**Kool-aid Molarity Lab**

Teacher Instructions

Objectives:

* Students will use taste sense to connect ideas of concentration.
* Students will calculate the molarity of a solution.

Possible Extension:

* Students will use UV-Vis spectroscopy and Beer’s Law to analyze the flavoring concentration in a drink.

Standards:

Nebraska State Standards: SC.HSP.3.1, SC.HSP.3.3.G, SC.HSP.4.2, SC.HSP.5.3.A, SC.HSP.5.3.D

Overview:

In a unit of solution chemistry, students will have a kool-aid tasting tour to determine the preferred concentration of sugar in kool-aid solution. They then perform molarity calculations to determine the concentrations of sugar in each solution when given the recipe for each.

Extension: To take this one step further, students will be given the problem of the Queen of England will be visiting and she only likes blue kool-aid with a specific concentration of flavoring that is not too tart. They will be given a solution of kool-aid that is “the Queen’s favorite,” and they will need to use spectroscopy using a Vernier colorimeter to find the concentration in order to more easily make the solution when she visits. The students will use the known concentrations to form a calibration curve, and then analyze the unknown to determine the concentration.

**Day 1: Meaning of concentration and Kool-aid Tasting Tour**

Bell ringer: Students will be asked to define concentration and to give an example.

Engage: Using the bellringer question, we will discuss as a class what concentration means and the examples given. Some examples might include concentrated acid, the concentration of oxygen for oxygen masks, the concentration of fish in a lake, concentration of people in a city, urine and hydration, etc.

Explore: Students will use small cups to go on a tasting tour around the room, tasting various solutions of kool-aid with differing amounts of sugar. Students will take a poll to determine what the preferred solution was. Students will generate a ranking of concentration based on the taste observations.

\*[Kool-aid Molarity Lab](https://docs.google.com/document/d/1HvcOxtBdWrRByL-AYyRj5qTOsyoZIWVj1ib8itet8CY/edit?usp=sharing)

Homework: Watch flipped video notes on Molarity

Using flipped video notes, students will be introduced to molarity and the units of the quantity.

\*[Molarity video notes](https://edpuzzle.com/media/5534781ae47b448d28251d56)

**Day 2: Calculating Molarity**

Bell Ringer: Students will be asked to give the units of molarity and to connect these units to the sugar concentration gradient they came up with for the previous day’s lab.

Explain: As a class, we will discuss the bell ringer question and re-examine the sugar gradient the class came up with. The students will be given the recipe from the Kool-aid packet and we will calculate the molarity of the recipe together as a class.

The concentrations of each Kool-aid solution from the tasting tour will be given to them, and they will calculate the molarity for each one. Finally, they will write a conclusion about the preferred molarity of their solution based on their data.

Elaborate: Students will complete the Molarity Practice worksheet to continue working and practicing with molarity calculations.

\*[Molarity worksheet #1-5](https://drive.google.com/file/d/0B0953uqe8RceMWVSUndJcFFIVXc/view?usp=sharing)

**Extension:**

**Day 3: Queen’s Concentration Problem**

Bell ringer: Students will look at different colored solutions to qualitatively determine concentration. Then they will be given amounts and practice calculating the actual molarity.

Evaluate: As a class, we will check the answers that were calculated from the bellringer, especially focusing on meaning and giving words to what the numbers mean.

Extend: Students will be introduced to the problem of the “Queen’s Drink.”

Problem: The Queen of England will be visiting and she only likes blue kool-aid with a specific concentration of flavoring in order to not be too tart and a 0.18M concentration of sugar. A perfect solution has been sent so we will have time to analyze it and make sure we can make it for her visit.

The question will be posed to them as to how to figure this out. Students will be given multiple resources and will use a station format to explore:

1. Meet with teacher to review all molarity concepts and dilution. Practice dilution problems.
2. Read through online written article resource: <https://goo.gl/hqL2cu>
3. View video: <https://www.youtube.com/watch?v=pxC6F7bK8CU>
4. Explore Phet simulation: <https://goo.gl/wovcF8>

\*[Phet simulation worksheet](https://drive.google.com/file/d/1ATVhae7qVTVw0dF_Jl1qDCE-jBVw04ld/view?usp=sharing)

Homework: Watch dilution flipped video notes to concrete knowledge. Students will need to develop some ideas for finding the concentration. They will need to write 3 sentences with testing ideas.

\*[Dilutions Flipped Notes](https://edpuzzle.com/media/5534787ce47b448d28251d5b)

**Day 4: Create calibration curve**

Bellringer: Pair up with another student and discuss ideas as to how to find the right concentration.

Students will present their ideas to the class and with teacher guidance, we will develop ideas for the “procedure.” It will be determined that we will need to do photospectrometry. In order for this to work, we will need to make a calibration curve of known concentrations. Then we should be able to use the calibration curve to test the known solution. The actual procedure will be handed out and students will read through it. We will create the data table and do an example dilution problem.

Assume kool-aid has a molar mass of 40g/mol

2.5 grams kool-aid x 1 mol x 1000 mL = 0.31M

200 mL water 40 grams 1 Liter

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Solution | M1 (M) | V1 (mL) | V2 (mL) | M2 Final [ ] | Observations | Absorbance |
| A | 0.31 | 200 |  | 0.31 |  |  |
| B | 0.31 | 100 | 200 | 0.125 |  |  |
| C | 0.125 | 100 | 200 | 0.0625 |  |  |
| D | 0.0625 | 100 | 200 | 0.0313 |  |  |
| E | 0.03125 | 100 | 200 | 0.0156 |  |  |
| F | 0.0156 | 100 | 200 | 0.0078 |  |  |

\*[Calibration procedure](https://drive.google.com/file/d/16ohm1Q_8HQYizyQ0QucuupMViIqLTAqa/view?usp=sharing)

**Day 5: Analyze unknown and Final Queen Recipe**

Bell ringer: Students will evaluate their progress and state their goals for the day.

Students will complete any part of the calibration they need. Then they will fill a cuvet with a sample of the unknown and analyze the unknown solution with the spectrophotometer and calibration curve.

\*[Queen’s Drink Instructions – Analysis of Unknown](https://drive.google.com/file/d/16ohm1Q_8HQYizyQ0QucuupMViIqLTAqa/view?usp=sharing)

Students will use lab report guidelines to create a conclusion and reflection about their lab. They will also write a final recipe that includes data from the flavoring analysis and the sugar analysis that will please the Queen.

\*[Queen’s Drink Instructions –Final Recipe of Queen’s Drink](https://drive.google.com/file/d/16ohm1Q_8HQYizyQ0QucuupMViIqLTAqa/view?usp=sharing)