EDUC 511

Feb 1, 2011

Agenda

- Items for the good of the order
  - Posters
  - Inquiry Lesson selection / signup
- Instructional Models
  - Learning cycle
  - 5 E
  - Inquiry Discovery Matrix
- Questioning strategies

Inquiry Lesson Presentation

- Setting the stage
  - Grade level
  - What has been taught previously or introduction
  - PA state Academic Science and Technology standard(s) met
  - Lesson Objective(s) [3 parts]
    - What the student is to learn
    - By what means will they learn
    - How do I know they learned?
- LOI
  - Written – no coversheet

Inquiry Characteristics

- *A case for inquiry*

Principles

- **Science is for all students.**
- **Learning science is an active process.**
- **School science reflects the intellectual and cultural traditions that characterize the practice of contemporary science.**
- **Improving science education is part of systemic education reform.**

Inquiry is NOT new

"…children should be trained to perform experiments and deal with the theory and practise of ***enquiry*** at an early age."

Joseph Priestley, 1790

National Science Education Standards

"Inquiry into authentic questions generated from student experiences is the central strategy for teaching science."

National Research Council, 1996

NSES CONTENT STANDARD A

- As a result of activities in grades K-4, all students should develop
  - Abilities necessary to do scientific inquiry
  - Understanding about scientific inquiry

NSTA Teacher Ed Recommendations

"Science content should be taught in the context of science investigations… should include laboratory and/or field experiences, some of which are open ended, requiring true inquiry on the part of the students."

PA Academic Science and Technology Standards

- **Standard 3.2 *Inquiry & Design***

The nature of science and technology is characterized by applying process knowledge that enables students to become independent learners. These skills include observing, classifying, inferring, predicting, measuring, computing, estimating, communicating, using space/ time relationships, defining operationally, raising questions, formulating hypotheses, testing and experimenting, designing controlled experiments, recognizing variables, manipulating variables, interpreting data, formulating models, designing models, and producing solutions. Everyone can use them to solve real- life problems. These process skills are developed across the grade levels and differ in the degree of sophistication, quantitative nature and application to the content.

What is meant by a higher level

- Bloom's Taxonomy (high to low)
  - Evaluation
  - Synthesis
  - Analysis
  - Application
  - Comprehension
  - Memorization
- Webb's DOK
  - Level 1 Recall and Reproduction
  - Level 2 Skills and Concepts
  - Level 3 Strategic Thinking
  - Level 4 Extended Thinking

Research Results

- Enhanced IQ scores
- Increase in student-initiated content-relevant speech
- Increase in language and general knowledge
- Develops measuring skills
- Increases mathematics concepts
- Increases number skills
- Increases language acquisition

Research Results

- Increases social studies skills
- Increases listening skills
- Improves visual perception
- Develops logical thinking
- Develops critical thinking
- Teaches science as a process
- Serves as reading-readiness
- Enhances curiosity
- Improves children's attitudes toward science and school

From the earliest grades, students should:

- experience science in a form that engages them in the active construction of ideas and explanations
- enhances their opportunities to develop the abilities of doing science.

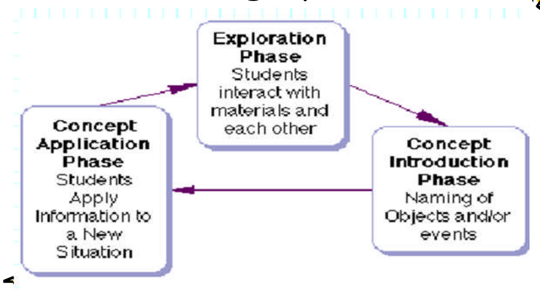
Teaching the standard

- Children develop concepts and vocabulary from investigating earth materials, organisms, and properties of common objects.
- Such experiences also should develop inquiry skills.
- Students should also learn through the inquiry process how to communicate about their own and their peers' investigations and explanations.

Techniques to teach by

- Ask questions about objects, organisms, and the events in the environment
- Plan and conduct simple investigations
- Employ simple equipment and tools to gather data and extend the senses.
- Use data to conduct a reasonable explanation

Learning Cycle



Learning Cycle

- Students explore a new concept or phenomenon with "minimal guidance."
- Students might make observations of and classify objects.
- They might be involved in "messing about" with batteries, bulbs and wires to find out how the light bulb works.
- Students might also perform experiments to gather data to test an hypothesis. In short, the exploration phase allows the students to examine "new ideas" and test them against their own ideas. Students are actively engaged in interacting with ideas, as well as their peers during the exploration phase.

Concept Introduction Phase

- Teacher assumes a more direct, active role and uses the students' exploratory activities as a means of introducing the scientists view of the concept or theory that was investigated in the exploratory phase.
- During this phase students express their ideas about the concepts and ideas, and the teacher presents in very succinct ways, the meaning of the concepts and ideas from a scientific point of view.
- The teacher assumes the direct/interactive mode during this phase

Concept Application Phase.

- Student centered phase in which small teams of students engage in activities designed to apply and extend their knowledge of science concepts.
- The teacher should design activities that challenge the students to debate and defend their ideas.
- Activities in the concept application phase should be problem-oriented. The teacher resumes the facilitative role in the concept application phase.

5 E Model

- Engagement
- Exploration
- Explanation
- Extension
- Evaluation

Engage the Learner

- The activities in this section capture the student's attention, stimulate their thinking and help them access prior knowledge
- Student Actions:
  - Demonstration
    - teacher and/or student
  - Reading from a
    - current media release
    - science journal or book
    - piece of literature (biography, essay, poem, etc)
  - Free write
  - Analyze a graphic organizer

Explore the Concept

- Students are given time to think, plan, investigate, and organize collected information
- Student Actions:
  - Reading authentic resources to collect information
    - to answer an open-ended question
    - to make a decision
  - Solve a problem
  - Construct a model
  - Experiment
    - design and/or
    - perform

Explain the Concept and Define the Terms

- Students are now involved in an analysis of their exploration
- Student Actions:

  Student analysis and explanation
  Supporting ideas with evidence
  Reading and discussion

Elaborate on the Concept

- Students take the opportunity to expand and solidify their understanding of the concept and/or apply it to a real world situation
- Student Actions
  - Problem solving
  - Experimental inquiry
  - Thinking Skills Activities
    - classifying, abstracting, error analysis, etc.
  - Decision-making

Evaluate students' Understanding of the Concept

- Dual purpose
  - students to continue to elaborate on their understanding
  - evaluate what they know now and what they have yet to figure out
- When the teacher determines the extent to which students have developed a meaningful understanding of the concept.

The Inquiry-Oriented Approach

Emphasizes

- Laboratory experiences to introduce the topic
- Restructuring the course; promoting an inquiry-oriented approach
- Laboratory component a more central role
- Post-laboratory activities as the driving force for further instruction

Starting Point

- In order to raise the level of Inquiry you need to know where you are starting at…

Levels of Inquiry/Discovery in Science Instruction

	PRE-LABORATORY Experience		LABORATORY Experience	POST-LABORATORY Experience	
Major Involvement by: ➔ Levels of Inquiry ➔	Proposes Problem or Issue to be Explored	Addresses or Plans Procedure to be Used	Carries Out Procedure	Supplies Answers or Conclusions	Laboratory Outcomes Used to Consider Applications and Implications and/or to Drive Further Instruction
0 ➔	Teacher	Teacher	Teacher	Teacher	Teacher
1 ➔	Teacher	Teacher	Teacher	Teacher	Students
2 ➔	Teacher	Teacher	Teacher	Students	Students
3 ➔	Teacher	Teacher	Students	Students	Students
4 ➔	Teacher	Students	Students	Students	Students
5 ➔	Students	Students	Students	Students	Students

3 Phases of an Inquiry Activity

- Pre-Laboratory Sequence
  - Problem addressed
  - Procedure
- Hands on Investigative Activity
- Post-laboratory Sequence
  - Conclusions
  - Follow-up

Pre-Laboratory Session Features

- Limits definition of terms
- Limits procedure review
- Emphasizes:
  - Resource materials
  - Review of safety practices

Post-Laboratory Session Features

- Use of student data & observations for post-laboratory discussion
- Relate scientific theory to observations
- New inquiry & student designed laboratory investigations growing out of discussion

Break

Questioning Strategies

- Closing questions
  - Asking for specifics
    - Which towel soaked up the most water?
    - What is this part called?
  - Tends to limit interaction to T-S
- Opening Questions
  - Invite response from all students
    - What do you believe caused the water to be absorbed?
    - What did you see happening…?
  - Opens up the interaction

Question Categories

- Encouraging & Expanding
  - Or re-organize the discussion
- Probing
  - Extend
  - Redirect
  - Justify
  - Clarify

Question Categories

- Closure
  - Classifying ideas
  - Procedure suggestions
  - Data interpretation

Requirements for opening questions

- Must have the students cooperation
- May require a fair amount of experience on the children's part
  - Used to yes/no or one word answers
- Reinforcement to help elicit student responses
  - Avoid negative or rejecting
  - Try accepting student response and asking for expansion

Wait time

- Mary Budd Rowe
  - Average time in waiting for a response before asking the next or re-phrasing is
  - Increased wait time has shown the following:
    - Length of response increases
    - Decrease in a failure to respond
    - S initiated responses increase
    - T-S interaction decreases while S-S increases
    - Number of S questions increases

Questioning In the Classroom

- Success depends on questioning
- Developed by practice
- Crucial in every teaching situation
- Clarity and non-ambiguity –effective Questions

Broad Functions

- Provocative
- Evaluative
- Developmental
- Probing
- Consolidating

All ? Fall into 2 broad Categories

- Convergent
  - Recall
  - Recognition
  - Application
- Divergent
  - Speculation
  - Analysis
  - Synthesis
  - Application

Purposes for ?

- Elicit a statement of relationship, differentiation or comparison
- Elicit a fact or idea
- Make a classification
- Develop an hypothesis or conclusion
- Develop an explanation or example
- Elicit a further question

Purposes for ?

- Summarize or organize
- Propose a procedure
- Application of an idea or principle
- Change a frame of reference

Characteristics of Effective ?

- Clear & definite
- Purposeful
- Brief
- Natural
- Thought provoking
- Limited in scope
- Appropriate to the level of the class

What to avoid

- Yes-no
- Elliptical/vague
- Tugging
- Guessing/Speculation
- Leading
- Directionless

Guidelines

- Engage the attention of the students
- Convey clues about what kind of answer and the appropriateness
- Utilize a range of questions
- Engage a broad base of students
- Allow time for an answer
- Accept student responses
- Plan in advance

Common Errors

- Change the question midstream
- Repetition
  - You know the answer they don't
- Answering your own question
- Accepting non-verbal responses
- Why?, How do you feel…, What about..

Wrap-up