LABORATORY TECHNIQUES IN EARTH SCIENCE

You are not here merely to make a living. You are here in order to enable the world to live more amply, with greater vision, with a finer spirit of hope and achievement. You are here to enrich the world, and you impoverish yourself if you forget the errand.

Woodrow Wilson

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COLLEGE CATALOG DESCRIPTION OF COURSE: The selection, preparation, maintenance, and proper use of laboratory equipment and supplies in earth science; practice in developing demonstrations and presentation of topics; and planning of laboratory exercises. Field trips may be required in which students share the costs. Prerequisite: JrS and 6 s.h. in approved earth sciences.

REQUIRED TEXT:
New York State Physical Setting: Earth Core Curriculum & Reference Tables

ADDITIONAL READING:
New York State Learning Standards for Mathematics, Science, and Technology
National Research Council, 1996, National Science Education Standards
NSTA, STANYS and OMNI homepages

RATIONALE

Numerous studies (e.g., TIMSS) have documented the dismal state of science literacy in the United States and have highlighted the need for a science-literate public. Additional studies have also shown that many prospective teachers are inadequately prepared to teach science.

Much of the blame for this situation has fallen on traditionally taught science courses at the secondary and college level, where the focus is on brief exposure to, and required recall of immense quantities of factual knowledge. This body of knowledge, obtained through the process of science, has come to mean science for many students. Most are never exposed to scientific inquiry and therefore never have the opportunity to experience the excitement of discovery that motivates scientists. This exacerbates the syndrome of “teaching as we were taught.” Alternative laboratory experiences during preservice education may be the best opportunity to break this cycle.

National reforms now emphasize science as a process and a way of knowing (National Science Education Standards, NSTA Standards) and this emphasis has taken root at the state level as well (e.g., New York’s Mathematics, Science and Technology Learning Standards) These standards include broad themes such as, science as inquiry, unifying concepts in science, the history and nature of science, the impact of science on society and culture and the human qualities of the scientific endeavor. Specific content is used as a vehicle for achieving an understanding of and appreciation for the nature of science. True laboratory experience, not “cookbook” laboratories, is the linchpin in this reform. This course is intended to give future teachers the opportunity to engage in scientific inquiry, i.e., to “do” science, and to design truly scientific laboratory experiences for their students. It is hoped that with this experience, the first steps toward a paradigmatic shift will be possible.

"Anything Not Understood in More than One Way Is Not Understood at All."

COURSE OBJECTIVES and OUTCOMES: This course is designed to provide students with opportunities
and experiences that will enable them to teach inquiry-based earth science. We will focus on the unifying
concepts and processes of science as applied to planet Earth. The specific Earth Science content from the
New York State Physical Setting: Earth Core Curriculum, supplemented by National Science Education
Standards (NRC 1996) will provide the backdrop for the exploration and development of inquiry-based
laboratory experiences. Students will participate in laboratory experiences that model inquiry-based instruction;
they will design and present laboratory investigations, activities and demonstrations that will model science as
inquiry. Content and instruction in this course are consistent with the NSES, NSTA Standards and New York’s
MST Learning Standards.

In accordance with standards developed by national professional teacher organizations, teacher pre-
professionals in this course will:

1. Communicate knowledgeably (read, write, speak, listen) about laboratory instruction, effective science
teaching, student learning in an earth science laboratory setting, and diversity in teaching.

2. Demonstrate familiarity with national and state curriculum standards and assessments and the Division of
Education’s Conceptual Framework, with particular emphasis on Theme 1: Academic and Professional
Excellence and Theme 4: Best Teaching Practices.

3. Develop writing skills through preparation of laboratory materials and other writing assignments.

4. Demonstrate positive interactional skills during small-group discussions and tasks such as peer conferencing
on laboratory preparation and presentations.

5. Use technology as a means of learning, teaching and communicating science.

6. Describe the nature of effective laboratory instruction.

7. Demonstrate understanding of current issues in science education (e.g., professionalism, diversity,
technology, effective teaching, parental involvement).

8. Demonstrate understanding of the Division of Education’s portfolio assessment process through
development of exemplary laboratory lessons which may be included in the student’s portfolio.

9. Demonstrate capability to synthesize knowledge gathered from various sources and to document
appropriately through APA documentation format.

**COURSE TOPICS**

Much of our focus will be on the following:

1. State and National Standards regarding science lab teaching.
2. Lab lesson planning: objectives, materials, preparation, activities, curricular resources, performance
assessment and laboratory safety.
3. Current issues/research/trends in science lab teaching; intellectual vitality.
4. Integration of technology into the earth science lab & teaching.
5. Consideration of diversity issues in science lab teaching.

**This focus is intended to enable the student to:**

- Determine and plan for the selection, preparation, maintenance and proper use of equipment and
  supplies used in an earth science laboratory.
- Plan and present lab exercises, demonstrations, etc.
- Demonstrate use of appropriate technology in lab instruction; and
- Develop strategies to meet the needs of diverse students in a laboratory setting.

**ASSESSMENT**

1. **Professionalism & Professional Development** (Objectives 1, 2, 4, 6 & 7) 5%
2. Lab Assignments: Development, Presentation, Analysis, Revision (Objectives 1-7, 9) 35%

3. Analytical Writing (Objectives 1-3, 6-8) 35%
   - Response and Questions (RQ) on Assigned Readings (4)
   - Summary, Response and Questions (SRQ) on Selected Readings (2)
   - Comments on RQs and SRQs (Commentaries on RQ and SRQs of other students) (6)
   - Critical Reflections (Self analysis of learning experiences) (6)

   NOTE: RQ, SRQ and Comments will be posted on a Course Notebook Website where they will be accessible to the entire class. Critical reflections will not be published to the Course Notebook unless permission is sought by the instructor and granted by the author.

4. Research Project: (Objectives 1, 3, 4, 5, 9) (Includes Progress Reports) 15%

5. Scavenger Science: (Objectives 1, 2-4, 6-8) 2%

6. Project BESSER: (Objectives 1, 2, 3, 5, 8, 9) 8%

COURSE POLICIES

Students are expected to
   - attend all classes and to participate in all class activities.
   - notify the instructor prior to any absence or instance of tardiness.
   - provide reasonable excuses for lateness and absenteeism.
   - actively seek information & materials covered during any absence.
   - hand in assignments or present on the scheduled DUE DATE. Prior permission must be sought for an exception to this policy. Any assignment which is not ready (w/out the instructor’s prior knowledge & consent) may receive a zero, with no opportunity for make-up.

“Far and away the best prize that life offers is the chance to work hard at work worth doing.”

Theodore Roosevelt
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<tr>
<th>MTG</th>
<th>TOPICS/ACTIVITIES</th>
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| 1/23 | MTG: Introduction & Self Exploration  
Discussion: Introduction, Expectations, Resources  
Activity: Messy Hands  
Artificial Dichotomies: Direct instruction/inquiry; Content/Skills  
Readings, Responses, Comments and the Course Notebook | Messy Hands Activity  
RQ I: Breaking the Cycle  
Subscribe to ESPRIT/CR I: A week in the teachers’ room  
Read Core Curriculum and Reference Tables  
Choose and prepare a lab from one of the resources | |
| 1/30 | MTG: Messy Hands Demonstrations  
Discussion: Core Curriculum and Reference Tables  
What are Critical Reflections?  
A genie in a bottle | Presentation Topics and Groups 1 & 2 (Due 2/13)  
CR I: “A week in the teachers’ room”  
Scavenger Science I  
Project BESSER (Due 4/10) | |
| 2/6  | MTG: Genie revisited  
Scavenger Science I  
Models in ESSE  
Introduction to Research Projects | Presentation Topics and Groups 3 & 4 (Due 2/20)  
CR II: The Genie and Me  
RQ II: Models  
Research Projects (Due 5/15) | |
| 2/13 | MTG: Lab Presentation Groups 1 & 2 | Scavenger Science II  
Analysis of Labs 1 & 2 to CNB  
Presenters CR III | RQ II to CNB  
Presentation Groups 1 & 2  
CR II: Genie |
| 2/20 | MTG: Lab Presentation Groups 3 & 4 | Analysis of Labs 3 & 4 to CNB  
Presenters CR III | Comment II to CNB  
Presentation Groups 3 & 4  
Presenters 1,2 CR III |
| 2/27 | MTG: NO CLASSES  
Data Driven Labs (DDLs)  
Lab lesson planning (5E, 7E, Learning Cycles, etc)  
Miniature intrusions and Mn nodules | RO III: 5E & 7E  
CR IV on DDL  
Research Project Progress Reports | Presenters 3,4 CR III |
| 3/6  | MTG: NORTHEAST GSA: Durham, NH  
Professional Development: GSA Discussion  
Scavenger Science II  
Research Projects: Progress Reports  
Convertible Labs: Graham Cracker Tectonics | RO IV: Bottlenecks  
Convertible Labs (New Groups) | RO III to CNB  
Scavenger Science II  
CR IV: DDL  
Research Prog. Reports |
| 3/13 | MTG: NO CLASSES  
Old Part D – the Lab Practical  
Analysis of Convertible Labs | RO IV: Bottlenecks  
Revision of Convertible Lab  
Group I Lab Conversion (Due 4/17) | Convertible Lab to CNB  
Comment III to CNB  
RO IV to CNB |
| 4/3  | MTG: NO CLASSES  
Project BESSER Posters and Papers  
Working Session: Presentations & Research Projects | SRQ I: TST Buffet (Must include Citation & Summary)  
Research Project Progress Reports  
Group II Lab Conversion (Due 4/24) | Comment IV to CNB  
Revised Convertible Lab  
Project BESSER |
| 4/10 | MTG: Lab Conversion Presentations (Group I)  
Analysis of Conversion Lab | Analysis of Conversion Lab  
CR V: “My first laboratory presentation” (Group I)  
Group III Lab Conversion (Due 5/1) | SRQ I to CNB  
Research Prog. Reports  
Group I Lab Conversion |
| 4/17 | MTG: Lab Conversion Presentations (Group II)  
Analysis of Conversion Lab | Analysis of Conversion Lab  
Revision of Conversion Lab  
SRQ II: JGE Potpourri (Must include Citation & Summary)  
CR V: “My first laboratory presentation” (Group II)  
Group IV Lab Conversion (Due 5/8) | Comment SRQ I to CNB  
Group II Lab Conversion  
Group I Lab Revision  
CR V (Group I) |
| 4/24 | MTG: Lab Conversion Presentations (Group III)  
Analysis of Conversion Lab | Analysis of Conversion Lab  
Revision of Conversion Lab  
SRQ II to CNB  
Group I Lab Revision  
CR V (Group II) | |
| 5/1  | MTG: Lab Conversion Presentations (Group IV)  
Analysis of Conversion Lab | Analysis of Conversion Lab  
Revision of Conversion Lab  
CR V: “My first laboratory presentation” (Group III) | SRQ II to CNB  
Group II Lab Conversion  
Group III Lab Revision  
CR V (Group III) |
| 5/8  | MTG: Lab Conversion Presentations | Analysis of Conversion Lab  
Revision of Conversion Lab  
CR V: “My first laboratory presentation” (Group IV)  
CR VI: Research Project | SRQ II to CNB  
Group IV Lab Conversion  
Group III Lab Revision  
CR V (Group IV) |
| 5/15 | MTG: Presentation of Research Projects  
Discussion/Critical Reflections on Project | Study and prepare for all your other exams, projects, etc! | Study and prepare for all your other exams, projects, etc! |
|      |                                                                 | | |