

CASE STUDY: SIMULTANEOUS DEVELOPMENT  
OF ONLINE AND FACE TO FACE VERSIONS  
OF A COLLEGE-LEVEL ENVIRONMENTAL SCIENCE COURSE

by

Theodore C. Smith

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Address:	7053 Enright Drive
City, State, Zip:	Citrus Heights, CA 95621
Phone:	(916) 726-4961
E-mail:	tcsmith@surewest.net
Instructor:	Cyd Strickland
Mentor:	None

## Abstract

The increasing interest in online instruction has prompted many instructors to modify existing face-to-face courses for online delivery. During that conversion or subsequent initial delivery, instructors typically recognize that specific face-to-face exercises or delivery modes probably are not effective in the online classroom. This paper examines a case where, as a new college-level science course is developed, the instructor simultaneously generates versions for (a) online and (b) face-to-face delivery. Simultaneously development presents opportunities to (a) consider the merits of a variety of teaching and learning techniques and (b) seek ways that extend and enhance learning. The linked approach also encourages (a) careful consideration of alternative techniques, (b) fine-tuning of content, and (c) planning for successful learning.

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## Introduction

Patten University, a nondenominational Christian college located in Oakland, California, offers a ministry-related Associate of Arts (AA) degree via several extension sites and is considering instituting an online degree program (Smith, 2003). The Science 100 course (Non-lab Science) required for the AA degree has never been developed (Frank Markow, personal communication), nor is it described in any university catalog.

This paper examines the initial development of a non-lab science course—Environmental Science—which may be suitable for Patten's use in face-to-face or online settings. Rather than first developing the face-to-face version or online version and subsequently converting the course to the second format, the approach used was to simultaneously develop both versions. This approach provides the opportunity to consider the merits of each approach and seek ways that extend and enhance learning.

This paper largely is a reflection on this development process. The first section describes the assumptions made about Patten's current and potential learners. The second section describes the course development, including learning objectives, textbook selection, design constraints, and the development process used in this case. The latter subsection reports on issues such as (a) course scheduling for the two formats, (b) the use of instructor-centered versus learner-centered approaches, (c) helping learners connect and develop personalized meaning, and (d) assessment. The final section presents some conclusions regarding the approach used herein.

## Learner Assumptions

At Patten extension sites, the typical learner is an adult who has a family and holds one or more full-time jobs. Several of these learners are ESL students and have limited access to

computers. Most extension sites have a small resource center that includes one or more computers. Most extension learners also have access to local public libraries and/or a local community college or other university library (Frank Markow, personal communication).

The initial target student population for the proposed online program includes approximately 6,500 Church of God (an evangelical fundamentalist denomination) pastors in the western United States who lack Bachelors degrees. Many of these pastors are bi-vocational, serve small communities, and are located far from any Christian university (Smith, 2003). No study has yet been conducted to determine the computer skill level of this target population or whether they have Internet access (Frank Markow, personal communication).

For the purpose of this paper, face-to-face learners are assumed to have some (but limited) access to the Internet. Online learners are assumed to have Internet access, although their computer skills may be limited. Learners also are assumed to have never completed a college-level science course. Because Patten has not yet offered any online courses, it is likely that many learners will be new to online learning.

## Course Development

### *Learning Objectives and Textbook Selection*

The first challenges included developing course objectives and selecting one or more suitable textbooks. Objectives for the Environmental Science course are:

1. Understand basic scientific principles and practices and thereby be equipped to begin to discern good science from bad or pseudoscience.
2. Be able to cite examples and describe ways that the environment affects mankind and that mankind can affect various parts of the environment.

3. Be able to differentiate and define concepts including adaptation, biodiversity, causes and connections, carrying capacity, chemical change, climate change, community ecology, conservation, cultural change, cumulative impact, ecosystems, energy, geologic processes, geologic hazards, global change, hazardous waste, local variability, matter and energy laws, measurement (accuracy, precision, and error), models, niches, physical change, pollution (of air, water, and soil), pollution control, population dynamics, probability, resources (food, water, minerals, and energy), risk, soil conservation, soil formation, systems, sustainability, and urbanization.
4. Describe and discuss some relationships between economics, market forces, laws, regulations, policy, various worldviews, and the environment.
5. Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. Be able to develop a list of principles, concepts, and rules to serve as guidelines in making decisions and continually evaluate and modify this list on the basis of experience.
6. Be able to interact with reading material, instructors, fellow learners, and others in ways that sharpen critical thinking skills.

As noted above, many of the potential learners hold evangelical fundamentalist beliefs. Potential textbooks were screened for suitability. Some textbooks were eliminated from consideration because of content that espoused a worldview that precluded God or included text that might be viewed as direct attacks on religious beliefs.

After reviewing several candidates, two textbooks—Lee (2000) and Miller (2002) were selected. Lee provides insights on the scientific process, while Miller (a biologist) focuses on providing a balanced view of environmental issues from a scientific perspective. Lee does

include content asserting that astrology, creation "science," dowsing, paranormal studies, UFOs, etc., are pseudosciences. However, Lee does not attack religious beliefs; thus, Lee's text provides an opportunity to briefly discuss the differences between scientific investigations and religious beliefs and the roles that worldviews play in assumptions and investigative approaches. Smith (1985) provides additional earth science content.

Both textbooks support evolution and an old (billions of years) earth, thus there is a risk that some learners will view the texts as attacking their faith. The university supports acknowledging the controversy and believes that the theories of evolution, continental drift, and big bang creation are appropriate to include in a science course. Instructors can prepare learners for these faith related questions early in the course. For example, see Appendices 5 and 6.

### *Design Constraints*

Patten uses a semester system. University policy dictates that all courses must begin and end during a single semester. Each semester is comprised of 17 weeks of instruction. Classes may meet one or more times per week. Science 100, typically taken during the freshman year, is designated as a three credit course, meaning that it is comprised of approximately three 50-minute hours of face-to-face instruction, plus approximately two hours of homework per hour of class time. The face-to-face course described in Appendices 1 and 2 is designed to be delivered in a twice-a-week lecture/discussion format. Although Patten may consider offering online courses in a compressed timeframe (e.g., 8 weeks of online class activity instead of 17), the online course described in Appendices 3 and 4 is designed to be delivered in 17 weekly units.

### *Course Planning Process*

Development of both versions of this course occurred simultaneously. Rather than taking an existing face-to-face course and trying to adapt lecture and in-class exercises for online presentation, the simultaneous development approach provided an opportunity to (a) search for teaching methods that worked in both formats and (b) consider adapting online materials and approaches for use in the face-to-face setting.

### *Course Schedule*

It quickly became apparent that the face-to-face twice-a-week lecture format allows one chapter of Miller (which contains 28 chapters) to be addressed during most class sessions. Initially the face-to-face schedule was developed (Appendix 2) on that basis; it was later adjusted to accommodate other content and major examinations.

Problems surfaced with an attempt to convert this proposed schedule to a 17-unit approach for the online course. A strict conversion suggested that one might simply cover two chapters of Miller in each weekly online unit. However, doing so without any adjustment leads to a less than optimal splitting of some topics. For example, as illustrated in Appendix 2, the discussion of geologic hazards would occur during Week 6, Session 2, and Week 7, Session 1. Minor adjustments in the order of presentation of some materials permitted geologic hazards to be addressed in a single unit in the online version of the course.

### *Instructor Centered or Learner Centered?*

A face-to-face, instructor-centered, lecture format potentially permits instructors to extract content from Lee and other sources for in-class presentation. However, the same approach for the online environment would have required extensive transcription of lectures and potentially expose instructors to charges of copyright infringement.

A learner-centered, active-learning approach frequently uses discussion forums to develop learning communities that explore and add to information presented in assigned readings and encourage learners to personalize content and make their own meanings (Ko and Rosen, 2001; Palloff and Pratt, 2003). Thus, a learner-centered, active-learning approach supports the achievement of Course Objective 5, especially the development of a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs.

Development of discussion questions for the online version of the course began to raise questions about the format of the face-to-face course. Specifically, does lecturing about assigned readings really add value or will learners benefit more from participatory discussions of the questions posed to online learners? That question remains unanswered here, but is something upon which each instructor should reflect as the course progresses and he or she becomes more aware of learner capabilities and classroom dynamics.

#### *Helping Learners Connect and Make Meaning*

Two exercises were included in the online version of the course to (1) help learners connect with their own environment, (2) help them begin to recognize how they and their neighbors are affected by environmental issues, (3) encourage them to begin taking charge of their own learning, and (4) help assure that university "seat-time" requirements were met. These exercises require learners to (a) develop summaries of news articles that address local or regional environmental issues and (b) maintain a reflective journal.

Recognizing that students in the face-to-face course also need to attain Course Objective 5, these two exercises were included in the face-to-face version of the course.

However, because (a) students ideally will present and discuss news articles class and (b) class time is limited, students may not be able present their articles each and every week.

Week 14 of the online version of the course includes a jigsaw approach to address four chapters of Miller in one week. While this approach also could be used in the face-to-face version of the course, doing so would require two class sessions for presentation of the material and substantial lead time for students to read the material and plan their presentations. This effectively loads twice as much work on learners during weeks 12 and 13, risking overload and potential less than optimal in-class learning.

### *Assessment*

Accurately evaluating learner achievement is a critical aspect of any undergraduate course. The suite of assignments proposed herein is intended to provide opportunities for meaningful learning, meet university guidelines, and minimize opportunities for cheating. Traditionally, face-to-face courses have depended on tests and written assignments as tools in which learners demonstrate learning. The Internet, cell phones, and other technology have afforded new opportunities for students to cheat on tests or acquire written materials to present as their own work.

Ko and Rosen (2001) suggest that instructors should not rely only on online testing for grading individuals, but that there are at least two other methods of evaluating learner performance (e.g., essays, discussion participation). CITES Educational Technologies (2002) suggests that instead of large, heavily weighted exams, more frequent and smaller-value quizzes tend to make cheating less likely. Moore (2001) suggests that instructors use a portfolio approach that may include student journals, class (or online) participation, short papers, submittal of draft

papers, and projects. Given these suggestions, the each version of the course includes a wide range of assignments and activities (Table 1; also see Appendices 1 and 3).

Two aspects of the portfolio merit further comment. In a face-to-face course, frequent pop quizzes can be a tool for assuring that students attend class, arrive on time, and do not leave early. In an online course, participation in online discussions is a critical component; by assigning significant value to online participation, the instructor helps ensure student participation. If face-to-face classes are less lecture and more discussion-oriented, it may be appropriate to increase the assigned value of in-class participation.

The syllabus for each version includes grading rubrics. For written products (e.g., reports) the rubrics are identical. The online participation rubric (included in Appendix 3) is modified after Enns (n.d.) and permits weekly feedback (or grading) of learner performance. Because the online version of the course may include a substantial discussion component, a similar rubric is

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Table 1

Relative weights of various learner products in the Science 100 face-to-face and online portfolios

Item	Percent of Grade for Online Course	Percent of Grade for Face-to-Face Course
Online participation	25%	0%
In-class participation	0%	10%
Environmental science news summaries	10%	10%
Environmental science journal	15%	15%
Paper/Project #1	15%	15%
Paper/Project #2	15%	15%
Quizzes	10%	10%
Mid-term exam	0%	10%
Final exam	10%	15%
TOTAL	100%	100%

included in Appendix 1. Also note that the schedule for the online version of the course (Appendix 4) directs learners to observe proper *netiquette* and directs them to the university guidelines for online behavior. However, the schedule for the face-to-face version of the course contains no such admonition. Thus, it falls to the face-to-face instructor to maintain order in the class and to verbally encourage proper etiquette. Should problems be encountered, it may be beneficial to develop a comparable document to guide face-to-face learners.

### Conclusions

This cases study suggests that simultaneously development of face-to-face and online versions of a given course (Science 100) presents opportunities to (a) consider the merits of a variety of teaching and learning techniques and (b) seek ways that extend and enhance learning. The linked approach encourages the instructor to carefully consider alternative techniques, fine-tune content, and plan for successful learning. It may be appropriate to (a) weight specific activities differently in the two settings to help assure consistent participation by students and (b) consider whether tools (such as netiquette guidelines) required for one course mode might aid if developed for the other course mode.

### References

- CITES Educational Technology (2002, November 18). *Syllabus checklist* [Electronic]. Retrieved September 16, 2003, from <http://www.cites.uiuc.edu/edtech/resources/pedagogy/syllabi/checklist.html>.
- Enns, B. (n.d.). *ED7504 assessment rubric*. Retrieved from ED7504 course room on January 11, 2003.
- Lee, Jeffrey A. (2000). *The scientific endeavor—A primer on scientific principles and practice*. San Francisco: Benjamin/Cummings.
- Ko, S., & Rosen, S. (2001). *Teaching online—A practical guide*. Boston: Houghton Mifflin.

- Miller, G. T. (2002). *Living in the environment—principles, connections, and solutions* (12th ed.). Belmont, CA: Brooks/Cole.
- Moore, G. S., Winograd, K., & Lange, D. (2001). *You can teach online—Building a creative learning environment*. Boston: McGraw Hill.
- Palloff, R. M., & Pratt, K. (2003). *The virtual student—A profile and guide to working with online learners*. San Francisco: Jossey-Bass.
- Smith, T. C. (1985). *Geohazards information in general plans: Problems and recommendations*. Unpublished Masters thesis, Consortium of the California State Universities. Available at <http://svit.org/faculty/tsmith/thesis/>.
- Smith, T. C. (2003, June). *Patten University learning communities: A strategic survey*. Unpublished course paper, Capella University, ED7692—Strategies for Building Online Learning Communities. Available at <http://www.lc.capellauniversity.edu/~ts5548/papers/TCSmith%20ED7692%20Final%20Paper.pdf>.

Appendix 1

Syllabus for the Face to Face Version of the Environmental Science Course

# Science 100—Non-Lab Science (Environmental Science) *Syllabus*

## ***Instructor & Contact Information***

Theodore (Ted) Smith

Phone: 916-726-4961 (call only between 10 AM and 9 PM Pacific time, please)

E-Mail: [tcsmith@calweb.com](mailto:tcsmith@calweb.com) (please include Sci 100 in the subject of your message so I may recognize it as relating to this course; e.g, Sci 100 question, or Sci 100–Question about project proposal).

## ***Learning Objectives***

By completion of this course, the learner will:

1. Understand basic scientific principles and practices and thereby be equipped to begin to discern good science from bad or pseudoscience.
2. Be able to cite examples and describe ways that the environment affects mankind and that mankind can affect various parts of the environment.
3. Be able to differentiate and define concepts including adaptation, biodiversity, causes and connections, carrying capacity, chemical change, climate change, community ecology, conservation, cultural change, cumulative impact, ecosystems, energy, geologic processes, geologic hazards, global change, hazardous waste, local variability, matter and energy laws, measurement (accuracy, precision, and error), models, niches, physical change, pollution (of air, water, and soil), pollution control, population dynamics, probability, resources (food, water, minerals, and energy), risk, soil conservation, soil formation, systems, sustainability, and urbanization.
4. Describe and discuss some relationships between economics, market forces, laws, regulations, policy, various worldviews, and the environment.
5. Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. Be able to develop a list of principles, concepts, and rules to serve as guidelines in making decisions and continually evaluate and modify this list on the basis of experience.
6. Be able to interact with reading material, instructors, fellow learners, and others in ways that sharpen critical thinking skills.

## ***Required Textbooks***

Miller, G. Tyler. (2002). *Living in the environment—principles, connections, and solutions* (12<sup>th</sup> ed.). Belmont, CA: Brooks/Cole. (\$106.95 from Amazon.com; \$58 to \$63 [new] from various Amazon merchants such as Scholars Depot, Super Book Deals, etc.). *Note: I highly recommend*

*that you purchase this textbook with the standard 4-month subscription to InfoTrac® (often included free with new textbooks), especially if you have a computer and access to the Internet. Doing so will make it possible for you to (1) read some assigned papers online without having to visit a library and also (2) quickly find and read material to cite in your own required research papers. However, because you will only have four months of access, don't access InfoTrac until AFTER the instructor tells you to do so.*

Lee, Jeffrey A. (2000). *The scientific endeavor—A primer on scientific principles and practice*. San Francisco: Benjamin/Cummings. (Typically costs \$34 to \$36 [new]; used copies are available from Amazon merchants and elsewhere).

## **Assignment Suite**

1. Read the university's policy regarding cheating and plagiarism. This policy will be enforced in this class.
2. Complete assigned reading **prior to each class**.
3. Attend class and **actively participate** in discussions and learning activities.
4. **Each week**, find a current news article (from a newspaper, magazine, or web site) related to environmental science, bring a copy to class, and present a 2-minute summary of the article. Focus your summary on the environmental issue, what controversy exists, who the affected parties are or would be, and how their views differ. If noted in the article, what steps are planned to resolve any differences of opinions. Finally, how might you personally be affected by the outcome? [Your summary can be as simple as one or two sentences about each of these questions.]
5. Keep a journal that documents your learning. At least **once or twice each week**, identify something that you learned about environmental science and reflect on how it affects you, someone you know, and/or your community. By the end of this course, your journal must include a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs (see Learning Objective 5 above). Your instructor will review your journal at least three times during the course.
6. You must complete **two projects** during this course. Choose any two of the following:
  - a. Select an environmental controversy (either ongoing or historical) and write a 5-page paper (1500 words minimum) about it. What is (or was) the issue/controversy? Who are (or were) the parties involved? How do (or did) their views differ? Who would be (or was) affected by the outcome? Etc. Cite your references.
  - b. Prepare a 5-page paper (1500 words minimum) about a historical environmental scientist. Who were they? What did they study? What was their worldview? What did they contribute to the understanding of environmental science? Etc. Cite your references.
  - c. Develop an annotated list of web sites that address a specific environmental science theme. Your list should be 3 to 5 pages long and list at least 15 sites.
  - d. Participate in (or develop and complete) an environmental project (e.g., a creek or beach clean-up effort, a restoration project) and write a paper summarizing the

experience. The project may be a group activity involving fellow learners, but each learner must write their own 3-page (900 words) summary paper. This project must be completed during the current term, must be pre-approved by the instructor, and must be submitted with appropriate documentation.

## **Grading**

### **Relative Weights for Assignments, Quizzes, and Tests**

Item	Percent of Grade
In-class participation	10%
Environmental science news summaries	10%
Environmental science journal	15%
Paper/Project #1	15%
Paper/Project #2	15%
Quizzes	10%
Mid-term exam	10%
Final exam	15%
TOTAL	100%

### **Written projects should meet the following criteria.**

All papers should be typed, double-space, using 12-point Times New Roman or Courier font. References cited should be single-spaced with a double-space between entries. Your reference list should only include those papers that you cite in your paper [I don't want a list of everything you consulted during your research]. Ideally the papers should follow Publication Manual of the American Psychological Association guidelines, but papers that follow other guidelines (e.g., of another professional society) will be accepted. If you don't have the APA manual, see <http://www.apastyle.org/faqs.html> for answers to frequent questions, tips, and other suggestions.

#### Research Papers (5a, 5b, and 5c)

Papers will be graded according to how well they

1. Represent original choice/aspect of topic within the scope of this course
2. Provide clear, detailed, logical explanation
3. Identify clear, analytical and sophisticated treatment of topic
4. Use appropriate/consistent citation structure and organized format
5. Use correct use of spelling, grammar, punctuation
6. Meet minimum length requirements (including bibliography)

Environmental Project

1. Represent original choice/aspect of topic within the scope of this course
2. Provide clear, detailed explanation of the purpose and, if pertinent, approach to project design/development
3. Document completion of project/demonstration within project parameters
4. Use appropriate/consistent citation structure and organized format
5. Use correct use of spelling, grammar, punctuation
6. Meet minimum length requirements
7. Note: Content may be presented via traditional print medium, or via an alternative medium, such as html/web page, PowerPoint, etc. If you have questions, be sure to ask your instructor.

***In-Class Participation Grading Rubric***

For initial posts:

A	B	C	F
1. The learner participates through active listening and willingly volunteers observations, insights, and questions that further the discussion, but does not dominate the discussion.	1. The learner participates through active listening and occasionally shares observations, insights, and questions.	1. The learner participates through active listening only.	1. The learner frequently tunes out, falls asleep, appears disinterested, disrupts the class, or frequently attempts to dominate the discussion.
2. Responses are substantive and related to key principles; there are no misconceptions.	2. Responses are substantive, but may include some misconceptions.	2. Responses mention some key principles, but there are significant misconceptions or omissions.	2. There are no references to key principles; if key principles are mentioned, there is no evidence that the learner understood the principles.
3. The response is clear, concise, and easy to understand. Terminology is used appropriately and the response is logically organized.	3. The response is adequately written, but it may contain some organization problems or a few inappropriately used terms.	3. The response is poorly written; one may comprehend the learner's ideas only after repeated readings.	3. The response is poorly written; one cannot comprehend the learner's ideas after repeated readings.
4. The response is submitted on or before the due date.	4. Not applicable.	4. The response was submitted after the due date.	4. No response was submitted.

Appendix 2

Schedule for the Face to Face Version of the Environmental Science Course

# Science 100—Non-Lab Science (Environmental Science) Course Schedule

## Week 1.

### Session I. Introduction

- A. Introductions
  - 1. Instructor
  - 2. Learners
- B. Format, course requirements, and expectations
  - 1. My goal is to help you learn. I'll do that by using a variety of teaching methods and techniques. Please understand that different people learn in different ways. You can help me to help you by periodically letting me know which techniques help you learn best.
  - 2. Please complete assigned reading prior to coming to each class.
  - 3. Class time will be devoted to a combination of in-class discussion, lecture, and various learning activities. These discussions, lectures, and activities will supplement and expand upon the readings. If you don't understand a concept or example, please ask for me to explain it further during class.
  - 4. There will be at least one quiz each week (some weeks there may be two quizzes). The quizzes may cover material (1) in the assigned reading and (2) discussed during the previous one or two class sessions.
  - 5. There will be two examinations—a mid-term and a final—during this course.
  - 6. Each learner also will complete the following projects:
    - a. A journal containing at least two entries each week. In this journal, you will record and reflect on something that you learned and that is related to the course. [The instructor will review your journal during Week 4, Week 10, and Week 16.]
    - b. Collect sixteen (16) current news articles (one each week) that pertain to environmental science issues covered in this course. Bring one article to class each time and be prepared to briefly (e.g., in 1 to 2 minutes) describe the article and one or two environmental issues or questions.
    - c. A collection of web resources that address an environmental issue and/or role and accomplishments of a historical figure. [Due Week 7.]
    - d. A 5-page report (about 2,500 words) on an environmental issue and/or role and accomplishments of a historical figure. This **MUST NOT** be the same issue and/or historical figure addressed in (c); however, you **MAY** use the resources that one or more of your colleagues gathered as starting points for your research. [Due Week 13.]
    - e. Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. [Due Week 16.]
- C. Lecture topic: How scientists think; understanding some basic terms and concepts (e.g., hypothesis, givens, assumptions, testing, experiment, observations, repeatable results, interpretation, theory, fact, and provability).
- D. Sample environmental news article presentation
- E. Distribute sample journal entry and discuss (1) what a journal is and (2) how it will be graded and used

- F. Homework to complete for next class
1. Prior to the next class, read pp. iii-vi in Miller; review the contents (pp. x-xx) and compare to this Course Schedule. Also read Lee, Chapters 1-5.
  2. Bring materials needed for in-class exercises to next class
  3. Begin journal writing
  4. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Session II. Science Basics**

- A. In-class measurement exercises and experiments
- B. Discussion. What did you learn in these exercises? Did they help clarify concepts discussed in Unit 1?
- C. Lecture: Faith, Personal Values, and Scientific Controversies
- D. Homework
  1. Prior to the next class, read Lee, Chapters 6-9, and Miller, Chapter 1
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Week 2.**

**Session I. Environmental Issues, Their Causes, and Sustainability**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
  1. Science, Pseudoscience, and a Skeptical Attitude
  2. Environmental Issues
- C. Homework
  1. Prior to the next class, read Miller, Chapter 2
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Session II. Overview of Environmental History**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 3
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.
  4. Select a topic for your web resource assignment and prepare an e-mail or memo to the instructor notifying him of your selection.

## Week 3.

### Session I. Science, Systems, Matter and Energy

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 4
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### Session II. Ecosystems: Components, Energy Flow, and Matter Cycling

- A. Instructor will distribute list of web resource topics being researched.
- B. Environmental news presentations
- C. Lecture/Discussion of course reading
- D. Homework
  1. Prior to the next class, read Miller, Chapter 5
  2. Prior to the next class, please take look at several web sites that discuss an apparent controversy: "Second thoughts about peppered moths" (Wells, 1999) at [http://www.arn.org/docs/wells/jw\\_pepmoth.htm](http://www.arn.org/docs/wells/jw_pepmoth.htm), "Goodbye, peppered moths" (Wieland, 1999) at <http://www.answersingenesis.org/docs/4105.asp>, "The peppered moth—An update (Miller, 1999) at <http://www.millerandlevine.com/km/evol/Moths/moths.html>, "Charges of fraud misleading" (Grant, 2000) at <http://www.pratttribune.com/archives/index.inn?loc=detail&doc=/2000/December/13-653-news92.txt>, and "Icons of evolution? Why much of what Jonathan Wells writes about evolution is wrong" (Gishlick, n.d.) at <http://www.ncseweb.org/icons/icon6moths.html>.
  3. Continue journal writing
  4. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## Week 4.

### Session I. Biodiversity, Niches, and Adaptation

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 6
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### Session II. Biogeography

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 7

2. Continue journal writing
3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 5.**

### **Session I. Aquatic Ecology**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 8
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Community Ecology**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 9
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 6.**

### **Session I. Population Dynamics, Carrying Capacity, and Conservation Biology**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 10 (the chapter introduction and Sections 10-1 through 10-4 only), and Smith, Chapter 2 and Table 2 (see <http://svit.org/faculty/tsmith/thesis/>)
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Geologic Processes and Hazards I**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Section 13-8 (in Chapter 13) and Smith, Chapter 3 (the first two subsections only) and Chapter 4
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

4. Complete your list of web resources, make copies for your fellow learners and the instructor, (or post it to a web site and share the URL), for distribution during the next class.

## **Week 7.**

### **Session I. Geologic Processes and Hazards II**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Distribute your list of web resources to fellow learners and the instructor.
- D. Homework
  1. Prior to the next class, read Miller, Chapter 10 (Section 10-5 to end of chapter)
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Soils**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 11
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 8.**

### **Session I. The Human Population**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 12
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Food Resources**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  1. Prior to the next class, read Miller, Chapter 13 (skip 13-8, read previously)
  2. Continue journal writing
  3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Week 9.****Session I. Midterm exam****Session II. Water Resources**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 14
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Week 10.****Session I. Nonrenewable Mineral and Energy Resources**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 15
  - 2. Continue journal writing
  - 3. Turn in your journals for review by the instructor
  - 4. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Session II. Energy Efficiency and Renewable Energy**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 16
  - 2. Pick up your journal from the instructor
  - 3. Continue journal writing
  - 4. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Week 11.****Session I. Risk, Toxicology, and Human Health**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 17
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Session II. Air and Air Pollution**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 18
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Week 12.****Session I. Climate Change and Ozone Loss**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 19
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

**Session II. Water Pollution**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 20
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.
  - 4. Remember that your five-page paper is due next week.

**Week 13.****Session I. Pesticides and Pest Control**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 21
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.
  - 4. Remember that your five-page paper is due next class.

**Session II. Solid and Hazardous Waste**

- A. Turn in your five-page papers.
- B. Environmental news presentations

- C. Lecture/Discussion of course reading
- D. Homework
  - 1. Prior to the next class, read Miller, Chapters 22 and 23
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 14.**

### **Session I. Sustaining Wild Species and Terrestrial Diversity**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 24
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Sustaining Aquatic Diversity**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 25
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 15.**

### **Session I. Class Session 1 Sustaining Cities**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 26
  - 2. Continue journal writing
  - 3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Class Session 2 Economics, Environment, and Sustainability**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Homework
  - 1. Prior to the next class, read Miller, Chapter 27
  - 2. Continue journal writing; be sure to bring it to the next class

3. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

## **Week 16.**

### **Session I. Class Session 1 Politics, Environment, and Sustainability**

- A. Environmental news presentations
- B. Lecture/Discussion of course reading
- C. Getting ready for the Final Exam, Part 1
  1. What to expect
  2. Ask questions that you have about the exam, course content, etc.
- D. Homework
  1. Prior to the next class, read Miller, Chapter 28
  2. Turn in your journals for review by the instructor
  3. Turn in your personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs.
  4. Find one current news article about an environmental issue, bring it to class, and be prepared to summarize it.

### **Session II. Class Session 2 Environmental Worldviews, Ethics, and Sustainability**

- A. Journals and personal statements will be returned so you may consult them during exam preparation
- B. Lecture/Discussion of course reading
- C. Getting ready for the Final Exam, Part 2
  1. Ask questions that you have about the exam, course content, etc.

## **Week 17.**

### **Session I. Final Exam**

Appendix 3

Syllabus for the Online Version of the Environmental Science Course

# Science 100—Non-Lab Science (Environmental Science) *Syllabus*

## ***Instructor & Contact Information***

Theodore (Ted) Smith

Phone: 916-726-4961 (call only between 10 AM and 9 PM Pacific time, please)

E-Mail: [tcsmith@calweb.com](mailto:tcsmith@calweb.com) (please include Sci 100 in the subject of your message so I may recognize it as relating to this course; e.g, Sci 100 question, or Sci 100–Question about project proposal).

## ***Learning Objectives***

By completion of this course, the learner will:

1. Understand basic scientific principles and practices and thereby be equipped to begin to discern good science from bad or pseudo science.
2. Be able to cite examples and describe ways that the environment affects mankind and that mankind can affect various parts of the environment.
3. Be able to differentiate and define concepts including adaptation, biodiversity, causes and connections, carrying capacity, chemical change, climate change, community ecology, conservation, cultural change, cumulative impact, ecosystems, energy, geologic processes, geologic hazards, global change, hazardous waste, local variability, matter and energy laws, measurement (accuracy, precision, and error), models, niches, physical change, pollution (of air, water, and soil), pollution control, population dynamics, probability, resources (food, water, minerals, and energy), risk, soil conservation, soil formation, systems, sustainability, and urbanization.
4. Describe and discuss some relationships between economics, market forces, laws, regulations, policy, various worldviews, and the environment.
5. Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. Be able to develop a list of principles, concepts, and rules to serve as guidelines in making decisions and continually evaluate and modify this list on the basis of experience.
6. Be able to interact with reading material, instructors, fellow learners, and others in ways that sharpen critical thinking skills.

## ***Required Textbooks***

Miller, G. Tyler. (2002). *Living in the environment—principles, connections, and solutions* (12<sup>th</sup> ed.). Belmont, CA: Brooks/Cole. (\$106.95 from Amazon.com; \$58 to \$63 [new] from various Amazon merchants such as Scholars Depot, Super Book Deals, etc.). *Note: I highly recommend that you purchase this textbook with the standard 4-month subscription to InfoTrac® (often included free with new textbooks), especially if you have a computer and access to the Internet.*

*Doing so will make it possible for you to (1) read some assigned papers online without having to visit a library and also (2) quickly find and read material to cite in your own required research papers. However, because you will only have four months of access, don't access InfoTrac until AFTER the instructor tells you to do so.*

Lee, Jeffrey A. (2000). *The scientific endeavor—A primer on scientific principles and practice*. San Francisco: Benjamin/Cummings. (Typically costs \$34 to \$36 [new]; used copies are available from Amazon merchants and elsewhere).

## **Assignment Suite**

1. Read the university's policy regarding cheating and plagiarism. This policy will be enforced in this class.
2. Complete assigned reading **each week**.
3. **Actively participate** in discussions and learning activities.
4. **Each week**, find a current news article (from a newspaper, magazine, or web site) related to environmental science. Prepare a 200-word summary of the article. Focus your summary on the environmental issue, what controversy exists, who the affected parties are or would be, and how their views differ. If noted in the article, what steps are planned to resolve any differences of opinions. Finally, how might you personally be affected by the outcome? [Your summary can be as simple as one or two sentences about each of these questions.]
5. Keep a journal that documents your learning. At least **once or twice each week**, identify something that you learned about environmental science and reflect on how it affects you, someone you know, and/or your community. By the end of this course, your journal must include a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs (see Learning Objective 5 above). Your instructor will review your journal at least three times during the course.
6. You must complete **two projects** during this course. Choose any two of the following:
  - a. Select an environmental controversy (either ongoing or historical) and write a 5-page paper (1500 words minimum) about it. What is (or was) the issue/controversy? Who are (or were) the parties involved? How do (or did) their views differ? Who would be (or was) affected by the outcome? Etc. Cite your references.
  - b. Prepare a 5-page paper (1500 words minimum) about a historical environmental scientist. Who were they? What did they study? What was their worldview? What did they contribute to the understanding of environmental science? Etc. Cite your references.
  - c. Develop an annotated list of web sites that address a **specific environmental science theme**. Your list should be 3 to 5 pages long and list at least 15 sites.
  - d. Participate in (or develop and complete) an environmental project (e.g., a creek or beach clean-up effort, a restoration project) and write a paper summarizing the experience. The project may be a group activity involving fellow learners, but each learner must write their own 3-page (900 words) summary paper. This project must

be completed during the current term, must be pre-approved by the instructor, and must be submitted with appropriate documentation.

## **Grading**

### **Relative Weights for Assignments, Quizzes, and Tests**

Item	Percent of Grade
Online participation	25%
Environmental science news summaries	10%
Environmental science journal	15%
Paper/Project #1	15%
Paper/Project #2	15%
Quizzes	10%
Final exam	10%
<b>TOTAL</b>	<b>100%</b>

### **Written projects should meet the following criteria.**

All papers should be typed, double-space, using 12-point Times New Roman or Courier font. References cited should be single-spaced with a double-space between entries. Your reference list should only include those papers that you cite in your paper [I don't want a list of everything you consulted during your research]. Ideally the papers should follow Publication Manual of the American Psychological Association guidelines, but papers that follow other guidelines (e.g., of another professional society) will be accepted. If you don't have the APA manual, see <http://www.apastyle.org/faqs.html> for answers to frequent questions, tips, and other suggestions.

#### Research Papers (5a, 5b, and 5c)

Papers will be graded according to how well they

1. Represent original choice/aspect of topic within the scope of this course
2. Provide clear, detailed, logical explanation
3. Identify clear, analytical and sophisticated treatment of topic
4. Use appropriate/consistent citation structure and organized format
5. Use correct use of spelling, grammar, punctuation
6. Meet minimum length requirements (including bibliography)

#### Environmental Project

1. Represent original choice/aspect of topic within the scope of this course
2. Provide clear, detailed explanation of the purpose and, if pertinent, approach to project design/development

3. Document completion of project/demonstration within project parameters
4. Use appropriate/consistent citation structure and organized format
5. Use correct use of spelling, grammar, punctuation
6. Meet minimum length requirements
7. Note: Content may be presented via traditional print medium, or via an alternative medium, such as html/web page, PowerPoint, etc. If you have questions, be sure to ask your instructor.

### ***Online Participation Grading Rubric***

**For initial posts:**

<b>A</b>	<b>B</b>	<b>C</b>	<b>F</b>
1. The response is at least 250 words in length.	1. The response is 200 to 250 words in length.	1. The response is 100 to 200 words in length.	1. The response is less than 100 words in length.
2. The response is substantive and related to key principles; there are no misconceptions.	2. The response is substantive, but a few key principles may be omitted. There may be some misconceptions.	2. The response mentions some key principles, but there are significant misconceptions or omissions.	2. There are no references to key principles; if key principles are mentioned, there is no evidence that the learner understood the principles.
3. The response is clear, concise, and easy to understand. Terminology is used appropriately and the response is logically organized.	3. The response is adequately written, but it may contain some organization problems or a few inappropriately used terms.	3. The response is poorly written; one may comprehend the learner's ideas only after repeated readings.	3. The response is poorly written; one cannot comprehend the learner's ideas after repeated readings.
4. The response is submitted on or before the due date.	4. Not applicable.	4. The response was submitted after the due date.	4. No response was submitted.

**For responses to other students:**

A	B	C	F
1. The response is substantively related to the course content; key principles are presented, clearly understood, and well integrated in the response.	1. The response is largely related to the course content; most of the key principles are presented and understood; most of the principles are integrated in the response.	1. The response presents a few principles from the course content; they may be poorly integrated in the response or there may be little evidence that they are understood.	1. The response contains no reference to key principles; if key principles are present, there is no evidence that the learner understood the principles or integrated them in the response.
2. The response addresses the ideas and concerns of the other learner.	2. The response largely addresses the ideas and concerns of the other learner.	2. The response addresses a few of the ideas and concerns of the other learner.	2. The response does not address any ideas or concerns of the other learner.
3. The response is characterized by three or four of the following criteria: <ul style="list-style-type: none"> <li>- Thought-provoking</li> <li>- Supportive</li> <li>- Challenging</li> <li>- Reflective</li> </ul>	3. The response is characterized by two of the following criteria: <ul style="list-style-type: none"> <li>- Thought-provoking</li> <li>- Supportive</li> <li>- Challenging</li> <li>- Reflective</li> </ul>	3. The response is characterized by one of the following criteria: <ul style="list-style-type: none"> <li>- Thought-provoking</li> <li>- Supportive</li> <li>- Challenging</li> <li>- Reflective</li> </ul>	3. The response does not include any of the following criteria: <ul style="list-style-type: none"> <li>- Thought-provoking</li> <li>- Supportive</li> <li>- Challenging</li> <li>- Reflective</li> </ul>
4. The response is clear, concise, and easy to understand. Terminology is used appropriately and the response is logically organized.	4. The response is adequately written, but it may contain some organization problems or a few inappropriately used terms.	4. The response is poorly written; one may comprehend the learner's ideas only after repeated readings.	4. The response is poorly written; one cannot comprehend the learner's ideas after repeated readings.
5. Both responses are submitted on or before the due date.	5. One of the responses is submitted on or before and one after the due date.	5. (a) Both responses are submitted after the due date; or, (b) only one response is submitted before or on the due date.	5. (a) No responses are submitted; or, (b) only one response is submitted after the due date.

Appendix 4

Schedule for the Online Version of the Environmental Science Course

## Science 100—Non-Lab Science (Environmental Science) Course Schedule

### Week 1. Introduction and Science Basics

- A. Format, course requirements, and expectations
1. My goal is to help you learn, not to trick you or trip you up. I don't teach by setting up traps for you to stumble into.
  2. Online discussions and assigned activities will supplement and expand upon the readings. If you are not sure that you understand a concept or example, please raise it for discussion.
  3. **Please complete the assigned reading weekly.**
  4. Please observe proper *netiquette*. See the university guidelines for online behavior [[click here](#)].
  5. **Please adhere to the following schedule.** Most assignments will be posted on Friday of each week. You may begin posting your initial responses once the assignments have been posted. All initial responses must be posted by the second Sunday thereafter. This gives you nine (9) days to complete the reading and the assignments for the week. Responses to posts made by other learners must be made within two weeks of the assignment. The weekly unit will be closed on the third Sunday (16 days) following the start of any given assignment.
  6. There will be one online quiz each week. The quizzes may cover material (1) in the assigned reading and (2) discussed during the previous week.
  7. There will be one examination—a final exam—at the conclusion of this course.
  8. Each learner also will complete the following projects:
    - a. A journal containing at least two entries each week. In this journal, you will record and reflect on something that you learned and that is related to the course. [The instructor will review your journal during Week 4, Week 10, and Week 16.]
    - b. Collect sixteen (14) current news articles (about one per week) that pertain to environmental science issues covered in this course. Be prepared to briefly (e.g., in 200-250 words) describe the article and identify one or two environmental issues or questions.
    - c. A collection of web resources that address an environmental issue and/or role and accomplishments of a historical figure. [Due Week 7.]
    - d. Either:
      - (1) A 5-page report (about 1,500 words) on an environmental issue and/or role and accomplishments of a historical figure. This **MUST NOT** be the same issue and/or historical figure addressed in (c); however, you **MAY** use the resources that one or more of your colleagues gathered as starting points for your research. [Due Week 13.]  
Or,
      - (2) Participate in (or develop and complete) an environmental project (e.g., a creek or beach clean-up effort, a restoration project) and write a paper summarizing the experience. The project may be a group activity involving fellow learners, but each learner must write their own 3-page (900 words) summary paper. This project must be completed during the current term, must be pre-approved by the instructor, and must be submitted with appropriate documentation.
    - e. Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. [Due Week 16.]

**B. Assignments:**

1. If this is your first online class at Patten University, please review the Online Classroom Navigation Guide. It provides an overview of the online classroom
2. Please visit the Personal Profiles area and update your profile.
3. Read the instructor's introductory text regarding **Science and Religion**.
4. Read the sample environmental news article presentation
5. Read the sample personal journal entry
6. Read pp. iii-vi in Miller; review the contents (pp. x-xx) and compare to this Course Schedule.
7. Read Lee, Chapters 1-5.
8. Begin journal writing.
9. Begin searching for a current news article about an environmental issue and be prepared to summarize and discuss it next week.

**10. Post responses to the following:**

- a. Week 1, Discussion 1: Please share some information about yourself. For example, what is your major and year in school? Have you previously completed any online courses? Feel free to tell us about family, work, or other personal interests.
  - b. Week 1, Discussion 2: Lee (Chapter 2) contains several italicized words and phrases. Select one word or phrase, define it, and discuss what it means and/or its significance.
  - c. Week 1, Discussion 3: Lee (Chapters 4 and 5) describes how science operates (or is supposed to operate). At the close of each chapter are several questions. Pick a question from the following list and post an answer: Questions 2 or 4 on pp. 64-65, or questions 1, 2, 3, 4, 5, 6, 7 or 9 on pp. 80-81.
  - d. Week 1, Discussion 4: Please review the syllabus (including the grading rubric) and course schedule. After doing so, please ask any questions that you have and/or post a message that affirms you understand the course requirements.
  - e. Questions for Ted: If you have any questions for me regarding the Science and Religion reading (or any other topic), please post them here.
  - f. Virtual Lounge: Feel free to "chat" with your colleagues here.
11. Select two posts made by fellow learners (see 8 above) and post substantive comments.

**Week 2. Science, Skepticism, and Environmental Issues****A. Assignments:**

1. Read Lee, Chapters 6-9, and Miller, Chapters 1 and 2
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue journal writing
4. Keep monitoring the news for articles about environmental issues.

**B. Post responses to the following:**

1. Week 2, Discussion 1: Reflect on Lee's writings about critical thinking, pseudoscience, skeptical attitude, and the scientific process. Think about the presentations (meaning books, articles, television or radio programs, speeches, sermons, etc.) that you routinely read, see, or hear. How often do the presenters speak from one particular worldview? Do they tend to present only part of the facts? Do they address contrary evidence and, if so, is their assessment objective

or one-sided? Although their conclusions might be correct, what might you do to increase your confidence or enable you to judge for yourself? Post your thoughts.

2. Week 2, Discussion 3: What stood out to you in Miller, Chapters 1 and 2? Was any information contained therein a surprise?
3. After reading Chapters 1 and 2, what worldview do you think Miller holds? Given what you read in Lee, what might you do as the course progresses to assure that Miller is presenting information objectively?
4. Select two posts made by fellow learners in Week 2 Discussions 1, 2, or 3, and post substantive comments.
5. Week 2, Discussion 4: Please share your proposed environmental issue or historical figure that will be the focus of your collection of web resources. In this assignment, due Week 7, you must develop an annotated list of 15 or more web sites that address a specific environmental science theme or historical figure.
6. Week 2, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article. Comment on or ask questions about one or more summaries made by other learners.
7. Questions for Ted: If you have questions for me about this course, please post them here.
8. Virtual Lounge: Feel free to "chat" with your colleagues here.

### **Week 3. Science, Systems, Matter and Energy, and Ecosystems**

#### A. Assignments:

1. Read Miller, Chapters 3 and 4. Chapter 4 describes all sorts of systems, connections, organisms, terms, etc. Don't get too bogged down in detailed terminology. It's more important that you begin to see the various links between plants, animals, atmosphere, sunlight, earth, water, etc., and how they interact and influence one another. However, see Discussion 3 for several terms that you should begin to master.
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue journal writing
4. Continue working on your compilation of environmental issue/figure-related web resources
5. Keep monitoring the news for articles about environmental issues.

#### B. Post responses to the following:

1. Week 3, Discussion 1: The concept of a system is important in science. Pick a system or system-like object (something that functions like a system). Briefly describe the components, inputs, outputs, and feedback loops. Diagrams (e.g., like Figure 3-4 on p. 51) or cartoons are acceptable.
2. Week 3, Discussion 2: Heinz-Fry (p. 48-49) describes critical thinking and asks what percentage of your learning involves rote learning and what percentage involves critical thinking. Let's take this one step further. Are there times when do you personally and fairly consistently tend to use rote thinking? Critical thinking?
3. Week 3, Discussion 3: Pick one of the following terms, define it, and post your definition: biodiversity, biogeochemical cycles, biomass, biome, carbon cycle, ecology, ecosystem, ecotone, food chain, greenhouse effect, hydrologic cycle, limiting factor, nitrogen cycle, phosphorous cycle, population, pyramid of energy flow, range of tolerance, sulfur cycle, sustainability, systems analysis.

4. Select two posts made by fellow learners in Week 3 Discussions 1, 2, or 3 and post substantive comments.
5. Week 3, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 4. Biodiversity, Niches, Adaptation, and Biogeography**

### A. Assignments:

1. Read Miller, Chapters 5 and 6
2. Please take look at several web sites that discuss an apparent controversy: "Second thoughts about peppered moths" (Wells, 1999) at [http://www.arn.org/docs/wells/jw\\_pepmoth.htm](http://www.arn.org/docs/wells/jw_pepmoth.htm), "Goodbye, peppered moths" (Wieland, 1999) at <http://www.answersingenesis.org/docs/4105.asp>, "The peppered moth—An update (Miller, 1999) at <http://www.millerandlevine.com/km/evol/Moths/moths.html>, "Charges of fraud misleading" (Grant, 2000) at <http://www.pratttribune.com/archives/index.inn?loc=detail&doc=/2000/December/13-653-news92.txt>, and "Icons of evolution? Why much of what Jonathan Wells writes about evolution is wrong" (Gishlick, n.d.) at <http://www.ncseweb.org/icons/icon6moths.html>.
3. Complete the weekly quiz (click here for quiz)
4. Continue working on your compilation of environmental issue/figure-related web resources
5. Continue journal writing; e-mail a copy of your journal to the instructor for review and constructive comment.
6. Keep monitoring the news for articles about environmental issues.

### B. Post responses to the following:

1. Week 4, Discussion 1: Decades after the first patterned moth-related experiments, debate continues. What, if anything, struck you about the five web-based contributions? What questions did the differing views presented in these articles generate in your mind?
2. Week 4, Discussion 2: After reading the first six chapters of Miller, do you agree or disagree with John Muir? According to Miller, Muir said "When we try to pick out anything by itself, we find it hitched to everything else in the universe" (p. 149). Why?
3. Week 4, Discussion 3: This week's reading included a chapter on evolution and articles that touch on the evolution-creation debate. An exploration of this controversy would easily take an entire semester and is beyond the scope of this course. However, if you would like to pose questions or discuss various viewpoints related to the debate, please do so here.
4. Select two posts made by fellow learners in Week 4 Discussions 1, 2, or 3 and post substantive comments.
5. Week 4, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 5. Aquatic and Community Ecology**

### A. Assignments:

1. Read Miller, Chapters 7 and 8
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure-related web resources
4. Continue journal writing
5. Keep monitoring the news for articles about environmental issues.

### B. Post responses to the following:

1. Week 5, Discussion 1:
2. Week 5, Discussion 2:
3. Week 5, Discussion 3:
4. Select two posts made by fellow learners in Week 5 Discussions 1, 2, or 3 and post substantive comments.
5. Week 5, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 6. Population Dynamics, Conservation Biology, and Human Population**

1. Read Miller, Chapters 9 and 11
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure-related web resources
4. Continue journal writing
5. Keep monitoring the news for articles about environmental issues.

### B. Post responses to the following:

1. Week 6, Discussion 1:
2. Week 6, Discussion 2:
3. Week 6, Discussion 3:
4. Select two posts made by fellow learners in Week 6 Discussions 1, 2, or 3 and post substantive comments.
5. Week 6, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 7. Geologic Hazards**

### A. Assignments:

1. Read Miller, Chapter 10 (the chapter introduction and Sections 10-1 through 10-4 only)

2. Read Smith, Chapters 2, (the first two subsections only), 4, and Table 2 (see <http://svit.org/faculty/tsmith/thesis/>)
  3. Complete the weekly quiz (click here for quiz)
  4. Continue journal writing
  5. Keep monitoring the news for articles about environmental issues.
- B. Post responses to the following:
1. Week 7, Discussion 1:
  2. Week 7, Discussion 2:
  3. Week 7, Discussion 3:
  4. Week 7, Discussion 4: Post your compilation of environmental issue/figure-related resources
  5. Select two posts made by fellow learners in Week 7 Discussions 1, 2, or 3 and post substantive comments.
  6. Week 7, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
  7. Questions for Ted: If you have questions for me about this course, please post them here.
  8. Virtual Lounge: Feel free to "chat" with your colleagues here.

## Week 8. Soils and Food Resources

- A. Assignments:
1. Read Miller, Chapters 10 (Section 10-5 to end of chapter) and 12
  2. Complete the weekly quiz (click here for quiz)
  3. Continue journal writing
  4. Keep monitoring the news for articles about environmental issues.
- B. Post responses to the following:
1. Week 8, Discussion 1:
  2. Week 8, Discussion 2:
  3. Week 8, Discussion 3:
  4. Select two posts made by fellow learners in Week 8 Discussions 1, 2, or 3 and post substantive comments.
  5. Week 8, Discussion 4: Here's a reminder regarding a required assignment. By week 17 you must either:
    - a. Complete a 5-page report (about 1,500 words) on an environmental issue and/or role and accomplishments of a historical figure. This **MUST NOT** be the same issue and/or historical figure addressed in (c); however, you **MAY** use the resources that one or more of your colleagues gathered as starting points for your research. [Due Week 13.] Or,
    - b. Participate in (or develop and complete) an environmental project (e.g., a creek or beach clean-up effort, a restoration project) and write a paper summarizing the experience. The project may be a group activity involving fellow learners, but each learner must write their own 3-page (900 words) summary paper. This project must be completed during the current term, must be pre-approved by the instructor, and must be submitted with appropriate documentation.

If you have not already done so, please indicate which option you will complete and what the topic of your paper will be or cite the environmental project that you plan to participate in. Post that information here.

6. Week 8, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
7. Questions for Ted: If you have questions for me about this course, please post them here.
8. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 9. Food and Water Resources**

### **A. Assignments**

1. Read Miller, Chapters 12 and 13
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]
4. Continue journal writing
5. Keep monitoring the news for articles about environmental issues.

### **B. Post responses to the following:**

1. Week 9, Discussion 1:
2. Week 9, Discussion 2:
3. Week 9, Discussion 3:
4. Select two posts made by fellow learners in Week 9 Discussions 1, 2, or 3 and post substantive comments.
5. Week 9, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 10. Minerals and Energy**

### **A. Assignments**

1. Read Miller, Chapters 14 and 15
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]
4. Continue journal writing; e-mail a copy of your journal to the instructor for review and constructive comment.
5. Keep monitoring the news for articles about environmental issues.

## B. Post responses to the following:

1. Week 10, Discussion 1:
2. Week 10, Discussion 2:
3. Week 10, Discussion 3:
4. Select two posts made by fellow learners in Week 10 Discussions 1, 2, or 3 and post substantive comments.
5. Week 10, Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

**Week 11. Risk, Toxicology, Human Health, and Our Air**

## A. Assignments

1. Read Miller, Chapters 16 and 17
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]
4. Continue journal writing
5. Keep monitoring the news for articles about environmental issues.

## B. Post responses to the following:

1. Week 11 Discussion 1:
2. Week 11 Discussion 2:
3. Week 11 Discussion 3:
4. Select two posts made by fellow learners in Week 11 Discussions 1, 2, or 3 and post substantive comments.
5. Week 11 Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

**Week 12. Climate Change and Water Pollution**

## A. Assignments:

1. Read Miller, Chapters 18 and 19
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]

4. Continue journal writing
  5. Keep monitoring the news for articles about environmental issues.
- B. Post responses to the following:
1. Week 12 Discussion 1:
  2. Week 12 Discussion 2:
  3. Week 12 Discussion 3:
  4. Select two posts made by fellow learners in Week 12 Discussions 1, 2, or 3 and post substantive comments.
  5. Week 12 Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
  6. Questions for Ted: If you have questions for me about this course, please post them here.
  7. Virtual Lounge: Feel free to "chat" with your colleagues here.

### Week 13. Pesticides and Waste

- A. Assignments:
1. Read Miller, Chapters 20 and 21
  2. Complete the weekly quiz ([click here for quiz](#))
  3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]
  4. Continue journal writing
  5. Keep monitoring the news for articles about environmental issues.
  6. **NOTE:** Next week we'll divide into three teams. Take a quick look at Chapters 22, 23, 24, and 25. Next week you'll be assigned **ONE** of these chapters to read and discuss with your team members. If you want to volunteer for a particular chapter, please **send me an E-MAIL** message and state your preference(s). I'll try to accommodate as many of you as possible.
- B. Post responses to the following:
1. Week 13 Discussion 1:
  2. Week 13 Discussion 2:
  3. Week 13 Discussion 3:
  4. Select two posts made by fellow learners in Week 13 Discussions 1, 2, or 3 and post substantive comments.
  5. Week 13 Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
  6. Questions for Ted: If you have questions for me about this course, please post them here.
  7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## Week 14. Biodiversity, Land Use, Conservation, and Sustainable Development

### A. Assignments:

1. This week we're going to try a team (jigsaw) approach to learning. First, I've divided you into four teams. Each team will be responsible for reading one chapter, posting a summary (in one or more messages) and discussing relevant issues and perspectives. How you accomplish this team assignment is entirely up to you.

During the first nine days, post only in your assigned team area. However, please do read the posts that other teams make. During the subsequent seven days you may pose a question or post comments in other team areas.

- a. Team 22: For team discussion of Chapter 22—Sustaining Wild Species
  - b. Team 23: For team discussion of Chapter 23—Sustaining Terrestrial Biodiversity
  - c. Team 24: For team discussion of Chapter 24—Sustaining Aquatic Biodiversity
  - d. Team 25: For team discussion of Chapter 25—Sustainable Cities
2. There's no quiz this week.
  3. No environmental news posts are required this week.
  4. Questions for Ted: If you have questions for me about this course, please post them here.
  5. Virtual Lounge: Feel free to "chat" with your colleagues here.

### B. Please use following areas for your team discussions:

1. Week 15 Team 22 Discussion Area:
2. Week 15 Team 23 Discussion Area:
3. Week 15 Team 24 Discussion Area:
4. Week 15 Team 25 Discussion Area:

## Week 15. Economics, Environment, Sustainability, and Politics

### A. Assignments

1. Read Miller, Chapters 26 and 27
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]
4. E-mail a copy of your journal to the instructor for final review.
5. Keep monitoring the news for articles about environmental issues.

### B. Post responses to the following:

1. Week 15 Discussion 1:
2. Week 15 Discussion 2:
3. Week 15 Discussion 3: The Final Exam approaches . . . Make sure that you have completed the reading, participated in the online discussions, and completed all of the online quizzes. Most (80 percent or more) of the exam questions will be repeats of the quiz questions, perhaps with some slight rewording. If you have questions about the exam or any information presented thus far in the course, feel free to ask for help here.

4. Select two posts made by fellow learners in Week 15 Discussions 1, 2, or 3 and post substantive comments.
5. Week 15 Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
6. Questions for Ted: If you have questions for me about this course, please post them here.
7. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 16. Environmental Worldviews, Ethics, and Sustainability**

### A. Assignments:

1. Read Miller, Chapter 28
2. Complete the weekly quiz ([click here for quiz](#))
3. Continue working on your compilation of environmental issue/figure paper or project. You may submit the completed paper and/or documentation at any time prior to the Final Exam. [Papers may be submitted via e-mail or snail mail; documentation of project participation should be submitted via snail mail.]

### B. Post responses to the following:

1. Week 16 Discussion 1:
2. Week 16 Discussion 2:
3. Week 16 Discussion 3: Develop a personal statement regarding the relationship among environmental ethics, personal and local needs, and global needs. Share your draft here for others to read and offer suggestions or comments. Finalize your draft and e-mail it to the instructor by [the second Sunday following—instructor specify date].
4. Week 16 Discussion 4: The Final Exam approaches . . . Make sure that you have completed the reading, participated in the online discussions, and completed all of the online quizzes. Most (80 percent or more) of the exam questions will be repeats of the quiz questions, perhaps with some slight rewording. If you have questions about the exam or any information presented thus far in the course, feel free to ask for help here.
5. Select two posts made by fellow learners in Week 16 Discussions 1, 2, or 3 and post substantive comments.
6. Week 16 Environmental News and Views: Briefly (e.g., in 200-250 words) summarize a recent news article that describes an environmental issue of local, regional, national, or international importance. Identify one or two environmental issues, questions, and or views addressed in or implied by the article.
7. Questions for Ted: If you have questions for me about this course, please post them here.
8. Virtual Lounge: Feel free to "chat" with your colleagues here.

## **Week 17. Final Exam and Assignments Due**

- A. Submit all papers and assignments on or before [specify date]. These items may be e-mailed or snail-mailed to the instructor.
- B. Complete the final examination on or before [specify date].
  1. Your final examination may be completed online or at a proctored site. Once you begin your exam, you cannot quit and complete it at a later time. You will have two hours to complete the exam. During the exam, you may consult your notes, journal, or textbooks.

## Appendix 5

## Draft of Initial Face to Face Lecture

The following lecture will be presented after introductions and a discussion of course objectives, expectations, assignment suites, grading rubrics, and the course schedule.

*Science*

What is *science*? When I say the word *science*, what images do you think of? The space shuttle? Men in white lab coats? Beakers? Chemicals? Microscopes and telescopes? What do you think scientists do?

Science is a collection of methods to acquire reliable *but not infallible* knowledge about our physical world and the forces and processes that affect it. Science is a way of learning about things; it is a process we use to improve our understanding of the universe and all that is in it.

Science is a systematic approach where understanding and knowledge is gained through study, research, and observation. Other approaches to gaining knowledge and understanding include the humanities (e.g., art and human affairs), mathematics (which some people consider a science), logic, and belief fields. Math and logic are closely related to science and are, in fact, used in science; however, math and logic also have been used to describe situations that do not physically exist. The belief fields include religion, ethics, morality, and political ideology.

This course focuses on science. By doing so I do not mean to imply that science is necessarily a better way of investigating things and acquiring knowledge or that other approaches are inferior. [In fact, most scientists believe that science currently has no way of reliably testing, investigating, or evaluating certain concepts (e.g., artistic beauty, ethical behavior, morality, and good and evil) and the spiritual realm (e.g., angels, God, satan, and

ghosts).] However, sometimes science can assist in these other disciplines. For example, science can be used to restore a medieval stained glass window or improve the acoustics of a music hall. Science also can be used to date and/or compare the composition of ancient artifacts that might be of religious importance. Similarly, the Old Testament—a religious text—is a useful source of information about Middle Eastern archaeology and environmental history.

By focusing on environmental science, we can examine issues that impact our daily lives. We will examine not only the methods used and findings of scientists, but the logic behind the science. At times we also will consider issues such as bias, ethics, morality, politics, economics, cultural attitudes, and differing worldviews, how those issues have impacted and influenced science, and how scientific information has been used and misused.

*Scientific statements* are attempts to describe or explain real phenomena. Some statements are more reliable and some more specific than others. Sample scientific statements include:

- A.  $F = MA$  (force = mass times acceleration)
- B. Antibiotics are effective at fighting infections.
- C. Americans tend to vote in an attempt to improve their economic condition.

Scientists approach their work with the understanding that there are no "absolute truths," that any given scientific statement might be wrong, and that probability is important. For a statement to be scientific, it must be testable. Examine the following sentences. Which are testable?

- A. The sun will rise tomorrow.
- B. It will rain tomorrow.
- C. A parrot is prettier than a snake.

- D. A hummingbird eats more food in one day than an ant does.
- E. All dogs eat cats.

Statements A, B, D, and E are testable. For D, one can measure the amount of food eaten by a hummingbird and an ant in a day and compare the results. For A and B, we can simply wait until tomorrow and observe what happens to determine whether the statements are true. For E, if we can find one dog that never ate a cat, then we can disprove the statement (but it's still a scientific statement because it's testable—this one just happens to be false). But what about C? *Prettier* is an aesthetic value judgment and, as such, is beyond the scope of science. If we had instead said "More people believe that a parrot is prettier than a snake," would that have made it a scientific statement? Why or why not?

Scientific statements must not only be testable, but the tests must be *reproducible*. Scientists who conduct experiments must document what they did, what the environmental conditions were at the time, and what happened as the experiment proceeded. Armed with that data, a second scientist can duplicate the experiment and compare the results. If others cannot get the same result, the first experiment cannot be considered to be a valid scientific experiment. As more scientists duplicate the experiment and obtain similar results, a case can be made that the statement is valid.

Lee (2002) states: *Scientific knowledge* should represent the most accurate view of the real world that is possible. It involves the most complete description of the phenomena we study and the most accurate explanation of why things are the way they are, given our current abilities to investigate. Keep in mind though, that all scientific knowledge may be found to be completely wrong. Science is an ongoing process; there is no end product (p. 14).

The phrase *scientific method* refers to a system in which the likelihood of being incorrect is reduced by methods used by individual scientists, skepticism, and interactions within the scientific community. Scientists work together to help assure that science is done properly.

The best known scientific method is *positivism*, which starts with a scientist thinking about a phenomenon that he or she plans to study. In that thinking process, the scientist develops a *hypothesis*—a possible explanation of how something works. In positivism, hypotheses are tested to find out if they are likely to be correct. Some scientists consider the word *theory* to be synonymous with hypothesis. Some scientists hypothesize for a statement prior to testing and theory for a statement that has been tested. Still other scientists consider that theories should represent logically consistent, clear statements of relationships, and relevant. While some scientists regard theories as *fact*, the truth is that theories are based on current knowledge and can be refined or dismissed as new knowledge is acquired. For example, during the past century technological improvements in microscopes and telescopes have enabled scientists to see increasingly smaller objects and increasingly distant objects and recognize things that were previously undetectable. In some cases, scientists had theorized, based on indirect evidence or mathematical relationships, that these objects existed.

A modification of the positivist approach is *falsification*. No matter how many times a theory passes a test, scientists can never be certain that it will pass all future tests. Falsification essentially is a method wherein a scientist develops a theory and then tries to prove it false. Consider our earlier "All dogs eat cats" statement. Even though we might find 1 million dogs that eat cats, we still could not with absolute certainty prove that all dogs eat cats. However, if we can find one dead dog that never ate a cat, we can disprove the statement. Once a hypothesis is falsified, it is modified and experiments are designed to try to prove the new version false.

After examining the dead dog and determining that it was an unweaned puppy with no teeth, we might modify the statement to "All adult dogs eat cats" and resume testing. Ziman (1984) states, "It is part of the art of scientific investigation not to be daunted by a few negative experimental results, and not to reject hypotheses that seem to have been 'falsified' by a few disconfirmatory instances but which still have a great deal going for them in other ways" (p. 47).

Although a hypothesis can never really be proven beyond a shadow of a doubt, through repeated testing of a hypothesis scientists can gain greater confidence that it reflects reality reasonably well. However, keep in mind that having more confidence is fundamentally different from believing it to be true. When most scientists in a given discipline are convinced that a hypothesis will pass every conceivable test, then it is called a *law* (e.g., the Law of Thermodynamics). Laws are regarded as having an extremely small likelihood of ever being found incorrect. Still, scientists can be wrong. Newton's "laws" of motion were shown to be incorrect when Einstein applied them to predict the motion of astronomical bodies, so Einstein modified them to incorporate his theory of relativity. Laws are quite rare in science and occur mainly in physics and chemistry.

Edward O. Wilson (1998) wrote: Few claims in science . . . are accepted as final. But as evidence upon evidence and theories interlock more firmly, certain bodies of knowledge do gain universal acceptance . . . . [They] ascend a scale of credibility from "interesting" to "suggestive" to "persuasive" and finally "compelling." And given enough time thereafter, "obvious" (p. 59).

Much of the science found in textbooks has been tested over and over and stood the test of time. However, the same cannot be said for *frontier science*—research being conducted on the "cutting edge." Also, one needs to be aware that the results of frontier research are sometimes misrepresented by the press. Thus, a new medical technique that causes some tumors to diminish in

size might be hailed by a reporter as a "cure for cancer." In contrast, scientists may simply regard the technique as "progress" but not a cure.

While scientists usually strive to be *objective* or unbiased, the truth is that our perceptions of the real world is influenced by what we expect to be there, and what we expect is influenced by our past experiences. We scientists often do not record absolutely every aspect of an experiment but focus only on those things that we expect will be significant. In that sense, we make *assumptions*. If, for example, I mix red dye with yellow dye to test whether I get orange dye, I might not measure the temperature of the dye. Similarly if I put a chemical on a weed to test whether it will kill the weed, I might not measure the barometric pressure. In those cases, I assumed that temperature and atmospheric pressure were not important. However, knowing that some chemicals react with water or can be washed away, I might observe whether the weed was wet or dry when I applied the chemical and whether or not it rained during the subsequent couple of days.

In addition to what we can observe, scientists also often rely on *indirect* evidence. For example, if you have a fever and go to the doctor, he will examine you and ask about other symptoms (that you have observed). He'll consider the evidence and either decide to run additional tests or prescribe a treatment based on the most likely cause. Whatever he decides, he has, in essence, developed a hypothesis and is acting on it. He may not be able to see your ulcer, but he (and you) have witnessed the indirect evidence.

### *Science and Religion*

Before I close tonight, I want to raise the topic of the relationship between science and religion. How many of you know that not everyone believes in God, Jesus, and the Holy Spirit? How many of you are aware that some scientists have argued that science proves that there is no

God? How many of you have heard or read that some scientific methods and theories are untrue or bogus because they conflict with some literal interpretations of the Bible?

I raise these questions for two reasons. First, all have happened. Some people are atheists and do not believe in God. Some of these people are scientists and have tried to argue that science proves that there is no God. However, I remind you of two things—first, scientists develop theories and "proof" is almost impossible to come by; even scientific laws—which more widely accepted by scientists than theories—have been modified as new information became available; second, science only deals with observable phenomena—it cannot detect the presence or absence of a spirit being or the human soul.

There are a great many scientists who are Christians, Catholics, Buddhists, Muslim, and so on. I am evangelical Christian. I believe in God, that Jesus is the Son of God, that He died for our sins, and that the Holy Spirit is present here on Earth with us today. There are many scientists who are Christians, as evidenced by the Affiliation of Christian Geologists (<http://www.wheaton.edu/ACG/>), the American Science Affiliation (<http://www.asa3.org/>), Christians in Science (<http://www.cis.org.uk/>), and the Evangelical Environmental Network (<http://www.creationcare.org/>). Just as there are different denominations that hold different religious beliefs and differing interpretations of the Bible, scientists don't always agree with one another about religion and even have differing interpretations of some Bible passages.

I have been a Christian for more than 45 years and a scientist for more than 30 of those years. As others have experienced, there were times in my life when I had doubts whether really God existed. However, I now no longer have doubts even though I also have come to believe scientific theories that some Christian organizations dismiss as false.

As I stated at the start of my lecture, this course focuses on science. The textbook is a science textbook. The author of our textbook has included statements that *most* scientists (probably 90 percent or more) believe to be valid and true, just as have all mainstream science textbooks. As you read the textbook, you may see a few statements that you disagree with, believe to be untrue, or that contradict some people's interpretations of statements found in the Bible. Do NOT let such statements shake your faith. When the time comes, we will briefly discuss those some of those statements, the relevant scientific theories, and some of the evidence. We also will discuss how scientists reconcile their faith with this evidence. I'll also briefly note some individuals and an organization that argues that these scientific findings are wrong, will discuss some reasons behind the conflict, and the nature of the discourse. Remember—this is a science course, intended to teach you about science, scientific methods, how scientists think, and how to properly consider and use scientific information.

Ted Smith

August 2003

## Appendix 6

## Online Reading Assignment: Science and Religion

The text for Week 1 Assignment 3 appears below.

*Science and Religion*

How many of you know that not everyone believes in God, Jesus, and the Holy Spirit?

How many of you are aware that some scientists have argued that science proves that there is no God? How many of you have heard or read that some scientific methods and theories are untrue or bogus because they conflict with some literal interpretations of the Bible?

I raise these questions for two reasons. First, all have happened. Some people are atheists and do not believe in God. Some of these people are scientists and have tried to argue that science proves that there is no God. However, I remind you of two things—first, scientists develop theories and "proof" is almost impossible to come by; even scientific laws—which more widely accepted by scientists than theories—have been modified as new information became available; second, science only deals with observable phenomena—it cannot detect the presence or absence of a spirit being or the human soul.

There are a great many scientists who are Christians, Catholics, Buddhists, Muslim, and so on. I am evangelical Christian. I believe in God, that Jesus is the Son of God, that He died for our sins, and that the Holy Spirit is present here on Earth with us today. There are many scientists who are Christians, as evidenced by the Affiliation of Christian Geologists (<http://www.wheaton.edu/ACG/>), the American Science Affiliation (<http://www.asa3.org/>), Christians in Science (<http://www.cis.org.uk/>), and the Evangelical Environmental Network (<http://www.creationcare.org/>). Just as there are different denominations that hold different

religious beliefs and differing interpretations of the Bible, scientists don't always agree with one another about religion and even have differing interpretations of some Bible passages.

I have been a Christian for more than 45 years and a scientist for more than 30 of those years. As others have experienced, there were times in my life when I had doubts whether really God existed. However, I now no longer have doubts even though I also have come to believe scientific theories that some Christian organizations dismiss as false.

As I stated at the start of my lecture, this course focuses on science. The textbook is a science textbook. The author of our textbook has included statements that most scientists (probably 90 percent or more) believe to be valid and true, just as have all mainstream science textbooks. As you read the textbook, you may see a few statements that you disagree with, believe to be untrue, or that contradict some people's interpretations of statements found in the Bible. Do NOT let such statements shake your faith. When the time comes, we will briefly discuss those some of those statements, the relevant scientific theories, and some of the evidence. We also will discuss how scientists reconcile their faith with this evidence. I'll also briefly note some individuals and an organization that argues that these scientific findings are wrong, will discuss some reasons behind the conflict, and the nature of the discourse. Remember—this is a science course, intended to teach you about science, scientific methods, how scientists think, and how to properly consider and use scientific information.

Ted Smith

August 2003

## Appendix 7

## Online Reading Assignment: Sample Environmental News Summary

The text for Week 1 Assignment 4 appears below.

*Sample Environmental News Article Summary*

Summary: Neighbors of the Lawrence Links golf course bought their homes because of the view, paying several thousand dollars extra for the view. The owner of the course wants to build 347 homes on the site, arguing that the golf course is losing money. Opponents suggest that mismanagement is the cause of the financial losses. Nearby residents also argue that the new housing will increase traffic and crowd schools. Proponents counter that developer fees will pay for improvements to overcome such problems. The city has not rendered a decision.

Analysis: In this case, the developer expects to make money. Nearby residents fear they will be personally impacted by loss of views, increased traffic, crowded schools, and devaluation of their homes. Issues related to the natural environment aren't mentioned in the article.

Reference: Werkman, D. (2003, September 11). Teed off over golf course—Neighbors of Lawrence Links don't want to see houses built there. *Sacramento Bee*. Retrieved September 16, 2003, from [http://www.sacbee.com/content/community\\_news/antelope\\_north\\_sacramento/story/7393434p-8336780c.html](http://www.sacbee.com/content/community_news/antelope_north_sacramento/story/7393434p-8336780c.html).

## Appendix 8

## Online Reading Assignment: Sample Journal Entry

The text for Online Week 1 Assignment 5 appears below. This information also will be distributed to and discussed with face-to-face learners during the first class session.

*Ima Student's Journal*

*September 10, 2003*

Today I read a newspaper article that described how fertile it used to be in much of the Middle East and how irrigation caused the soil to become loaded with so much salt that little would grow there. That fits with what we discussed in Environmental Science a couple of weeks ago. I wonder if California's Imperial Valley will one day look like the Iraqi desert and be just as infertile.

*September 14, 2003*

Today I got in a discussion with Bill about a proposed new highway through Happy Valley. We started listing all the potential benefits that the highway would have. Then we started looking for potential impacts. Wow! It quickly became clear that someone could argue that one of our potential benefits really adversely affected them. Plus we came up with a long list of...