

## 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, 1997, NSTA Pathways to the Science Standards, High School Edition: NSTA, Arlington, VA, 146p.

NSTA, 1998, NSTA Pathways to the Science Standards, Middle School Edition: NSTA, Arlington, VA, 146p.

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%**

- ◆ Attendance, punctuality, preparation, active participation and collegiality

**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

# SCHEDULE OF TOPICS AND ASSIGNMENTS

(Schedule may be subject to revision.)

MTG	TOPICS/ACTIVITIES	ASSIGNMENT	ASSIGNMENT DUE
1/23	<ul style="list-style-type: none"> <li>➔ Discussion: Introductions &amp; Self Exploration</li> <li>➔ Introduction, Expectations, Resources</li> <li>➔ Activity: Messy Hands</li> <li>➔ Artificial Dichotomies: Direct instruction/Inquiry; Content/Skills</li> <li>➔ Readings, Responses, Comments and the Course Notebook</li> </ul>	<ul style="list-style-type: none"> <li>▶ Messy Hands Activity</li> <li>▶ <b>RQ I: <i>Breaking the Cycle</i></b></li> <li>▶ Subscribe to ESPRIT/CR I: A week in the teachers' room</li> <li>▶ Read Core Curriculum and Reference Tables</li> <li>▶ Choose and prepare a lab from one of the resources</li> </ul>	
1/30	<ul style="list-style-type: none"> <li>➔ Messy Hands Demonstrations</li> <li>➔ Discussion of Core Curriculum and Reference Tables</li> <li>➔ What are Critical Reflections?</li> <li>➔ A genie in a bottle</li> </ul>	<ul style="list-style-type: none"> <li>▶ Presentation Topics and Groups 1 &amp; 2 (Due 2/13)</li> <li>▶ CR I: "<i>A week in the teachers' room</i>"</li> <li>▶ Scavenger Science I</li> <li>▶ Project BESSER (Due 4/10)</li> </ul>	<ul style="list-style-type: none"> <li>• Messy Hands</li> <li>• <b>RQ I to Course Notebook (CNB)</b></li> </ul>
2/6	<ul style="list-style-type: none"> <li>➔ Genie revisited</li> <li>➔ Scavenger Science I</li> <li>➔ Models in ESSE</li> <li>➔ Introduction to Research Projects</li> </ul>	<ul style="list-style-type: none"> <li>▶ Presentation Topics and Groups 3 &amp; 4 (Due 2/20)</li> <li>▶ CR II: The Genie and Me</li> <li>▶ <b>RQ II: <i>Models</i></b></li> <li>▶ Research Projects (Due 5/15)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Comment I to CNB</b></li> <li>• Read Core &amp; ESRT</li> <li>• Scavenger Science I</li> <li>• CR I: Teachers' Room</li> </ul>
2/13	➔ Lab Presentation Groups 1 & 2	<ul style="list-style-type: none"> <li>▶ Scavenger Science II</li> <li>▶ Analysis of Labs 1 &amp; 2 to CNB</li> <li>▶ Presenters CR III</li> </ul>	<ul style="list-style-type: none"> <li>• <b>RQ II to CNB</b></li> <li>• Presentation Groups 1 &amp; 2</li> <li>• CR II: Genie</li> </ul>
2/20	➔ Lab Presentation Groups 3 & 4	<ul style="list-style-type: none"> <li>▶ Analysis of Labs 3 &amp; 4 to CNB</li> <li>▶ Presenters CR III</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Comment II to CNB</b></li> <li>• Presentation Groups 3 &amp; 4</li> <li>• Presenters 1,2 CR III</li> </ul>
2/27	<b>NO CLASSES</b>		
3/6	<ul style="list-style-type: none"> <li>➔ <b>Data Driven Labs (DDLs)</b></li> <li>➔ Lab lesson planning (5E, 7E, Learning Cycles, etc)</li> <li>➔ Miniature intrusions and Mn nodules</li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>RQ III: <i>5E &amp; 7E</i></b></li> <li>▶ CR IV on DDL</li> <li>▶ Research Project Progress Reports</li> </ul>	<ul style="list-style-type: none"> <li>• Presenters 3,4 CR III</li> </ul>
3/13	<b>NORTHEAST GSA: Durham, NH</b>		
	Attend GSA or Work on Research Projects		
3/20	<ul style="list-style-type: none"> <li>➔ Professional Development: GSA Discussion</li> <li>➔ Scavenger Science II</li> <li>➔ Research Projects: Progress Reports</li> <li>➔ <b>Convertible Labs: Graham Cracker Tectonics</b></li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>RQ IV: <i>Bottlenecks</i></b></li> <li>▶ Convertible Labs (New Groups)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>RQ III to CNB</b></li> <li>• Scavenger Science II</li> <li>• CR IV: DDL</li> <li>• Research Prog. Reports</li> </ul>
3/27	<ul style="list-style-type: none"> <li>➔ Part D: the Lab Practical</li> <li>➔ New Part D – June, 2008</li> <li>➔ Analysis of Convertible Labs</li> </ul>	<ul style="list-style-type: none"> <li>▶ Revision of Convertible Lab</li> <li>▶ Group I Lab Conversion (Due 4/17)</li> </ul>	<ul style="list-style-type: none"> <li>• Convertible Lab to CNB</li> <li>• <b>Comment III to CNB</b></li> <li>• <b>RQ IV to CNB</b></li> </ul>
4/3	<b>NO CLASSES</b>		
4/10	<ul style="list-style-type: none"> <li>➔ <b>Project BESSER Posters and Papers</b></li> <li>➔ Working Session: Presentations &amp; Research Projects</li> </ul>	<ul style="list-style-type: none"> <li>▶ <b>SRQ 1: <i>TST Buffet (Must include Citation &amp; Summary)</i></b></li> <li>▶ Research Project Progress Reports</li> <li>▶ Group II Lab Conversion (Due 4/24)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Comment IV to CNB</b></li> <li>• Revised Convertible Lab</li> <li>• Project BESSER</li> </ul>
4/17	<ul style="list-style-type: none"> <li>➔ <b>Lab Conversion Presentations (Group I)</b></li> <li>➔ <b>Analysis of Conversion Lab</b></li> </ul>	<ul style="list-style-type: none"> <li>▶ Analysis of Conversion Lab</li> <li>▶ CR V: "<i>My first laboratory presentation</i>" (Group I)</li> <li>▶ Group III Lab Conversion (Due 5/1)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>SRQ I to CNB</b></li> <li>• Research Prog. Reports</li> <li>• Group I Lab Conversion</li> </ul>
4/24	<ul style="list-style-type: none"> <li>➔ <b>Lab Conversion Presentations (Group II)</b></li> <li>➔ <b>Analysis of Conversion Lab</b></li> </ul>	<ul style="list-style-type: none"> <li>▶ Analysis of Conversion Lab</li> <li>▶ Revision of Conversion Lab</li> <li>▶ <b>SRQ II: <i>JGE Potpourri (Must include Citation &amp; Summary)</i></b></li> <li>▶ CR V: "<i>My first laboratory presentation</i>" (Group II)</li> <li>▶ Group IV Lab Conversion (Due 5/8)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Comment SRQ I to CNB</b></li> <li>• Group II Lab Conversion</li> <li>• Group I Lab Revision</li> <li>• CR V (Group I)</li> </ul>
5/1	<ul style="list-style-type: none"> <li>➔ <b>Lab Conversion Presentations (Group III)</b></li> <li>➔ <b>Analysis of Conversion Lab</b></li> </ul>	<ul style="list-style-type: none"> <li>▶ Analysis of Conversion Lab</li> <li>▶ Revision of Conversion Lab</li> <li>▶ CR V: "<i>My first laboratory presentation</i>" (Group III)</li> </ul>	<ul style="list-style-type: none"> <li>• <b>SRQ II to CNB</b></li> <li>• Group III Lab Conversion</li> <li>• Group II Lab Revision</li> <li>• CR V (Group II)</li> </ul>
5/8	<ul style="list-style-type: none"> <li>➔ <b>Lab Conversion Presentations (Group IV)</b></li> <li>➔ <b>Analysis of Conversion Lab</b></li> </ul>	<ul style="list-style-type: none"> <li>▶ Analysis of Conversion Lab</li> <li>▶ Revision of Conversion Lab</li> <li>▶ CR V: "<i>My first laboratory presentation</i>" (Group IV)</li> <li>▶ CR VI: Research Project</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Comment SRQ II to CNB</b></li> <li>• Group IV Lab Conversion</li> <li>• Group III Lab Revision</li> <li>• CR V (Group III)</li> </ul>
5/15	<ul style="list-style-type: none"> <li>➔ <b>Presentation of Research Projects</b></li> <li>➔ <b>Discussion/Critical Reflections on Project</b></li> </ul>	▶ Study and prepare for all your other exams, projects, etc.!	<ul style="list-style-type: none"> <li>• Research Projects</li> <li>• Group IV Lab Revision</li> <li>• CR V (Group IV)</li> <li>• CR VI: Research Project</li> </ul>

