RESET | Getting Loose: Do Dilutions Matter?

TEACHER

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SUBJECT/GRADE LEVEL

Subject

Chemistry

Biology

Grade

High School

Materials

- Dilution Lab:
  - Water, Plastic Cups, Scale, Pipette, Volumetric Flask, Hot Plate, Benedict's Solution, Table sugar or corn syrup (for control), pH paper, Spot plate, Orange Juice
- Homeostasis Lab:
  - 3 plastic cups per group (with holes punctured)
  - 2 drops yellow food color per 2 liters for both Homer and the control color cup
  - 10 drops of yellow food color per 2 liters for the concentrated cup
  - 1 thermometer per group
    - *Use a thin nail to make a hole in the cups.*
    - *1 set up between 4 students.*

Next Generation Science Standards

- HS-PS1-7: Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

LESSON OBJECTIVE(S)

Students will model blood sugar homeostasis and investigate the sugar concentrations in various drinks by conducting serial dilutions.

CAREER STATEMENT

Obi Chukwu worked with Kathryn Guy at the ERDC CERL Army Research Lab in Champaign, Illinois. Dr. Guy's research focuses on a novel aerobic wastewater treatment system for energy generation at Forward Operating Bases. Their work led to the creation of this lesson plan.

ENGAGEMENT

Introduce homeostasis with the lab Homer-o-stasis.

Have students watch the video on Blood Sugar Homeostasis.

Explain: (ppt or reading guide): There are two types of diabetes. Type I diabetes is the one that you are born with. You have to take insulin to help regulate because your body doesn't produce it. Type II diabetes is developed over time due to bad nutrition or exercise habits. The end result of having type II diabetes is that you have to have a controlled diet and take medicine to regulate it correctly. Whether you are a type I or type II diabetic you have to watch what you consume because it can cause your blood sugar to rise really high. In today's lesson, we are going to look at the effect of orange juice on blood sugar levels. Let's Watch this quick video. Type of Juices

Exit Ticket: Have students fill in the boxes

EXPLORATION

Students are given a scenario in which a patient needs the correct concentration of orange juice. Students will dilute the orange juice until the correct concentration is found.

See Appendix A for the attached worksheet

EXPLANATION

- How does the diluted nature of orange juice affect a person's blood sugar level?
- Watch this video before the Lab (https://ed.ted.com/lessons/how-do-carbohydrates-impact-your-health-richard-j-wood)
- What vocabulary will be introduced and how will it connect to students' observations?
    - Solution, Solute, Solvent, Dilution, Serial dilution, Concentration, Qualitative analysis, Quantitative analysis, Molarity, Spectroscopy
- Students will learn about dilution, the terms and concepts.
    - Inquiry in Action/ Chemistry Review: Dissolving, American Chemical society, 2018 http://www.inquiryinaction.org/chemistryreview/dissolving/
- Students will learn calculations associated with concentration solutions in units of molarity and will apply on the PHET simulation https://phet.colorado.edu/en/simulation/molarity
- How is this knowledge applied in our daily lives?

ELABORATION

- Students will conduct a serial dilution of a sports drink, orange juice, soda, or any sweet drink that the student wants to investigate. They'll even be able to quantify the use of it using a Vernier Spec. 20.
- Discuss in groups how to design an experiment to study the concentration of sugar in juices.
- Think about the procedure:
    - What will be our control?
    - How many dilutions should we do?
    - How can we test sugar levels?
    - How can we know that a chemical reaction happened?
    - How many samples will we be able to do?
    - How should we record the data?
    - What safety procedures must we follow?

EVALUATION

The final hands-on activity will be to give students apple, grape, and pineapple juice. They will have to figure out the right dilution amount they need to be able to create a safe juice for a diabetic to drink.

They will present the final product and all the procedures to the class using GIF animation, comic cartoons, infographics, or video presentations.

APPENDIX A

There has been a mix-up in the cafeteria at Obi Hospital. Someone came in and wiped off all the patients' names from the juice glasses. The entire set needed to be thrown away. Mr. Lemons has come in for an evaluation and needs his morning orange juice. Since he is diabetic he cannot drink the kind of juice as it is. We need to help Mr. Lemons by diluting the orange juice concentrate. You will be conducting research to find the right mixture.

When you add water to a sugary drink it dilutes the drink and lowers its calorie content, as long as the portion stays the same. A good place to start is to replace 1 cup of juice with 1/2 cup of the juice and 1/2 cup of water, which will cut the sugar in half. Next students will use ¼ cup of juice. Then 1/8 cup of juice. Finally, the students will use 1/16 cup of juice. The rest of each cup will be water in order to correctly measure one cup of water/ juice mixture. Students will use calculations to test the amount of sugar in each drink. They can also use a Sugar metabolism kit similar to pH test strips to measure the glucose in the juices. Students can complete a table to show their data.

Amount of juice	Amount of water	Amount of sugar
1 cup = 240 mL	0	40 grams
½ cup = 120 mL		
¼ cup = 60 mL		
⅛ cup= 30 mL		
1/16 cup= 15 mL		