Engaging Students in the Learning of Science

Consider Teaching How Science Works

What is the scientific method?

- How to put it to use in teaching
- How to put it to use in engaging students
- How to use it in more "creative" areas-- like drama

Engaging Students in the Learning of Science

- A big challenge to science teaching is in the affective domain – some folks just don’t like science or are fearful of it
- However, it is not science they fear, it is science instruction
- Science itself is inherently interesting but the way it has been taught can be a “turn off”

“Everyday science”...we all do it
- The role of multiple hypotheses
- Observing, measuring and identifying processes
- Seeking evidence
- Recognizing patterns and cycles
- Identifying causes and effects
Engaging Students in the Learning of Science
Consider Teaching How Science Works

- Use the history-of-science approach to make points about how science functions.
- For instance, consider the case of the people behind important scientific discoveries:
  - Alfred Wegener and Continental Drift
  - Darwin and Evolution by Natural Selection

Engaging Students in the Learning of Science

- Engage students in discussions of debates in science such as:
  - What are the roles of science and religion in modern society?
  - How did life begin?
  - Evolution vs. Intelligent Design
  - Are we alone in the universe?

Engaging Students in the Learning of Science
Use of internet resources

- Increase the use of active learning and critical thinking strategies
- Ask higher-level questions of students
- Ensure that students must seek not just repeat answers to questions
- Have students interact and lead discussions

Engaging Students in the Learning of Science
Frame “wrong answers” as a way to explore alternative ideas from students

- Use a variety of teaching styles
- Make the laboratory a place of discovery not just verification
The Laboratory: Goals and Rationales

- get students actively involved in science learning
- encourage problem-solving and higher-order thinking
- provide a bridge from concrete to abstract thinking
- spark student interest and curiosity
- simulate the "doing" of science
- provide a common and shared experience on which to build instruction

Exemplary Laboratory Teaching: Philosophical Issues

Students should work cooperatively to investigate and negotiate conclusions

Developing a Taxonomy of Laboratory Types: Who Makes the Following Decisions?

- the question(s) to be investigated?
- The questions to be tested?
- the procedure to be followed?
- what to observe and record?
- how to record and report data?
- what the data mean?

Exemplary Laboratory Teaching: Philosophical Issues

Some investigations should be long term (lasting several days or class sessions)
Exemplary Laboratory Teaching: Philosophical Issues

Investigations should teach authentic and accurate lessons about the nature of science.

Exemplary Laboratory Teaching: Pedagogical Issues

Laboratory investigations should come before significant class discussion of related concepts.

Laboratory Learning: The Nature of Science

- Emphasize scientific methods but not THE scientific method
- Make the distinction between activities, investigations and experiments
- The goal for lab work is substantiation not proof, exploration not just verification

Exemplary Laboratory Teaching: Practical Issues

Assessment of laboratory learning should be authentic
Assessment of Laboratory Learning

- Consider using practical examinations
- Student lab reporting methods should be personally relevant
- Assign new (but related) challenge questions
- Apply continuous evaluation
- Use skills-based check lists

Exemplary Laboratory Teaching: Practical Issues

When possible, the laboratory should begin with a challenge question without step-by-step instructions

Exemplary Laboratory Teaching: Pedagogical Issues

Provide support to students working in the laboratory, but avoid intruding.

How to Enhance Published Activities

- reformat lab as part of a learning cycle or conceptual change model of instruction
- standardize terms across all labs
- improve the included questions (higher-order & less rote)
- modify to meet equipment or student-ability limitations
- distill the activity into a “challenge question”
Conclusions: Enhancing the Laboratory Experience

- Discuss the changes
- Invite discussion
- Involve your colleagues to gain support and to encourage partnerships
- Celebrate student successes and innovations while paying attention to their comments, questions and reactions
- Stick with it!

Engaging Students in the Learning of Science

- Consider for yourself the distinction between teaching and learning
- As you design science lessons think about the most appropriate ways to assess outcomes
- Consider the “golden rule” of science teaching – do unto others...
- Don’t necessarily teach as you were taught!

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The Multimedia Revolution

- Students today expect and are accustomed to a multimedia environment – as long it is serves the goals of instruction
- Consider where PowerPoint succeeds and fails
- Make appropriate use of the internet
- Consider the use of “clickers”
- Explore the use of classroom websites and “Blackboard”
- Establish an appropriate email policy to extend your availability

Engaging Students in the Learning of Science

Final Thoughts

- Discuss the changes
- Invite discussion
- Involve your colleagues to gain support and to encourage partnerships
- Celebrate student successes and innovations while paying attention to their comments, questions and reactions
- Stick with it!