**MSCI 307:** **Team Science**

Tuesdays, September 20-October 18, 2011; 6:00-9:00PM

Gray Conference Room, Lurie, Chgo Campus

0.5 Credit Course

**Instructor (office hours by appointment):**

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**Course Description:** Important health, technology, social, and environmental problems impacting our world are complex and researchers are increasingly able to address them through collaborative scientific and scholarly pursuit. This type of challenge necessitates cross-disciplinary engagement and a high level of teamwork—an activity referred to as *team science*. As the trend toward collaboration and team science continues, effective practices, tools, and training to support the efforts of researchers and institutions to initiate and nurture partnerships and secure collaborative research funding becomes increasingly important. It is imperative that we then understand the most effective practices for productive cross-disciplinary collaboration and team science and train individual investigators and institutional leaders to employ them. This course offers practical guidance about how best to engage in team science: to pursue complex science questions, to work effectively with team members, and produce high impact research outcomes that help meet society’s needs.

**Prerequisites:** PhD students must already be passed to candidacy.

**Course Learning Objectives:** Students in this course will be able to:

* Recognize the trend toward collaboration in research over the last 50 years
* Examine the scientific basis of team science
* Apply evidence-based guidance to effectiveness of team science
* Differentiate between multidisciplinary, interdisciplinary, and transdisciplinary team research
* Identify factors that promote and inhibit productivity of science teams
* Examine factors to consider when joining/forming a science team
* Explain the individual collaboration readiness factors that motivate and detract from team science
* Explain factors that facilitate trust building between in a science team
* Summarize skills and mechanisms for effective conflict management
* Identify funding opportunities that support team science initiatives
* Analyze effective practices of model examples of successful team science
* Recognize the importance of leadership to promote team science
* Illustrate effective collaborative research training
* Describe institutional and agency policies and procedures that act as barriers or facilitators to team science
* Assess tools and methodologies to evaluate team science antecedents, processes, activities, outputs and outcomes

**Course Format and Outline:**

The class will consist of a set of readings to be followed by a combination of didactic lecture and group discussion. Students will be expected to read the assigned materials prior to each class session and are expected to attend each class and actively participate in discussions. Students will be expected to complete one assignment in small groups and one computer-based learning assignment.

Class 1: Cross-disciplinary Research, Team Science, and the Science of Team Science (SciTS)

*Required Readings for Class Discussion*

* Wuchty, S., Jones, B.F., and Uzzi, B. (2007). The Increasing Dominance of Teams in Production of Knowledge. Science *316*, 1036-1038.
* Fiore, S.M. (2008). Interdisciplinarity as teamwork - How the science of teams can inform team science. Small Group Research *39*, 251-277.
* Disis, M., and Slattery, J. (2010). The Road We Must Take: Multidisciplinary Team Science. Science Translational Medicine *2*, 22cm29.
* Börner, K., Contractor, N., Falk-Krzesinski, H.J., Fiore, S.M., Hall, K.L., Keyton, J., Spring, B., Stokols, D., Trochim, W., and Uzzi, B. (2010). A Multi-Level Systems Perspective for the Science of Team Science. Science Translational Medicine 2, cm24.
* Falk-Krzesinski, H.J., Contractor, N., Fiore, S.M., Hall, K.L., Kane, C., Keyton, J., Klein, J.T., Spring, B., Stokols, D., and Trochim, W. (2011). Mapping a Research Agenda for the Science of Team Science. Research Evaluation 20, 143-156.

*Reference Readings*

* Brainard, J. (2002). U.S. Agencies Look to Interdisciplinary Science. In Chronicle of Higher Education, pp. A20-A22.
* Huerta, M.F., Farber, G.K., Wilder, E.L., Kleinman, D.V., Grady, P.A., Schwartz, D.A., and Tabak, L.A. (2005). NIH Roadmap interdisciplinary research initiatives. PLoS Comput Biol *1*, e59.
* Stokols, D., Hall, K.L., Taylor, B.K., and Moser, R.P. (2008). The Science of Team Science: Overview of the Field and Introduction to the Supplement. American Journal of Preventive Medicine *35*, S77-S89.
* Falk-Krzesinski, H.J., Börner, K., Contractor, N., Fiore, S.M., Hall, K.L., Keyton, J., Spring, B., Stokols, D., Trochim, W.*, et al.* (2010). Advancing the Science of Team Science. Clinical and Translational Sciences *3*.
* Falk-Krzesinski, H.J., Hall, K., Stokols, D., and Vogel, A. (2010). Science of Team Science. In Wikipedia: The Free Encyclopedia (Wikimedia Foundation, Inc).

Case Studies

* Kong, H.H., and Segre, J.A. (2010). Bridging the Translational Research Gap: A Successful Partnership Involving a Physician and a Basic Scientist. J Invest Dermatol 130, 1478-1480.
* Magill-Evans, J., Hodge, M., and Darrah, J. (2002). Establishing a transdisciplinary research team in academia. J Allied Health 31, 222-226.
* Jordan, P.J., Ory, M.G., and Sher, T.G. (2005). Yours, mine, and ours: The importance of scientific collaboration in advancing the field of behavior change research. Annals of Behavioral Medicine 29, 7-10.
* Hede, K. (2010). Making Team Science Work: Advice From a Team. In Science Careers (Science).

Class 2: Evaluating Team Science

*Required Readings for Class Discussion*

* Wagner, C.S., Roessner, J.D., Bobb, K., Klein, J.T., Boyack, K.W., Keyton, J., Rafols, I., and Borner, K. (2011). Approaches to understanding and measuring interdisciplinary scientific research (IDR): A review of the literature. Journal of Informetrics *5*, 14-26.
* Porter, A.L., Cohen, A.S., Roessner, J.D., and Perreault, M. (2007). Measuring researcher interdisciplinarity. Scientometrics *72*, 117-147.
* Frey, B.B., Lohmeier, J.H., Lee, S.W., and Tollefson, N. (2006). Measuring collaboration among grant partners. American Journal of Evaluation *27*, 383-392.
* Mâsse, L.C., Moser, R.P., Stokols, D., Taylor, B.K., Marcus, S.E., Morgan, G.D., Hall, K.L., Croyle, R.T., and Trochim, W.M. (2008). Measuring collaboration and transdisciplinary integration in team science. American Journal of Preventive Medicine *35*, S151-S160.
* Stokols, D., Harvey, R., Gress, J., Fuqua, J., and Phillips, K. (2005). In vivo studies of transdisciplinary scientific collaboration Lessons learned and implications for active living research. Am J Prev Med *28*, 202-213.
* Hall, K.L., Stokols, D., Stipelman, B.A., Vogel, A.L., Feng, A., Masimore, B., Morgan, G., Moser, R.P., Marcus, S.E., and Berrigan, D. (2012). Assessing the Value of Team Science: A Study Comparing Center- and Investigator-Initiated Grants. American Journal of Preventive Medicine *42*, 157-163.

*Reference Readings*

* Trochim, W.M., Marcus, S.E., Masse, L.C., Moser, R.P., and Weld, P.C. (2008). The evaluation of large research initiatives - A participatory integrative mixed-methods approach. American Journal of Evaluation *29*, 8-28.
* Gray, D.O. (2008). Making Team Science Better: Applying Improvement-oriented Evaluation Principles to Evaluation of Cooperative Research Centers. In New Directions for Evaluation, C.L.S. Coryn, and M. Scriven, eds. (Wiley Periodicals, Inc.), pp. 73-87.
* Börner, K., Contractor, N., Falk-Krzesinski, H.J., Fiore, S.M., Hall, K.L., Keyton, J., Spring, B., Stokols, D., Trochim, W., and Uzzi, B. (2010). A Multi-Level Systems Perspective for the Science of Team Science. Science Translational Medicine *2*, cm24.
* Falk-Krzesinski, H.J., Contractor, N., Fiore, S.M., Hall, K.L., Kane, C., Keyton, J., Klein, J., Stokols, D., and Trochim, W. (2010). Mapping a Research Agenda for the Science of Team Science. In preparation.

Class 3: Team Leadership and Team Composition

*Required Readings for Class Discussion*

* Gray, B. (2008). Enhancing transdisciplinary research through collaborative leadership. American Journal of Preventive Medicine *35*, S124-S132.
* Whitfield, J. (2008). Group Theory. Nature *455*, 720-723.
* Guimerà, R., Uzzi, B., Spiro, J., and Amaral, L.A.N. (2005). Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance. Science 308, 697-702.
* Jones, B.F., Wuchty, S., and Uzzi, B. (2008). Multi-University Research Teams: Shifting Impact, Geography, and Stratification in Science. Science 322, 1259-1262.
* Joshi, A., and Boppart, S. (2010). Report of the 'Success in Research Labs' Study (Urbana, IL, University of Illinois at Urbana-Champaign), pp. 1-22.

*Reference Readings*

* Isohanni, M., Isohanni, I., and Veijola, J. (2002). How should a scientific team be effectively formed and managed. Nordic Journal of Psychiatry 56, 157 - 162.
* Morgeson, F.P., DeRue, D.S., and Karam, E.P. (2010). Leadership in Teams: A Functional Approach to Understanding Leadership Structures and Processes. Journal of Management *36*, 5-39. **🡪 Only read from start thru ‘Team Leadership Functions’ on pg 10 and look carefully at Tables 1&2**
* Rhoten, D. (2003). A Multi-Method Analysis of the Social and Technical Conditions for Interdisciplinary Collaboration (The Hybrid Vigor Institute), pp. 82. 🡪**Focus on findings from pg 42 and on**

Class 4: Sociotechnical Coordination of Distributed Teams

*Required Readings for Class Discussion*

* Olson, G.M., and Olson, J.S. (2000). Distance Matters. Human-Computer Interaction *15*, 139-178.
* Miller, K. (2008). Successful Collaborations: Social Scientists Who Study Science Have Noticed a Trend. In Biomedical Computation Review (Simbios at Stanford University,  National NIH Center for Biomedical Computing), pp. 7-15.
* Cummings, J.N. (2009). A socio-technical framework for identifying team science collaborations that could benefit from cyberinfrastructure (VOSS, National Science Foundation).
* Cummings, J.N., and Kiesler, S. (2007). Coordination costs and project outcomes in multi-university collaborations. Research Policy *36*, 1620-1634.
* Cummings, J.N., and Kiesler, S. (2008). Who collaborates successfully? Prior experience reduces collaboration barriers in distributed interdisciplinary research. Paper presented at: Proceedings of the ACM 2008 Conference on Computer Supported Cooperative Work (San Diego, CA).

*Reference Readings*

* Lee, K., Brownstein, J.S., Mills, R.G., and Kohane, I.S. (2010). Does Collocation Inform the Impact of Collaboration? Plos One 5.
* Zakaria, N., Amelinckx, A., & Wilemon, D. (2004). Working together apart? Building a knowledge-sharing culture for global virtual teams. Creativity and innovation management, 13(1),15-29.
* Jaeger, P.T. and Burnett, G. (2010). Information Worlds: Social Context, Technology, and Information Behavior in the Age of the Internet. New York, NY: Routledge.
* Lee, C., Dourish, P., and Mark, G. 2006. The Human Infrastructure of Cyberinfrastructure. Proc. ACM Conf. Computer-Supported Cooperative Work CSCW 2006 (Banff, Alberta), 483-492.
* Gorman, M.E. (2008). Trading zones and interactional expertise as a framework for studying technoscientific collaborations. Int J Psychol 43, 52-52.

Class 5: Collaboration Readiness and Integrity in Collaboration

*Required Readings for Class Discussion*

* Hagstrom, W.O. (1964). Traditional and Modern Forms of Scientific Teamwork. Administrative Science Quarterly 9, 241-263.
* Salazar, P.D.M., Lant, P.D.T., and Kane, P.D.A. (2011). To Join or Not to Join: An Investigation of Individual Facilitators and Inhibitors of Medical Faculty Participation in Interdisciplinary Research Teams. Clinical and Translational Science 4, 274-278.
* DuBois, J.M., Carroll, K., Gibb, T., Kraus, E., Rubbelke, T., and Vasher, M. (2011). Environmental Factors Contributing to Wrongdoing in Medicine: A Criterion-Based Review of Studies and Cases. Ethics and Behavior *In Press*.
* Case Study paper presentations

*Reference Readings*

* Bennett, L.M., Gadlin, H., and Levine-Finley, S. (2010). Collaboration and Team Science: A Field Guide (Bethesda, MD, National Institutes of Health). From [www.teamscience.nih.gov](http://www.teamscience.nih.gov) **🡪 Reference, peruse but don’t read cover to cover**
* Macrina, F.L. (2005). Collaborative Research, Chapt 8 in Scientific integrity : text and cases in responsible conduct of research, 3rd edn (Washington, D.C., ASM Press).

Class 6: Communication and Conflict Management

*Required Readings for Class Discussion*

* Thompson, J.L. (2009). Building Collective Communication Competence in Interdisciplinary Research Teams. J Appl Commun Res 37, 278-297.
* Eigenbrode, S.D., O'Rourke, M., Wulfhorst, J.D., Althoff, D.M., Goldberg, C.S., Merrill, K., Morse, W., Nielsen-Pincus, M., Stephens, J., Winowiecki, L., et al. (2007). Employing philosophical dialogue in collaborative science. Bioscience 57, 55-64.
* The Toolbox: Enhancing Cross-Disciplinary Research, <http://www.cals.uidaho.edu/toolbox/One-Page_intro.pdf> **🡪 Don’t read through or complete before class, just bring a copy with to class**

Class 7: Team Cognition and Learning for Cross-disciplinary Collaboration

*Required Readings for Class Discussion*

* Fiore, S. M. & Schooler, J. W. (2004). Process mapping and shared cognition: Teamwork and the development of shared problem models. In E. Salas & S.M. Fiore (Editors). Team Cognition: Understanding the factors that drive process and performance (pp. 133-152). Washington, DC: American Psychological Association.
* Collins, H. (2004). Interactional expertise as a third kind of knowledge. Phenomenology and the Cognitive Sciences 3, 125-143.
* Pennington, D.D. (2008). Cross-Disciplinary Collaboration and Learning. Ecol Soc 13, 8.
* A team-based learning or collaborative learning article

*Reference Readings*

* Fiore, S. M. & Salas, E. (2004). Why we need team cognition. In E. Salas & S.M. Fiore (Editors). Team Cognition: Understanding the factors that drive process and performance (pp. 235-248). Washington, DC: American Psychological Association.
* Mohammed, S., Ferzandi, L., and Hamilton, K. (2010). Metaphor No More: A 15-Year Review of the Team Mental Model Construct. J Manage 36, 876-910.
* DeChurch, L.A., and Mesmer-Magnus, J.R. (2010). Measuring Shared Team Mental Models: A Meta-Analysis. Group Dyn-Theor Res 14, 1-14.
* Gorman, M.E. (2010). Trading Zones, Interactional Expertise, and Future Research in Cognitive Psychology of Science. Top Cogn Sci 2, 96-100.

Class 8: Gender (Diversity) Issues in Collaboration and Team Science

*Required Readings for Class Discussion*

* Rhoten, D., and Pfirman, S. (2007). Women in interdisciplinary science: Exploring preferences and consequences. Res Policy 36, 56-75.
* Bear, J.B., and Woolley, A.W. (2011). The Role of Gender in Team Collaboration and Performance. Interdiscipl Sci Rev 36, 146-153.
* Kyvik, S., and Teigen, M. (1996). Child Care, Research Collaboration, and Gender Differences in Scientific Productivity. Science, Technology & Human Values 21, 54-71.
* Joshi, A. (2011). Role Models, Black Sheep, or Queen Bees?: The Effects of Women’s Incongruent Status on Expertise Recognition in Groups (Champaign, IL, University of Illinois at Urbana-Champaign), pp. 67.
* Team Science and the Diversity Advantage <http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2008_09_12/caredit.a0800135>

*Reference Readings*

* Baugh, S.G., and Graen, G.B. (1997). Effects of Team Gender and Racial Composition on Perceptions of Team Performance in Cross-Functional Teams. Group & Organization Management 22, 366-383.
* Joshi, A., and Boppart, S. (2010). Report of the 'Success in Research Labs' Study (Urbana, IL, University of Illinois at Urbana-Champaign), pp. 1-22. 🡪 Focus on the gender-related issues of the report
* *A Lab of Her Own* (autobiography of first AWIS president) by Neena Schwartz
* *The Dark Lady of DNA* (Rosalind Franklin biography) by Brenda Maddox
* *Molecules of Emotion* (idiosyncratic autobiographical study) by Candice Pert
* *Feminism and Science* by Nancy Hardy

Class 9: Competencies and Training for Interdisciplinary Research and Team Science

*Required Readings for Class Discussion*

* References focused on: Competency frameworks for graduate/postgraduate trainees and faculty in the sciences and/or biomedicine: Developing effective IR and collaboration skills through formal and informal training venues; How training improves team effectiveness; Leadership training; and Team-based or collaborative learning for graduate science/medicine courses.
* Milner, R.J., Gusic, M.E., and Thorndyke, L.E. (2011). Perspective: Toward a Competency Framework for Faculty. Academic Medicine 86, 1204-1210
* Fuhrmann, C.N., Halme, D.G., O'Sullivan, P.S., and Lindstaedt, B. (2011). Improving graduate education to support a branching career pipeline: recommendations based on a survey of doctoral students in the basic biomedical sciences. CBE Life Sci Educ 10, 239-249.
* Core Competencies for Interprofessional Collaborative Practice report
* McGee, R., and DeLong, M.J. (2007). Collaborative Co-Mentored Dissertations Spanning Institutions: Influences on Student Development. CBE-Life Sciences Education 6, 119-131.
* Humphrey, J.D., Coté, G.L., Walton, J.R., Meininger, G.A., and Laine, G.A. (2005). A New Paradigm for Graduate Research and Training in the Biomedical Sciences and Engineering. Advances in Physiology Education 29, 98-102.
* Larson, E.L., Landers, T.F., and Begg, M.D. (2011). Building interdisciplinary research models: a didactic course to prepare interdisciplinary scholars and faculty. Clin Transl Sci 4, 38-41.

Class 10: Organizational Theory & Institutional Structure and Policy for Team Science

*Required Readings for Class Discussion*

* Jones, B. (2010). As Science Evolves, How Can Science Policy? National Bureau of Economic Research Working Paper 16002, 1-31.
* Cummings, J., and Kiesler, S. (2011). Organization theory and new ways of working in science. Paper presented at: Science and Innovation Policy, 1-5.

**Team Science and Collaboration Resources:**

Numerous Team Science and Science of Team Science (SciTS) resources, tools, and references are available at <http://scienceofteamscience.northwestern.edu/team-science-resources>.

**Grading/Evaluation:**

Attendance and Active Class Participation (summarizing findings, asking questions, etc.) 80%

Case Study Small Group Assignment 10%

[TeamScience.net](http://teamscience.net) Learning Modules 2-4 (incld pre/post tests) 10%