The Science of Team Science and Collaborative Research

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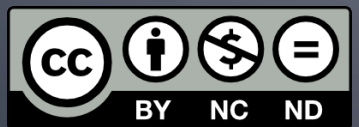
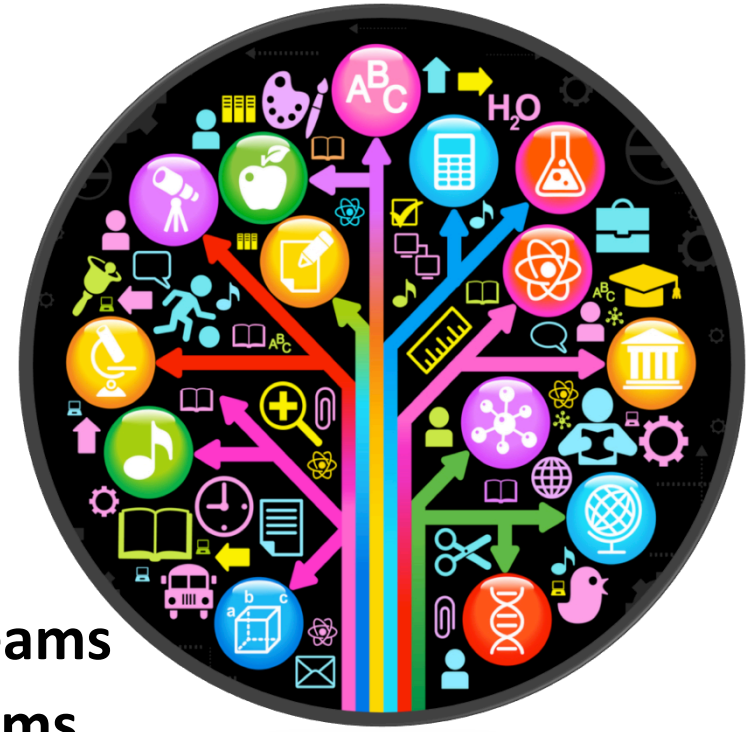


Overview

- Part 1. Laying Foundation for a *Science of Team Science*
- Part 2. Developing the Science of Team Science
- Part 3. Applying Team Theory to Scientific Collaboration
  - 3.1. Of Teams and Tasks
  - 3.2. Leading Science Teams
  - 3.3. Educating and Training Science Teams
  - 3.4. Interpersonal Skills in Science Teams
- Part 4. Resources on the Science of Team Science



Part 1. Laying the Foundation for a Science of Team Science

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ISSUE - *Dealing with Scholarly Structure*

- Disciplines are distinguished partly for historical reasons and reasons of administrative convenience (such as the organization of teaching and of appointments)… But all this classification and distinction is a comparatively unimportant and superficial affair. **We are not students of some subject matter but students of problems. And problems may cut across the borders of any subject matter or discipline** (Popper, 1963).

ISSUE - *Dealing with University Structure*

- What is critical to realize is that "the way in which our universities have divided up the sciences does not reflect the way in which nature has divided up its problems" (Salzinger, 2003, p. 3)

To achieve success in scientific collaboration we must surmount these challenges.

Popper, K. (1963). *Conjectures and Refutations: The Growth of Scientific Knowledge.* London: Routledge.

Salzinger, K. (2003). Moving Graveyards. *Psychological Science Agenda, Summer, 3.* Washington, DC: American Psychological Association.

Part 1. Laying the Foundation for a Science of Team Science

- Consider what was published on this topic in the journal *Science*:
  - "The interdisciplinary approach is becoming one of the prominent characteristics of [science] and represents a synthesizing trend which focuses the specialized research techniques on problems common to a number of separate disciplines. Such cooperative research has to overcome serious obstacles when operating within the existing departmentalized framework of the universities. It appears that real progress in this direction will be made in institutions which are organized on a permanent and frankly cooperative basis. Psychologically, interdisciplinary research requires not only abstract, theoretical intelligence…, but also 'social intelligence.' Cooperative work is a social art and has to be practiced with patience."

Part 1. Laying the Foundation for a Science of Team Science

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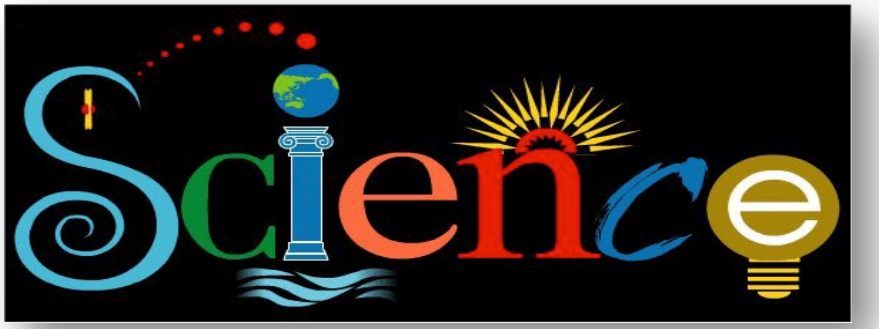
What is informative here?

- Increasing influence/importance of interdisciplinarity as method of inquiry
- Challenge of interdisciplinarity distinguished in 2 ways:



1) The problem of **INFRASTRUCTURE** - tangible and tacit

- Inherent challenge associated with structure of the modern university - **the discipline bound department**
- **Tacit norms** which prevent or stifle interaction amongst them

2) The problem of **INTERACTION**

- Difficulty in **communicating** across disciplines
- Need for patience and **particular form of social intelligence** to effectively collaborate

Part 1. Laying the Foundation for a Science of Team Science

- Anyone familiar with some manner of cross-disciplinary collaborative effort will likely have experienced some or all of these factors
  - ***So one might wonder why this quote is particularly informative***
- What is informative is not **what** was said, it is **when** it was said
  - ***Written well over a half century ago in one of first articles specifically addressing interdisciplinary research (Brozek & Keys, 1944).***

- **Science still struggles so why should we think anything will change?**
  - ***Should we be so bold as to think that we have a better chance at overcoming these challenges than those from generations before us?***

Part 1. Laying the Foundation for a Science of Team Science

YES - for THREE main reasons:

1. Increased **emphasis on collaborative research** projects that create a team of scholars cutting across disciplines to address complex phenomena
2. **Policy, Academia, and Industry** communities all making more of a concerted effort to understand and improve collaborations
3. Tremendous **growth** in study and understanding of teams

- ***It is the scientific study of teamwork that could be the true catalyst for change***
  - Matured into its own area of inquiry producing a rich base of knowledge
  - Helped us to better understand the complex coordinative processes engaged by teams

Part 1. Laying the Foundation for a Science of Team Science

- What do we mean by teams
  - Multiple information sources and intensive communication
  - Task-relevant knowledge with meaningful task interdependencies
  - Affective and attitudinal factors influence group dynamics
  - Coordination among members with specialized roles

- Reframing science collaboration as a process of teamwork to be mastered (Fiore, 2008)
  - Allows us to leverage social sciences
  - Changes question to understanding team activities necessary for science
  - Makes the achievement and measurement of team science more tractable

Fiore, S. M. (2008). Interdisciplinarity as teamwork: How the science of teams can inform team science. *Small Group Research, 39(3),* 251-277.

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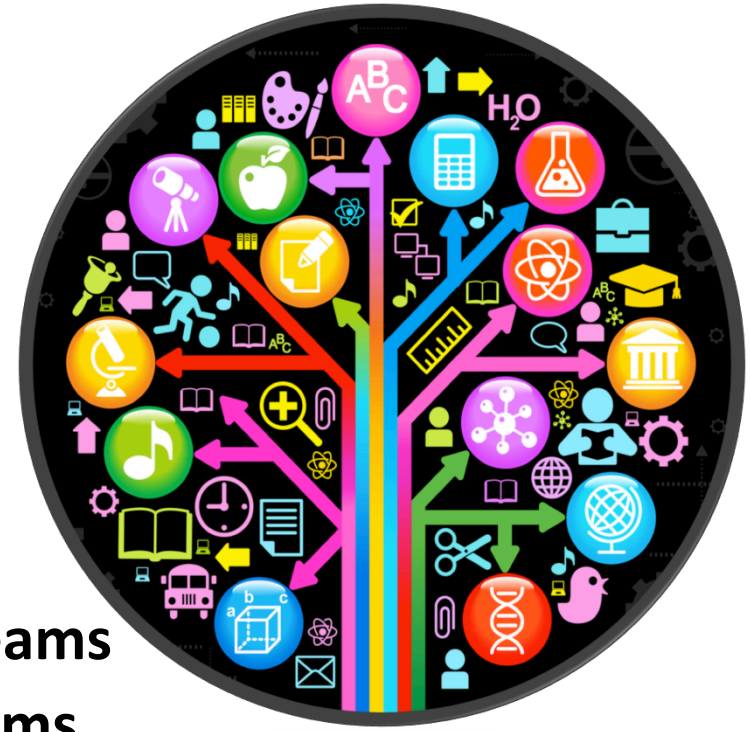

Part 2. Developing the Science of Team Science

A New Field - *Science of Team Science*

- Commitment to **develop scholarly examination of teamwork in science**
  - "*the inherent complexity of contemporary public health, environmental, political, and policy challenges… [leads to] realization that an integration of multiple disciplinary perspectives is required to better understand and ameliorate these problems*" (Stokols et al., 2008).
- Understand and improve how scholars interact and integrate across disciplinary, professional, and institutional boundaries (e.g., Börner et al., 2010; Falk-Krzesinski et al., 2010; Fiore, 2008; Hall et al., 2008; Stokols et al., 2008).

- *Must understand how to make full use of the **scientific capacity** of science teams (Salazar et al., 2012)*

Salazar, M. R., Lant, T. K., Fiore, S. M., & Salas, E. (2012). Facilitating innovation in diverse science teams through integrative capacity. *Small Group Research, 43(5),* 527-558.

Part 2. Developing the Science of Team Science

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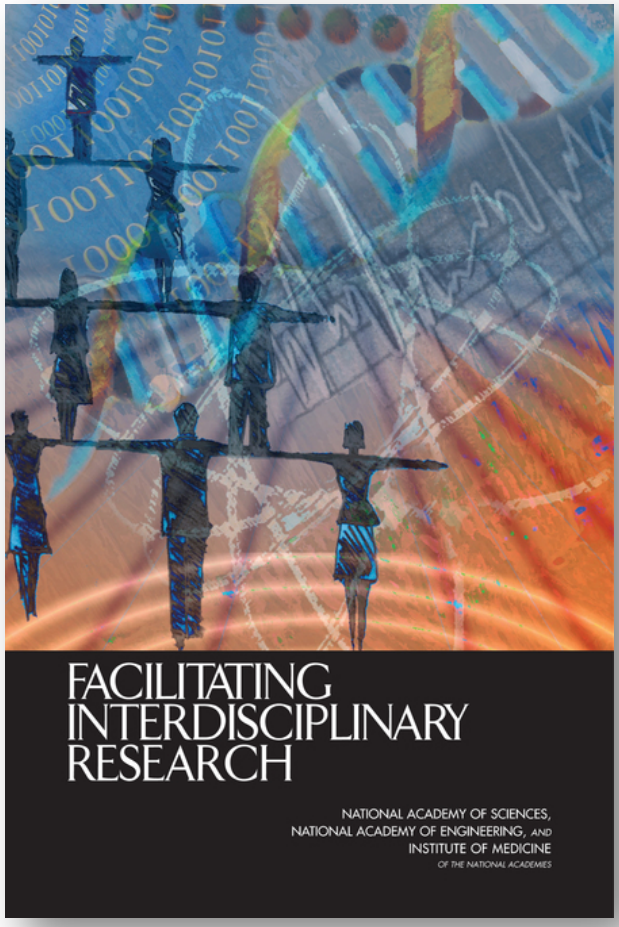
***What does it mean to do* research across disciplines?**

CROSS-disciplinary Research

- **Offer this as a general term to describe:**
  - Research utilizing, in some way, varied concepts, methods, and theories from differing fields
  - Team members contribute their disciplinary expertise and collectively contribute to the production of new knowledge
- ***The form of collaboration tailored to research needs***
  - ***Multi-, Inter-, and Trans-disciplinary Research***
  - Depends upon the nature of the research question
  - Varies based upon the complexity of the interdependencies and need for integrative outcomes
  - Depends on composition of team (scientists, stakeholders)



Part 2. Developing the Science of Team Science

National Academies of Science Consensus Study

- **Rationale:** Clear need to **provide research-based guidance** to improve the processes and outcomes of team science
- **Sponsor:** National Science Foundation, Directorate of **Computer and Information Sciences and Engineering**

- **Goal:** **Enhance effectiveness** of collaborative research in science teams, research center, and institutes.
- **Audiences:** NSF and other **public and private research funders** and **scientific community**.

Enhancing the Effectiveness of Team Science (2015) -- http://www.nap.edu/catalog/19007/enhancing-the-effectiveness-of-team-science

Part 2. Developing the Science of Team Science

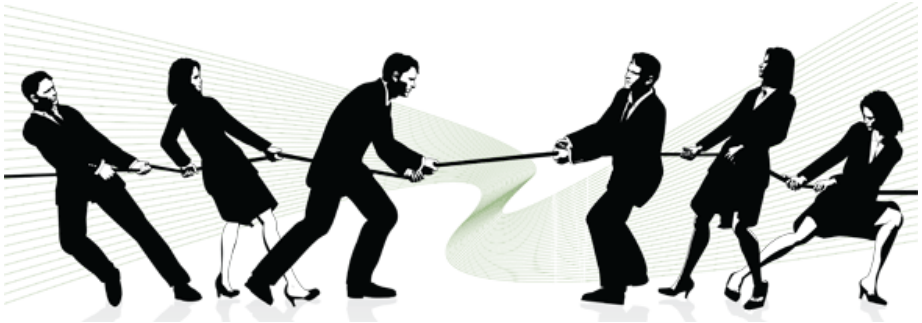
- **Duality to the Science of Team Science (SciTS)**
  - Exists a complementarity in our goals
  - Draws from iterative give-and-take between understanding and use in context of scientific teamwork

- (1) Applying what is known to improve effectiveness of science teams
  - Utilize concepts from study of other team types (e.g., team training)
  - Draw from measures and metrics of teamwork (e.g., information sharing)
- (2) Studying science teams to:
  - Gain fundamental understanding about the production of knowledge
  - Develop methods and models to improve the scientific enterprise

Enhancing the Effectiveness of Team Science (2015) -- http://www.nap.edu/catalog/19007/enhancing-the-effectiveness-of-team-science

Part 2. Developing the Science of Team Science

Key Features that Create Challenges for Team Science



- Sometimes large size
- Large membership diversity
- High task interdependence
- Deep knowledge integration
- Permeable boundaries
- Goal misalignment with other teams
- Geographic dispersion

Part 2. Developing the Science of Team Science

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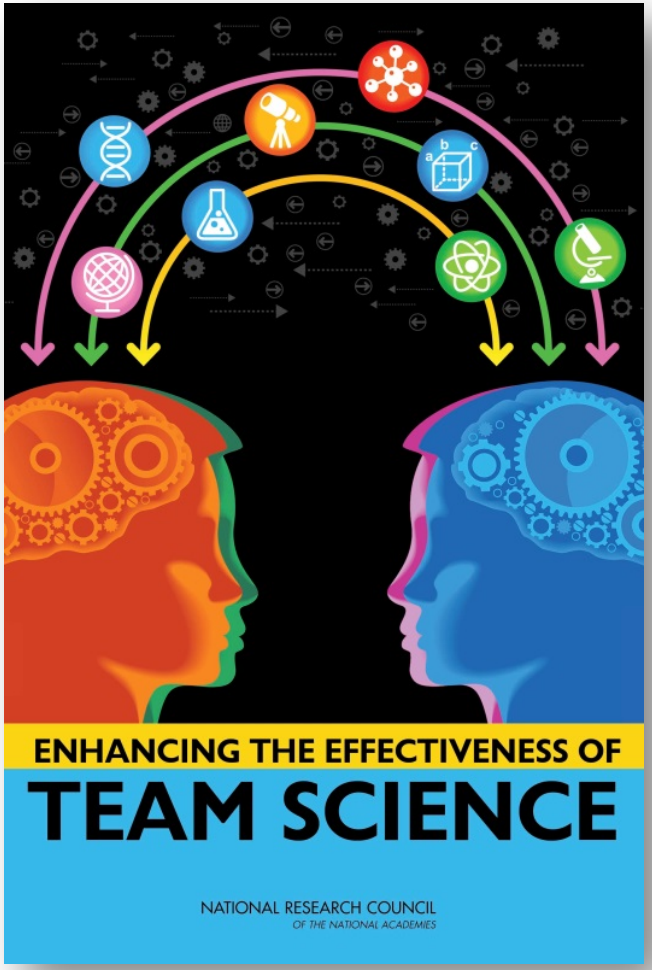
There is a rich and robust science of teams that can be extended to improve team science effectiveness

- The science points to interventions through:
  - Assembling teams
  - Providing professional development and education opportunities
  - Leadership development opportunities
- Other interventions can improve:
  - Virtual collaboration
  - P&T credit for team-based work
  - R&D in support of team science



Report and Summary Available

http://sites.nationalacademies.org/DBASSE/BBCSS/Enhancing_Effectiveness_of_Team_Science/index.htm

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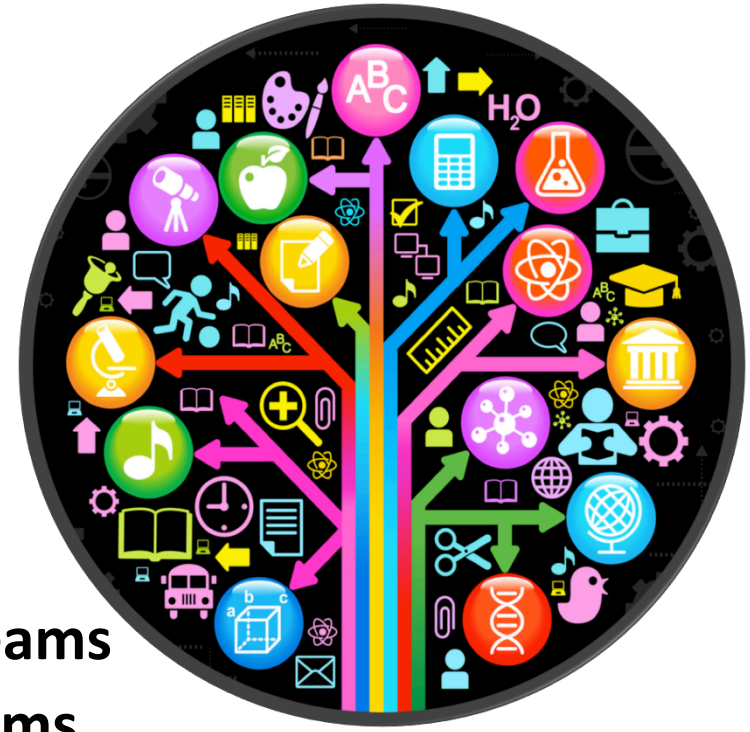

Part 3. Applying Team Theory to Scientific Collaboration

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Guidance for University of Cincinnati Research Teams

- **GOAL 1:** Provide summary of subset of concepts necessary for team effectiveness
- **GOAL 2:** Make explicit key areas of teamwork on which YOU should reflect
  - Good scientists already reflect on their scientific process; that is, they reflect on the research processes
    - In which s/he is engaged
    - In which his/her colleagues and peers are engaged
    - In which his/her students are engaged
- **OUTCOME:** Recognize that, to be a good 'team scientist' YOU also need to reflect on your *team processes*

Part 3. Applying Team Theory to Scientific Collaboration

3.1. *Of Teams and Tasks*

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Scientists Should DISTINGUISH Between TASKwork and TEAMwork

- TASKwork refers to what needs to be accomplished to meet goals and complete objectives (Morgan et al., 1986)
- This is the content relevant "work" of science teams (Fiore, 2008)
- Can be categorized along dimensions based upon KSAs for TASKwork
  - Knowledge necessary for a project
    - Understanding the relevant theories and constructs
  - Skills supporting execution of a project
    - Developing and running experiments and analyzing and writing findings
  - Attitudes about particulars of a project
    - Preferences for methodological approaches, trust in certain technologies

Fiore, S. M. (2008). Interdisciplinarity as Teamwork: How the Science of Teams can inform Team Science. *Small Group Research, 39(3),* 251-277.

Morgan, B. B., Jr., Glickman, A. S., Woodard, E. A., Blaiwes, A. S., & Salas, E. (1986). *Measurement of team behaviors in a Navy environment (NTSC Tech. Rep. No. 86-014)*. Orlando, FL: Naval Training Systems Center.

Part 3. Applying Team Theory to Scientific Collaboration

3.1. *Of Teams and Tasks*

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Scientists Should DISTINGUISH Between TASKwork and TEAMwork

- TEAMwork refers to the factors required to function effectively as part of an interdependent team (Morgan et al., 1986)
- This the collaborative component of team science (Fiore, 2008)
- Can be categorized along dimensions based upon KSAs for TEAMwork
  - Knowledge associated with teammates
    - Understanding the roles and responsibilities and their capabilities
  - Skills supporting interaction with teammates
    - Communicating effectively about project and managing conflict
  - Attitudes about teammates based upon interactions
    - Trust in teammates and sense of efficacy with teammates

Fiore, S. M. (2008). Interdisciplinarity as Teamwork: How the Science of Teams can inform Team Science. *Small Group Research, 39(3),* 251-277.

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Part 3. Applying Team Theory to Scientific Collaboration

3.1. *Of Teams and Tasks*

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Scientists Should MEAUSURE Taskwork and Teamwork

- **Questionnaires using Self and Peer Ratings**
  - Ohland et al. (2012) - Comprehensive Assessment of Team Member Effectiveness (CATME)
  - Assesses teamwork and taskwork using **behavioral referents**:
    - (1) **contributing** to the team's work
    - (2) **interacting** with teammates
    - (3) keeping the **team on track**
    - (4) expecting **quality**
    - (5) having **relevant KSAs**

Ohland, M.W., Loughry, M.L., Woehr, D.J., Finelli, C.J., Bullard, L.G., Felder, R.M., Layton, R.A., Pomeranz, H.R., & Schmucker, D.G. (2012). The Comprehensive Assessment of Team Member Effectiveness: Development of a Behaviorally Anchored Rating Scale for Self and Peer Evaluation. *Academy of Management Learning & Education, 11 (4),* 609-630.

						This self and peer evaluation asks about how you and each of your teammates contributed to the team during the time period you are evaluating. For each way of contributing, please read the behaviors that describe a "1", "3," and "5" rating. Then confidentially rate yourself and your teammates.
Contributing to the Team's Work	**5**	**5**	**5**	**5**	**5**	• Does more or higher-quality work than expected. • Makes important contributions that improve the team's work. • Helps to complete the work of teammates who are having difficulty.
	4	**4**	**4**	**4**	**4**	Demonstrates behaviors described in both 3 and 5.
	3	**3**	**3**	**3**	**3**	• Completes a fair share of the team's work with acceptable quality. • Keeps commitments and completes assignments on time. • Fills in for teammates when it is easy or important.
	2	**2**	**2**	**2**	**2**	Demonstrates behaviors described in both 1 and 3.
	1	**1**	**1**	**1**	**1**	• Does not do a fair share of the team's work. Delivers sloppy or incomplete work. • Misses deadlines. Is late, unprepared, or absent for team meetings. • Does not assist teammates. Quits if the work becomes difficult.
Interacting with Teammates	**5**	**5**	**5**	**5**	**5**	• Asks for and shows an interest in teammates' ideas and contributions. • Improves communication among teammates. Provides encouragement or enthusiasm to the team. • Asks teammates for feedback and uses their suggestions to improve.
	4	**4**	**4**	**4**	**4**	Demonstrates behaviors described in both 3 and 5.
	3	**3**	**3**	**3**	**3**	• Listens to teammates and respects their contributions. • Communicates clearly. Shares information with teammates. Participates fully in team activities. • Respects and responds to feedback from teammates.
	2	**2**	**2**	**2**	**2**	Demonstrates behaviors described in both 1 and 3.
	1	**1**	**1**	**1**	**1**	• Interrupts, ignores, bosses, or makes fun of teammates. • Takes actions that affect teammates without their input. Does not share information. • Complains, makes excuses, or does not interact with teammates. Accepts no help or advice.
Keeping the Team on Track	**5**	**5**	**5**	**5**	**5**	• Watches conditions affecting the team and monitors the team's progress. • Makes sure that teammates are making appropriate progress. • Gives teammates specific, timely, and constructive feedback.
	4	**4**	**4**	**4**	**4**	Demonstrates behaviors described in both 3 and 5.
	3	**3**	**3**	**3**	**3**	• Notices changes that influence the team's success. • Knows what everyone on the team should be doing and notices problems. • Alerts teammates or suggests solutions when the team's success is threatened.
	2	**2**	**2**	**2**	**2**	Demonstrates behaviors described in both 1 and 3.
	1	**1**	**1**	**1**	**1**	• Is unaware of whether the team is meeting its goals. • Does not pay attention to teammates' progress. • Avoids discussing team problems, even when they are obvious.

Part 3. Applying Team Theory to Scientific Collaboration

3.1. *Of Teams and Tasks*

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Studying Collaborative Processes in Research Teams

Collaborative Productivity
Please evaluate the collaboration within your TREC center over the past twelve months
• Communication among collaborators.
• Ability to capitalize on the strengths of different researchers.
• Resolution of conflicts among collaborators.
• Productivity of collaborative meetings.
• Overall productivity of collaboration.
Please indicate how strongly you agree or disagree with the following statements about TREC collaborations over the past twelve months.
• In general, I feel that I can trust the colleagues with whom I collaborate.
• In general, I feel that I respect the colleagues with whom I collaborate.
• In general, I find that my collaborators are open to criticism.
• In general, collaboration has improved my research productivity.

Hall, K. L., Stokols, D., Moser, R. P., Taylor, B. K., Thornquist, M. D., Nebeling, L. C., ... & Jeffery, R. W. (2008). The collaboration readiness of transdisciplinary research teams and centers: findings from the National Cancer Institute's TREC Year-One evaluation study. *American Journal of Preventive Medicine, 35(2)*, S161-S172.

Part 3. Applying Team Theory to Scientific Collaboration

3.1. *Of Teams and Tasks*

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Scientists Should Distinguish Between FORMS of CONFLICT

- TASK Conflict
  - Awareness of differences in viewpoints regarding group's task
  - Discussing pros and cons, considering alternative courses of action, or evaluating how conflicting evidence fits with the group's decisions.
- RELATIONSHIP Conflict
  - Awareness of interpersonal incompatibilities, including feelings of tension/friction
  - Associated with negative emotion and strongly reflects operating norms
- CONTRIBUTION Conflict
  - Conflict about member contributions (or lack thereof) that disrupts group process.
  - Influences member satisfaction and commitment to the group
  - Disrupts planned process for getting work done (members must compensate)
- LOGISTICAL Conflict
  - Disagreements about how to most effectively organize/utilize resources to accomplish task
  - Assigning member responsibilities and deciding how to best use group's time and resources.

Behfar, K. J., Mannix, E. A., Peterson, R. S., & Trochim, W. M. (2011). Conflict in Small Groups: The Meaning and Consequences of Process Conflict. *Small Group Research, 42(2),* 127-176.

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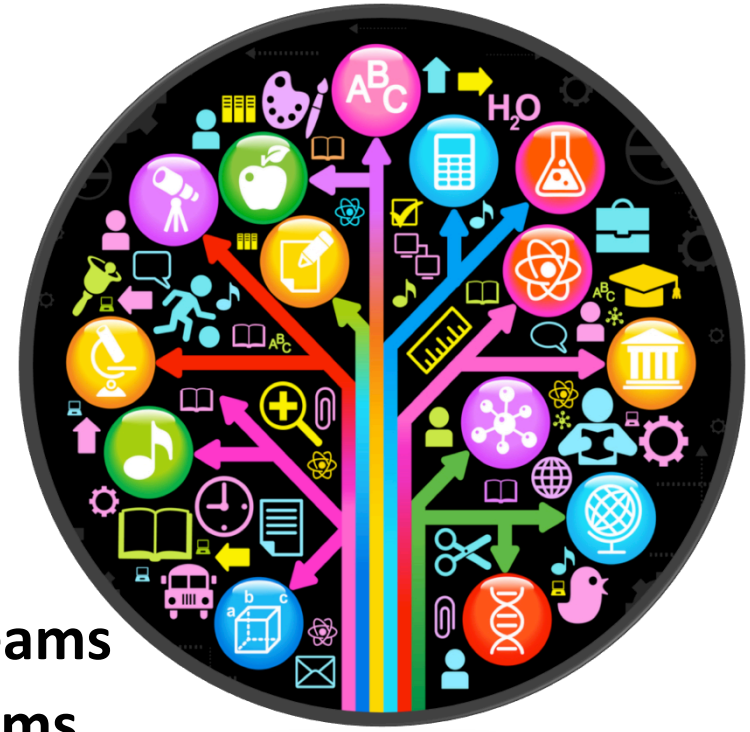

Part 3. Applying Team Theory to Scientific Collaboration

3.2. *Leading Science Teams*

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Scientists Should Recognize Importance of Leadership

- ***What does the leadership data show? (Burke et al., 2005)***
  - Task-focused and person-focused leadership behaviors important
    - Task-focused leadership: 12% of variance
    - Person-focused leadership: 10% of variance
  - But…degree of **interdependence matters**
    - Leadership behavior explained **19% of variance** in performance in **highly interdependent teams**
    - Leadership behavior explained 6% of variance in performance within teams characterized by low interdependence

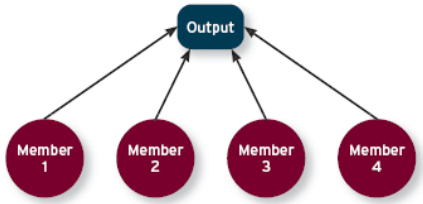
Burke, C. S., Stagl, K. C., Klein, C., Goodwin, G. F., Salas, E., & Halpin, S. M. (2006). What type of leadership behaviors are functional in teams? A meta-analysis. *The Leadership Quarterly*, *17*(3), 288-307.

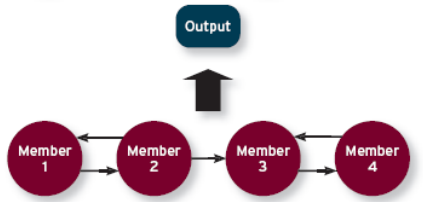
Part 3. Applying Team Theory to Scientific Collaboration

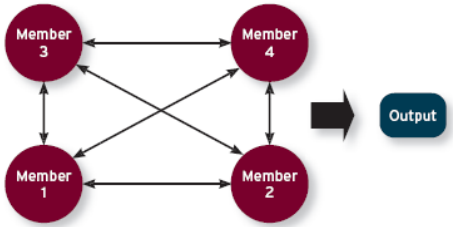
3.2. *Leading Science Teams*

Across these is the need to consider interdependencies - *who relies on whom for task completion and how does that alter collaboration (Fiore, 2008; Saavedra et al., 1993)*

- ***Pooled interdependence***, each scientist performs his/her own task, and the team result is the sum of each scientist's output
- ***Sequential interdependence*** occurs when one scientist's output is necessary for another scientist's input (i.e., B cannot act without output from A).
- ***Reciprocal interdependence***, one scientist's output becomes another scientist's input and vice versa
- ***Intensive interdependence*** is the highest form of coordinated activity – scientists "jointly diagnose, problem solve, and collaborate to complete a task"







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Saavedra, R., Early, P. & Van Dyne, L. (1993). Complex Interdependence in Task-Performing Groups. *Journal of Applied Psychology, 78(1),* 61-72.

Part 3. Applying Team Theory to Scientific Collaboration

3.2. *Leading Science Teams*

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Science Leaders Should PROMOTE Taskwork AND Teamwork

Promoting TASKwork

- Articulate clear and precise goals
- Maintain a collective focus
- Coordinate in support of team interdependence
- Seek and value member input
- Plan future contingencies with members

Promoting TEAMwork

- Serve as a model of teamwork
- Explain rationale for decisions
- Create a supportive climate for teamwork
- Help members gain self-efficacy
- Collect performance information and provide feedback

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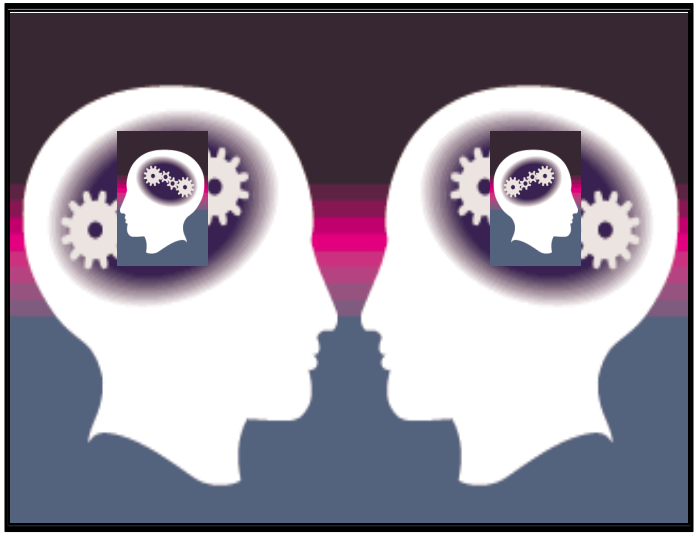
Part 3. Applying Team Theory to Scientific Collaboration

3.2. *Leading Science Teams*

Science Leaders Should be AWARE of Varied Forms of Conflict

- Leaders support TASK conflict
  - Make explicit knowledge diversity
  - Encourage discussion of evidence
- Leaders influence RELATIONSHIP conflict
  - Foster openness
  - Create sense of safety
  - Manage affect/emotional issues
- Leaders manage LOGISTICAL conflict
  - Develop awareness of what resources are available
  - Offer clear strategies
- Leaders manage CONTRIBUTION conflict
  - Increase understanding of role's objectives/goals
  - Make explicit each person's contribution to performance



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Part 3. Applying Team Theory to Scientific Collaboration

3.2. *Leading Science Teams*

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Leaders pay attention to and recognize value of differing outcomes

Outcomes from Team Science (Pennington, 2011)

- Quality and form of the material artifacts produced
- Quality and nature of shared vocabulary developed
- Density and diffusion of social ties created/strengthened
- Number of collaboration skills developed

Project Outcomes (Cummings & Kiesler, 2005)

- Ideas
  - Started new field or area of research
  - Created new grants or spin-off projects
  - Developed new methodologies
  - Recognized for contribution to field
- Tools
  - Created new software
  - Created new hardware
  - Generated new datasets
  - Submitted patent application
- Education/Learning
  - Undergrad/graduate student finished thesis
  - Undergrad/graduate/postdoc got academic job
  - Undergrad/graduate/postdoc got industry job
- Outreach
  - Formed partnership with industry
  - Formed community relationships through research
  - Formed collaborations with different researchers

Cummings, J.N., S. Kiesler. (2005). Collaborative Research Across Disciplinary and Organizational Boundaries. Social Studies of Science, 35(5), 703-722.

Pennington, D., (2011), Collaborative, cross-disciplinary learning and co-emergent innovation in informatics teams. International Journal of Earth System Informatics, 4(2), 55-68.

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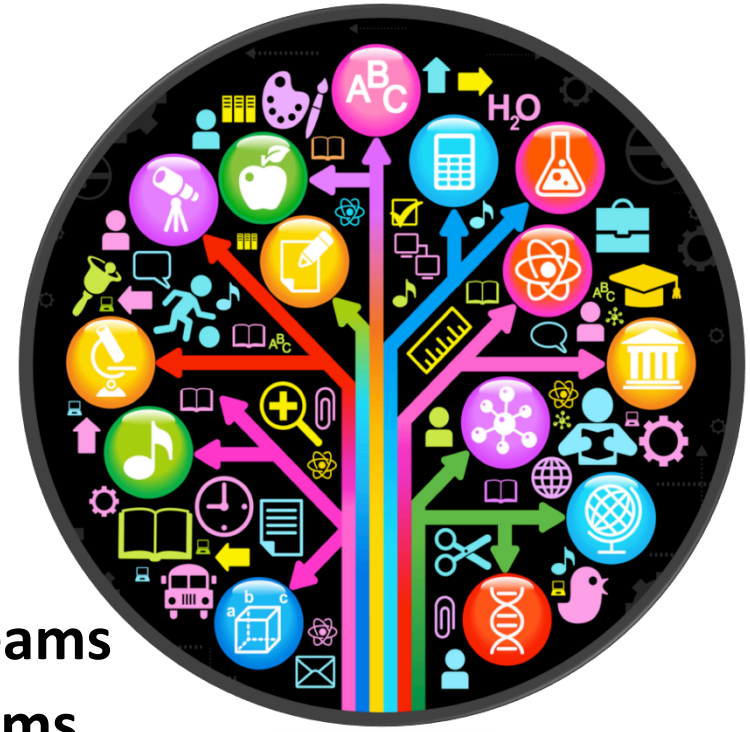


Part 3. Applying Team Theory to Scientific Collaboration

3.3. *Educating and Training Science Teams*

Education and Training for Team and Task Competencies

- Way to classify team/task competencies as knowledge, skills, and attitudes necessary in nearly all team situations versus specific to certain teams (Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995).

Team Competencies

- **TEAM GENERIC** competencies are those **necessary regardless of the context** or the setting
- **TEAM SPECIFIC** competencies are more **directly related to teams** and include knowledge of the abilities held by team members

Task Competencies

- **TASK GENERIC** competencies are those **necessary across task** situations
- **TASK SPECIFIC** competencies **important within particular task**

Part 3. Applying Team Theory to Scientific Collaboration

3.3. *Educating and Training Science Teams*

		Relation to TASK	
		Specific	Generic
Relation to TEAM	Specific	***CONTEXT DRIVEN*** • Knowledge – *Team objectives and resources* • Skills – *Particular analyses* • Attitudes - *Collective efficacy*	***TEAM CONTINGENT*** • Knowledge – *Teammate characteristics* • Skills – *Providing teammate guidance* • Attitudes – *Team cohesion*
	Generic	***TASK CONTINGENT*** • Knowledge – *Procedures for task accomplishment* • Skills – *Problem analysis* • Attitudes – *Trust in technology*	***TRANSPORTABLE*** • Knowledge – *Understanding group dynamics* • Skills – *Communication and assertiveness* • Attitudes – *Interdisciplinary appreciation*

Part 3. Applying Team Theory to Scientific Collaboration

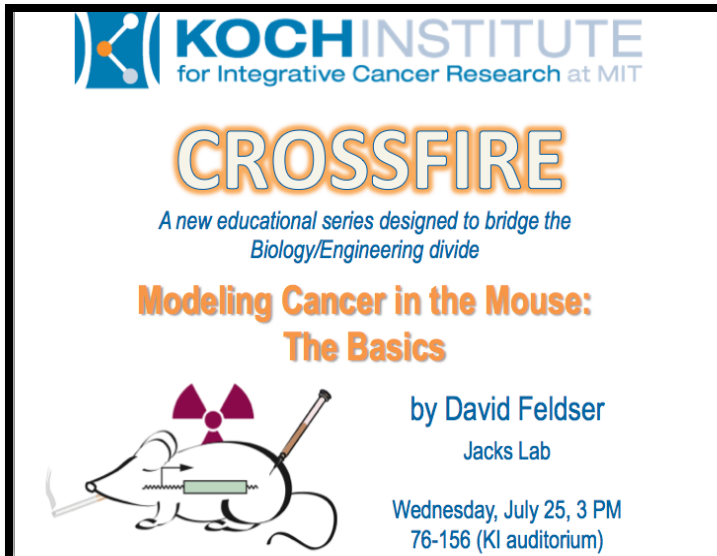
3.3. *Educating and Training Science Teams*

Professional Development and Education for Science Teams

- Example of what we'd call "**context driven competencies**"

Institute for Integrative Cancer Research at MIT

- Casual Research Article Discussion Groups
  - **"Friday Focus Seminar Series"** – attended by team members at ALL levels (grad students, postdocs, faculty mentors)
  - *Present research relevant methods and findings*
  - **"The Doctor Is In"** – inter-professional problem –focused lecture series
  - *Helps scientists and engineers understand cancer through talks by physicians*
- Interdisciplinary Educational Series developed by students and post-docs
  - **"Crossfire Educational Series"** – relies on peer-to-peer learning approach
  - *Designed to bridge the Biology/Engineering divide*
  - **"Genius Bar" –** opportunities for technology focused learning
  - *Engineering fellows available to answer questions on a specified research topic*



Part 3. Applying Team Theory to Scientific Collaboration

3.3. *Educating and Training Science Teams*

UCF Cognitive Sciences

Professional Development and Education for Science Teams

- Example of what we'd call "**team contingent competencies**"

Toolbox Training (O'Rourke & Crowley (2013)

- Designed to **facilitate cross-disciplinary communication**
- Relies on **probing statements** during focused discussions
- Devised to **elicit fundamental assumptions** about science
- **Forces reflection** on epistemologies and values
- Targets **knowledge, skills, and attitudes** supportive of interdisciplinary communication

Part 3. Applying Team Theory to Scientific Collaboration

3.3. *Educating and Training Science Teams*

Potential Training Methods for Science Teams

- ***Promising approaches developed for teams outside science***
- Example of what we'd call "**task-contingent competencies**"

Knowledge Building Training

- Focuses on helping members learn how to **integrate idiosyncratic knowledge** required for problem solving (Rentsch et al., 2010)
- Uses **interventions that support communications** to:
  - **Elicit structure and organization** of member knowledge
  - **Draw out assumptions, meaning, rationale**, and interpretations associated with each member's knowledge
  - Relies on **knowledge maps** where members post, organize, and visually manipulate that knowledge

Part 3. Applying Team Theory to Scientific Collaboration

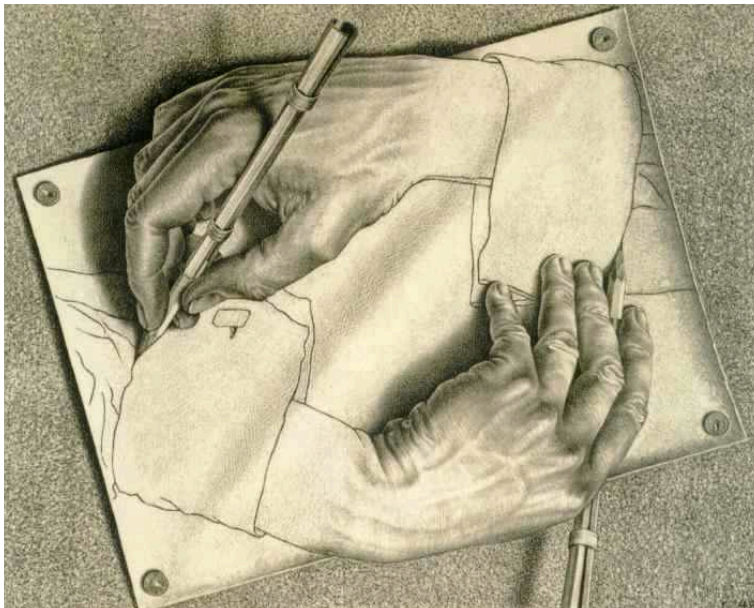
3.3. *Educating and Training Science Teams*

Potential Training Methods for Science Teams

- ***Promising approaches developed for teams outside science***
- Example of what we'd call "**transportable competencies**"

Team Reflexivity Training or Self-Correction Training

- Train **self-regulation and self-efficacy** in support of collaboration
- Requires members **reflect on performance** and **objectives** met and not met
- **Reflect on strategies** used or group processes engaged
- Members **speculate performance** improvement (e.g., Gurtner, Tschan, Semmer, and Nägele, 2007)
- Reflections prompted by series of questions for team discussion



Part 3. Applying Team Theory to Scientific Collaboration

3.4. *Interpersonal Skills in Science Teams*

		Relation to TASK	
		Specific	Generic
Relation to TEAM	Specific	***CONTEXT DRIVEN*** • Knowledge – *Team objectives and resources* • Skills – *Particular analyses* • Attitudes - *Collective efficacy*	***TEAM CONTINGENT*** • Knowledge – *Teammate characteristics* • Skills – *Providing teammate guidance* • Attitudes – *Team cohesion*
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Part 3. Applying Team Theory to Scientific Collaboration

3.4. *Interpersonal Skills in Science Teams*

Interpersonal Skills as Transportable Team Skills for Science Teams

- Klein, DeRouin, & Salas (2006) reviewed and synthesized literature on IPS to develop taxonomy of IPS
- Considers - Goal-directed behaviors, including communication and relationship-building competencies
- Employed during interaction episodes characterized by:
  - complex perceptual-cognitive processes
  - dynamic verbal / nonverbal exchanges
  - diverse roles, motivations, and expectancies

- **Key Point for Science Teams**
  - *Foundational to effective interdisciplinary interactions*

Part 3. Applying Team Theory to Scientific Collaboration

3.4. *Interpersonal Skills in Science Teams*

Communication Competencies	
Active Listening	• Carefully attending to <u>what is said</u> • Asking other party to explain exactly <u>what is meant</u> • Requesting that <u>ambiguous ideas</u> or statements are <u>repeated</u>
	For science teams this competency targets "listening to learn and understand" and "listening to contribute and integrate to problem solving"
Oral and Written Communication	• Sending verbal and written <u>messages clearly</u> • Speaking/writing <u>constructively</u> • Speaking/writing <u>critically in appropriate ways</u>
	For science teams this competency targets the ability to "express yourself clearly to others outside one's discipline" (e.g., avoiding jargon) and "effectively conveying intended meaning of other disciplinary perspectives"
Assertive Communication	• Directly <u>expressing</u> one's <u>ideas and opinions</u> • Addressing <u>conflict purposely</u> and openly • <u>Addressing differences</u> without intimidation
	For science teams this competency targets the ability to "propose ideas", to "defend one's disciplinary values/methods" and to "be directive and appropriately assert your needs and views"

Fiore, S. M. (2015). The Science of Team Science and Collaborative Research. *Invited Colloquium, University of Cincinnati, Office of Research Advanced Seminar Series.* October 19th, Cincinnati, OH.

Part 3. Applying Team Theory to Scientific Collaboration

3.4. *Interpersonal Skills in Science Teams*

Relationship Management Competencies	
Coordination	• Understanding how to work with others as a team • Being mindful of interdependencies and how to pace activities • Offering help/back-up as needed
	For science teams this competency targets understanding importance of "awareness of shared scientific goals" and "monitoring and feedback"
Interdisciplinary Appreciation	• Appreciating differing disciplinary theories and concepts • Respecting varied disciplinary methods • Encouraging input from across disciplinary perspectives
	For science teams this competency targets learning "acceptance of, and openness to new ideas" and "sensitivity to disciplinary perspectives"
Collaborative Orientation	• Predisposition to provide help to others • Intellectual curiosity in service understanding others • Building rapport with others
	For science teams this competency targets the ability to "elicit ideas for purpose of understanding" and "offer solutions in support of problem solving"

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Part 3. Applying Team Theory to Scientific Collaboration

3.4. *Interpersonal Skills in Science Teams*

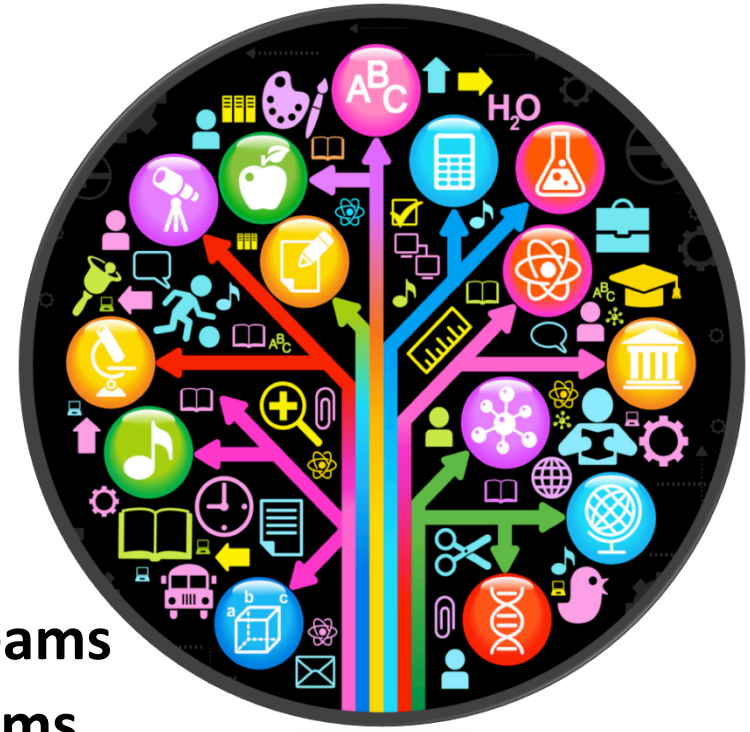
IPS Represent Important Set of Competencies for Science Teams

- The interdisciplinary nature of science teams necessitates a **better understanding of the specific and generic team and task competencies** required for effective collaboration.

- ***Scientific Organizations Recognizing Importance of Such Skills***
  - Interdisciplinary researchers need to be skilled interpersonally to form and maintain collegial collaborative relationships with those outside their primary discipline (Nash et al., 2003)

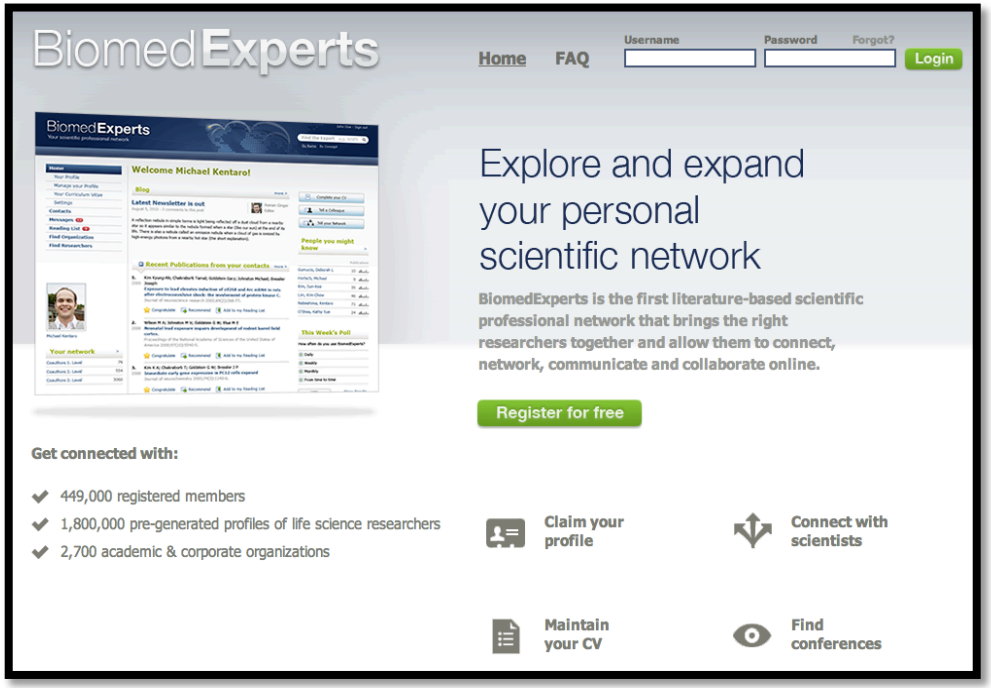
Overview

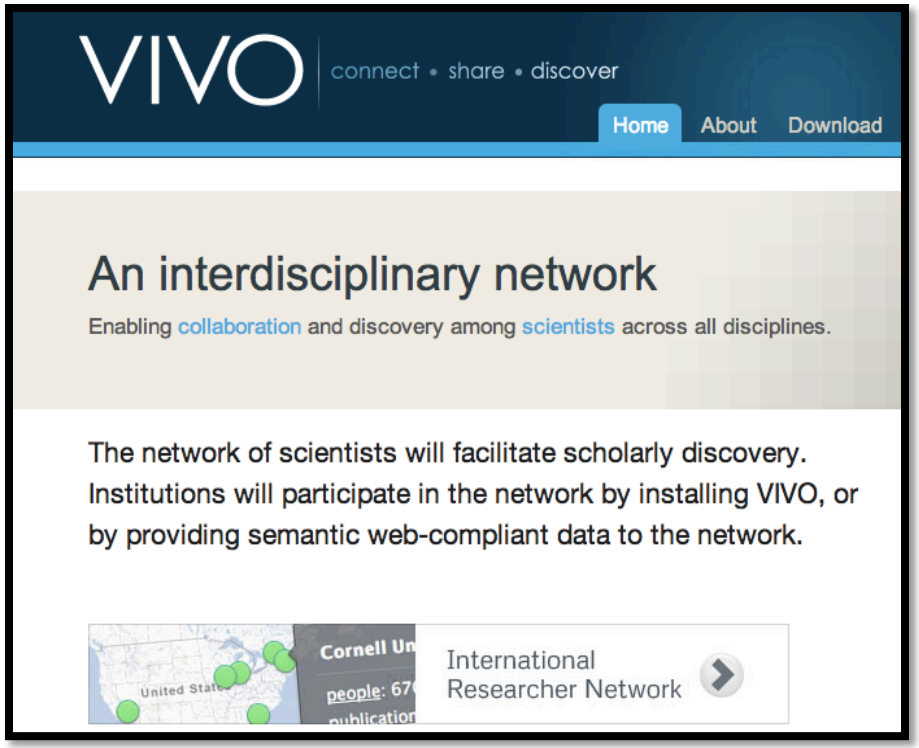
- Part 1. Laying Foundation for a *Science of Team Science*
- Part 2. Developing the Science of Team Science
- Part 3. Applying Team Theory to Scientific Collaboration
  - 3.1. Of Teams and Tasks
  - 3.2. Leading Science Teams
  - 3.3. Educating and Training Science Teams
  - 3.4. Interpersonal Skills in Science Teams
- Part 4. Resources on the Science of Team Science

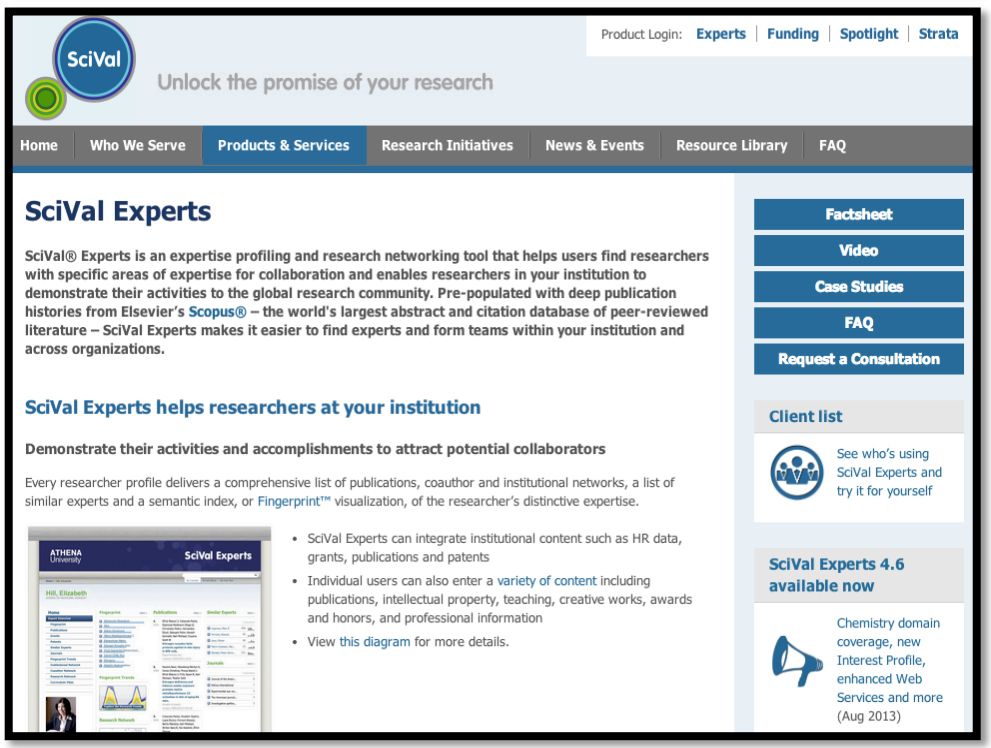


Resources for finding collaborators when working across disciplines

- Leverage "research networking tools"
  - *"Enable investigators to search for collaborators with particular substantive and methodological areas of expertise who are located within their institutions or at external institutions" (p. 427, Hall et al., 2012).*
- **http://www.biomedexperts.com**
- **http://vivoweb.org/**
- **http://www.info.scival.com/experts**

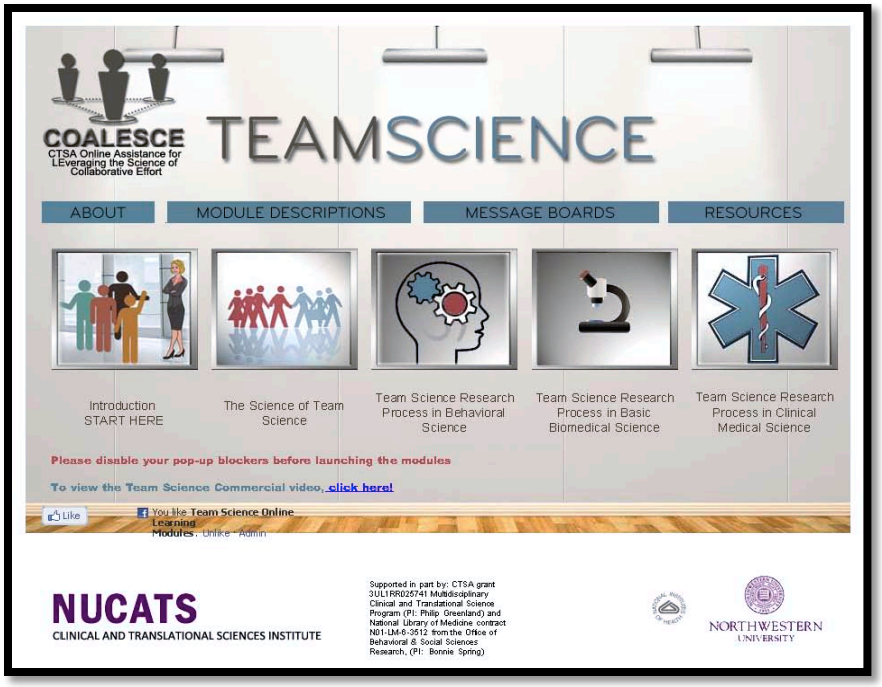




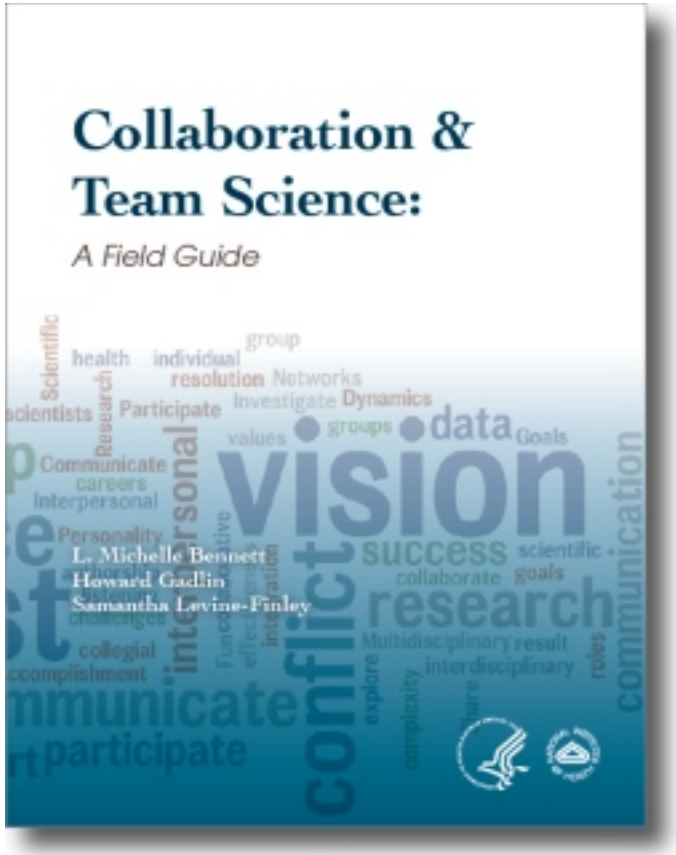


Part 4. Resources on the Science of Team Science

Resources for Developing and Managing Team Science

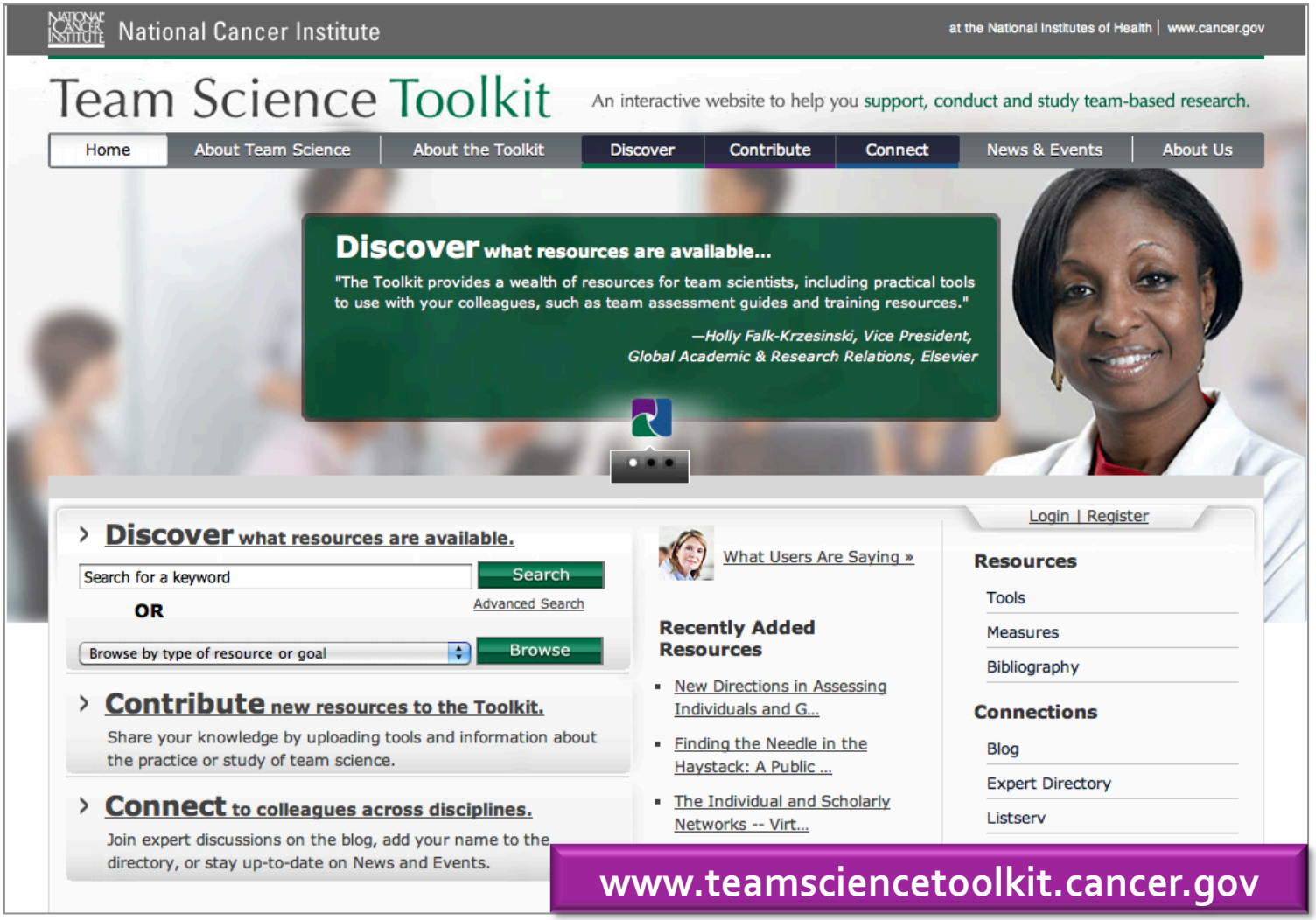


- TEAMSCIENCE.NET is a suite of e-learning resources designed to foster learning for those interested in team science
- Provides examples of real world scenarios unique to team-based research.



https://ccrod.cancer.gov/confluence/download/attachments/47284665/TeamScience_FieldGuide.pdf

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



Vogel, A. L., Hall, K. L., Fiore, S. M., Klein, J. T., Bennett, L. M., Gadlin, H., ... & Falk-Krzesinski, H. J. (2013). The team science toolkit: Enhancing research collaboration through online knowledge sharing. *American Journal of Preventive Medicine, 45(6)*, 787-789.

Part 4. Resources on the Science of Team Science

- **Consolidates information** on team-based research and SciTS field in one accessible location
- **Integrates resources** from multiple disciplines and fields, such as psychology, management, public health and communications
- **Includes a user-generated resources**, such as practical tools and strategies, measures and metrics, bibliographic citations, and publications
- Includes **sections written or coordinated by the NCI**, such as introductions to team-based research and the SciTS field, key resources, and expert blogs

Part 4. Resources on the Science of Team Science

- **Discover:**
  - **Learn by exploring** Toolkit resources contributed by other users
  - **Download resources** that can support your goals
- **Contribute:**
  - **Share your knowledge** of team-based research in 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

Part 4. Resources on the Science of Team Science

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If you are:	And you want to:	Use the Toolkit to find resources such as:
A leader or member of a science team	Find practical tools and strategies to help support successful team science	• Publications on effective team science approaches • Pre-collaboration discussion guides addressing issues such as data ownership, authorship, and patents • Strategies for team communication and data sharing • Training resources to build team science competencies
A team science evaluator or researcher	Evaluate or study team science processes, outcomes, and contextual influences	• Survey instruments and interview guides • Measures, metrics and algorithms • Reliability, validity and scoring methods
An administrator at an academic institution, business, or other organization	Support team science approaches and scholarship at your institution	• Promotion and tenure policies recognizing team science • Collaboration techniques to bridge departments and organizations
A funding agency official	Provide support for team science	• Funding announcements • Protocols for data sharing and co-authorship

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  b) advance understanding about group dynamics through research
  c) advance theory and methods for understanding groups, and
  d) promote interdisciplinary research