Lesson Title	Percentages of Dissolved Solids
Length of Lesson	Two 50 minute periods
Created By	Corey Ladner
Subject	Pre-Algebra – Number and Operations
Grade Level	9^{th} – 12^{th} Grade
State Standards	1b
DOK Level	DOK 2
DOK Application	Cause/Effect, Infer, Interpret, Distinguish, Make Observations, Relate, Compare.
National Standards	**Data Analysis** Develop and evaluate inferences and predictions that are based on data Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
Graduate Research Element	Measurement of Dissolved Solids and Conductivity is an important factor in defining water quality in streams

Student Learning Goal:
Students will solve real-life problem involving addition, subtraction, multiplication and division of rational numbers. This lesson will focus on a real-life problem that requires calculations of percentages while also inferences and predictions of collected data that can be used as general standards for the problem.

National Standards
Data Analysis

- Develop and evaluate inferences and predictions that are based on data.
- Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.

Materials Needed (supplies, hand-outs, resources):
1 Gallon container of Sweetened Tea, 12 ounce plastic cups (identical in size and weight), granulated sugar, measuring cups (for ounces), digital weight scale, dataset (Ladner_GP_dataset_7.13.12.doc), Independent Practice/ Assessment worksheet (DS_assessment_7.13.12.doc)

Lesson Performance Task/Assessment:

The students will be assessed on their ability to make measurements, record data, and make the required percentage calculations correctly for the Independent Practice activity. For details refer to the Independent Practice section and the attached DS_assessment_7.13.12.doc.

Lesson Relevance to Performance Task and Students:
The lesson provides the students with a real-life problem involving percentages and making inferences of the collected data that can be used to develop solutions to the problem.

Anticipatory Set/Capture Interest:
The students will be shown a 1 gallon container of sweetened tea and asked, "Do you think the tea is sweeter at the top, middle, or bottom?"

Note: Typically the concentration of dissolved sugar should be equal throughout the volume of tea. People often perceive tea to be sweeter at the bottom of a container, but in actuality, tea can only taste sweeter at the bottom because undissolved sugar has fallen to the bottom of the container.

Guided Practice:
The students will be presented with the real world problem and be asked to provide a mathematical analysis of a given dataset (Ladner_GP_dataset_7.13.12.doc) of Dissolved Solids and Electrical Conductivity values. This dataset activity will serve the sole purpose of providing the students with practice calculating percentages. The dataset consists of a real-life stream water quality analysis containing values for Dissolved Solids and Electrical Conductivity. As for water quality analyses, the measurement of Electrical Conductivity reflects the conductivity generated by dissolved solids present in water. Therefore, Electrical Conductivity values can be directly related to Dissolved Solids values. Ideally, the Electrical Conductivity values should be within 10% of the measured Dissolved Solids values. The students will compare the values of Dissolved Solids and Conductivity in the dataset in order to determine the percent accuracy of the Conductivity measurements. The data sheet will be explained to the students, as well as the values needed to solve the problem described in the handout containing the dataset (Ladner_GP_dataset_7.13.12.doc). The students will be given review of the equations and calculations involved with the activity. Afterwards, the students will be allowed time to perform the percent difference calculations. Once the students have had time to make the calculations, the teacher will discuss the simulated problem with the students and consider inferences that can be made from the data. Following the discussion, the students will apply the real world example to a similar hands-on activity presented in the independent practice.

Independent Practice:
The students will perform an activity to experience the idea of dissolved solids and how

mathematics can be used to determine the percentage of a solid that can be dissolved in water. The activity will require **two days (50 minutes each day)** to complete.

Day 1: Following the guided practice, each student will be given a 12 ounce plastic cup (*cups should be all the same size and weight*). Students will fill their cups with a known volume and weight of warm water, and then, add a known volume and weight of granular sugar to the warm water. It is recommended that approximately two ounces of sugar be used so that some of the sugar will not be dissolved in the water. Prior to creating the sugar water solution, students should make predictions of how much of the sugar will be dissolved in the water and how much sugar will precipitate to the bottom of the cup. After the sugar water solution is allowed to settle for 10 minutes, the sugar water solution will be poured into another empty cup leaving the non-dissolved sugar in the bottom of the cup used to create the solution. The non-dissolved sugar will be stored away for ***24 hours or as long as needed*** to allow for any remaining water to evaporate. The cups containing the sugar water solution will also be stored away for ***several days until all of the water is evaporated*** and the dissolved sugar is left in the cups.
Day 2: *After the cups have been stored away several days to allow the water to evaporate,* the cups (all identical in size and weight) can then be weighed on a digital weight scale to determine the amount of sugar that was dissolved in water and the amount that was not dissolved. *Be sure to subtract the weight of the cup.* The students will use this information to calculate the percentages of dissolved and non-dissolved sugar that was in their cups. From this data, the students can make inferences and predictions on the average amount of sugar that can be dissolved per volume of water. Students will use DS_assessment_7.13.12.doc to record data. Students will use the INSPIRE_LP_Ladner_7.13.12_handout to geometric representations of percentages calculated from the data.

Remediation and/or Enrichment:
Remediation:
In the case that remediation is needed, the student can meet with the instructor for individual tutoring. The student can also be grouped with a higher performing student that understands the lesson.
Enrichment:
In situations where there is complete understanding and performance, the lesson can be extended by considering the inferences that were gained on the amount of sugar that can be dissolved in a certain volume of water, then applying them to a larger scale problem (e.g., one gallon of water).

Check(s) for Understanding:
The students will be asked to provide answers to the following questions related to the independent practice section.

Why didn't all of the sugar added to the water dissolve completely?

As the volume of water used is increased, how will the percentage of dissolved sugar change?

What information is needed to calculate percentages?

Closure:
The teacher can close the lesson by discussing with the students, how percentages and dissolved solids can be applied to their daily lives (e.g., sweet tea, Kool Aid, drinking water quality) Additionally, I will share with the students how the concepts of the lesson relate to problems addressed in my research.

Possible Alternate Subject Integrations:
This lesson can be incorporated into middle and high school physical science, biology, and chemistry courses.

Teacher Notes:

Attachments

- Dataset document(Ladner_GP_dataset_7.13.12)
- Assessment/ Independent Practice worksheet (DS_assessment_7.13.12)
- INSPIRE_LP_Ladner_7.13.12_handout