WAYNE STATE UNIVERSITY

STEM Day Lesson Plan

Lesson Plan Author(s) Names and Affiliation: This lesson plan is a modified version of the protocol for DNA extraction from oranges on sciencing.com for use at WSU STEM day 2019 ; Instructors are Kristin Richardson, Carthic Rajagopalan, Melissa Bukowski, and Cameron Pinnock

Title: DNA Extraction from Oranges

Subject Area: Cell Biology, Genetics

Learning Activity Description: Students will take blended oranges and go through a series of simple steps to produce and extract DNA from the blended samples that they will be able to see with their own eyes when the experiment is finished.

Lesson Activity Objective: This activity helps to point out that DNA is part of all living things, including fruit, and not just humans or other mammals. It makes us who/what we are and physically seeing an example of DNA from a plant helps to make that connection.

Lesson Activity Outcomes: Students will appreciate the fundamental requirements for DNA in all living things and take home a fun simple experiment that they can do in their own kitchens.

Materials/Supplies Listed:

Oranges
Blender
Glass Jars
Rubbing Alcohol (cold)
Toothpicks
Salt
Warm water
Coffee Filters
Dish Soap
Eye droppers (or small transfer pipette)

Teacher Procedures:

1. Before starting: make sure rubbing alcohol has been in freezer for ~30 minutes beforehand; It is also helpful if oranges are blended prior to the students arrival, which saves time and avoids loud noise in the classroom, but this is not necessary.
2. Peel orange and cut into small pieces. Put the pieces in the blender and fill with warm water until oranges are covered. Add 1 teaspoon of salt and blend until a thick easily pourable liquid is formed.

    a. The salt acts as a method of neutralizing the charge of the DNA's sugar phosphate backbone. This makes the DNA less hydrophilic (less soluble in water) and therefore when the alcohol is added it promotes bonds between the salt and the sugar in DNA and causes the DNA to precipitate.
3. Students (groups) should have a glass jar at their station. Have them cover the opening to the jar with a coffee filter and pour some of the orange mixture into the jar through the filter.
4. Remove the filter and add 2 teaspoons of liquid dish soap to the jar. Stir this carefully so not to create bubbles.
    a. Dish soap is a detergent; it breaks down the membranes of the cells contained in the mixture and allows the DNA to be released from the cell.
5. Remove cold alcohol from the freezer and slowly pour it into the orange mixture down the side of the jar. This is where the eye dropper can be used in order to avoid pouring the alcohol directly on top of the mixture.
    a. Only pour enough to make a small separated layer on top of the mixture
6. Let mixture sit undisturbed for 10 minutes.
7. The DNA will start to coagulate and form a long white strand that will float to the top of the alcohol layer.
8. Use a toothpick to pick it up and visualize it.

Preparation Time for Learning Activity: 30 minutes – rubbing alcohol needs to be cold for experiment to work, keep it in freezer for 30 minutes prior to starting.

Room set-up: stations should be made so that smaller groups of students can participate. Each station will need a glass jar, coffee filter, a small cup of dish soap, a small cup of rubbing alcohol, eye dropper, toothpick

Group Strategies (example, group size, expected time for groups, etc.):
Groups should be no greater than 5-6 students, so that each student feels involved. Task should take ~25-30 minutes depending on discussion.

Student Products/Artifacts/work pages: Consider a coloring page of an orange and a DNA molecule if time permits. Not necessary.

Assessment Criteria/Rubric: Students will discuss at the end what they saw in the jar. Did they get DNA or not? Why may some groups not have gotten DNA while others did (that's how experimental sciences work sometimes) What did it look like? What does DNA structure look like? Why couldn't they see that structure? Do they think an entire orange has only one strand of DNA, or are they looking at many strands clumped together? Ask thought provoking questions.

Closing/Transition to next activity: N/A