

Unit 1: Scientific Measurement, Data Collection, and Photospectroscopy

Differentiation for English Language Learners

View: A short video or a demonstration using chemical indicators is used in order for students to “see” or begin to visualize the concepts of dissolution, solutes and solutions, chemicals dissolved in water, and how these substances can be observed and quantified. Language is secondary to observing and “seeing”. The goal is to have the students visualize the lesson objectives through either a video or quick demonstration. To further enhance the beginning of the lesson a windowpane diagram may be used to show how the activities will progress. This also helps students understand through a visual, the flow of the lesson and to get an overview of the objectives.

Experience: Students participate in a lab experience prior to formal introduction of vocabulary in order to develop an understanding of the concepts and the tools used to measure concentration. The approach is to “frontload” the experience and then introduce the concepts and vocabulary formally later through “flipped” reading and videos with in class practice. The students experience how to record data and how to think about data collection through this lab experience while learning about photospectroscopy. They are able to share their experiences and begin to learn the future relevance of the techniques they are using. Precision and accuracy are explained as they are being practiced and introduced in the lab. Some vocabulary will be introduced so that understanding is developed in context. Time is specifically used for mini-lessons as the lab progresses to make important points and clarify language. A PowerPoint is used to simplify the lab procedures and help students progress through the College Board provided student lab sheet which is dense in complex vocabulary and difficult for some students to follow.

Speak: While doing the lab, students work in groups to collect data. This data collection is dispersed among the different groups so that collaboration is needed to complete the data table. Students are regrouped prior to the lab so that there is as much language diversity and skill diversity as possible in each group. Students are allowed to speak and ask questions in their native language as long as they are sensitive to other members in their group. In these working groups English predominates as not all members have the same first language but individuals frequently ask questions in native languages across groups to clarify procedures and protocols. Group data is collected and debriefed in English.

“The Quest for Clean Drinking Water” or other short article on dissolved chemicals in water is used to introduce the problem of unknown quantities of chemicals found in drinking water. These short articles are read or discussed for the sole reason of bringing up the question of how scientists identify, classify and measure what is dissolved in water. These same articles can be used again in the chapter on aqueous solutions. Students read, discuss, and use the compass model to identify the issues and stake holders connected to chemicals found in water supplies. Students are allowed and encouraged to use their native language for support as needed but groups always report their progress to the class in English.

Transform: Using video and PowerPoint, students will research, read, and learn about the concepts, skills, and vocabulary related to photospectroscopy and scientific measurement and observations.

Students practice skills related to significant digits, scientific notation, error analysis, and SI units as well as review the concepts of molarity and making dilute solutions using molar ratios. The students transition to a formal use of English and become familiar with the vocabulary that will help them conceptualize photospectroscopy. Through mini-assessments and formative assignments they will demonstrate attainment of the formal knowledge, skills, and vocabulary as well as practice scientific communication skills. A careful review of their AP Chemistry I lab report will help them understand the format and language used in formal laboratory reporting. A depth-of-knowledge rubric will be used to help students better understand the communication criteria and expectations expected in scientific report writing for AP chemistry. The information collected from both formal and informal assessments is used to determine their scientific understanding as well as their academic English development.

Extend: In order to apply what they have learned and to demonstrate their mastery, students will complete a simulation lab activity to analyze four samples of water containing different amounts of phosphate. One sample represents water found in a drowned businessman's lungs and the other three samples represent three different bodies of water. The goal of the lab is to determine which body of water has a matching concentration of phosphates to the businessman's lungs. As students progress through the lab, instruction to separate individuals is differentiated. Some individuals may be regrouped and some groups may receive very little support as they design and work their way through the project. Other groups may receive much more guidance. It is very important to monitor how students are recording data to make sure that they are prepared to communicate their result in a satisfactory way. Clear depth of knowledge rubric communicates to students what is acceptable and how students can extend beyond the required proficiencies.

The Activity scenario and lab procedure has been reconstructed as a "close test" to help language-learners identify key vocabulary. The "close test" hand out, removes the academic vocabulary and many of the tier two words so that students have to define and assign meaning to important words prior to starting the activity. The two sets of vocabulary words are provided to students to help them with their vocabulary development.

Deliver: Students will apply all the skills that have been taught in the lab to demonstrate mastery of content knowledge about photospectroscopy and skills related to scientific reporting and measurement. The project rubric is a depth-of-knowledge rubric based on the reporting standards provided by the College Board. This rubric focuses on the quality of student work and is designed to challenge students to create professional pieces of scientific writing that demonstrate superior understanding of the conventions and skills related to reporting, measuring, observing, and error analysis.