TE 802: Unit Plan 1

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Part I: Information about the Unit

Topic: Introduction, Measurements, and Problem Solving

Type of Class

- Grade level(s): 10 11 High school basic chemistry
- Type of school: Suburban
- Tracking level: College bound (middle range chemistry)

Abstract

This unit focuses on measurements and different strategies to problem solving. The activities will include labs, worksheets, demonstrations, lecturing on notes, book reading, and in-class activities. It is the first unit of the year so we will also focus on how to calculate percentages and grades for quizzes, tests, marking periods or semesters.

Part II: Clarifying Your Goals

Big Ideas

Science is the search for relationships that explain and predict the behavior of the universe. Two categories of science are pure and applied. Pure science is the investigation for a better understanding of the world for its own sake. Applied science is the practical application of discoveries and technology. Science is organized into two main fields of study, biological and physical sciences. There are many disciplines that compose each field. Botany and zoology are two examples of biological sciences. Chemistry, physics, and geology are some disciplines in physical science. Chemistry is the study of matter, its structure and the changes it undergoes; in other words, the science of materials around us. Many other science fields use chemistry in their practices, which is why chemistry is known as the central science.

The scientific method is an organized way to solve problems. The first step in the scientific method is to determine the question or problem. The next step is to do research in order to find all the information known about the question or problem. Formation of a hypothesis that predicts an outcome based upon previous knowledge follows research. Next, tests or experiments must be designed and implemented in order to explore the hypothesis. Experiments involve the testing of variables and the use of different groups. The independent variable is the variable that one changes, while the dependent variable is the effect of changing the independent variable. The experimental group is the group that is testing the variable, while the control group is the group that remains constant and is

compared with the experimental. The next step is to make observations. The two main types of observations are qualitative, which involves using the five senses to notice or perceive something, and quantitative data, which consists of numerical measurements. The last step in the scientific method is to develop conclusions. There are main ways to form these interpretations from the observations; in the form of a theory or a law. A theory is the reasonable explanations of observed events that are related. A law is the statement that describes a natural event and has been proven to be true.

A quantity of measurement consists of a number followed by a unit. A unit is what the quantity is measured in. There are three main reasons why the metric system is used in chemistry instead of the English system. The first is that it's easier because it is based on units of ten. Secondly, everyone uses it, so it gives consistency. Lastly, there are standards to which everyone can compare. The entire world uses the international system of units (SI), which is composed of fundamental or base units. The seven main quantities are: length, meter (m); mass, kilogram (kg); time, second (s); amount/count, mole (m); temperature, Kelvin (K); electric current, ampere (A); luminous intensity, candela (cd). Derived units are measurements that use a combination of the base units.

There is ambiguity in every measurement. This is due to the fact that instruments are never completely free of flaws and that measuring involves estimation because humans are reading it. The last number in any measurement is estimated and therefore uncertain. Accuracy is how close a measurement is to the true or accepted value, and precision is how reproducible the measurements are. Significant figures are the digits in a measurement that are certain, plus the one that is uncertain. Scientific notation is written as $M \times 10^n$, where M is determined by moving the decimal so that M is a number less than ten but greater than one, and n is how many spaces the decimal was moved; n is positive if the decimal was moved to the left, while n is negative if the decimal was moved to the right. Dimensional analysis is a technique for converting between units. Scientific graphs are used to show relationships between variables.

Experiences, Patterns, and Explanations

Observations or experiences (examples, phenomena, data)	**Patterns (laws, generalizations, graphs, tables, categories)**	**Explanations (models, theories)**
Incoming experiences - hair stylists - construction engineers - biologists	- all these professions involve some knowledge of chemistry	- why chemistry is known as the central science
- your height	- is a number, followed by a unit	- is a measurement, usually given in feet and inches
- three darts thrown very close to bullseye	- darts are close to bullseye (accepted value)	- throws are said to be accurate
- three darts thrown very close to the double 15s	- darts are close to one another, but far away from bullseye (accepted value)	- throws are said to be precise, but not accurate

Target experiences - cook an onion	- cooked onion is sweet, unlike uncooked onion	- follow scientific method to find that cooking destroys the ability of the onion to produce the gas and allows you to taste the sugar
- the volume of a washing machine	- volume is about one cubic meter	- volume is a derived unit, and the SI unit of volume is the cubic meter
- using an electronic balance	- write down the number given, sometimes goes back and forth between two numbers for the last digit to right	- the last digit is uncertain due to the limited accuracy of the instrument, but still significant
- reading a value from a graduated cylinder	- write down the nearest ml value (round down) and the estimated tenths of a ml	- the ones digit of the ml is certain, and the tenth place is estimated and uncertain due to human error
- water droplets	- each water droplet contains billions of water molecules	- express the number of water molecules in scientific notation (ex. 6.02×10^{23} molecules)
- a gallon of milk	- volume is given in gallons, which is a unit in the English system	- use the conversion of 1 gal= 3.785 L to convert the units to the metric system, this is dimensional analysis
Application: Model-based Reasoning – using models/theories to explain experiences ⇐		
Inquiry: Finding and Explaining Patterns in Experience ⇒		

Objectives for Student Learning

Michigan Objectives	Type
1. C 1.1 A	1. process
2. C 1.1 B	2. process
3. C 1.1 C	3. content
4. C 1.1 D	4. process
5. C 1.1 E	5. process
6. C 1.1 F	6. process
7. C 1.1 G	7. content
8. C 1.1 H	8. process
9. C 1.2 A	9. process
10.C 1.2 B	10. process
11. C 1.2 C	11. content

12.C 1.2 D 13. C 1.2 E 14. C 1.2 F 15.C 1.2 G 16. C1.2 H 17.C 1.2 K	12. content 13. content 14. process 15. process 16. content 17. process
Synthesized Unit Objectives	
1. Explain the two main categories to which science is divided and give examples of disciplines for each type.	Content
2. State steps and purpose of the scientific method	Process
3. Apply the scientific method: given proper lab equipment, investigate the relationship between the burn time of a candle and the volume of jars placed over the candle	Process
4. Using the results obtained from the jar volume vs. burn time lab, plot the data, draw the best fit line, analyze the results, and draw conclusions between variables.	Content
5. Given a scientific scenario, critique and discuss whether a hypothesis could be generated and then tested through scientific investigation.	Process
6. Based on empirical evidence (observation), explain and critique the reasoning used to draw a scientific conclusion (inference) or explanation.	Process
7. State three reasons why the metric system is preferred over the English system in the scientific world.	Process
8. State the purpose of using significant figures and when given a measurement, determine the number of significant figures which tells the accuracy of the measuring instrument.	Content
9. Perform operations with scientific measurements and round answers off to the correct number of significant figures.	Content
10. Express numbers in scientific notation and positional notation.	Content
11. Given a list of metric system prefixes, convert measurements within the metric system.	Content
12. Given the appropriate conversion factors, use the factor-label method to convert measurements from the English system to the metric system and from the metric system to the English system.	Content
13. Through laboratory investigation, simulate an oil spill and analyze the effectiveness of clean up methods and social implications for the oil spill.	Content
14. Given a score on a test or a quiz, calculate the % and corresponding grade for the assignment.	Content
15. Given the marking period and final exam percentages, calculate the overall percentage and final grade for a course.	Content

* Synthesized unit objectives and references to state objectives are from my mentor, Mike Kapustka.