Questions, Claims, and Evidence: The Important Place of Argument in Science Writing

Presented by: Jay Staker, Lori Norton Meier, and Brian Hand

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Introducing today’s presenters…

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Questions, Claims, and Evidence: The Important Place of Argument in Science Writing

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Focus

Follow up from regional workshops with introduction for the new attendees

• Explore learning and argument

• Practice:
  – Assumption: content knowledge not an issue

• Examine standards

• Explore how to get started
Next Generation Science Standards

Scientific and Engineering Practices
1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
The advancement of science is about a process of construction and critique.

Scientists negotiate with each other.

Scientists do not advance science through information transfer.

- If this was the case, who gave the first scientists the information to pass on?
- Who gives the current generation of scientists the “new” knowledge?
What do you think is the one tool that all scientists use in their work with each other?

A. Technology  
B. Language  
C. Math  
D. Computers
What is:

**Question from Atlanta**

• Please define in the chat:

• What is:
  – Teaching?

  – Learning?
• If learning is about negotiation
• Teaching should be about negotiation
  – Concepts not factoids
  – Space for connections
• Please describe these from your experience in the chat:
  – Argument?
  – Explanation?
• **Argument**
  – Deals with unsettled knowledge
  – Trying to persuade others

• **Explanation**
  – Deals with settled knowledge
  – To inform others
Argument

• Made up of questions, claims, and evidence

• What is a claim?

• What is evidence?
Always use the words claims and evidence in your dialogue.

Shift the way you talk to students. Challenge them to provide evidence for every claim they make.
Mr. Xavier C&E Exercise: Explain how Mr. Xavier died.

• Read the mystery and think about all the points of data/observations in the story.
• What prior knowledge do you have that applies and identify where it came from.
• Review the data points and your prior knowledge. Would you use all of the data to make your evidence?
• Make a claim: Use the data you see as helpful to create a claim, a story (how and why).
  — Please use the chat to share.
• How does your evidence compare to others’? Review the data and your claims and evidence. What did you include? Omit? How did you make the decision?
You and your partner are private detectives who have been hired to investigate the death of the wealthy but eccentric Mr. Xavier, a man who was well known for his riches and for his reclusive nature. He avoided being around others because he was always filled with anxiety and startled easily. He also suffered from paranoia, and he would fire servants whom he had employed for a long time because he feared they were secretly plotting against him. He would also eat the same meal for dinner every night—two steaks cooked rare and two baked potatoes with sour cream.

Upon arriving at the tragic scene, you are told that the servants found Mr. Xavier dead in his home early this morning. The previous evening after the chef had prepared the usual dinner for Mr. Xavier, the servants had been dismissed early to avoid returning home during last night’s terrible storm. When they returned in the morning, Mr. Xavier’s body was found face down in the dining room.

Looking into the room, you start your investigation. The large window in the dining room has been shattered and appears to have been smashed open from the outside. The body exhibits laceration wounds and lies face down by the table, and there is a large red stain on the carpet that emanates from under the body. An open bottle of red wine and a partially eaten steak still remain on the table. A chair that has been tipped over is next to the body, and under the table is a knife with blood on it.

Due to his paranoid nature, Mr. Xavier always had Kurt Wagner, the butler, lock all doors to the mansion at night. However, detectives found that the back door had in fact been left open. Detectives found that the chef, Robert Drake, had been the last employee to leave that night. When questioned, Mr. Drake stated that the doors are supposed to lock behind him when he leaves. In addition, a bottle of medication for high cholesterol was discovered in the medicine cabinet. Also, the carpet in the dining room was wet.

With this additional information, come up with a single claim and supporting evidence that explains how Mr. Xavier died.
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How does it work?

• Are you putting forward an argument or explanation?

• Is the knowledge that you are constructing correct?

• Are you trying to persuade or explain?
Relationship

Data + Reasoning = Evidence
Question

Claims

Claims

Evidence
Argument

• Deals with questions, claims, and evidence

• There must be connections between questions, claims, and evidence

• There has to be strong coherence between the various components

• Arguments require reasoning – not something to be simply learned
Learning

• What were you doing cognitively when trying to develop claims and evidence?

• When you make claims/evidence, who are you debating/negotiating with?

• What about with yourself?
There are not separate learning theories for different countries or culture

When shifting the focus to learning we need to start teaching where the students are at – not where we think they are

Learning is about negotiation; thus, we have to negotiate with students
Language

• Task – teach a science lesson without any form of language

• There is no science without language

• Language is required for negotiation – with each other (talking), with text (reading), with constructing text (writing)
Poll: Which of the following ways do you have students represent information?

A. Oral language
B. Written text
C. Pictographic
D. Graphs
E. Equations/Mathematic
Other – type in chat
What does this mean?

- If we do not control what goes on inside someone’s head – how can we teach?

- Do we have to do something different?

- What does it mean to learn – not teach, but learn?
If learning is about negotiation . . .

What would the teacher talk to student talk ratio look like in your classroom during a typical lesson?

Use clip art to stamp your answer.

| 100:0 | 40:60 |
| 90:10 | 30:70 |
| 80:20 | 20:80 |
| 70:30 | 10:90 |
| 60:40 | 0:100 |
| 50:50 |       |
Essential ideas

• Argument is about unsettled knowledge – explanation is about settled knowledge

• Emphasis on questions, claims, and evidence

• Learning is about negotiation – both public and private

• Language is critical for doing and learning science
The Science Writing Heuristic Approach

• An approach that uses argument-based inquiry

• Involves a structure based on how scientists work, not what they report

• Is language based in building understanding of all the representational demands of science

• Requires students to both construct and critique science knowledge through public and private negotiation
**Difference between traditional and SWH format**

**Traditional format**
1. Title, purpose
2. Outline procedure
3. Data and observation
4. Calculations, balanced equations and graphs
5. Results
6. Conclusion

**SWH format**
1. Beginning questions – what are my questions
2. Tests & safety – what will I do? How will I stay safe?
3. Observations – what can I see?
4. Claims – what can I claim?
5. Evidence – why am I making these claims?
6. How do my ideas compare with others (peers, text, instructor)?
7. How have my ideas changed?
Implementing the SWH

• Prior Knowledge
  – How do you assess now?
  – How does this guide instruction?

• Engagement
  – Applying your existing strategies in new ways
  – Focal point to generate questions and guide learning

• Have a go!
  – Professional discussions around the approach, observe, critique, argue/negotiate
Given the Procedure:
• Light the candle
• Invert jar
• Lower neck over the candle and into the water

What questions do you have about this system?
Students observe:

• A few bubbles at the very beginning (~40% of the time)

• Water rises into the jar

• The flame goes out

• Water continues to rise even after flame is out

• Condensation on the inside walls of the jar
What testable questions can you ask? Please answer in the chat.

What variable would you change that could allow you to collect information to answer your question? Please answer in the chat.
Questions and Tests

• What questions do you have?
  – How to manage questions
  – Student-centered/teacher negotiated
  – Testable/researchable
  – Nice to know/need to know
  – Curriculum aligned (issue of negotiation)

• Tests: safety, sophistication, equipment/supplies
  – Developed or provided
**Instruction**

**Ineffective Instructor**
- Tells students what to do and what will happen; beginning questions not discussed
- Individual or pairs work separately from the class
- Assigns task
- Does not promote sharing of analysis of class data
- Shows students how to do calculations and tells students what their results mean

**Effective Instructor**
- Provides opportunities for students to discuss beginning questions
- Allows students to assign their own groups and tasks
- Class data are presented on the chalkboard
- Class data are analyzed and discussed as a group
- Instructor guides a class discussion of concepts covered in the laboratory
Getting started

What can you do to get started?

– Think about the questions you ask.

– Reframe how you approach an inquiry.

– Stop talking and let students talk. Negotiation requires space.
Questions: Please answer in chat

• What is the purpose of your questioning?

• If learning is about negotiation, how does questioning fit into this?

• Whose knowledge are you trying to challenge?

• How do you challenge students and get them to scientifically acceptable knowledge?
Try the following steps

1. Focus on a “big idea” in your discipline

Physics – with non contact forces, the force decreases with distance

Biology – All ecosystems are balanced systems

Chemistry – Matter is conserved
2. Draw a concept map of this big idea
   List all the relevant words
   Group them
   Label the groups

3. List four inquiry activities you presently use for the unit

4. What is a good testable question to help guide the unit?
5. Determine potential pathways that students could take in terms of the activities
   – If they start with activity 3 what is the order of activities that could be used?

6. What are the typical student “misconceptions”
Group 1

Does increasing the amount of heat affect the results?
Group 2: testable question

Does the height of the candle change the results?
Group 3

Does a larger bottle affect the results?
Group 4

Note the sides of the container
Did any of the questions match your questions?

- What questions do you have?
Thanks to today’s presenters!

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