

Session II

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Methods of
STEM Education

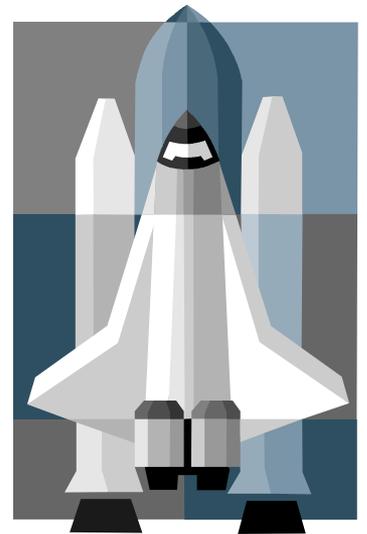
Session Agenda:

I. Guest: Rebecca Shapiro, Technology

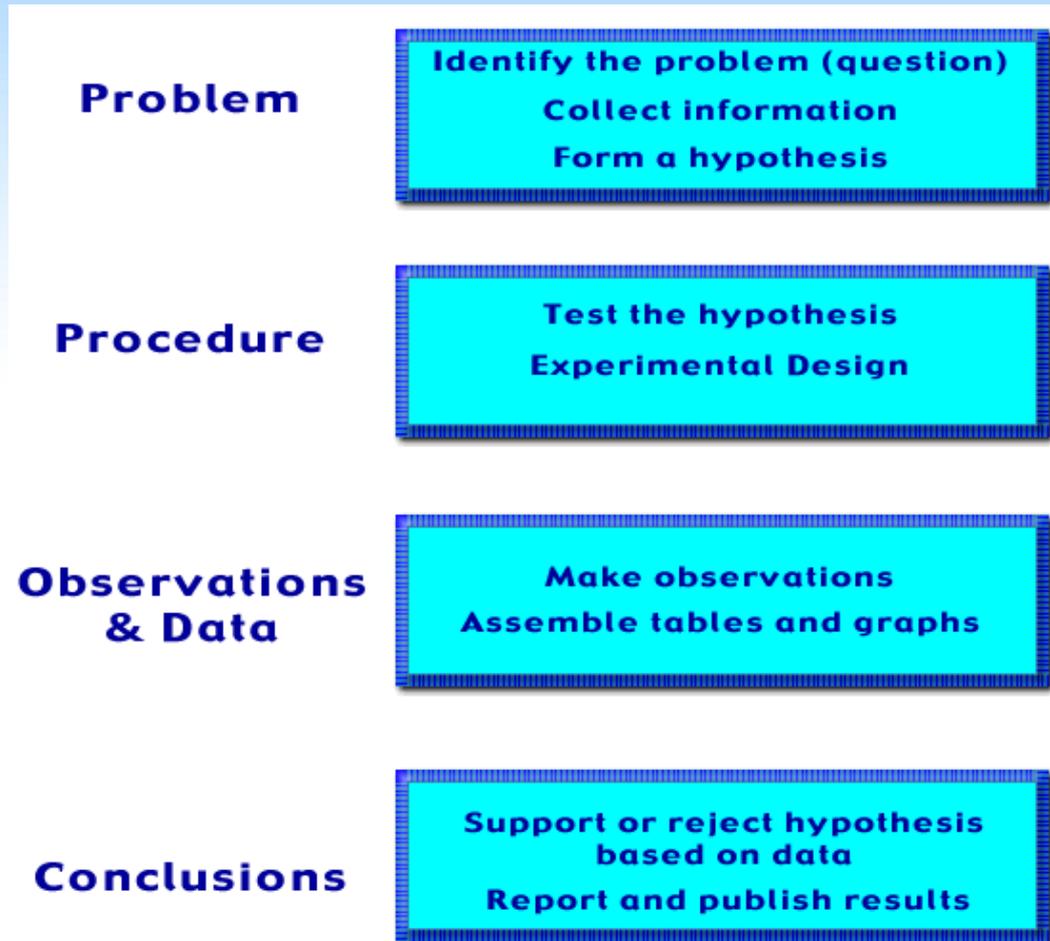
II. The Nature of Science and STEM
Instruction

II. Science Project Assignment
NOS Assignment

III. Science-Technology- Society and
Socioscientific Issues



The “Traditional” Scientific Method

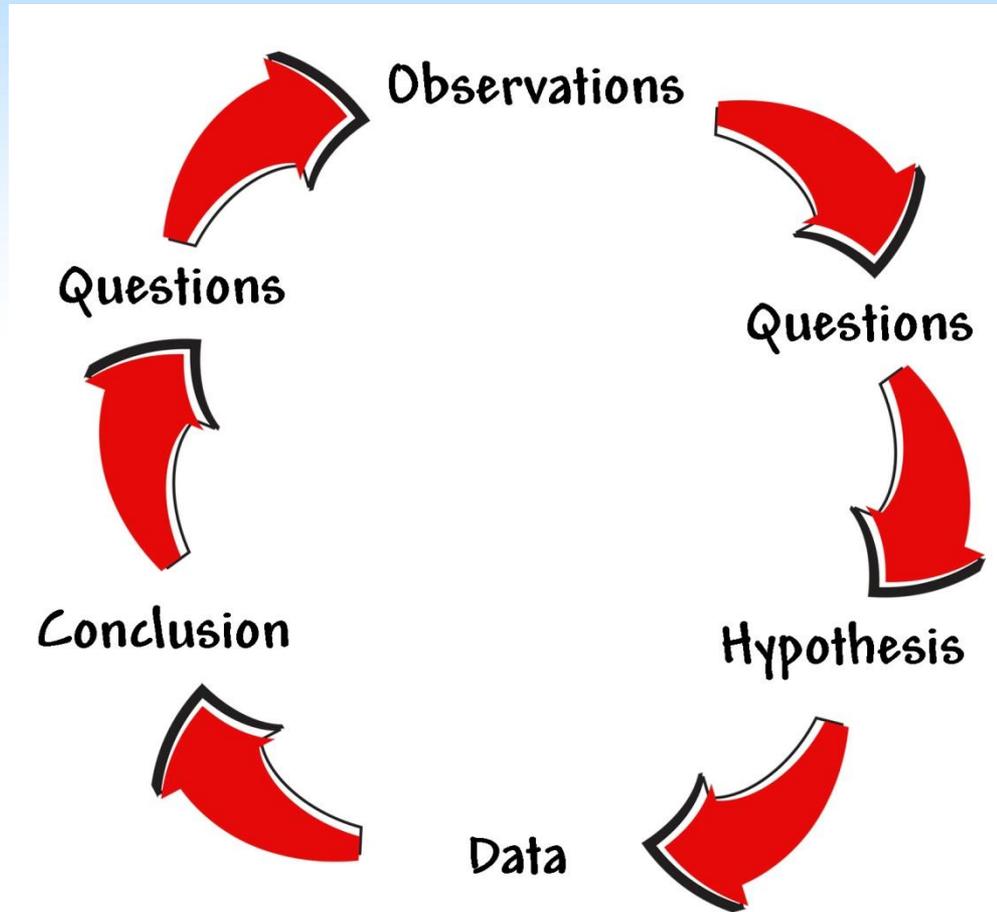


Credit: Biology Corner.com

Poll: The Scientific Method

- What is the role (if any) of this topic in the STEM classroom?
- What criticisms/objections do you have (if any) to using it in the STEM classroom?

A Different View of the Scientific Method:



Credit: U.S. Satellite Laboratory, Inc.

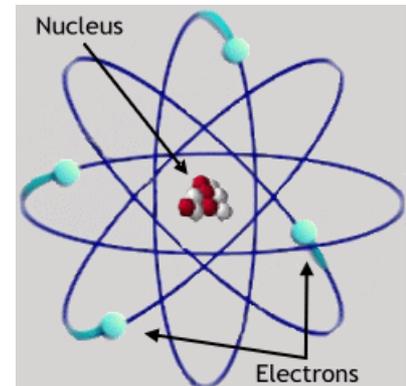
Why Include the Methods of Science?



- Help students understand what scientists do/interest them in STEM careers
- Help students understand NOS
- Introduction to evidence-based conclusions
- Build critical thinking skills

The Nature of Science

- Distinction between observations & inferences
- Distinction between laws and theories
- Knowledge is derived from observations of the natural world
- Involves human imagination and creativity and therefore is partially subjective
- Socially and culturally embedded
- Subject to change



Some Important NOS Words:

- Hypothesis

- A testable statement based on prior observation and background knowledge

- Data

- Collections of observation

- Fact

- An objective, verifiable observation

- Theory

- A scientifically accepted general principle that explains observations. A body of knowledge

- ****Law

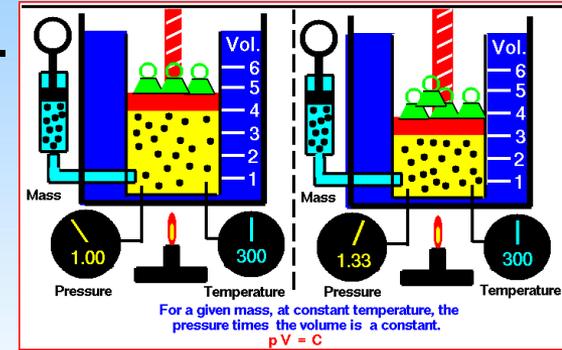
- A set of observed regularities expressed in a concise verbal or mathematical statement. Describes relationships between natural phenomena



Some Sample Theories and Laws:

Boyle's Law ($V = T/P$) relates facts about gases.

The Kinetic Theory of Gases explains why it is true



Mendel's Laws calculate expected patterns of inheritance.

The Theory of Molecular Genetics explains why Mendel's Laws are approximately true, and when they are false

Hubbell's Law states that the speed at which a distant galaxy is moving away from Earth is directly proportional to its distance from Earth.

The Big Bang Theory explains why Hubbell's Law is true

Some “Dead Words” & Their Replacements

Words to be banned	Replace with . . .
Proof/Prove/Proving	Support/unsupport/provide evidence
Right/Wrong	Supported/valid/evidence-based/unsupported
True/false	Valid/supported/evidence-based/unsupported
Correct/incorrect	Valid/supported/evidence-based/unsupported
	(Adapted from Schwartz, 2007)

Poll: What ideas do you have to improve your students' understanding of NOS?



NOS Assignment

2. Nature of Science Assignment

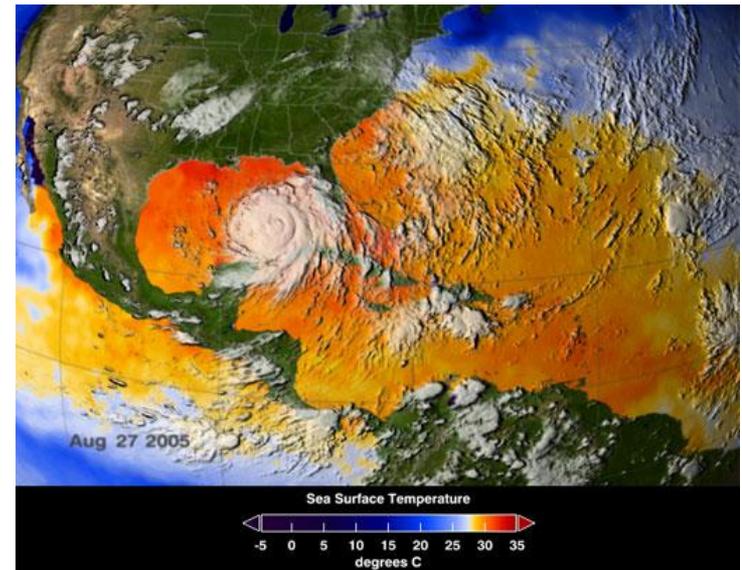
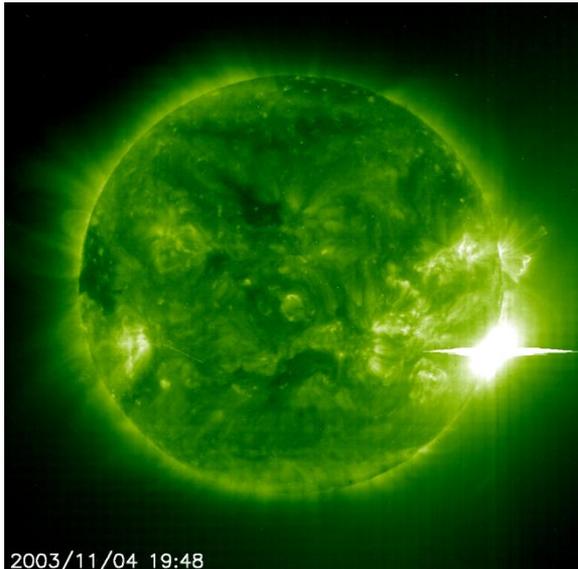
Due Date: February 22nd

Protocol: Visit sites such as the New York Times, the Science News, CNN, or similar and find an article that describes a **scientific study**. Post the link to the article and your analysis of how it meets any/all of the tenets of the NOS discussed in some of the articles you have read:

- Distinction between Observation and Inference
- Distinction between Theory and Law
- Science as a creative, imaginative process
- Science as socially and culturally embedded
- Science as subject to change

Science Project Assignment

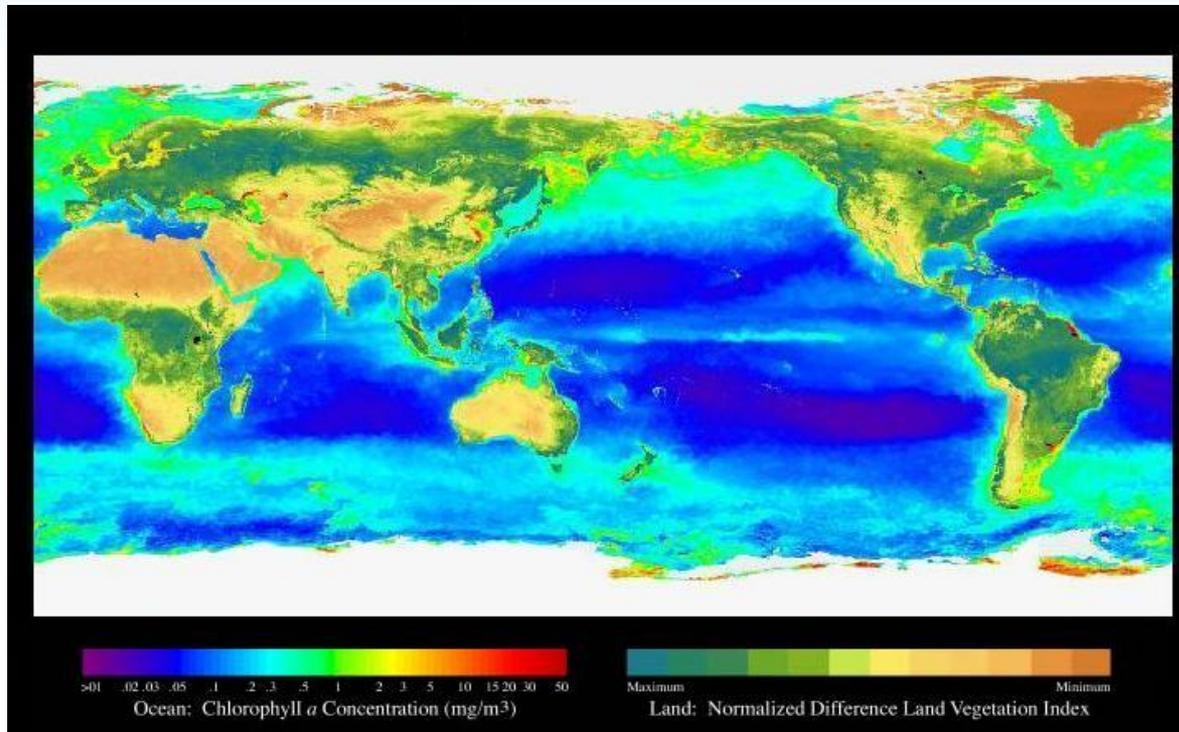
- Use long term observation to examine a phenomena.
- Can be an experiment or an investigation.
- Can physically conduct the observation or use online data sets
 - i.e., weather, sunspots, sea surface temperatures, vegetation imagery, etc.



Credit: NASA

Science Project Assignment

- Give background— Why do you want to know about this phenomenon? What have others done? (briefly)
- You will work through writing up a scientific paper.



Credit: NASA

Science Project Paper Outline

Introduction: Provide background information on the subject that you are investigating. Your research question and/or hypothesis should be identified here.

Methods: Describe how data are collected and analyzed. Be as specific as possible.

Observations/Data: What were your overall findings? Give charts, graphs, and/or drawings where appropriate.

Conclusions: What conclusions can you make based on your data?

Discussion: Why is this study significant? What are further research questions?

*Incorporate NOS in project and paper.

**Think science fair, not doctoral dissertation!



Adams State Library Access

Adams State College Library:

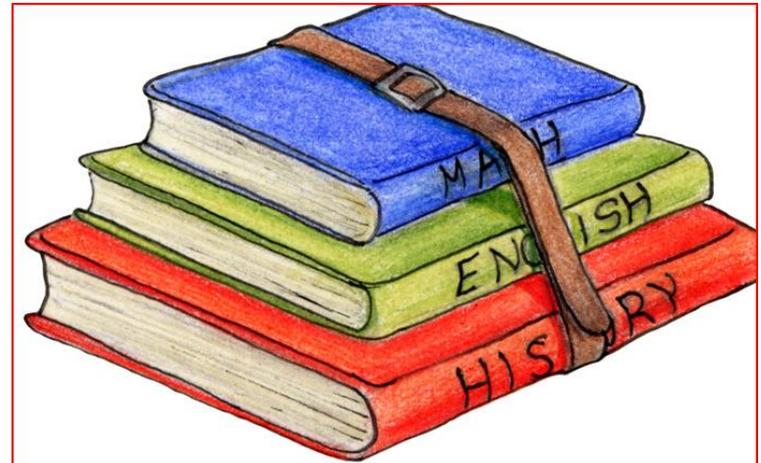
<http://www.adams.edu/library/databases/databases.php>

To access the EBSCOhost databases, go to:

<http://search.epnet.com/userlogin.asp>

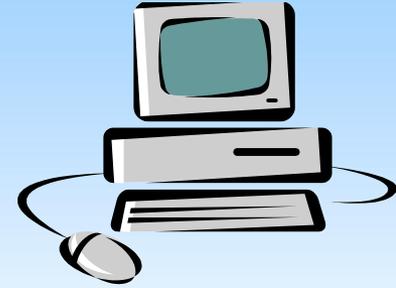
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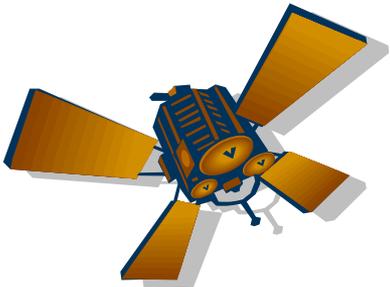


STS and SSI :

What the research says



- Science-Technology- Society (STS)
 - Considers the relationships between science, technological innovation, sociopolitical issues, and culture.
 - Helps students to make cross-disciplinary connections
 - Emphasizes real-world contexts for learning



STS and SSI Approaches :

What the research says

Socioscientific Issues (SSI): “complex, open-ended, often contentious dilemmas, with no definitive answers”

- Students analyze personal & societal decisions
- Good application of reasoning
- Important for development of scientific literacy
- Can be difficult for students to draw upon science instruction



What SSI's do you/can you use today in science instruction?



**What successes and difficulties
have you had teaching SSI's?**



Asynchronous Weeks...

- ✓ Feb 22 -Constructivist Science and Conceptual Change
- ✓ Feb 29 -Integrating Science Content and Process
- ✓ March 7 - STEM for All Students



Methods of
STEM Education