Understanding By Design (UbD)– Backwards Design Process

(Modified from Grant Wiggins and Jay McTighe, 2002 for Self-Evaluation of RMAIS lessons)

The Nature of Science: How and Why of Science

<table>
<tr><th colspan="2">Stage 1 – Desired Results</th></tr>
<tr><td colspan="2">Content: Topic for Lesson
• The How and Why of Science</td></tr>
<tr><td>Understanding (s)/goals
Participants will understand that:
• There is a step-wise scientific method that is often described in the U.S, although there are multiple variations and viewpoints.
• The Nature of Science (NOS) is a more inclusive term to describe the scientific process, including making observations (grounded in laws), identifying assumptions (grounded in theories), generating multiple alternative hypotheses, collecting data (either through experimentation or naturalistic studies), and engaging in iterative cycles of study, and peer review.
• “The” scientific method is contextual.
• Natural scientists can impact the societal context of science through education and advocacy.
• Natural science is impacted by societal contexts (funding, interest, lobbying efforts, war, drought, etc.)</td><td>Essential Question(s):
• How does science progress? (i.e. what is “the” scientific method and does it exist?)
• How does context (e.g, cultural) impact science?
• How do scientists themselves impact the context of science?</td></tr>
<tr><td colspan="2">Lesson objectives (outcomes):
Participants will be able to demonstrate:
• KNOWLEDGE: Common components of the scientific method as used in the U.S., examples of how the scientific method may vary in different contexts, examples of how scientists impact the societal context of their work and why this is important for non-scientists
• SKILLS: Ability to apply main components of scientific method to their research problem</td></tr>
<tr><th colspan="2">Stage 2 – Assessment Evidence</th></tr>
<tr><td>Performance Task(s):
• Individual and small group work to apply the scientific process to a problem.
• Presentation of scientific method commonly advocated in the U.S.
• Discussion of how science is contextual and what (including scientists) impacts the context.</td><td>Other Evidence:
• Description of the scientific process used in problem exercise.
• Participant reflections of how context impacts science and how scientists may influence context.</td></tr>
<tr><th colspan="2">Stage 3 – Learning Plan</th></tr>
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Learning Activities:

- 1. Nature of Science Activity
  - Engage participants: Start with wooden block exercise and encourage students to develop hypotheses about the information on a hidden side based on observations they gather from the information on the other five observable sides.
  - Participants engage with each other: Bring individuals together to compare observations and hypotheses that they developed individually.
  - Explore topic with participants: Determine the concepts that participants used during the block exercise such as observation, assumptions, hypothesis generation.
- 2. Explore "scientific method" vs. NOS
  - Powerpoint on main U.S. scientific method frameworks including the four main points of Platt (1964): 1) Devising multiple, alternative hypotheses 2) Devising crucial experiments to test hypotheses with the goal of exclusion 3) Carry out experiments to get results 3) Cyclical application of process in order to revise scientific understanding.
- 3. Science is socially embedded
  - Thomas Kuhn: 1) Paradigm shifts occur due to slow accumulation of evidence or massive reorganization of understanding (e.g. due to new methods) 2) Science is context dependent.
  - Motokawa (1989): Discussion on how culture impacts the scientific method
  - Discussion on how scientists impact science through education of the public on the process of science and through advocacy.

References:

Kuhn, T. 1962. Structures of Scientific Revolutions. Chicago: University of Chicago Press.
Motokawa, T. 1989 Sushi Science and Hamburger Science. Perspectives in Biology and Medicine 32: 489-504.
Platt, J.R. 1964. Strong Inference. Science 146: 347-353.
Understanding Science Retrieved from http://www.undsci.berkeley.edu