TE 802: Formative and Summative Assessment

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Part I: Clarifying Your Goals for the Unit

Unit: Scientific Inquiry

Topic: Metric Conversions

Type of Class

- Grade level(s): 9
- High school: Basic
- Type of school: Urban
- Tracking level: College bound

Abstract

In this unit students will be introduced to scientific inquiry by learning the components to the scientific method in different stages. I will be scaffolding my students through the different components of the scientific method through multiple application-based lessons throughout this unit. After learning all of the components to the scientific method my students will practice designing and testing their experimental procedures in class. They will also critique their experimental design and type a formal laboratory report once they are finished with their investigation.

A. Big Ideas

Science is the process of studying of the natural world using observations, experimentation, and logic to explain the phenomena within our universe. It is the continuous search for knowledge and understanding (Michigan Merit Curriculum). The scientific method is a rigorous framework utilized by scientists worldwide to conduct science in a systematic manner. The scientific method includes making observations, asking questions, and framing testable statements that lead to experimentation and data collection. The scientific method is not a linear process, but rather a cyclic process with similar to components to most investigations.

Experimentation allows scientists to continually contribute new information to the scientific community. In laboratory settings, most experiments are controlled experiments. Conducting controlled requires the manipulation of one variable, the independent variable, in an effort to study the response of another variable, the dependent variable. For data collection to be reliable within a controlled experiment all other variables must remain constant. Constants must remain the same for both the control group, the group that receives no treatment or the same treatment it has always received, and the experimental group, the group that receives the new treatment. As data is collected throughout a controlled experiment, quantitative data must be collected with the same units of measurement. The International System of Units, or SI units, are typically the units of measurement used throughout a scientific investigation.

After data has been collected, an analysis must be completed to formulate logical conclusions that best explain the evidence. Once enough experiments have been completed over a particular topic, and an explanation is currently supported by irrefutable evidence the explanation becomes a theory. Theories make up the core knowledge studied by scientists (Michigan Merit Curriculum).

B. Student Practices or Crosscutting Concepts

1. Naming key practices

- Make and record quantitative and qualitative observations.
- Draw logical inferences from their quantitative or qualitative observations.
- Ask testable questions from a set of observations.
- Describe the distinctions between scientific theories, laws, hypotheses, and observations.
- Determine what the independent and dependent variables are in a controlled experiment.
- Identify the control group and experimental group within an experiment.
- Identify and list the constant variables in a controlled experiment.
- Conduct scientific investigations using appropriate tools and techniques (e.g., selecting an instrument that measures the desired quantity—length, volume, weight, time interval, temperature—with the appropriate level of precision).

  -- Students will be able to measure and record the volume of a liquid using a graduated cylinder.

  -- Students will be able to measure and record the length of an object using a metric ruler.

  -- Students will be able to measure and record the temperature of a liquid using an electronic thermometer.

  -- Students will be able to measure and record the mass of an object using an electronic balance.
- Design an experimental procedure to a question posed in class.
- Critique their experimental design and propose changes to the experiment.
- Convert between SI units using the prefixes kilo-, hecto-, deca, the base unit, deci-, centi, and milli-.

(a) 2. Using practices or crosscutting concepts to make connections

Students will use the scientific method throughout every unit over the course of this year. They will have to identify the variables within an experiment, graph the variables and data, and apply these concepts to ACT prep questions. Students will practice collecting and recording data with laboratory equipment throughout the year. They will also be given data sets and asked to find the patterns within these data sets. Students will be asked to develop models and test their validity.

To be successful with science the students will practice writing procedures that are reproducible by themselves and by other people in the classroom. They will also practice avoiding bias when they making observations, and then recording their observations clearly for the reader. They will practice writing explanations that are simple and precise so that the reader will understand exactly what they are trying to communicate. Finally, they will have to connect their study to other

scientific models that we'll study in the future units so that they can see how their study connects to a greater framework of studies and information.

OPM Table: Observations, Patterns, and Models

Scenarios given to the students over the course of the unit…

1.) Black Box Lab. The Black Box Lab was developed by Amy Lark. Students are given an enclosed box with unknown objects inside. They are asked in groups to write a list of what they think is inside. The group must come to a consensus. They can shake, move, or manipulate the box anyway they like – they just cannot open it. Once they have a list of objects they have to explain to the class what they thought was inside, the methods they used to make this deduction, and their evidence for why they picked those objects.

2.) Three redwood trees are kept at different humidity levels inside a greenhouse for 12 weeks. One tree is left outside in normal conditions. The height of each tree is measured once a week.

3.) Ms. Beggs is testing to see if a new fertilizer, Fertilize-E, will increase the yield of corn. She has two 100m x 100m plots of land that are line up next to each other. On plot 1 she adds the Fertilize-E and on plot 2 she does not add any fertilizer. She uses the same number and types of corn seeds when she plants the plots.

4.) Tyler wants to know if she can dissolve more sugar into her coffee if she increases the temperature of the coffee. Her coffee is normally at 85°C when she pours it out of the coffee pot. She adds 1 cup of sugar to four cups of coffee that are at 85°C, 90°C, 95°C, and 100°C. Then she filters the coffee to separate the liquid from the undissolved sugar and masses the solid sugar.

5.) Kya buys 6 puppies with smooth, glossy coats. After a few weeks, she notices that their coats are not as glossy as before. She talks to the breeder who sold her the puppies and discovers that he fed the puppies a different type of food than what she gives them. She decides to have one puppy keep eating the food she's been using and then have the other puppies each try a different food.

Observations	Patterns	Model
1.) Number of sounds.	***Quantitative Observations:*** *observations involving numerical measurements or data.*	Controlled Experiments are conducted in a systematic fashion as part of the scientific method to collect data. All of the variables must be defined and controlled (with the exception of the dependent variable) to obtain accurate and reliable data.
2.) 12 weeks		
3.) 100m x 100m plot of land		
4.) 1 cup of sugar, 4 cups of coffee		
5.) 6 puppies		
1.) What did the sounds of the objects sound like? What did the experimenter feel when they moved the box?	***Qualitative Observations:*** *observations made through descriptive language.*	
2.) redwood trees		
3.) same type of corn seeds		
4.) undissolved sugar clumps together in the bottom of mug		
5.) glossiness/smoothness of coat		
1.) The boxes.	***Independent Variable:*** *The variable the experimenter purposefully manipulates and changes throughout an experiment.*	
2.) Different humidity levels		
3.) amount of fertilizer		
4.) temperature		
5.) type of dog food		
1.) The students choices for what was inside the box.	***Dependent Variable:*** *The variable the experimenter measures. (The response variable to the independent variable.)*	
2.) Tree height		
3.) yield of corn		
4.) undissolved sugar		
5.) glossiness/smoothness of coat		
1.) --	***Control Group:*** *The group that either does not receive a treatment, or receives the same treatment that it has always had.*	
2.) Tree left outside in normal conditions.		
3.) Plot 2		
4.) 85 °C		
5.) Puppy that receives the food		

Kya initially gave puppies		
1.) students in the	***Experimental Group:*** *The group that receives the new, experimental treatment.*	
2.) Trees inside at humidity levels different from the humidity outside.		
3.) Plot 1		
4.) 90°C, 95°C, 100°C		
5.) Puppies that receive the new dog food		
Use electronic balance.	***Taking Measurements:*** *Use laboratory equipment as well as the appropriate SI Metric units for expressing the value of the data.*	
Use graduated cylinder.		
Use metric ruler.		
Use thermometer.		
Practice converting metric units.		

C. Objectives for Student Learning

Objective	Type
Illinois Objective(s) (PSAE)	
1. **11.11.01** Understand and follow procedures relating to scientific investigations, including understanding the design and procedures used to test a hypothesis, organizing and analyzing data accurately and precisely, producing and interpreting data tables and graphs, performing appropriate calculations, applying basic statistical methods to the data, identifying appropriate conclusions, making predictions, and evaluating competing models.	Using SP
2. **11.11.04** Distinguish and define the following components fo typical experiments: constants, variables, experimental group, control group (or control setup).	Identifying SP
Specific Lesson Objective(s)	
1. Identify the control group and an experimental group in an experiment.	Identifying SP
2. Identify and graph the independent variable and dependent variable within an experiment.	Identifying Sp
3. Convert units using the same SI base unit of measurement.	Inquiry & Using SP
4. Design and test experimental procedure based of a question posed in class.	Inquiry
5. Critique an experimental design and propose changes to the procedure for future experiments.	Reflection