Understanding By Design (UbD)– Backwards Design Process

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

UbD TEMPLATE

<table>
<tr><th colspan="2">Stage 1 – Desired Results</th></tr>
<tr><td colspan="2">Content: Topic for Lesson
• Critical thinking and the scientific method</td></tr>
<tr><td>Understanding/goals
Participants will understand that:
• Critical thinking through the scientific method is important for scientific discovery and everyday life</td><td>Essential Question(s):
• What types of problems and questions can the scientific method be applied to?
• Does everyone use the same scientific method?</td></tr>
<tr><td colspan="2">Lesson objectives (outcomes):
Participants will be able to demonstrate:
• KNOWLEDGE: a brief history of the scientific method and a simple critical thinking framework
• SKILLS: Be able to apply the framework to various situations</td></tr>
<tr><th colspan="2">Stage 2 – Assessment Evidence</th></tr>
<tr><td>Performance Task(s):
• Students should be able to describe the purpose of critical thinking and the scientific method
• Students should be able to reach a solution to a small problem they have encountered using the framework of critical thinking</td><td>Other Evidence:
• Students will complete a reflective post-assessment</td></tr>
<tr><th colspan="2">Stage 3 – Learning Plan</th></tr>
<tr><td colspan="2">Outline of Learning Activities (to be accompanied by a PowerPoint presentation):
• River-crossing riddle. Present riddle and have students come up with solutions. (10 minutes of intro and solving the riddle)
  ○ Talk about other variants of this riddle from other ancient civilizations.
  ○ Riddles are a universal among humans, these help us to think about problems in new ways – riddle variants for situations individuals might actually encounter
  ○ Talk about the process you went through to solve the riddle (5 minutes of whole class discussion)
• Explore several ways to learn truths about the world (10 minutes of slides and whole class discussion)
  ○ Feelings/intuition, thinking/reasoning (discuss the connotations of this dichotomy and explore ways that we can accept both)
  ○ Both ways are valid, but one might be more appropriate for certain problems. What is the role of feelings and intuition in science? What feelings did you have when you were solving the riddle?
  ○ Critical thinking: applying logical principles, rigorous standards of evidence, careful reasoning, etc. to claims, beliefs, and issues, etc.
  ○ Scientific method: commonly used in science and is another formalized way to systematically make guesses and evaluate them
• Scientific method: Systematic collection and testing of facts and theories. (5 minutes of slides)
  ○ Differs by scientist, long history of different ways of doing science, we shouldn't get stuck in one way. One constant among all the different approaches to science is being systematic.
  ○ One common iteration of scientific method, upheld mostly by science educators, is the five step process:
  ▪ 1) observation; 2) hypothesis; 3) collect data; 4) analyze data; 5) conclusions</td></tr>
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        - What parts of this method are influenced by your social context?
- Scientific method can be applied to big questions and small questions: *(10 minutes: explain and give examples, then pair up in mentor-mentee groups and discuss problems and questions that arise during your own research.)*
    - Example of a big question in ecology or biology solved through making hypotheses (example to be determined, possibly about cell theory? Could also be about invasive species or something more ecological)
    - Example of a small question that might arise during routine lab work, simple data collection, sample handling, etc.
    - In both cases, alternatives are weighed, you try different things out, make decisions based on the purpose of your question or experiment. Thinking about why you are making each step is critical for understanding the best course of action.
    - In mentor-mentee pairs: think of an example from your work this summer that you could apply critical thinking and the scientific method to. How might you need to modify the framework for your problem? What are the advantages and disadvantages of applying the framework to your problem?
- Why is critical thinking important? *(5 minutes whole class discussion)*
    - Classic question in many college or high school classes: "when am I ever going to use this again".
    - Critical thinking of all types (calculus, literary analysis, science, etc.) all help us to get practice thinking through problems and approaching them in different ways.
    - Many future jobs will rely on humans making important decisions. To be prepared for these jobs that might not even exist yet, we need to be prepared to solve new problems without easy answers that haven't even been asked yet.
    - The alternative to critical thinking is to be easily swayed by other people's idea, only following others, not being able to lead, making decisions that may be worse for you and others in the long term. We are better scientists and citizens when we critically think.
- Reflection and post-assessment *(5 minutes)*
    - This discussion made me think about something differently than I did before. (Scale from 1 to 5)
    - A question this week raised for me is…

Key words: critical thinking, problem solving, scientific method, reasoning, riddles

References:

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