



AGRICULTURE & LIFE SCIENCES

Outreach: From Theory to Practice

ESSM 689, Fall 2019

Thursdays, 9 AM – 11:50 AM

Location: WFES 317

Instructor

Rhonda Struminger, PhD

Research Assistant Professor/Assistant Professor of the Practice

Ecosystem Science and Management

Office: WFES 314

struminger@tamu.edu

Course Description

Successful conservation outcomes, environmental health, and human capital development are just a few of the benefits of effective communication between scientists and the general public. Many major funding agencies evaluate research proposals' broader impacts as an integral part of proposal review. This ABS III graduate course, **Outreach: From Theory to Practice (ESSM 689)**, is designed to teach graduate students about informal STEM education (ISE), and how to incorporate ISE methods into outreach efforts to the general population. Students will learn about the role ISE plays in a democratic society and how ISE can impact a wide range of public policies from air quality monitoring to controlling the spread of zebra mussels. Using their gained insight into ISE, students will propose and implement an ISE program that relates to their own research or related STEM topic at an outreach event of their choosing.

Learning Outcomes

By the end of this course, students will be able to:

1. Articulate and critique the role of informal STEM education (ISE) in a democratic society
2. Evaluate the various ways that ISE can affect public policy
3. Assess the quality of ISE efforts and provide constructive feedback on how to improve or expand such efforts
4. Create an ISE activity that demonstrates an understanding of ISE
5. Present scientific research to the general public at an Outreach event

Absence and Late Work Policy

"The University views class attendance as the responsibility of an individual student. Attendance is essential to complete the course successfully. University rules related to excused and unexcused absences are located on-line at <http://student-rules.tamu.edu/rule07>."

Late assignments will be accepted only in the case of a University Excused Absence with no penalty within a reasonable timeframe (i.e., one week). All other work will be given a five-percentage point penalty for every day it is late, including weekends. University Excused Absences must have written verification, like a doctor's note.

Grading

All assignments must be submitted to pass this course.

The Standard Letter Grading Scale will be applied:

A = 90-100; B = 80-89; C = 70-79; D = 60-69; F = <60

Participation (30%)

Classes will be journal club format so plan to lead some discussions.

The syllabus is broken up into three sections as follows:

Part I: Informal STEM Education (ISE)

- ISE literature synthesis paper (15%)
 - Students must demonstrate their understanding of ISE theories and creatively explore what a successful Outreach event might look like based on the ISE literature (1,000 -1,500 words).

Part II: Public and Policy Impacts

- ISE Project Proposal (25%)

Students must design a project that can be implemented by the end of the course and has the potential to affect public attitudes or knowledge (this will be implemented in part 3 of the class). The project must have an evaluation component and implementation venues identified and secured for Part III of the course.

Part III: Educating the Public

- ISE Project implementation (20%)
- ISE Project Evaluation (10%)

Topics and Related Reading Assignments

NOTE: Required readings are subject to change

Part I: Informal STEM Education (5 weeks)

Week 1 (August 29): Teaching and Learning in different contexts

- What is “pedagogy” and what are the underpinnings of a quality educational experience?
- What is science education v communication
- Informal v Formal Science Education (similarities and differences)

Required Readings: Falk et al 2007; Falk & Dierking 2010; Stocklmeyer et al 2010

Suggested Readings: Bell et al 2016; Bevan et al 2010; NASEM 2017, Sacco et al 2014

Week 2 (September 5): Informal Education Venues (e.g., aquaria, museums, zoos, field stations)

- What do different venues offer participants?
- How similar/different are these venues?

Required Readings: Struminger et al 2018; Schwan et al 2014

Suggested Readings: Falk, Randol, & Dierking 2012; Nadkarni 2013

Week 3 (September 12): Informal Learning Activities, Relevant Pedagogies and Frameworks

- In what ways does pedagogy matter for assessment and evaluation?
- How does science benefit? (e.g., science literacy, quality big data, new directions/innovation)

Required Readings: Varner 2014; Bonney et al 2009a

Suggested Readings: NRC 2009; NASEM 2018, Bonney et al 2009b

Week 4 (September 19) & Week 5 (September 26): Assessing Implementation in Informal Contexts and Evaluating Learning in Informal Contexts

- What does quality implementation look like? (e.g., participation, products, return visits)
- What impact does/could ISE have on participants of all ages? (e.g., science literacy, 6 science strands)

Required Readings Week 4 (Sept 19): CAISE 2011; Jordan et al 2012

Required Readings Week 5 (Sept 26): Lesen et al 2016; Grand and Sardo 2017

Suggested Readings: Phillips et al 2018

End of Part I: ISE Synthesis Paper (Due October 4 – Friday)

Students must demonstrate their understanding of ISE theories and creatively explore what a successful Outreach event might look like based on the ISE literature (1,000 -1,500 words).

Part II: Planning & Implementing an ISE Project (4 weeks)

Week 6 (October 3): What is the Texas A&M University Internal Review Board (IRB) process for human research? What documents are needed for the process? What does a valid, efficient, and useful survey look like?

GUEST: Tara Foster, Research Compliance Coordinator, Division of Research, Texas A&M University – Human Research Protection Program

Required Readings: Rubin 2013/14 (CAISE IRB Blog Series); Chapter 9 in Price et al 2015; Collie & Rine 2009

Week 7 (October 10): Creating an Evaluation Plan

Required Readings: Garabay & Teasdale 2019; Fu et al 2019; Friedman 2008 (pp 17 – 27)

Suggested Readings: Allen & Peterman 2019

Week 8 (October 17): Submitting to the IRB and Project Planning

Rough Draft of the Project Proposal Due beginning of class for class discussion/review

Week 9 (October 24): Considerations when interacting with the public (especially around controversial topics)

Required Readings: Blanton & Ikizer 2019; Fernbach et al 2019 (GMOs); Drummond & Fischhoff 2017

ISE Project Proposal (Due Friday, November 8 or earlier!)

Students must propose a project that can be implemented by the end of the course and has the potential to affect public attitudes or knowledge. The project must have an evaluation component that has met IRB standards.

Part III: Public and Policy Impacts (4 weeks)

Week 10 (October 31) What is the potential for informal learning to affect individual and community behaviors, as well as science research? Which individuals are left out?

Required Readings: Struminger & Ross (submitted); Riesch & Potter 2014; Dawson 2018

Suggested Readings: Freitag et al 2016

Week 11 (November 7) What is the potential for informal learning to affect public support of government policy (especially in the areas of conservation, natural resource management, and environmental protection)?

Required Readings: Dean 2018; Ellwood et al 2017; McKinley et al 2017

Suggested Readings: Fernández Pinto & Hicks 2019

Week 12 (November 14): Science outreach among skeptics; when scientific credibility is questioned or appears biased

Required Readings: Hardy 2019; Ross et al. 2018; Pettorelli et al. 2019

Week 13 (November 21): Project Reflection and Next Steps

Required Readings: Cockrell et al 2018; Hulcr et al 2019; Lubchenco 1998

Week 14 (November 28) – No Class (Thanksgiving Holiday)

Week 15 (TUESDAY, December 3) – Reassigned Class Day – Wrap Up and Reflections

Evaluation is due on December 6

Submit an evaluation of the implemented project. What succeeded? Why? What could have been done better? Make recommendations (1,000 - 1,500 words).

Notice

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, currently located in the Disability Services building at the Student Services at White Creek complex on west campus or call 979-845-1637. For additional information, visit <http://disability.tamu.edu>.

Honor Code

“An Aggie does not lie, cheat or steal, or tolerate those who do.” (www.tamu.edu/aggiehonor)

Readings/Bibliography

- Allen, Sue, and Karen Peterman. 2019. "Evaluating Informal Stem Education: Issues and Challenges in Context." *New Directions for Evaluation* 2019(161): 17-33.
- Bell, Jamie, John Falk, Roxanne Hughes, Geoff Hunt, Julia Parrish, Monya Ruffin, Kalie Sacco, and Grace Troxel. 2016. "Informal Stem Education: Resources for Outreach, Engagement and Broader Impacts." *Science Education (CAISE)*.
- Bevan, B, J Dillon, GE Hein, M Macdonald, V Michalchik, D Miller, and S Yoon. 2010. "Making Science Matter: Collaborations between Informal Science Education Organizations and Schools." Washington, DC: Center for the Advancement of Informal School Science Education (CAISE)."
- Blanton, Hart, and Elif G Ikizer. 2019. "Elegant Science Narratives and Unintended Influences: An Agenda for the Science of Science Communication." *Social Issues and Policy Review* 13(1): 154-81.
- Bonney, R, Ballard, H, Jordan, R, McCallie, E, Phillips, T, Shirk, J and Wilderman, CC. 2009a. *Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report*. Washington, DC: Center for Advancement of Informal Science Education (CAISE).
- Bonney, R, Cooper, CB, Dickinson, J, Kelling, S, Phillips, TB, Rosenberg, KV and Shirk, J. 2009b. "Citizen Science: A Developing Tool for Expanding Science Knowledge and Scientific Literacy." *Bioscience*, 59(11): 977– 984. DOI: <https://doi.org/10.1525/bio.2009.59.11.9>
- Center for the Advancement of Informal Science Education [CAISE]. 2011. *Principal Investigator's Guide: Managing Evaluation in Informal STEM Education Projects*. Washington, DC.
- Cockrell, Marcy, Kate Dubickas, Megan Hepner, Alex Ilich, and Matthew McCarthy. 2018. "Embracing Advocacy in Science." *Fisheries* 43(4): 179-82.
- Collie, Sarah L. and P. Rine. 2009. *Survey Design: Getting the Results You Need*. Office of Process Simplification, University of Virginia. https://www2.virginia.edu/processsimplification/resources/survey_design.pdf
- Dawson, Emily. 2018. "Reimagining Publics and (Non) Participation: Exploring Exclusion from Science Communication through the Experiences of Low-Income, Minority Ethnic Groups." *Public Understanding of Science* 27(7): 772-86.

- Dean, Angela J., Emma K. Church, Jenn Loder, Kelly S. Fielding, and Kerrie A. Wilson. 2018. "How Do Marine and Coastal Citizen Science Experiences Foster Environmental Engagement?" *Journal of Environmental Management* 213: 409-16.
- Ellwood, Elizabeth R, Theresa M Crimmins, and Abraham J Miller-Rushing. 2017. "Citizen Science and Conservation: Recommendations for a Rapidly Moving Field." Elsevier.
- Falk, JH, Storksdieck, M and Dierking, LD. 2007. Investigating public science interest and understanding: Evidence for the importance of free-choice learning. *Public Understanding of Science*, 16(4): 455–469. DOI: <https://doi.org/10.1177/0963662506064240>
- Falk, John H, and Lynn D Dierking. 2010. "The 95 Percent Solution." *American Scientist* 98(6): 486-93.
- Falk, JH, Randol, S, & Dierking, LD. 2012. "Mapping the Informal Science Education Landscape: An Exploratory Study." *Public understanding of science (Bristol, England)*, 21(7), 865-874.
- Fernández Pinto, Manuela, and Daniel J Hicks. 2019. "Legitimizing Values in Regulatory Science." *Environmental health perspectives* 127(3): 035001.
- Fernbach, Philip M., Nicholas Light, Sydney E. Scott, Yoel Inbar, and Paul Rozin. 2019. "Extreme Opponents of Genetically Modified Foods Know the Least but Think They Know the Most." *Nature Human Behaviour*.
- Freitag, A., Meyer, R., & Whiteman, L. 2016. "Strategies Employed by Citizen Science Programs to Increase the Credibility of Their Data." *Citizen Science: Theory and Practice*, 1(1), 2. doi:<http://doi.org/10.5334/cstp.6>
- Friedman, A., ed. 2008. *Framework for Evaluating Impacts of Informal Science Education Projects* Washington DC: National Science Foundation.
- Fu, A. C., Kannan, A., & Shavelson, R. J. 2019. "Direct and unobtrusive measures of informal STEM education outcomes." In A. C. Fu, A. Kannan, & R. J. Shavelson (Eds.), *Evaluation in Informal Science, Technology, Engineering, and Mathematics Education*. New Directions for Evaluation, 161, 35–57.
- Garibay, C., & Teasdale, R. M. 2019. "Equity and evaluation in informal STEM education." In A. C. Fu, A. Kannan, & R. J. Shavelson (Eds.), *Evaluation in Informal Science, Technology, Engineering, and Mathematics Education*. New Directions for Evaluation, 161, 87–106

- Grand, A. and Sardo, A.M. 2017. "What Works in the Field? Evaluating Informal Science Events." *Frontiers in Communication*. 2(22). doi: 10.3389/fcomm.2017.00022
- Hardy, Bruce W, Meghna Tallapragada, John C Besley, and Shupe Yuan. 2019. "The Effects of the 'War on Science' Frame on Scientists' Credibility." *Science Communication* 41: 90-112.
- Hulcr, Jiri, Prarthana S Dharampal, Ronda L Hamm, Gwen Pearson, and Cara Gibson. 2019. "Influence Is Power: Strategic Communication for Entomologists." *American Entomologist* 65(2): 92-96.
- Jordan, Rebecca C, Heidi L Ballard, and Tina B Phillips. 2012. "Key Issues and New Approaches for Evaluating Citizen-Science Learning Outcomes." *Frontiers in Ecology and the Environment* 10: 307-09.
- Lesen, Amy E, Ama Rogan, and Michael J Blum. 2016. "Science Communication through Art: Objectives, Challenges, and Outcomes." *Trends in ecology & evolution* 31(9): 657-60.
- Lubchenco, J. 1998. "Entering the century of the environment: A new social contract for science." *Science* 279: 491-497.
- McKinley, Duncan C, Abe J Miller-Rushing, Heidi L Ballard, Rick Bonney, Hutch Brown, Susan C Cook-Patton, Daniel M Evans, Rebecca A French, Julia K Parrish, and Tina B Phillips. 2017. "Citizen Science Can Improve Conservation Science, Natural Resource Management, and Environmental Protection." *Biological Conservation* 208: 15-28.
- Nadkarni, Nalini M. 2013. "Not Such Strange Bedfellows: Underserved Public Audiences as Collaborators for Ecologists." In *Linking Ecology and Ethics for a Changing World*: Springer. 333-47.
- National Academies of Sciences, Engineering, and Medicine [NASEM]. 2018. *Learning through Citizen Science: Enhancing Opportunities by Design*. Washington, DC: The National Academies Press.
- National Academies of Sciences, Engineering, and Medicine [NASEM]. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC: The National Academies Press. doi: 10.17226/23674.
- National Research Council [NRC]. 2009. *Learning science in informal environments: People, places, and pursuits*. Washington, DC: National Academies Press. DOI: <https://doi.org/10.17226/12190>

- Pettorelli, Nathalie W, Jos Barlow, Marc W Cadotte, Kirsty Lucas, Erika Newton, Martin A Nuñez, and Philip A Stephens. 2019. “Applied Ecologists in a Landscape of Fear.” *Journal of Applied Ecology* 56(5): 1034-39.
- Phillips, T, et al. 2018. “A Framework for Articulating and Measuring Individual Learning Outcomes from Participation in Citizen Science.” *Citizen Science: Theory and Practice* 3(2): 3, pp.1–19, DOI: <https://doi.org/10.5334/cstp.126>
- Price, Paul C, Rajiv Jhangiani, and I-Chant A Chiang. 2015. *Research Methods in Psychology*: BCCampus.
<https://kora.kpu.ca/islandora/object/kora%3A384/datastream/PDF/view>
- Riesch, Hauke, & Potter, Clive. 2014. “Citizen science as seen by scientists: Methodological, epistemological and ethical dimensions.” *Public Understanding of Science*, 23(1), 107-120.
- Ross, Ashley D, Rhonda Struminger, Jeffrey Winking, and Kathryn R Wedemeyer-Strombel. 2018. “Science as a Public Good: Findings from a Survey of March for Science Participants.” *Science Communication* 40: 228-45.
- Rubin, Andee. 2013 & 2014. IRB Blog. CAISE. <https://www.informalscience.org/blog-series-institutional-review-board-irb-considerations-informal-science-education-settings>
- Sacco, Kalie, Falk, John H., & Bell, James. (2014). Informal Science Education: Lifelong, Life-Wide, Life-Deep. *PLOS Biology*, 12(11), e1001986.
doi:10.1371/journal.pbio.1001986
- Schwan, Stephan, Grajal, Alejandro, & Lewalter, Doris. 2014. “Understanding and Engagement in Places of Science Experience: Science Museums, Science Centers, Zoos, and Aquariums.” *Educational psychologist*, 49(2), 70-85.
doi:10.1080/00461520.2014.917588
- Stocklmayer, Susan M., Rennie, Léonie J., & Gilbert, John K. (2010). “The roles of the formal and informal sectors in the provision of effective science education.” *Studies in Science Education*, 46(1), 1-44. doi:10.1080/03057260903562284
- Struminger, Rhonda, Zarestky, Jill, Short, Rachel A., & Lawing, A. Michelle. (2018). Informal STEM learning at biological field stations. *BioScience*, 68(12), 969–978.
doi:<https://doi.org/10.1093/biosci/biy108>
- Struminger, Rhonda and Ashley R. Ross. Submitted. “Bridging Partisan Divisions with Science Experience.” TBD.

Varner, Johanna. 2014. "Scientific Outreach: Toward Effective Public Engagement with Biological Science." *BioScience* 64: 333-40.

Additional Readings that may be of interest:

Bonney, Rick, Tina B. Phillips, Heidi L. Ballard, and Jody W. Enck. 2015. "Can Citizen Science Enhance Public Understanding of Science?". *Public Understanding of Science* 25: 2-16.

Chase, Sarah K, and Arielle Levine. 2016. "A Framework for Evaluating and Designing Citizen Science Programs for Natural Resources Monitoring." *Conservation Biology* 30: 456-66.

Fischhoff, Baruch. 2013. "The Sciences of Science Communication." *Proceedings of the National Academy of Sciences* 110: 14033-39.

Newman, G., Chandler, M., Clyde, M., McGreavy, B., Haklay, M., Ballard, H., . . . Gallo, J. (2017). Leveraging the power of place in citizen science for effective conservation decision making. *Biological Conservation*, 208(Supplement C), 55-64.
doi:<https://doi.org/10.1016/j.biocon.2016.07.019>

Nisbet, M., & Markowitz, E. (2016). Public Engagement Research & Major Approaches. A Commissioned Annotated Bibliography in support of the Leshner Leadership Institute, American Association for the Advancement of Science. Retrieved from:
http://www.aaas.org/sites/default/files/content_files/Biblio_PublicEngagement_FINAL11.25.15.pdf.

Pace, Michael L, Stephanie E Hampton, Karin E Limburg, Elena M Bennett, Elizabeth M Cook, Ann E Davis, J Morgan Grove, Kenneth Y Kaneshiro, Shannon L LaDeau, and Gene E Likens. 2010. "Communicating with the Public: Opportunities and Rewards for Individual Ecologists." *Frontiers in Ecology and the Environment* 8: 292-98.

Phillips, T, Ferguson, M, Minarchek, M, Porticella, N and Bonney, R. 2014. User's Guide for Evaluating Learning Outcomes in Citizen Science. Ithaca, NY: Cornell Lab of Ornithology. Retrieved from: http://cdn1.safmc.net/wp-content/uploads/2016/11/28101058/CitizenScienceUsersGuide_Evaluation_2014.pdf.

Pugh, Kevin J., and Mark Girod. 2007. "Science, Art, and Experience: Constructing a Science Pedagogy from Dewey's Aesthetics." *Journal of Science Teacher Education* 18(1): 9-27.

Salguero-Gomez, Roberto, Matthew D Whiteside, Jenny M Talbot, and William F Laurance. 2009. "After "Eco" Comes "Service"." *Frontiers in Ecology and the Environment* 7: 277-78.

Scheffer, Marten, Jordi Bascompte, Tone Bjordam, Stephen Carpenter, Laurie Clarke, Carl Folke, Pablo Marquet, Nestor Mazzeo, Mariana Meerhoff, and Osvaldo Sala. 2015. “Dual Thinking for Scientists.” *Ecology and Society* 20(2).

Shirk, Jennifer L, Heidi L Ballard, Candie C Wilderman, Tina Phillips, Andrea Wiggins, Rebecca Jordan, Ellen McCallie, Matthew Minarchek, Bruce V Lewenstein, and Marianne E Krasny. 2012. “Public Participation in Scientific Research: A Framework for Deliberate Design.” *Ecology and Society* 17.

Zollman, A., 2012. Learning for STEM literacy: STEM literacy for learning. *School Science and Mathematics*, 112(1), pp.12-19.

Other Resources:

http://www.nisenet.org/search/product_type/programs-and-activities-10