The Principles of Scientific Inquiry

What's the point of this class?

Syllabus

This is a "capstone" course which means it is designed to help you integrate your knowledge and will be a challenge. Rather than just **memorizing facts** in this class we will be **thinking, creating and synthesizing**. You will be asking questions, defining problems, developing and using models, planning and carrying out investigations, analyzing and interpreting data, using mathematics and computational skills, constructing explanations and designing solutions, engaging in argument from evidence, obtaining, evaluating and communicating information.

Syllabus

This is a "capstone" course which means it is designed to help you integrate your knowledge and will be a challenge. Rather than just **memorizing facts** in this class we will be **thinking, creating and synthesizing**.

Specifically the objectives are:

To examine science as a "way of knowing" through experiencing scientific inquiry via a course project, activities, readings, and discussion.

To provide content necessary to enable teacher licensure students to address K-12 Colorado Model Content Standards in Science.

Not Methods!

- This course is about content : The content of **thinking scientifically**

  and **doing science**

Designed specifically for the **pre-service elementary teacher**

- Learn about and practice **scientific inquiry** as described in K-7 content standards
- At **college level** to push your minds at the an appropriate level
  - **Research**: you sorted through different sources on mitosis and meiosis
  - Your students will **research** content listed in the standards for their grade.
  - **Generalizations**: sympathetic vibration vs. resonance

Vertical Articulation

Read the titles of each page

Pay special attention to the verbs used to describe each title.

How often are they about

- Knowing or memorizing?
- Doing science?

Read

Colorado Academic Standards Science

Colorado Academic Standards Science

Science is facts; just as houses are made of stone, so is science made of facts; but a pile of stones is not a house, and a collection of facts is not necessarily science."

--Jules Henri Poincaré (1854-1912) French mathematician.

Colorado Academic Standards Science

Science is both a **body of knowledge** that represents the current understanding of natural systems, and the **process** whereby that body of knowledge has been **established** and is continually **extended, refined**, and **revised**. Because science is both the knowledge of the natural world and the processes that have established this knowledge, **science education must address both of these aspects.**

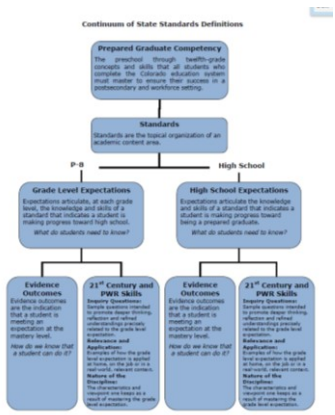
Colorado Academic Standards Science

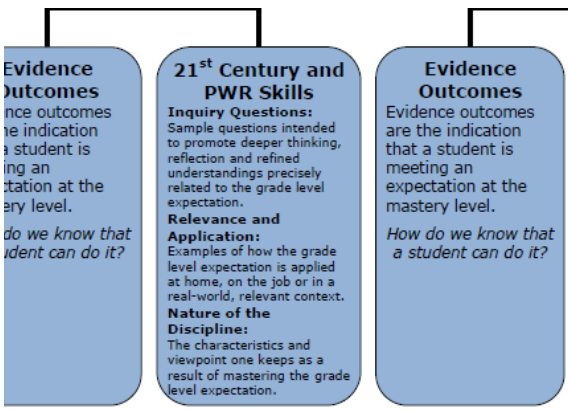
…so they can reason through and think critically about popular scientific information,

and draw valid conclusions based on evidence…

For example, during class activities, laboratory exercises, and projects,

students learn and practice self-discipline, collaboration, and working in groups.





Inquiry Questions

- Read definition of Inquiry Questions and Nature of Discipline pg 24 of 108

21st Century Skills and Readiness Competencies in Science

- Read the skills
- Which of these do you feel your education provided for you?
- This is K-12 so elementary does not expect all but you will be **building towards** this.

Scientific Method

1. Define a question
2. Gather information and resources (observe)
3. Form an explanatory hypothesis
4. Test the hypothesis by performing an experiment and collecting data in a reproducible manner
5. Analyze the data
6. Interpret the data and draw conclusions that serve as a starting point for new hypothesis
7. Publish results
8. Retest (frequently done by other scientists)

The iterative cycle inherent in this step-by-step method goes from point 3 to 6 back to 3 again.

Scientific Method

While this outlines a typical hypothesis/testing method, it should also be noted that a number of philosophers, historians and sociologists of science claim that such descriptions of scientific method have little relation to the ways science is actually practiced.

Consider Derry Pathways or

Your magic bead inquiries or

Your energy skate park investigations

Hypothesis

theoretical, hypothetical explanations of observations and measurements of the subject

Prediction

reasoning including logical deduction from the hypothesis or theory

The role of the hypothesis

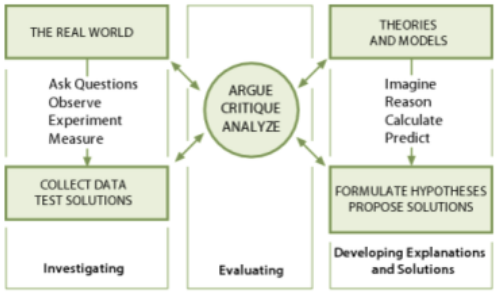


FIGURE 3-1 The three spheres of activity for scientists and engineers.

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (2012). Board on Science Education (BOSE). National Academies Press

Over emphasis of the Hypothesis

- Structured format "If, then" unrealistic and just plain incorrect. That's a prediction

"birds forage more efficiently in larger flocks"

"watching excessive amounts of television reduces a persons ability to concentrate"

"Machu Picchu was the birthplace of the first Inca and the hearth area of the Inca civilization"

Generalization

- Dry organic materials burn
- A musical instrument requires a source of vibration, a way to change the pitch, a way to make it loud (move lots of air).

Over emphasis of the Hypothesis

"birds forage more efficiently in larger flocks"

"watching excessive amounts of television reduces a persons ability to concentrate"

"Machu Picchu was the birthplace of the first Inca and the hearth area of the Inca civilization"

Hypothesis = Generalization

- Structured format "If, then" unrealistic
- Asked at the beginning of every experiment or lab
- Creates student frustration because they are not adequately prepared to formulate a hypothesis
- K-3 standards don't even mention the word!

Project 21st Century Skill learning goals

- Share the 21st Century skill(s) that you have listed as learning goal(s) for your project.
- As a group, help each person in your group refine their 21st Century Skill learning goal(s).
- Whole class discussion