

**ESCI 4450/6450 - Science Curriculum and Learning
Spring Semester 2009**

Instructors:

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Catalog Course Description

Science curriculum models for students in grades 7* through 12 in relation to goals for science education and classroom practice. Development, selection, and evaluation of curriculum materials based on research in learning.

Prerequisite: EPSY 2020 and EFND 2030

*The State is now including 6th grade in certification.

Course Overview

In this course, you will learn about essential aspects of science curriculum and how curriculum can be used to enable student learning. The course is organized around three major themes: (1) science is a way of thinking and investigating as well as a body of knowledge, (2) effective instructional planning enables and facilitates student learning, and (3) standards, curriculum, teaching, learning and assessment are inextricably linked, guiding how teachers teach and what students learn.

The following questions will be explored in this course:

Science

What is science? What are the unifying concepts of science? How are science and technology related? How does science differ from other ways of knowing?

Inquiry

What is inquiry? What does inquiry look like in the context of school science?

Issues in Science

How is science related to socially important issues? What processes can be used to analyze and make decisions about science-related societal issues?

Science in the Community

How is science related to the community? How can community resources be used to promote the learning of science?

Learning

What is learning? How can we design meaningful learning experiences for diverse learners that address the cognitive, affective and psychomotor attributes of doing science?

Assessment

What tools and strategies can be used to assess student learning?
How can assessment results be used to guide and modify
instruction, the classroom environment, and student learning?

Curriculum

What are the curricular recommendations of the National Science Education Standards (NSES), the Project 2061 standards of the American Association for the Advancement of Science (AAAS) and the Georgia Performance Standards (GPS)? How can units of study be planned that address the goals of the NSES, AAAS, and the GPS as well as the learning needs and abilities of students?

Attendance Policy

Good attendance and punctuality are critical elements of teacher professionalism. It is recognized that people get sick, attend professional meetings, and have family emergencies, but attendance and participation are prerequisites to learning.

More than two unexcused absences (i.e., without written documentation) will result a student being dropped from the course. Arriving more than 30 minutes late or leaving class with 30 minutes or more remaining will be counted as an absence. If you have extenuating circumstances that cause you to be absent more than twice during course (e.g., serious illness), please consult your instructor about how to make up missed work.

Requests for Modifications

It is policy of the University of Georgia to make reasonable accommodations for qualified individuals with disabilities. If you are a person with a disability and want to request accommodations to complete your course requirements, please make an appointment with the course professors as soon as possible to discuss your request. For information on documentation requirements, contact the office of Disability Services (2-8719).

Academic Honesty

The University of Georgia seeks to promote and ensure academic honesty and personal integrity among students and other members of the University community. In keeping with the University Honor Code and Academic Honesty Policy, each student is expected to do his/her academic work and to acknowledge fully any assistance and academic resources. All academic work must meet the standards contained in "A Culture of Honesty." All students are responsible to inform themselves about those standards before performing any academic work. Terms of this policy, resolution procedures, and consequences of violation are available at:

http://www.uga.edu/ovpi/academic_honesty/culture_honesty.html

Chemical Right to Know Training
CHEMICAL RIGHT TO KNOW TRAINING:

By January 14 (Wednesday), please provide verification that you have completed the "Chemical-Specific RKT Training for Laboratory Personnel," provided online:

<http://www.busfin.uga.edu/rtk/index.htm>

Textbooks and Other Instructional Materials**Required**

Alvarez, W. (1997). *T. rex and the crater of doom*. Princeton, NJ: Princeton University Press. [Tr]

Chiappetta, E. L., & Koballa, T. R. (2006). *Science instruction in middle and secondary schools*. Upper Saddle River, NJ: Merrill Prentice-Hall. [C&K]

National Science Teachers Association. 2003. *Standards for Science Teacher Preparation*. Available online: <http://www.nsta.org/pdfs/NSTASTandards2003.pdf>

Georgia Department of Education. *Introduction to Science Performance Standards, Grades 6-8 and 9-12*. Available online: <http://www.georgiastandards.org/science.aspx>

Michaels, S., Shouse, A. W., & Schweingruber, H. A. (2008). *Ready, set, science: Putting research to work in K-8 classrooms*. [RSS] National Academies Press. Available: online: http://www.nap.edu/catalog.php?record_id=11882#toc

America's lab report: *Investigations in high school science*. [AL] National Academies Press. Available: online: http://www.nap.edu/catalog.php?record_id=11311&ups=11882#toc

Rutherford, F. J., & Ahlgren, A. (1990). American Association for the Advancement of Science [AAAS] Project 2061, Available online: <http://www.project2061.org/>; and the Science Literacy Maps Available online: <http://www.project2061.org/>

In addition, there will be required "Readings (R)" for which copies will be provided to you.

Course Requirements and Grading Summary

1. Science literacy activity	5% (=10 points)
2. Core science concept map	10% (=20 points)
3. Performance assessment	15% (=30 points)
4. Nature of science	15% (=30 points)
5. Inquiry	15% (=30 points)
6. Curriculum unit and reflections	40% (=80 points)
Total Possible Points	200 points

Grades are assigned by summing each student's points and dividing by 200 to obtain a percentage with 93-100 percent = A; 90-92 percent = A-; 87-89 percent = B+; 83-86 percent = B; 80-82 percent = B-; 77-79 percent = C+; 73-76 percent = C; 70-72 percent = C-; etc.

Course Assignments

If you have questions about an assignment, please consult your instructor. All written work must be typed and submitted as email attachments.

- 1. Science literacy activity** - Science is a human endeavor to understand the natural world we live in and its history. One approach teachers are engaged in is developing the scientific literacy of their students through reading. Reading across the curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. Throughout the semester, each of you will develop an activity for a selected chapter of *T. rex and the crater of doom* (Alvarez, 1997) for class presentation and discussion. **Due during the semester.**
- 2. Core science concept map** - Teachers are central to helping students develop age-appropriate, expert-like understandings of science. Teachers must recognize their own understanding of the hierarchical structure of the science discipline they teach. In this assignment, you will construct a map of the conceptual terrain for a science course that you plan to teach (e.g., high school biology). In doing so, you will develop a visual representation of your understanding of the hierarchical structure and interconnections that exist among the core science concepts that comprise a science course. A handout will provide more details about this assignment. **Due on Friday,**
- 3. Performance assessment** - Science units tend to have multiple learning outcomes that address content knowledge, skills, and occasionally learner dispositions. For this reason, the preferred summative assessment of student learning associated with science units is often a performance task rather than a paper-and-pencil test. In this assignment, you will develop assessments and rubrics that make explicit what counts as evidence of learning for the unit and how students will demonstrate their understanding. A rubric tells students what is expected of them and can be used to scaffold students' learning as well as to assess their mastery of the unit's intended learning outcomes. A handout will provide more details about this assignment. **Due on Friday,**
- 4. Nature of science** - All Americans must come to understand science as a way of thinking and a way of investigating in addition to a collection of knowledge. Moreover, they must understand how scientists go about their work and the significance of laws, theories, argumentation, and models used in the context of science. In this assignment, you will build a science learning experience to help students develop accurate understandings about the nature of science. A handout will provide more details about this assignment. **Due on Friday**

5. **Inquiry** - All students must be provided with many opportunities to explore the natural world in order to learn how it works. Student interest in and understanding of science increases when they are placed in situations where they are actively involved in the study of natural phenomena. However, in order for school science to resemble authentic science, to some degree, it must reflect how science is practiced. In this assignment, you will build a science learning experience that illuminates the thinking and investigative activities that scientists use to construct knowledge. **Due on Friday**
6. **Curriculum unit and reflections** - Well-designed curriculum units lead to meaningful science learning. A curriculum unit is a segment of a course of study that reflects coherence, is aligned with standards, and develops in students a deep understanding of concepts, principles, and topics. For this assignment, you will develop a science curriculum unit suitable for a high school or middle school course. Your unit must address the following Standards for Science Teacher Preparation (2003) and be accompanied by statements that indicate how each standard is met in your unit:
- Science Concepts and Principles (Standard 1a)
 - Unifying Concepts of Science (Standard 1b)
 - Technology in Science (Standard 1c)
 - Nature of Science (Standard 2c)
 - Inquiry (Standard 3b)
 - Issues in Science (Standard 4b)
 - Learning in Science (5a, 5b)
 - Curriculum (Standard 6)
 - Science in the Community (Standard 7b)
 - Assessment (Standard 8)
- Due on Friday**

**ESCI 4450/6450 - Science Curriculum and Learning
Tentative Daily Calendar
Spring Semester 2009**

January

Jan 9 Fri Week 1	<p>Topic: Where are we going, what are we doing, and why? "The First Day of School" - <i>Finding Nemo</i> Course Syllabi and Assignments</p> <ul style="list-style-type: none"> - NSTA Standards for Science Teacher Preparation <http://www.nsta.org/> <p>Activity: Introduction to science teaching: What can we learn from skulls of extant vertebrates?</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - C&K Chapters 1,2, & 3: Thoughts, Purpose, & Planning - R Schwab, J. 1978. What do scientists do? In: J. Schwab. <i>Science, curriculum and liberal education</i>. 184-228.
Jan 12 Mon	Clarke Middle School - Science Fair
Jan 16 Fri Week 2	<p>Topic: Thoughts, Purpose, & Planning in Science Teaching: What is the role of planning to teach science?</p> <ul style="list-style-type: none"> - Purpose of science teaching in U.S. schools - National Science Education Standards <http://www.nap.edu/openbook.php?record_id=4962> - Georgia Performance Standards <http://www.georgiastandards.org/> <p>Activity: Introduction to science teaching: What can we</p>

	<p>learn from skulls of extinct hominids? Part 1.</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - RSS Chapter 4 Organizing Science Education Around Core Concepts Available: <http://www.nap.edu/catalog.php?record_id=11882#toc> - C&K Chapter 7 Nature of Science - Tr Chapter 1 Armageddon
Begin Rotation 1	
Jan 21 Wed	Rotation 1: Apalachee HS & Haymon Morris MS
Jan 23 Fri Week 3	<p>Topic: The nature of teaching the Nature of Science (NOS): What is the role of planning for teaching science? Cont.</p> <ul style="list-style-type: none"> - Introduce curriculum unit assignment - Discuss core concept map assignment - Student learning (prior knowledge, learning is a social process, what counts as learning in science) <p>Activity: Introduction to science teaching: What can we learn from skulls of extinct hominids? Part 2.</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - RSS Chapter 3 Foundational Knowledge & Conceptual Change & Chapter 5 Making Thinking Visible: Talk and Argument Available: <http://www.nap.edu/catalog.php?record_id=11882#toc> - C&K Chapter 9 Learning Science - Tr Chapter 2 <i>Ex libro lapidum, historica mundi</i>
Jan 28 Wed	Rotation 1: Apalachee HS & Haymon Morris MS
Jan 30 Fri Week 4	<ul style="list-style-type: none"> - Topic: Learning Science: What is the nature of science? - Unifying concepts of science - Historical perspectives - Einstein's Big Idea <http://www.pbs.org/wgbh/nova/einstein/> <p>Activity: Introduction to science teaching: Teaching atomic structure using VAST-models.</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - RSS Chapter 6 Making Thinking Visible: Modeling and Representation & Appendix B - Assessment Items Based on a Learning Progression for Atomic-Molecular Theory Available: http://www.nap.edu/catalog.php?record_id=11882#toc - C&K Chapter 8 Diverse learners - Tr Chapter 3 Gradualist versus catastrophist

February

Feb 4 Wed	No Class/Practicum
Feb 6 Fri Week 5	<p>Topic: Diverse Learners & Introduction to the "structure of scientific revolutions and conceptual change"</p> <ul style="list-style-type: none"> - Unifying concepts of science - Historical perspectives <p>Activity: Investigating Absolute Zero http://www.pbs.org/wgbh/nova/zero/</p>

	Assignment for next class: <ul style="list-style-type: none"> - AL Chapter 1 Introduction, History and Definition of Laboratories - C&K Chapter 4 Teaching science - R Duit, R. & Treagust, D. 2003. - Tr Chapter 4 Iridium
Feb 11 Wed	Rotation 1: Apalachee HS & Haymon Morris MS
Feb 13 Fri Week 6	Topic: Nature of Science and Technology <ul style="list-style-type: none"> - Locate learning experiences that emphasize nature of sci and tech - Discuss nature of science assignment - Discuss NSTA standards: Science Concepts and Principles (Standard 1a), Unifying Concepts of Science (Standard 1b), Technology in Science (Standard 1c), and Nature of Science (Standard 2c) Activity: Visit to Center for Ultrastructural Research < http://www.uga.edu/caur/ > Assignment for next class: <ul style="list-style-type: none"> - RSS Chapter 7 Learning from science investigations - C&K Chapter 10 Science as inquiry - Tr Chapter 5 The search for the impact site
Feb 17 Tue	Rotation 1: Apalachee HS & Haymon Morris MS: Team Teach
Feb 18 Wed	Rotation 1: Apalachee HS & Haymon Morris MS: Team Teach
Feb 19 Thu	Rotation 1: Apalachee HS & Haymon Morris MS: Team Teach
Feb 20 Fri	Rotation 1: Apalachee HS & Haymon Morris MS: Team Teach
End Rotation 1	
Feb 25 Wed Week 7	Topic: <ul style="list-style-type: none"> - Curriculum unit assignment (reflective statements) - Nature of science assignment Activity: Presentation of concept maps Private Universe "Out of Thin Air" < http://www.learner.org/teacherslab/pup/index.html > Assignment for next class: <ul style="list-style-type: none"> - - C&K Chapter 10 Science as inquiry (cont.) - Tr Chapter 6 The crater of doom
Feb 27 Fri Week 7	Topic: Science Assessment <ul style="list-style-type: none"> - Science learning assessment system - Science tests Activity: 8:00 - 9:30 Using motion detectors in learning physics - Guest Presenter - Dr. Ji Shen Assessing assessments Assignment for next class: <ul style="list-style-type: none"> - C&K Chapter 11 Discussion, demonstration, lecture - Tr Chapter 7 The world after chicsulub

March

Begin Rotation 2	
Mar 4 Wed	Rotation 2: Apalachee HS & Haymon Morris MS
Mar 6 Fri Week 8	Topic: Science Assessment Cont. <ul style="list-style-type: none"> - Alternative assessments - Locate alternative assessments, rubrics and checklists - Discuss performance assessment assignment

	<ul style="list-style-type: none"> - C&K Chapter 13 Laboratory and Fieldwork <p>Activity: Assessing assessments</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - RSS Chapter 7 Learning from Science Investigations - C&K Chapter 13 Laboratory and Fieldwork - Tr - Lawson, A. (2004). <i>T.rex</i>, the crater of doom and the nature of scientific discovery. <i>Science & Education</i>, 13, 155-177
Mar 9 - 13	Spring Break University of Georgia
Mar 18 Wed	Rotation 2: Apalachee HS & Haymon Morris MS
Mar 20 Fri Week 9	<p>Topic: Inquiry</p> <ul style="list-style-type: none"> - Conceptions of inquiry <p>Activity: The Ascent of Man hosted by Jacob Bronowski</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - C&K Chapter 6 Assessing performance in science - R - Rudolf, J. (2005). Epistemology for the masses: The origins of the "scientific method" in American schools. <i>History of Education Quarterly</i>, 45, 341-376.
Mar 25 Wed	Rotation 2: Apalachee HS & Haymon Morris MS
Mar 27 Fri Week 10	<p>Topic: Inquiry</p> <ul style="list-style-type: none"> - Locate learning experiences that emphasize scientific inquiry - Discuss inquiry assignment <p>Activity:</p> <p>Assignment for next class: NSTA Standard for Science Teacher Preparation 3; Ready, Set Science, Chaps 5 and 6</p> <ul style="list-style-type: none"> - C&K Chapter 6 Assessing performance in science (cont)

April

Apr 4 Wed	No Class/Practicum
Apr 3 Fri Week 11	<p>Topic: Revisiting and Clarifying</p> <ul style="list-style-type: none"> - Curriculum unit assignment - Nature of science assignment - Inquiry assignment <p><i>Presentation of performance assessment</i></p> <p>Activity:</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - C&K Chapter 12 Science, technology and society
Apr 8 Wed	Rotation 2: Apalachee HS & Haymon Morris MS
Apr 10 Fri Week 12	<p>Topic: Issues in Science</p> <ul style="list-style-type: none"> - Areas of pedagogical importance for SSI - Analytical decision-making and structured controversy models - Discuss NSTA Standard: Issues (Standard 4) <p>Read: Science Instruction, Chap 12 (pp. 187-195); NSTA Standards for Science Teacher Preparation 4</p> <p>Activity:</p> <p>Assignment for next class:</p> <ul style="list-style-type: none"> - C&K Chapter 16 Long-term planning and assessment

Apr 14 Tue	Rotation 2: Apalachee HS & Haymon Morris MS: Team Teach
Apr 15 Wed	Rotation 2: Apalachee HS & Haymon Morris MS: Team Teach
Apr 16 Thu	Rotation 2: Apalachee HS & Haymon Morris MS: Team Teach
Apr 17 Fri	Rotation 2: Apalachee HS & Haymon Morris MS: Team Teach
Apr 22 Wed	Practicum Meets on Campus
End Rotation 2	
Apr 24 Fri Week 13	<p>Topic: Science in the Community</p> <ul style="list-style-type: none"> - Culturally relevant science teaching - Discuss NSTA Standard: Science in the Community (Standard 7) - Identify community resources for teaching science <p><i>Presentation of nature of science learning experience</i></p> <p>Activity: Open</p> <p>Assignment for next class: NSTA Standards for Science Teacher Preparation 7</p> <ul style="list-style-type: none"> - C&K Chapter 5 Managing a science learning environment
Apr 20-24	Spring Break Barrow County
Apr 29 Wed Week 14	<p>Topic: Revisiting and Clarifying</p> <ul style="list-style-type: none"> - Inquiry assignment - Curriculum unit assignment - Differentiated instruction <p>Activity: Teaching Georgia's Natural History</p> <p>Assignment for next class: Science Instruction In press, Chap 8 (provided by Thomson)</p>

May

May 1	Reading Day
May ? Final Exam Period	<p>Celebration of Learning</p> <p><i>Presentation of inquiry learning experiences and unique selection from curriculum unit</i></p>

NSTA Standards

Notes

<p>1. Content. Teachers of science understand and can articulate the knowledge and practices of contemporary science. They can interrelate and interpret important concepts, ideas, and applications in their fields of licensure; and can conduct scientific investigations. To show that they are prepared in content, teachers of science must demonstrate that they</p> <p>(a) understand and can successfully convey to students the major concepts, principles, theories, laws, and interrelationships of their fields of licensure and supporting fields as recommended by the National Science Teachers Association;</p>	
<p>(b) understand and can successfully convey to students the unifying concepts of science delineated by the National Science Education Standards;</p>	
<p>(c) understand and can successfully convey to students important personal and technological applications of science in their fields of licensure;</p>	
<p>(d) understand research and can successfully design, conduct, report and</p>	
<p>(e) evaluate investigations in science; and understand and can successfully use mathematics to process and report data, and solve problems, in their field(s) of licensure.</p>	
<p>2. Nature of Science. Teachers of science engage students effectively in studies of the history, philosophy, and practice of science. They enable students to distinguish science from nonscience, understand the evolution and practice of science as a human endeavor, and critically analyze assertions made in the name of science. To show they are prepared to teach the nature of science, teachers of science must demonstrate that they</p> <p>(a) understand the historical and cultural development of science and the evolution of knowledge in their discipline;</p>	
<p>(b) understand the philosophical tenets, assumptions, goals, and values that distinguish science from technology and from other ways of knowing the world; and</p>	
<p>(c) engage students successfully in studies of the nature of science including, when possible, the critical analysis of false or doubtful assertions made in the name of science.</p>	
<p>3. Inquiry. Teachers of science engage students both in studies of various methods of scientific inquiry and in active learning through scientific inquiry. They encourage students, individually and collaboratively, to observe, ask questions, design inquiries, and collect and interpret data in order to develop concepts and relationships from empirical experiences. To show that they are prepared to teach through inquiry, teachers of science must demonstrate that they (a) understand the processes, tenets, and assumptions of multiple methods of inquiry leading to scientific knowledge; and</p>	

(b) engage students successfully in developmentally appropriate inquiries that require them to develop concepts and relationships from their observations, data, and inferences in a scientific manner.	
4. Issues. Teachers of science recognize that informed citizens must be prepared to make decisions and take action on contemporary science- and technology-related issues of interest to the general society. They require students to conduct inquiries into the factual basis of such issues and to assess possible actions and outcomes based upon their goals and values. To show that they are prepared to engage students in studies of issues related to science, teachers of science must demonstrate that they	
(a) understand socially important issues related to science and technology in their field of licensure, as well as processes used to analyze and make decisions on such issues; and	
(b) engage students successfully in the analysis of problems, including considerations of risks, costs, and benefits of alternative solutions; relating these to the knowledge, goals and values of the students.	
5. General Skills of Teaching. Teachers of science create a community of diverse learners who construct meaning from their science experiences and possess a disposition for further exploration and learning. They use, and can justify, a variety of classroom arrangements, groupings, actions, strategies, and methodologies. To show that they are prepared to create a community of diverse learners, teachers of science must demonstrate that they	
(a) vary their teaching actions, strategies, and methods to promote the development of multiple student skills and levels of understanding;	
(b) successfully promote the learning of science by students with different abilities, needs, interests, and backgrounds;	
(c) successfully organize and engage students in collaborative learning using different student group learning strategies;	
(d) successfully use technological tools, including but not limited to computer technology, to access resources, collect and process data, and facilitate the learning of science;	
(e) understand and build effectively upon the prior beliefs, knowledge, experiences, and interests of students; and	
(f) create and maintain a psychologically and socially safe and supportive learning environment.	
6. Curriculum. Teachers of science plan and implement an active, coherent, and effective curriculum that is consistent with the goals and recommendations of the National Science Education Standards. They begin with the end in mind and effectively incorporate contemporary practices and resources into their planning and teaching. To show that they are prepared to plan and implement an effective science curriculum, teachers of science must demonstrate	

that they (a) understand the curricular recommendations of the National Science Education Standards, and can identify, access, and/or create resources and activities for science education that are consistent with the standards; and	
(b) plan and implement internally consistent units of study that address the diverse goals of the National Science Education Standards and the needs and abilities of students.	
7. Science in the Community. Teachers of science relate their discipline to their local and regional communities, involving stakeholders and using the individual, institutional, and natural resources of the community in their teaching. They actively engage students in science-related studies or activities related to locally important issues. To show that they are prepared to relate science to the community, teachers of science must demonstrate that they (a) identify ways to relate science to the community, involve stakeholders, and use community resources to promote the learning of science; and	
(b) involve students successfully in activities that relate science to resources and stakeholders in the community or to the resolution of issues important to the community.	
8. Assessment. Teachers of science construct and use effective assessment strategies to determine the backgrounds and achievements of learners and facilitate their intellectual, social, and personal development. They assess students fairly and equitably, and require that students engage in ongoing self-assessment. To show that they are prepared to use assessment effectively, teachers of science must demonstrate that they (a) use multiple assessment tools and strategies to achieve important goals for instruction that are aligned with methods of instruction and the needs of students;	
(b) use the results of multiple assessments to guide and modify instruction, the classroom environment, or the assessment process; and	
(c) use the results of assessments as vehicles for students to analyze their own learning, engaging students in reflective self-analysis of their own work.	
9. Safety and Welfare. Teachers of science organize safe and effective learning environments that promote the success of students and the welfare of all living things. They require and promote knowledge and respect for safety, and oversee the welfare of all living things used in the classroom or found in the field. To show that they are prepared, teachers of science must demonstrate that they (a) understand the legal and ethical responsibilities of science teachers for the welfare of their students, the proper treatment of animals, and the maintenance and disposal of materials;	

(b) know and practice safe and proper techniques for the preparation, storage, dispensing, supervision, and disposal of all materials used in science instruction;	
(c) know and follow emergency procedures, maintain safety equipment, and ensure safety procedures appropriate for the activities and the abilities of students; and	
(d) treat all living organisms used in the classroom or found in the field in a safe, humane, and ethical manner and respect legal restrictions on their collection, keeping, and use.	
10. Professional Growth. Teachers of science strive continuously to grow and change, personally and professionally, to meet the diverse needs of their students, school, community, and profession. They have a desire and disposition for growth and betterment. To show their disposition for growth, teachers of science must demonstrate that they	
(a) engage actively and continuously in opportunities for professional learning and leadership that reach beyond minimum job requirements;	
(b) reflect constantly upon their teaching and identify ways and means through which they may grow professionally;	
(c) use information from students, supervisors, colleagues and others to improve their teaching and facilitate their professional growth; and	
(d) Interact effectively with colleagues, parents, and students; mentor new colleagues; and foster positive relationships with the community.	