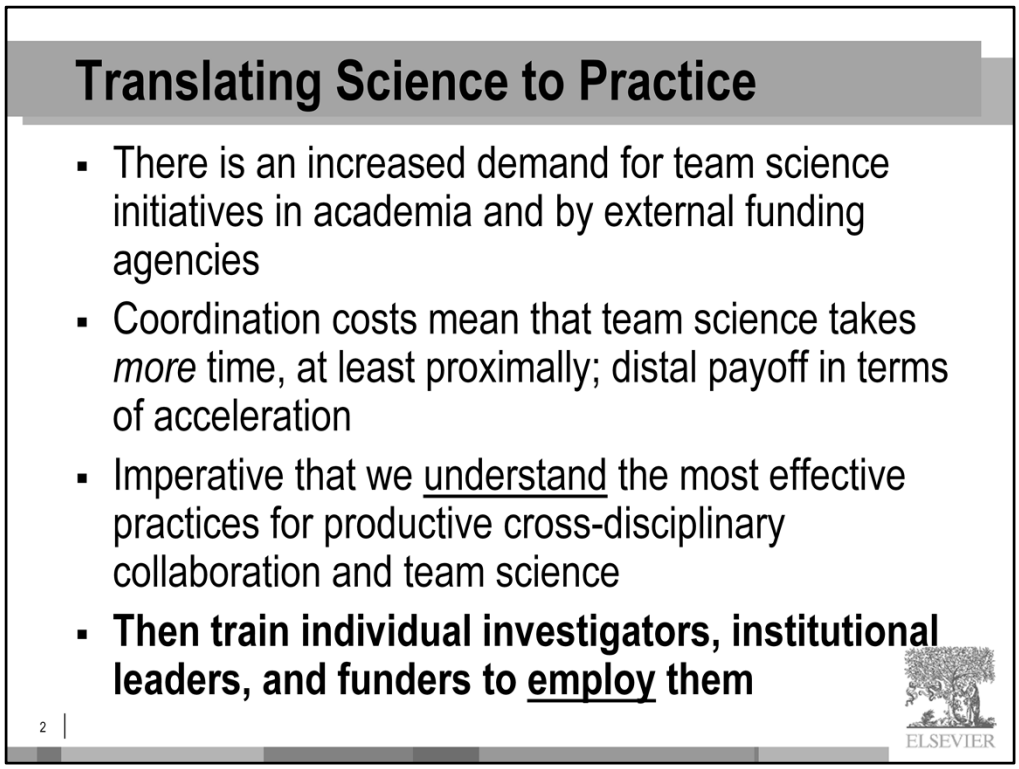
Seminar: Team Science Tools You Can Use

Team science initiatives are characterized by cross-disciplinary collaboration focused on complex problem-, project-, or product-oriented research. Over the last decade, academia has generated an upsurge in team science initiatives, while external funding agencies in the United States and around the globe have made more collaborative and team-based science funding opportunities available. Studies on research centers funded by the National Science Foundation (NSF) and National Institutes of Health (NIH) have demonstrated that team science initiatives entail significant coordination costs. As a result, team science takes more time, at least proximally, than individual research; however, studies have also demonstrated a distal payoff in terms of research acceleration. Consequently, it is imperative that team science leaders and practitioners understand the most effective practices for productive team science.

Drawing from a rich evidence base, this seminar will present participants with a collection of tools and resources for implementing effective practices in team science. The seminar will cover:

- An overview of the literature in the science of team science;
- Leadership for team science;
- Team science communication;
- Team science evaluation; and,
- Reward and recognition for collaborative science.



Coordination Costs:

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. (2005). Collaborative Research Across Disciplinary and Organizational Boundaries. Soc. Stud. Sci. *35*, 703–722.

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.

"What are the features which distinguish multidisciplinary team research from other kinds of research undertakings?"

Blackwell, G.W. (1955). Multidisciplinary Team Research. Social Forces 33, 367-374.

Elsevier's Academic Executive Brief

TEAM SCIENCE
Volume 2, Issue 2 – 2012

In our new issue, academic leaders around the globe share their knowledge of and experience with team science. Authors from the United States, Germany, Malaysia, and India explore team science in terms of institutional and national influence, team science tools and leadership, team formation and research networking systems.

DOWNLOAD PDF

http://academicexecutives.elsevier.com/volume-2-issue-2-2012

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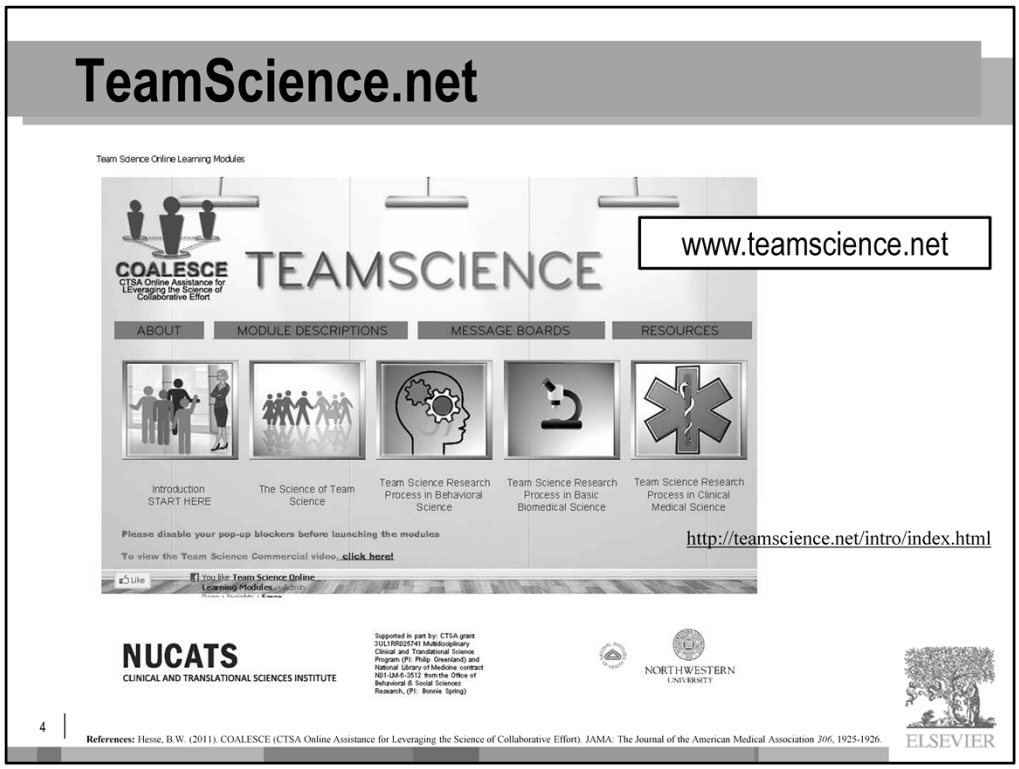


Hyperlinked to the Introduction

Solutions to complex problems in biomedical sciences require teams of specialists from diverse backgrounds working across the boundaries of disciplinary silos. The COALESCE (CTSA Online Assistance for LEveraging the Science of Collaborative Effort; 3UL1RR025741-02S4) project at Northwestern University resulted in **TeamScience.net**, an online learning tool to enhance skills needed to perform cross-disciplinary, team-based biomedical research. Diverse audiences, including trainees, senior/junior investigators, educators, institutional research development officers, and funding agency program officers can benefit from the tool.

TeamScience.net is an exciting open suite of e-learning resources designed to foster learning and skill development in Team Science.
TeamScience.net addresses a diverse audience of researchers at multiple career stages, research development officers and research administrators, and students and educators interested in conducting and/or facilitating team science in biomedical and clinical sciences.
The tool enables learners to gain access to information relevant to forming, leading, and evaluating teams that realizes the benefits of a conversation with a human expert. TeamScience.net provides examples of real world scenarios unique to collaborative team science through four self-guided learning modules intended to help researchers acquire and apply a basic knowledge of team science. All content presented in the modules is grounded in empirical research and theory about the science of team science (SciTS) and team research more broadly, and the experts interviewed are well-published in those domains.

Module 1 provides a didactic yet interactive overview of SciTS; modules 2-4 afford an experiential learning environment where the researcher can adopt different roles and engage virtually in the challenges of team research.

Module 1: The SciTS module introduces key concepts of team science by showcasing successful national multi/inter/transdisciplinary research programs, and introduces learners to empirical and theoretical research that provides evidence-based guidance about effective science teams through interviews with prominent team science experts and a presentation of their findings;

Module 2: The Behavioral Team Science module takes learners through a series of simulations as a senior investigator applying for an interdisciplinary program project grant;

Module 3: The Biomedical Team Science module takes learners through a series of simulations as a research development officer working with a senior investigator to develop a very large, transdisciplinary research center;

Module 4: The Clinical Team Science module takes learners through as series of simulations as an early career physician scientist developing a collaborative clinical trial research project grant proposal.

Portable Team Science Training

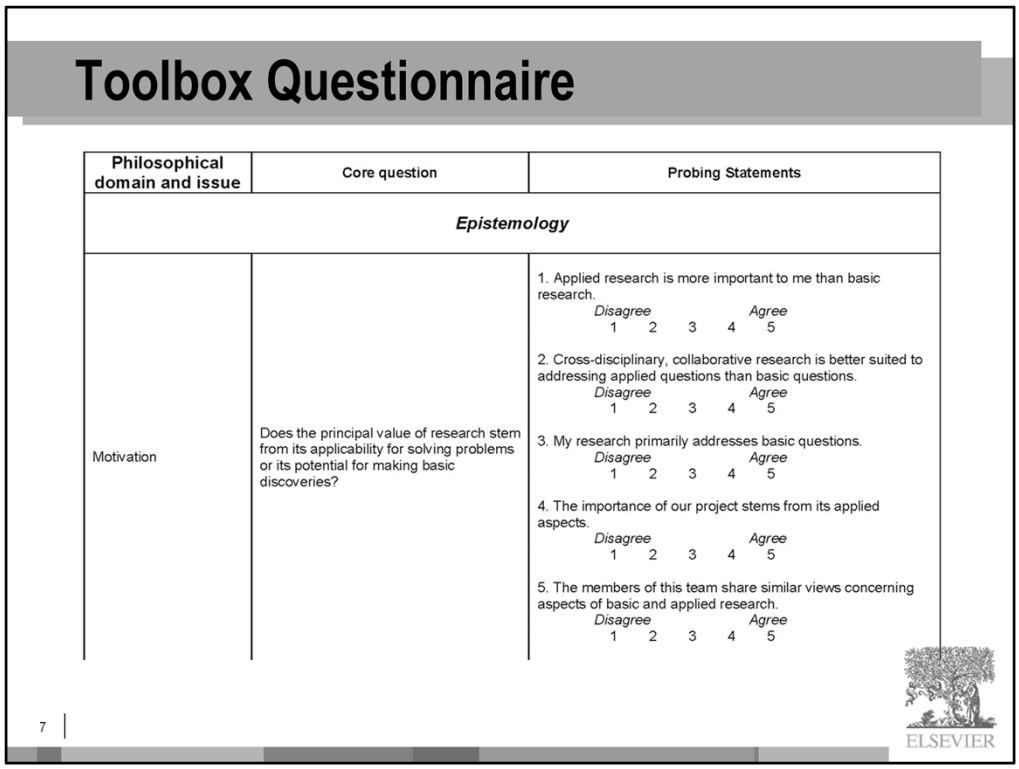
Case Study Approach:

- 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
- What was the nature/impetus for the collaboration?
- What factors helped the team build trust?
- What factors threatened that trust?
- How did the team use communication effectively?
- What communication issues were problematic for the team?
- How did the team manage conflict?
- What role, if any, do power and hierarchical relationships play in this case?
- What strategies did the team employ to share credit?

Toolbox Project

The Toolbox Project[1,2] Collaborative Communication Workshop provides a philosophical yet practical enhancement to cross-disciplinary, collaborative science. Rooted in philosophical analysis, the Toolbox workshop enables investigators, research development professionals, project managers, and collaborators to engage in a structured dialogue about their research assumptions and cross-disciplinary collaboration. This yields both self-awareness and mutual understanding, supplying individuals with the robust foundation needed for effective collaborative research. Led by Toolbox Project Facilitators, Workshop participants will engage in small group discussion and share respective views in response to a number of probing statements about science motivation, methodology, confirmation, objectivity, values, and reductionism.

[1]*Eigenbrode, S.D., O'Rourke, M., Wulfhorst, J.D., Althoff, D.M., Goldberg, C.S., Merrill, K., Morse, W., Nielsen-Pincus, M.A.X., Stephens, J., Winowiecki, L., et al. (2007). Employing Philosophical Dialogue in Collaborative Science. Bioscience 57, 55-64.*
[2]*Crowley, S., Eigenbrode, S.D., O'Rourke, M., and Wulfhorst, J.D. (2010). Cross-disciplinary localization: A philosophical approach. MultiLingual, September, 1-4.*



Toolbox Questionnaire

Philosophical domain and issue	Core question	Probing Statements
	Epistemology	
Motivation	Does the principal value of research stem from its applicability for solving problems or its potential for making basic discoveries?	1. Applied research is more important to me than basic research. *Disagree* 1 2 3 4 5 *Agree* 2. Cross-disciplinary, collaborative research is better suited to addressing applied questions than basic questions. *Disagree* 1 2 3 4 5 *Agree* 3. My research primarily addresses basic questions. *Disagree* 1 2 3 4 5 *Agree* 4. The importance of our project stems from its applied aspects. *Disagree* 1 2 3 4 5 *Agree* 5. The members of this team share similar views concerning aspects of basic and applied research. *Disagree* 1 2 3 4 5 *Agree*

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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.*
Crowley, S., Eigenbrode, S.D., O'Rourke, M., and Wulfhorst, J.D. (2010). Cross-disciplinary localization: a philosophical approach. MultiLingual *September, 1-4.*

Collaboration Readiness

- **On-line diagnostic survey for geographically distributed collaborations. The survey probes factors that may strengthen or weaken the collaboration. The Wizard provides both personal and project-level reports to help build successful and productive collaborative projects.**

http://hana.ics.uci.edu/wizard/index.php

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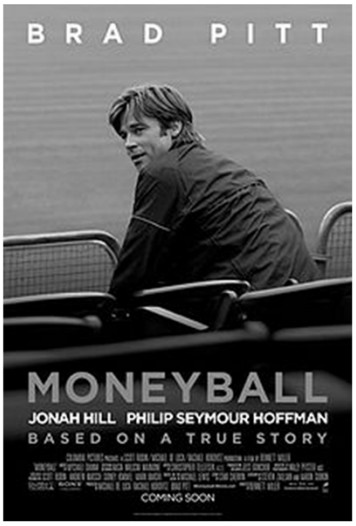
Based on the Theory of Remote Collaboration (TORC)

See also Bennett, L.M., and Gadlin, H. (2012). Collaboration and Team Science: From Theory to Practice. J Invest Med *60*, 768-775

Team Composition



Team of Experts ≠ Expert Team

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The Winning Model

- **Right mix of expertise and team-players**
- **Intervention/coaching to help use the collective expertise well**

11

Hackman, J.R. (2011). Collaborative Intelligence: Using Teams to Solve Hard Problems .

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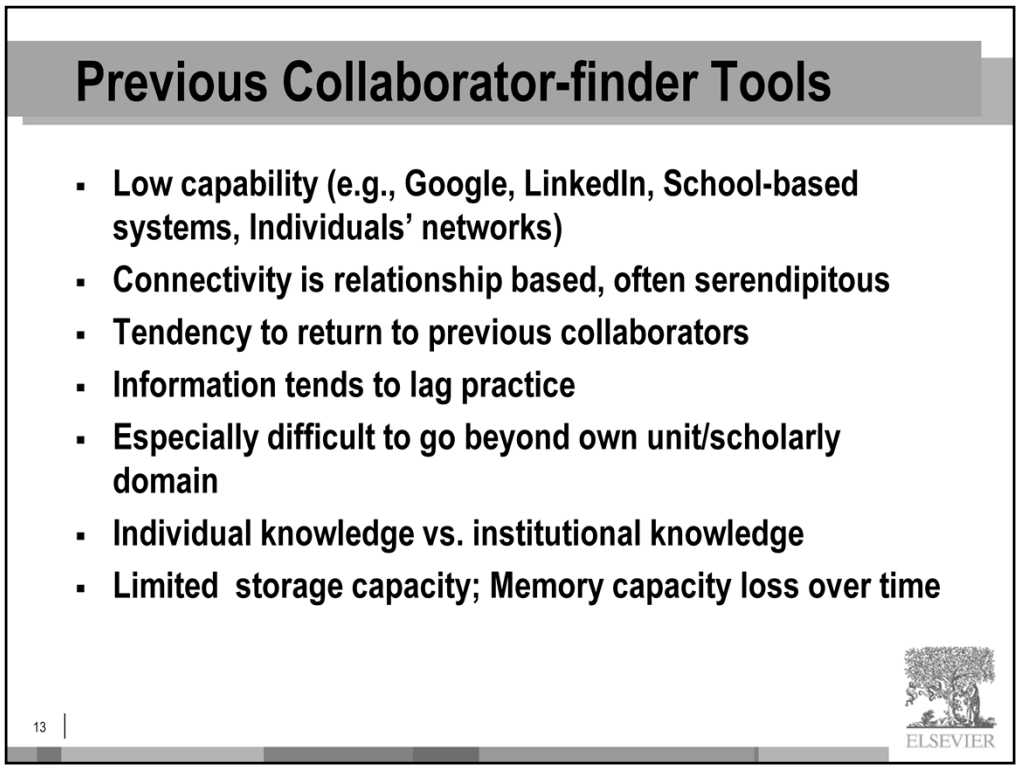
High Expertise but NO Coaching = Significantly Impaired Performance, even more so than lower level of expertise w/ coaching

1980 Olympic Hockey Gold Medal team

The book "Cracking the Code" is about the US team for the Ryder cup. It's a real story of how superstars were brought together by figuring out their strengths, and matching them together in groups so that they helped each other, instead of bumping heads and egos. They used professional assessments like the Myers-Briggs so that they complemented one another.
http://www.amazon.com/Cracking-Code-Winning-Ryder-Strategy/dp/1929619383

"If more work is being done in teams and that work is of greater impact, then surely locating the right members for any team is more important than ever." *Carey, J. (2011). Faculty of 1000 and VIVO: Invisible Colleges and Team Science. In Issues in Science and Technology Librarianship.*



Faculty will make connections on their own only to a small extent
Current connector facilitators are Research Development Professionals, Research Administrators, & Librarians
Need to find matches more quickly, and to help make *non-intuitive* matches

Research Networking Systems

- **Web-based knowledge management system for the research enterprise**
- **Faculty expertise/profile systems**
  - Harvest expertise and scholarship information
  - Automatic ingest from authoritative systems, validated data
  - Interoperability and connectivity with: school-level resources, University enterprise systems, national research networks, publicly available research data, and restricted data about faculty expertise and scholarly/research activity
- **Recommender system**
- **Analytics to evaluate research, scholarly activity, and resources**
- **Facilitate new collaborations through discovery of expertise**
- **Intellectual networking vs. social networking**
- **Research network visualization**

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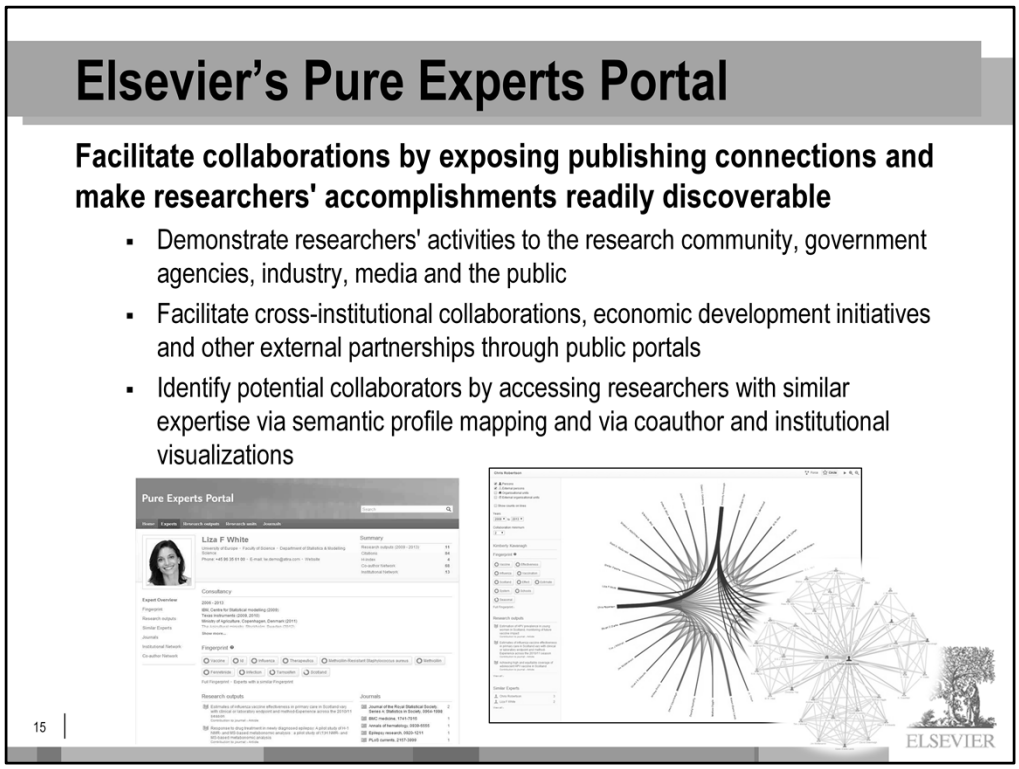


Pure Experts Portal helps research managers, research administrators and research development professionals at your institution
Facilitate collaborations by exposing publishing connections and make researchers' accomplishments more discoverable

Pure Experts Portal makes it easy to demonstrate researchers' activities to the research community, government agencies, industry, media and the public.
Facilitate cross-institutional collaborations, economic development initiatives and other external partnerships through your public Experts Portal.
Connect and collaborate: Users can identify potential collaborators by accessing a list of researchers with expertise similar to the profiled researcher and via coauthor and institutional visualizations.

With SciVal Experts, you can enable collaboration internally or across institutions. You can connect your faculty with researchers at a range of institutions in the US and beyond. Furthermore, you can make your SciVal Experts application publically available, and showcase your researchers' activities and accomplishments worldwide. Demonstrate the strength of your researchers and research programs while forming new partnerships globally.

Old SciVal Experts:

Expertise profiling and research networking tool

- Find collaborators by areas of mutual interest inside and outside your institution
- Showcase your researchers' accomplishments and attract new partners
- Identify organizational strengths by revealing expertise via publication histories at the individual, department or institution levels
- Reduces administrative burdens: an in-house profiling system can take at least one to two years; SciVal produces an in-depth database in little time

SciVal Experts is an expertise profiling and research networking tool pre-populated with publication histories from Scopus, the world's largest abstract and citation database of peer reviewed literature.

New Pure Experts Portal:

Pure allows you to combine your internal systems, external data sources and legacy data into a single platform, providing a comprehensive view on your institution's research activities. Utilizing this validated data, Pure provides unique expertise profiling and research networking capabilities, making it easier to find experts and form teams within your institution and across organizations.

The Pure Experts Portal helps researchers at your institution

Demonstrate researcher activities and accomplishments to attract potential collaborators

Every researcher profile delivers a comprehensive list of publications, coauthor and institutional networks, a list of similar experts and a semantic index, or Fingerprint™ visualization, of the researcher's distinctive expertise.
Pure can integrate institutional content from systems such as HR, student administration, finance and award management which can be displayed in the Experts Portal*
Individual users can also enter a variety of content including publications, intellectual property, teaching, press clippings, awards and honors, and professional information
Identify a researcher's area of expertise through their unique semantic Fingerprint and uncover related content linked to their semantic index of concepts

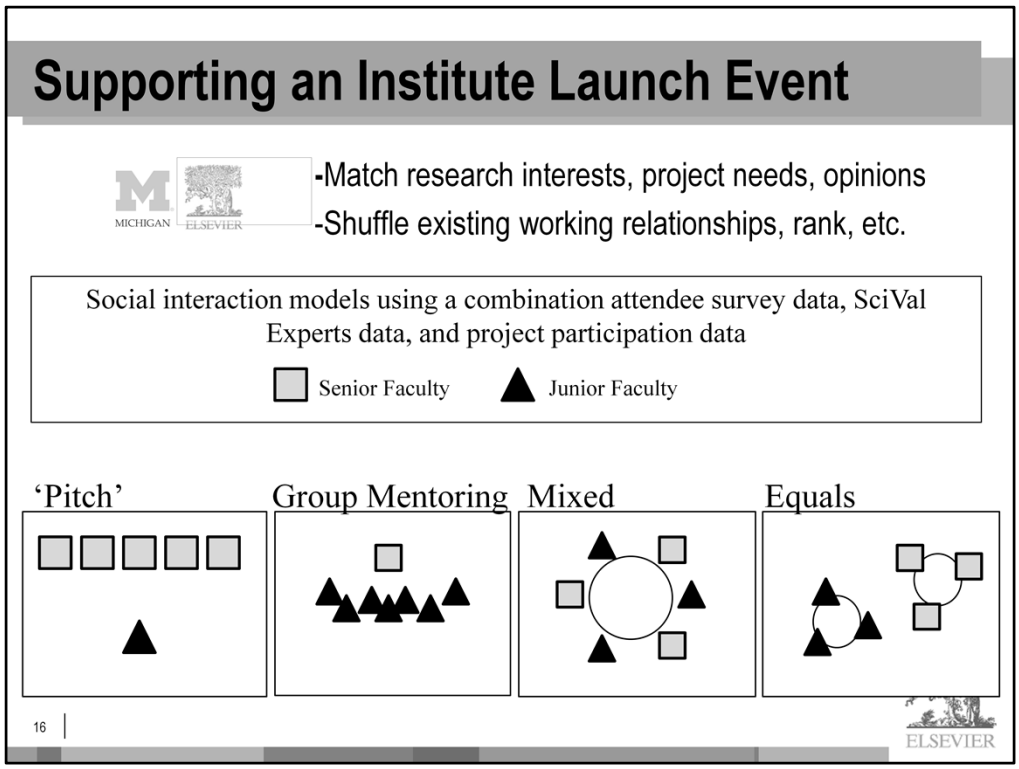
Discover more about the content written by other researchers

Link directly to comprehensive detail pages for all content published on the portal, including links through to the source articles
Learn more about the article's social media impact via integrated Altmetrics
Discover new research articles through related content and the full article Fingerprint

Identify other researchers' distinctive expertise and find potential partners

Powered by the Elsevier Fingerprint Engine™, Pure uses semantic technology and field-of-research specific vocabularies to help researchers identify their peers' expertise – down to the most precise terms.

Search by concept or last name, or enter free text such as an abstract or funding opportunity, and the Experts Portal provides a targeted list of researchers within the institution who have authored articles related to the search criteria.
From summer 2014, researchers can also form partnerships with experts at other institutions by searching across the Experts Portal Community, an international network of organizations that have adopted SciVal Experts, Pure Experts Portal, andDIRECT2experts, a network of additional research profile systems.



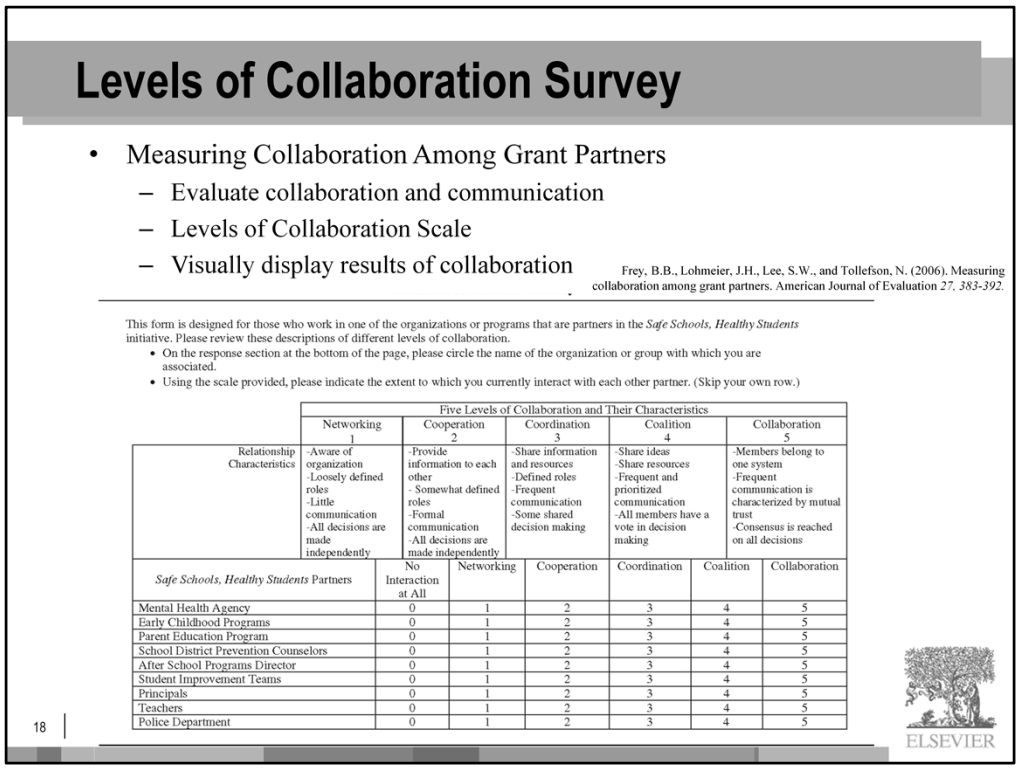
Drive Better-than-chance Interactions
When researchers:

- Don't know each other well
- Have some common interest(s)
- Stand to mutually benefit

Grant Proposal Fodder

Team Development Activities

- **Identify and engage potential collaborators and assemble the team**
- **Develop partnerships, a collaborative research agenda, shared conceptual framework**
- **Consider how to expand the *number* and *type* of investigators working in the collaboration**
- **Promote mentoring, conflict management, cross-talk, integration**
- **Disseminate findings, sustain the collaboration**
- **Evaluate process and outcomes**



Levels of Collaboration Survey

- Measuring Collaboration Among Grant Partners
  - Evaluate collaboration and communication
  - Levels of Collaboration Scale
  - Visually display results of collaboration

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.*

This form is designed for those who work in one of the organizations or programs that are partners in the *Safe Schools, Healthy Students* initiative. Please review these descriptions of different levels of collaboration.

- On the response section at the bottom of the page, please circle the name of the organization or group with which you are associated.
- Using the scale provided, please indicate the extent to which you currently interact with each other partner. (Skip your own row.)

	Five Levels of Collaboration and Their Characteristics				
	Networking 1	Cooperation 2	Coordination 3	Coalition 4	Collaboration 5
Relationship Characteristics	-Aware of organization -Loosely defined roles -Little communication -All decisions are made independently	-Provide information to each other - Somewhat defined roles -Formal communication -All decisions are made independently	-Share information and resources -Defined roles -Frequent communication -Some shared decision making	-Share ideas -Share resources -Frequent and prioritized communication -All members have a vote in decision making	-Members belong to one system -Frequent communication is characterized by mutual trust -Consensus is reached on all decisions

Safe Schools, Healthy Students Partners	No Interaction at All	Networking	Cooperation	Coordination	Coalition	Collaboration
Mental Health Agency	0	1	2	3	4	5
Early Childhood Programs	0	1	2	3	4	5
Parent Education Program	0	1	2	3	4	5
School District Prevention Counselors	0	1	2	3	4	5
After School Programs Director	0	1	2	3	4	5
Student Improvement Teams	0	1	2	3	4	5
Principals	0	1	2	3	4	5
Teachers	0	1	2	3	4	5
Police Department	0	1	2	3	4	5

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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.*

- Measuring Collaboration Among Partners
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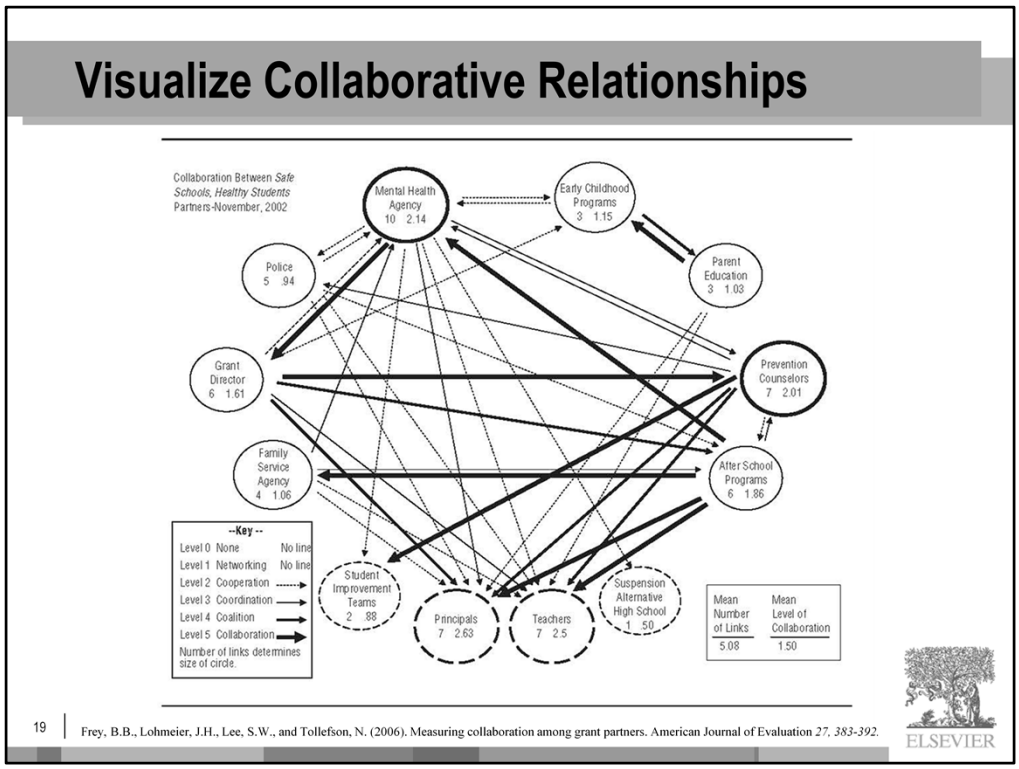
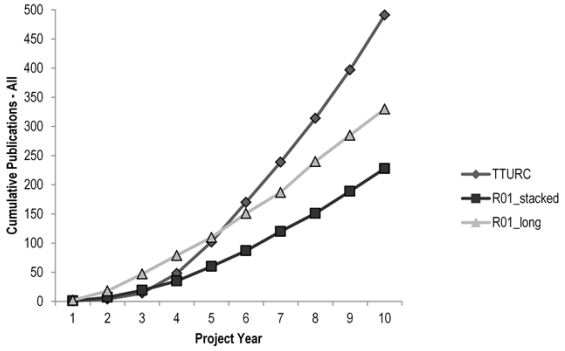


Frey, B.B., Lohmeier, J.H., Lee, S.W., and Tollefson, N. (2006). Measuring collaboration among grant partners. American Journal of Evaluation *27, 383-392.*

Funding for Team Science

Comparing (cumulative) number of publications of TD initiative with matched R01 projects from the tobacco field over 10-year period



Centers initial lag in number of publications is eliminated around Project Year 4.

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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.

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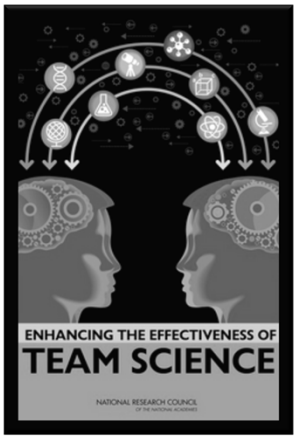
This study used a quasi-experimental design incorporating three comparison groups. The first group included the six TTURC centers with continuous funding from 1999 to 2009; these centers encompassed 39 distinct primary research subprojects that lasted for either 5 (n33) or 10 (n6) years. The second and third components consisted of two comparison groups encompassing investigator-initiated tobacco use research grants funded through theNIHR01 grant mechanism. These groups were generated using an NIH-wide grants management database and subsequently screened by tobacco scientists to identify grants that matched the TTURC primary research subprojects on duration, timing, scope, and topical focus. The longitudinal R01 (LR01) award comparison group (n21) was designed to match the 10-year duration and consistent institutional infrastructure and resources of the six TTURCs. The stacked R01 (SR01) award comparison group (n39) was designed to match the duration and funding periods of the 39 TTURC subprojects.

National Academies Consensus Report



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DIVISION OF BEHAVIORAL AND SOCIAL SCIENCES AND EDUCATION

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The Science of Team Science

Project Scope

The NRC will conduct a consensus study on the science of team science to recommend opportunities to enhance the effectiveness of collaborative research in science teams, research centers, and institutes. The science of team science is a new interdisciplinary field that empirically examines the processes by which large and small scientific teams, research centers, and institutes organize, communicate, and conduct research. It is concerned with understanding and managing circumstances that facilitate or hinder the effectiveness of collaborative research, including translational research. This includes understanding how teams connect and collaborate to achieve scientific breakthroughs that would not be attainable by either individual or simply additive efforts. The committee will consider factors such as team dynamics, team management, and institutional structures and policies that affect large and small science teams. Among the questions the committee will explore are:

- How do individual factors (e.g., openness to divergent ideas), influence team dynamics (e.g., cohesion), and how, in turn, do both individual factors and team dynamics influence the effectiveness and productivity of science teams?
- What factors at the team, center, or institute level (e.g., team size, team membership, geographic dispersion) influence the effectiveness of science teams?
- How do different management approaches and leadership styles influence the effectiveness of science teams? For example, different approaches to establishing work roles and routines and to the division of labor may influence team effectiveness.
- How do current tenure and promotion policies acknowledge and provide incentives to academic researchers who engage in team science?
- What factors influence the productivity and effectiveness of research organizations that conduct and support team and collaborative science, such as research centers and institutes? How do such organizational factors as human resource policies and practices and cyberinfrastructure affect team and collaborative science?
- What types of organizational structures, policies, practices and resources are needed to promote effective team science, in academic institutions, research centers, industry, and other settings?

Sponsored by the National Science Foundation and Elsevier, the project began in October, 2012. A report will be issued in late 2014 or early 2015.

Members

Dr. Nancy J. Cooke, *Chair*, Arizona State University
Dr. Roger Blandford, Department of Physics, Stanford University

NSF

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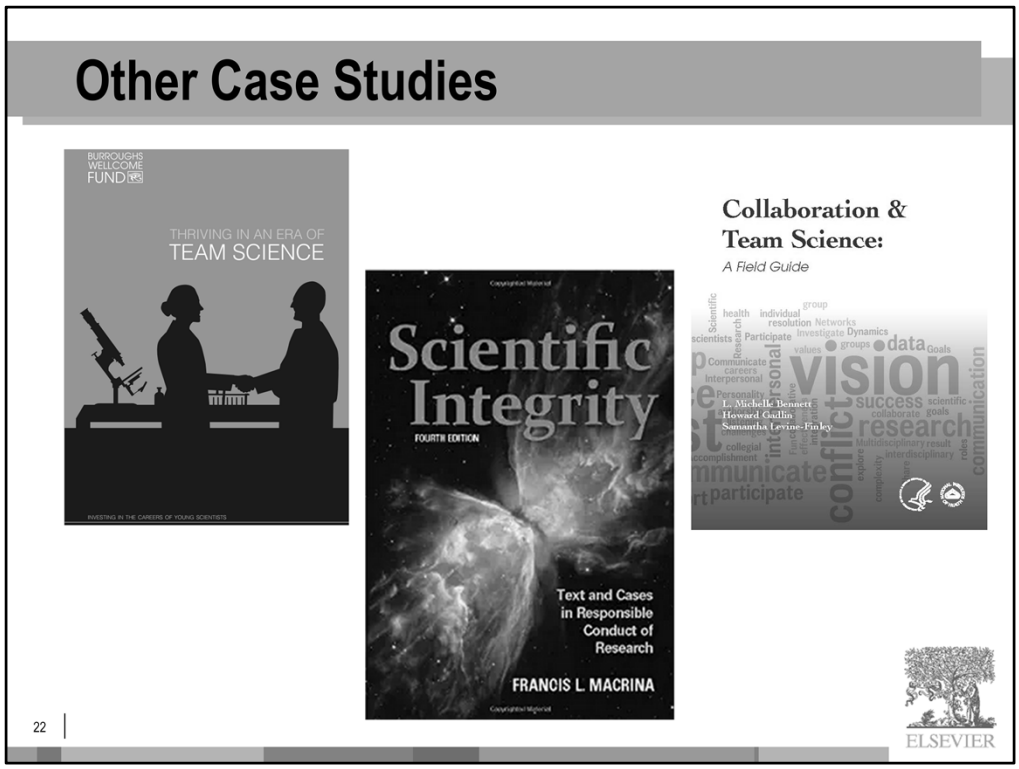
http://sites.nationalacademies.org/dbasse/bbcss/currentprojects/dbasse_080231



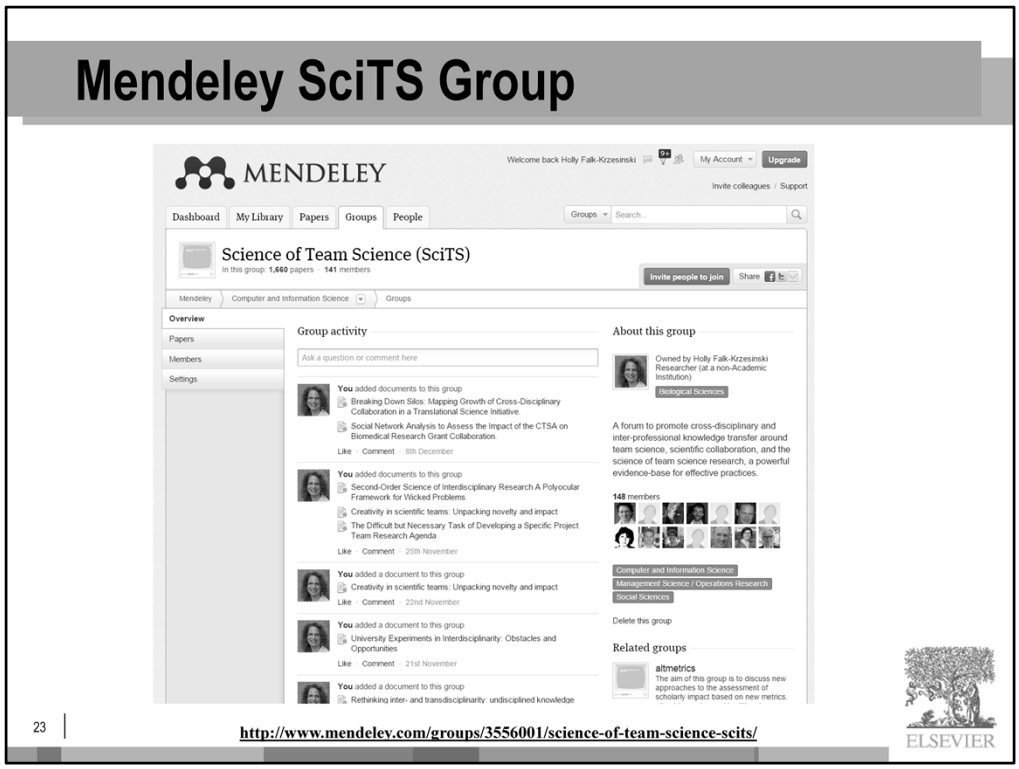
http://www.bwfund.org/career-tools/thriving-era-team-science

The fourth installment of the Burroughs Wellcome Fund Career Development Guide series has been released. *Thriving in an Era of Team Science*. It, like the others in the series, offers tips and advice from established investigators on how to survive and thrive in collaborative science.

Chapters include how to build a career in teams, how to prepare to work as part of a team, and what the future outlook holds for team science initiatives. Written by former BWF communications officer Karyn Hede, this installment offers four case studies from scientists who have successfully navigated collaborative science.

As the introduction explains, "…most academic scientists work in a system that has not yet defined how its historical and traditional methods for evaluation and rewarding scholars will adapt to a world in which important contributions are made not only by a principal investigator driving projects, but also by investigators whose most critical and valuable work occurs in the context of team efforts."

For a free copy of *Thriving in an Era of Team Science*, please email Russ Campbell at news@bwfund.org and provide a mailing address. The booklet is also available at scribd, issuu, and as a PDF.

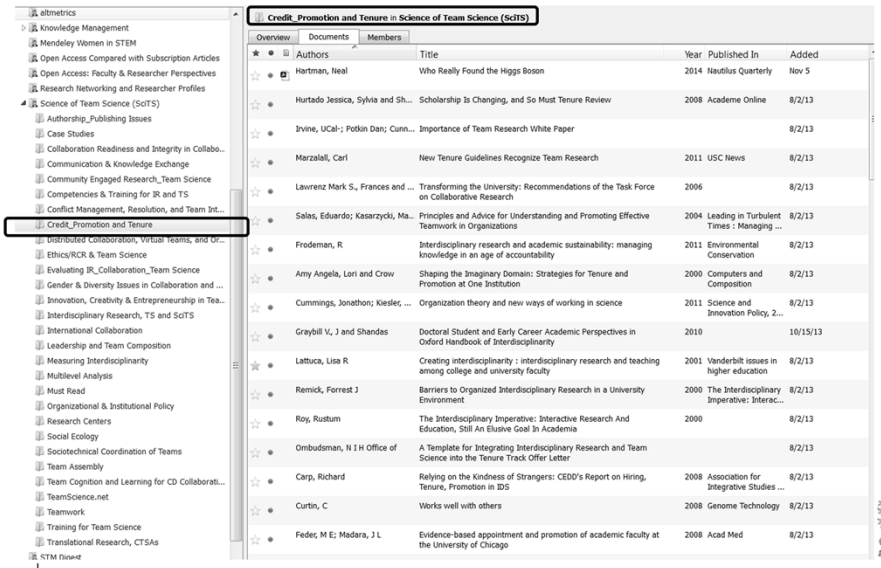


Screen shot from Mendeley Science of Team Science (SciTS) Group (which is public!)

The Mendeley Science of Team Science (SciTS) Group library is the most comprehensive, authoritative source of empirical literature on team science and scientific collaboration in the world.

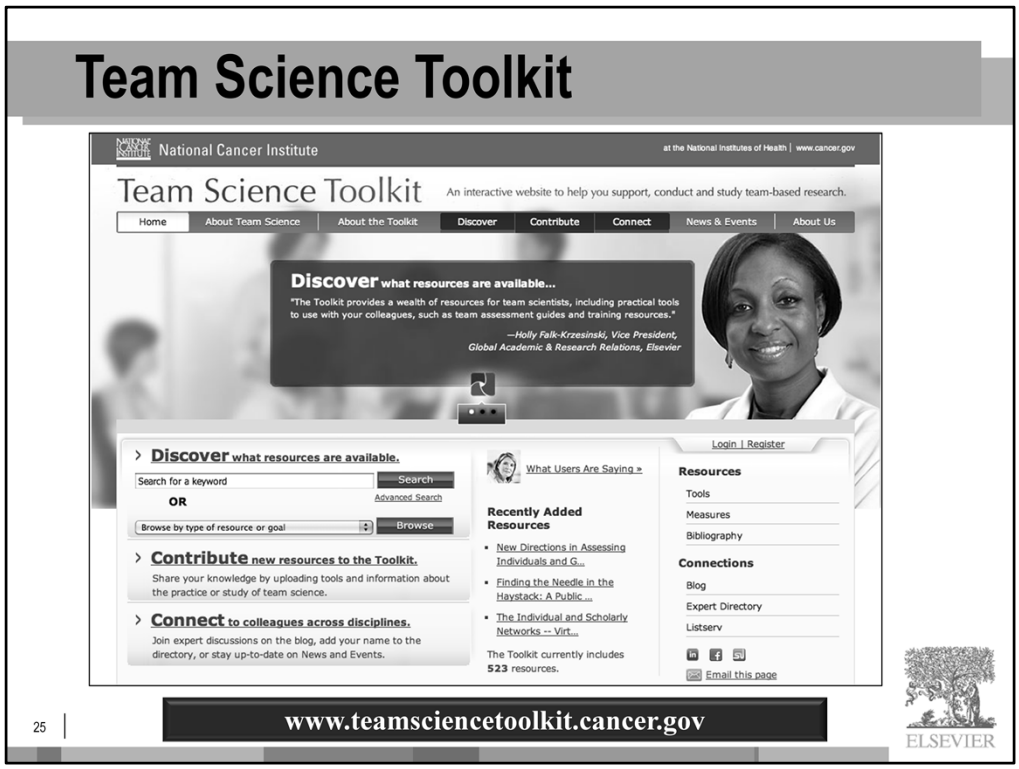
It is a free, public group available via the web and through the (free) Mendeley Desktop tool that syncs with the web. It provides access to almost 1,700 references, some organized into practice-oriented subgroups. Since this is a public group, any member can add references directly (and in the Desktop tool, add to and/or create new subgroups) for all members to read—a genuine community resource. The Mendeley Science of Team Science (SciTS) Group is the source of references for the NIH's Team Science Toolkit and was used by the National Academy of Science to conduct their consensus report on the science of team science, which will be released at the end of 2014.

Groups of Documents



http://www.mendeley.com/groups/3556001/science-of-team-science-scits/

Screen shot from Desktop version



The Team Science Toolkit is an interactive website that provides resources to help users support, engage in, and study team-based research.

Discover:

Learn from colleagues by exploring Toolkit resources contributed by other users
Download resources that can support your goals

Contribute:

Share your knowledge of team-based research and the Science of Team Science (SciTS) field
Upload resources such as documents and links, or comment on resources already in the database

Connect:

Connect with colleagues who share your interest in team-based research through the expert blogs, news and events bulletin boards, expert directory, and listserv

SciTS Listserv

- The **Science of Team Science (SciTS) listserv** facilitates conversation among individuals who are engaged in, studying, or managing team science, in the US and internationally. The listserv is maintained collaboratively by the SciTS Team at the National Cancer Institute, Division of Cancer Control and Population Sciences, Behavioral Research Program (http://cancercontrol.cancer.gov/brp/scienceteam) at the NIH.
  - TO SUBSCRIBE: Send an email with a blank subject line to: listserv@list.nih.gov. The message body should read: subscribe SciTSlist [your full name]. Please do not include the brackets. For example, for Robin Smith to subscribe, the message would read: subscribe SciTSlist Robin Smith. You will receive a confirmation email.
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  - TECHNICAL PROBLEMS WITH YOUR SUBSCRIPTION? Contact the list administrator, Judy Kuan, at: kuanj@mail.nih.gov. Please be sure to state that your email is in reference to the SciTS listserv.

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