 minutes)

1. Time permitting, you can create an exit pass, and ask the following:
 - a. What did you learn about yourself from this activity?
 - b. What is your opinion on bioremediation and the Genki Balls?