Syllabus for TE 936: Scientific Literacy
Fall, 2016

Instructor: Charles W. (Andy) Anderson
319A Erickson Hall, 517-432-4648
andya@msu.edu

Course Description

Scientific literacy includes the science-related knowledge, practices, language, and values that citizens use in their roles as workers, consumers, family members, and participants in civil society. Thus in focusing on scientific literacy we concentrate on the aspects of science teaching and learning that do *not* involve preparing students for specialized work in the sciences.

In this course we will explore the following questions about scientific literacy through readings, discussions, writing, and projects:

- *Defining scientific literacy:* What do we mean by scientific literacy? How is it evident in people's lives, uses of media, and civic discourse? How is it related to literacy in other disciplines? When are genres such as arguments, explanations, and predictions "scientific?"
- *Debating scientific literacy:* What are alternative visions of literacy in science and other disciplines? How are they evident in individuals, communities, and societies? How are they evident in standards, curricula, and assessments?
- *Developing scientific literacy:* We will discuss the development of scientific literacy both in individuals and in societies:
    - *Development in individuals:* What are the personal, social, and cultural resources that learners bring with them from their homes and communities and the barriers that they must overcome to achieve scientific literacy? How do they need to acquire language, knowledge, and practices from scientific communities and educational institutions?
    - *Development in societies:* How have the knowledge, practices, and values of scientific communities changed over time, and how has our understanding of the value of science to citizens changed in response?
- *Teaching for scientific literacy:* How do current patterns of classroom practice support, or fail to support, development of scientific literacy in diverse learners? What alternative practices are being considered and supported?

In this course we will focus primarily on teaching for scientific literacy through formal science education (in contrast with informal education or learning from experience at home or through institutions such as zoos and museums). We have to remember, though, that science learning is always rooted in people's lives and experiences outside of formal education. Furthermore, a key goal of formal education is *preparation for future learning:* We need to prepare people for lives outside of school, so the connections between learning in school and out will be an issue we discuss in this course. These connections also play a key role for issues of equity and social justice in science education; we need to understand why students' cultures and family backgrounds so often influence their success in achieving scientific literacy, and how we can serve social justice while teaching science.

Scientific literacy is both a goal of practical work—what science educators do from one day to the next in their jobs—and an area of scholarly inquiry. Both of these aspects will be reflected in the course. Parts of the course will be focused on the practical work of teaching and learning: How can you develop goals for science instruction and teaching strategies to accomplish those goals? How can you help others to be successful in these basic tasks? Part of the course will also focus on the roles of scholarship in improving our practical work: How can science education research help us understand, evaluate, and improve science curriculum and instruction?

Finally, this is a course where you will have a chance to meet and talk with science educators, including faculty members here at Michigan State and visitors from other universities. As they talk about their work and their interests, you will be able to learn about the variety of approaches that science educators are taking to issues of science curriculum and instruction.

Assignments and Grading

This course will include two major assignments, one focusing on data analysis and the other on a project of your choice. You will also do a position paper and two short reviews, focusing on practical and scholarly documents of your choice, and you will play a role in leading a class of your choice or hosting a visitor. The key assignments are as follows:

1. *Position paper on scientific literacy* (10% of course grade; draft due September 19; final paper due September 26). This will be a short paper in which you (a) review readings about scientific literacy to identify the aspects of this topic that are most important or salient to you, and (b) suggest questions or issues that you would like to focus on in this course.
2. *Data analysis assignment.* (30% of course grade) There is often a gap in the kinds of writing that graduate students do while they are taking courses: They have many chances to do literature reviews, write proposals, etc., but few chances to actually analyze data. So this assignment is a bit of an experiment. The core of the assignment will be an analysis of data related to analyzing, assessing, or teaching for scientific literacy. We will do this in three steps:
    a. Identifying data sets (and possibly guides and partners): due September 19. You will identify some data that you intend to analyze, along with a guide to the data (if they are not your own data). If you would like to work with a partner on this assignment, that will be a possibility. Here are some possibilities for data to analyze:
        i. Data that you already have available through your participation in a research project or your own work on a practicum or other research project. Criteria for these data include (a) connection to analyzing, assessing, or teaching for scientific literacy, (b) sufficient quantity and quality to support a fruitful analysis, and (c) practicality for a partial analysis that can be completed in six weeks.
        ii. Data available through the *Carbon TIME* project: We'll talk more about this, but this project has several kinds of data that you could be involved in analyzing, including (a) student responses to written assessment items, (b) individual and group interviews with students, (c) videos of classroom teaching, and (d) student classroom work.
    b. Analysis plan: due October 3. You will submit a plan for data analysis that includes:
        i. Rationale and research questions or goals
        ii. Description of data
        iii. Methods for analysis, including evidence for validity and reliability
    c. Analysis report, due October 31. You will report on methods of analysis, patterns you found in the data and your interpretations of those patterns. You will have the option of making a presentation to the class either about your data analysis project at this time or about your final project at the end of the semester
3. *Final assignment* (30% of course grade; proposal due November 7; final assignment due December 15). You will write a scholarly paper on a topic related to the course that includes critical analysis of an issue, using literature from the course and other sources. This will be a two-step process: You will submit a proposal on November 7; after I have critiqued and approved the proposal, the final paper will be due December 15. If you did not make a presentation about your data analysis project, you will make a presentation about your final project on December 5. You will have substantial freedom to define your final project in a way that works for you. Possible types of project include
    a. Following up and extending something you wrote earlier, such as extending your data analysis or developing a short review into a more extensive critical review of a body of work
    b. Proposal for empirical research on scientific literacy or teaching for scientific literacy
    c. Literature review about an issue discussed in the course
    d. Connecting an issue discussed in this course to another domain in science education (e.g., teacher learning, nature of science, research on science learning, social justice in science education).
    e. Developing and annotating an artifact of your own, such as a plan to teach some aspect of scientific literacy with supporting materials

NOTE: If you want, you can do one of the two major assignments with a partner, but not both.

4. *Short reviews* (Each 10% of course grade; due October 17 and November 21). You will write two short reviews evaluating a research article and an artifact of your choice. You should write one review of each of two types:
    a. Review of an artifact, such as a standards document, teaching materials, or a website designed to promote scientific literacy.
    b. Review of a research article or book chapter.
5. *Class participation and leadership* (10% of course grade). You will share in responsibilities for participation and leadership in the class, including the following:
    a. Completing quick responses to readings on the class Google spreadsheet before each class (due by midnight on Saturday).
    b. Leadership in class discussions or hosting a visitor
    c. Sharing either your data analysis or your final project with the class
    d. Participation in class discussions and activities

Tentative Schedule

Date	***Activities***	***Readings***
Part 1: Defining the goal: What is scientific literacy?		
8/31	Introductions Using climate change to define and discuss scientific literacy Course expectations and overview	NY Times Op Ed: Post-truth Politics NRC Science Literacy report: Box 2.2, pp 38-9
9/12	Defining literacy in general and scientific literacy in particular Due this week:* • Complete IRB training: https://train.ora.msu.edu/Saba/Web/Main	Gee (2 articles) Covitt, et al. NRC Science Literacy report: Ch 1 (pp. 22-9) & Ch 2 (pp. 30-42, 49-50)
9/19	Standards and policies focusing on scientific literacy Due this week: • Draft position paper on scientific literacy • Choice of data to analyze (and possibly partner)	Standards and frameworks (NRC Framework, NGSS, Vision and Change, CCSS): Introduction and topic that you are interested in
Part 2: Assessing scientific literacy		
9/26	Assessing scientific literacy: NGSS and validity Co-instructor: Christie Morrison Thomas Due this week: Position paper on scientific literacy	AERA/APA/NCTM Manual Doherty et al validity NRC NGSS assessment report, 20-42
10/3	Assessing scientific literacy: Evaluating items and learning progressions Co-instructor: Olivia Crandell, Joelyn de Lima Due this week: Data analysis plan	Parker et al Johnson & Anderson NGSS Appendix E (in 9/19 > NGSS)
Part 3: Teaching for scientific literacy		
10/10	Teaching for scientific literacy: Activity sequences Co-instructor: Chris Klager Due this week:	Covitt, et al. Activity sequences *Taking science to school,* Executive summary & Chapter 9
10/17	Teaching for scientific literacy: Oral and written language Co-instructor: Craig Kohn Due this week: Short review 1	*Ready, Set, Science!,* Chapters 1, 5, 6 *Talk Science Primer* NGSX
Part 4: Development of scientific literacy in individuals		
10/24	Scientific literacy at the high school and college level Alicia Alonzo visit Co-instructor: Won Kim, Julie Christensen Due this week:	Miller & Anderson Vision and Change, Chapters 1 & 2 CLUE text, pages 1-11
10/31	Presentations of data analyses Due this week: Data analysis report	--

Date	Activities	Readings
11/7	Development of scientific literacy in young children Co-instructor: Rachel Larimore, Kraig Wray Due this week: Final project proposal	Amelia Gotwals, Tanya Wright, Christina Schwarz visit TSTS chapter Wright & Gotwals
Part 5: Historical and sociocultural development of scientific literacy		
11/14	Scientific literacy in communities and societies Co-instructor: Day Greenberg, Katie Schenkel Due this week:	NRC Science Literacy report: Chapter 4: Communities Angie Calabrese Barton visit
11/21	Cultural origins of scientific literacy Co-instructor: Krista Damery, Christina Restrepo Nazar, Swati Mehta Due this week: Short review 2	Egan Bazerman Keller Latour & Woolgar
11/28	Co-instructor: Kirsten Edwards Literacy across the disciplines Due this week:	Moje Wineburg & Reisman Shanahan & Shanahan
12/5	Presentations of final projects Co-instructor: Due this week:	--
12/15	Final exam schedule: Thursday, Dec 15 2016 7:45am - 9:45am in 113 Erickson Hall Due this week: Final project (December 14)	
* Comments on readings or other short responses are due almost every week, but not repeated every week in this short schedule. In general, the schedule for turning in assignments is as follows: • Comments on readings: midnight Saturday • Draft of assignment due: bring to class (in electronic form) on Monday • Final version of assignment due: midnight Tuesday		

Readings and Resources

August 31

Davies, W. (2016, August 24). The age of post-truth politics. *New York Times*. http://nyti.ms/2bz5Jr5

Snow, C., & Dibner, K., Eds. (2016). *Science literacy: Concepts, contexts, and consequences.* Washington, DC: National Academies Press. http://www.nap.edu/23595

September 12

Covitt, B. A., Dauer, J. M., and Anderson, C. W. (in press). The role of practices in scientific literacy. In B. Reiser, C. Schwarz, & C. Passmore (Eds.). *Bringing next generation science & engineering practices into our K-12 Classrooms: Moving beyond "knowing" science to making sense of the world.* Washington, DC: NSTA Press.

Gee, J. P. (1991). What is literacy? In C. Mitchell and K. Weiler (eds.), *Rewriting literacy: Culture and the discourse of the other.* New York: Bergin & Garvey, pp. 3-12.

Gee, J. P. (2012). The old and the new in the new digital literacies. The Educational Forum, 76:4, 418-420. http://dx.doi.org/10.1080/00131725.2012.708622

September 19

Achieve, Inc. (2013). *Next Generation Science Standards.* Washington, DC: Achieve, Inc. http://www.nextgenscience.org/next-generation-science-standards

Brewer, C. A., and Smith, D. (Eds). (2011). *Vision and change in undergraduate biology education: A call to action.* Washington, DC: American Association for the Advancement of Science. http://visionandchange.org/

Common Core State Standards Initiative (2012). Common Core Standards in Mathematics and English/Language Arts. Washington, DC: Common Core State Standards Initiative. http://www.corestandards.org/

National Research Council (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, DC: National Academies Press. http://www.nap.edu/catalog.php?record_id=13165#

Rhodes, H., and Feder, M., Rapporteurs (2014). Literacy for Science: Exploring the Intersection of the Next Generation Science Standards and Common Core for ELA Standards: A Workshop Summary. Washington, DC: National Academies Press. http://nap.edu/18803

September 26

AERA/APA/NCME. (2014). *Standards for Educational and Psychological Testing*. http://www.aera.net/Publications/-Online-Store/Books-Publications/BKctl/ViewDetails/SKU/AERWSTDEPTB1

Doherty, J. H., Draney, K., Shin, H. J., Kim, J. H., & Anderson, C. W. (2015). Validation of a learning progression-based monitoring assessment. Environmental Literacy Project, Michigan State University.

Pellegrino, J. W., Wilson, M. R., Koenig, J. A., & Beatty, A. S. (Eds.). (2014). *Developing assessments for the next generation science standards*. National Academies Press. https://www.nap.edu/catalog/18409/developing-assessments-for-the-next-generation-science-standards (Read summary and introduction, pdf pages 20-42)

October 3

Johnson, W. R., & Anderson, C. W. (2016, in press). Unpacking the climate change performance expectations in the *Next Generation Science Standards.* In D. Sheperdson, A. Roychoudhury, and A. Hirsch (Eds.), *Teaching and learning about climate change: A framework for educators* (pp. x-x). New York: Routledge.

Parker, J., de los Santos, E., and Anderson, C. W. (2015, April). What learning progressions tell us about students' ability to participate in the global climate change and biofuels debates. *American Biology Teacher, 77(4),* 232-238.

October 10

Anderson, C. W. (2014). Activity sequences. Michigan State University.

Covitt, B. A., Harris, C. B., and Anderson, C. W. (2013, November). Evaluating scientific arguments with slow thinking. *Science Scope, 37(3)*, 44-52.

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (Eds.). (2007). *Taking science to school: Learning and teaching science in grades K-8*. National Academies Press. https://www.nap.edu/download/11625 (Executive Summary and Chapter 9)

October 17

Michaels, S., Shouse, A. W., & Schweingruber, H. A. (2007). *Ready, set, science!: Putting research to work in K-8 science classrooms*. National Academies Press. https://www.nap.edu/catalog/11882/ready-set-science-putting-research-to-work-in-k-8?gclid=CIqcypOll88CFU42gQodATsF8g

Michaels, S., & O'Connor, C. (2012). Talk science primer. Cambridge, MA: TERC. http://cgcs.org/cms/lib/DC00001581/Centricity/Domain/155/TalkScience_Primer.pdf

October 24

Miller, H. K., & Anderson, C. W. (submitted, 2015). Climate change in the community: Why climate change deserves a good argument. *Journal of Research in Science Teaching.*

Cooper, M. M., & Klymkowsky, M. W. (2016). Chemistry, life, the universe, and everything. (Read pages 1-11 of full CLUE text). http://virtuallaboratory.colorado.edu/CLUE-Chemistry/

Brewer, C. A., and Smith, D. (Eds). (2011). *Vision and change in undergraduate biology education: A call to action.* Washington, DC: American Association for the Advancement of Science.

http://visionandchange.org/ (Previously a reading for September 19. Read "A Vision for Implementing Change," pp. xiv-xv, and Chapters 1 and 2.)

November 7

Wright, T. S., & Gotwals, A. W. (in press). Supporting Kindergartners' Science Talk in the Context of an Integrated Science and Disciplinary Literacy Curriculum. *Elementary School Journal.*

Duschl, R. A., Schweingruber, H. A., & Shouse, A. W. (Eds.). (2007). *Taking science to school: Learning and teaching science in grades K-8*. National Academies Press. https://www.nap.edu/download/11625 (Also a reading for October 10. Read Chapter 3: "Foundations for Science Learning in Young Children)

November 14

Snow, C., & Dibner, K., Eds. (2016). *Science literacy: Concepts, contexts, and consequences.* Washington, DC: National Academies Press. http://www.nap.edu/23595 (Chapter 4: Science Literacy for Communities) (optional

Calabrese Barton, A., & Tan, E. (2010). "It changed our lives": Activism, science, and greening the community. Canadian Journal of Science, Mathematics and Technology Education, 10(3), 207-222. doi:10.1080/14926156.2010.504480

Barton, A. C., Tan, E., & Rivet, A. (2008). Creating Hybrid Spaces for Engaging School Science Among Urban Middle School Girls. American Educational Research Journal, 45(1), 68–103. https://doi.org/10.3102/0002831207308641

Calabrese Barton, A. & Tan, E. (2010). We be burnin: Agency, Identity and Learning in a Green Energy Program. *Journal of the Learning Sciences. 19(2),* 187-229.

Birmingham, D., & Calabrese Barton, A. (2014). Putting on a green carnival: Youth taking educated action on socioscientific issues. Journal of Research in Science Teaching, 51(3), 286–314. https://doi.org/10.1002/tea.21127 (optional)

November 21

Bazerman, C. (1988). Shaping written knowledge: The genre and activity of the experimental article in science. Madison, WI: University of Wisconsin Press. (Chapter1: The Problem of Writing Knowledge, and Chapter 4: Between Books and Articles: Newton Faces Controversy http://wac.colostate.edu/books/bazerman_shaping/

Egan, K. (1987). Literacy and the oral foundations of education. Harvard Educational Review, 57 (4), 445-472.

Keller, E. F. (1985). Reflections on gender and science. New Haven, CT: Yale University Press. (Chapter 3: Spirit and Reason at the Birth of Modern Science)

Latour, B., and Woolgar, S. (1979). Laboratory life: The construction of scientific facts. Princeton, NJ: Princeton University Press. (pages 81-6 on how citations signal levels of uncertainty)

November 28

Moje, E. B. (2007). Developing socially just subject-matter instruction: A review of the literature on disciplinary literacy teaching. *Review of research in education*, *31*(1), 1-44.

Shanahan, T., & Shanahan, C. (2012). What is disciplinary literacy and why does it matter?. *Topics in Language Disorders*, *32*(1), 7-18.

Wineburg, S., & Reisman, A. (2015). Disciplinary literacy in history. *Journal of Adolescent & Adult Literacy*, *58*(8), 636-639.