Fundamentals of Team Science

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It is teamwork that remains the ultimate competitive advantage, both because it is so powerful and so rare.”

Patrick Lencioni, 2005
The Five Dysfunctions of a Team: A Leadership Fable
Outline

• Overview: The “what” and “why” of Team Science
• What Team Science tells us about working together in research teams
• Identify key Team Science concepts you can use today
• Resources
TEAM examples

• What examples come to mind when you hear the word "team"?
TEAMS & TEAM EFFECTIVENESS

Dalenberg et al., 2009

Hughes et al., 2016

Salas et al., 2015

McEwan & Beauchamp, 2014

Littlepage et al., 2016
What is Team Science?

Cross-Disciplinary Research

Collaborations

= Team Science
“Most of the work still to be done in science and the useful arts is precisely that which needs knowledge and cooperation of many scientists and disciplines. That is why it is necessary for scientists and technologists in different disciplines to meet and work together, even those in branches of knowledge which seem to have least relation and connection with one another”

Antoine Lavoisier
1793
What novel approaches can be developed that have the potential to be truly transformative for human health?

NIH Roadmap: [https://commonfund.nih.gov/sites/default/files/ADecadeofDiscoveryNIHRoadmapCF.pdf](https://commonfund.nih.gov/sites/default/files/ADecadeofDiscoveryNIHRoadmapCF.pdf)
Transdisciplinary
Combines or integrates from more than one field: concepts, methods, and theories

Interdisciplinary
A joint, interactive process where each member draws from his or her own discipline and specific perspective to address a common research problem

Multidisciplinary
An independent, sequential process where team members contribute individually, representing the tradition of their own discipline, and staying well within their own areas of expertise

Unidisciplinary
Researchers from a single discipline work together to address a common research problem.
What is a Scientific Research Team?

.....think of it as a continuum.....

- **Investigator-Initiated Research**
  Investigator works on a scientific problem, largely on his or her own.

- **Research Collaboration**
  - Group works on a scientific problem, each bringing some expertise to the problem.
  - Members work on separate parts, which are integrated at the end.
  - The interaction of the lead investigators varies from seldom to frequent with regard to data sharing or brainstorming.

- **Integrated Research Team**
  - Team works on a research problem with each member bringing specific expertise to the table.
  - There are regular meetings and discussions of the team’s overall goals, objectives of the individuals on the team, data sharing, and next steps.
  - One person takes the lead while other members have key leadership roles in achieving the goal.
The following color coding is used for the disciplinary map:

- **Math & Physics**
- **Chemistry**
- **Computer Science & EE**
- **Other Engineering**
- **Biotechnology**
- **Earth Sciences**
- **Biology**
- **Infectious Diseases**
- **Medical Specialties**
- **Brain Research**
- **Health Professionals**
- **Social Sciences**

**Scientific Research Team**

....think of it as a continuum.....

**Investigator-Initiated Research**  **Collaboration**  **Integrated Research Team**

- **Bioinformatics**
- **Drug modification**
- **Biotechnology**
- **Nanotechnology method for delivery**
- **Capitil venture - drug**
- **HIV**
- **HIV pathogenicity**
- **Clinical Trials**
- **Brain Research**
- **Medical Specialty**

NIH Field Guide
What is Team Science?

Definition: **integration** of two or more scientific approaches to solve a **complex, multifaceted** problem.

It is a **collaborative effort to** address a scientific challenge that leverages the strengths and expertise of professionals trained in different fields.
• Team Science is a collaborative effort to address a scientific challenge that leverages the strengths and expertise of professionals trained in different fields.

National Research Council (2015) Enhancing Effectiveness of Team Science

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Why Team Science?
Why TEAM Science?

- **Complex** 21st-century societal (health, social, environmental, energy, and technological) problems require cross-disciplinary solutions
- Advances in technologies
- Vast data sets
- Enormously increased range of questions
- Research is increasingly conducted in teams across virtually all fields
- ~90% of all work in science & engineering disciplines is done in teams
Why Team Science?

researchers; endocrinologists; pediatricians; internists; surgeons; exercise physiologists; nutritionists; behavioral researchers; psychologists economists—to name just a few types of specialists

Know your Network !!!!
Teams produce more highly cited research & patents than individuals.
Mapping longitudinal scientific progress, collaboration, and impact of the Alzheimer's disease neuroimaging initiative growth of co-publication networks over time.

Why Team Science?

- The **synergy** of Team Science fosters unique insights into problems that may not be readily available from the perspective of a solitary discipline
- **Speed up the rate of discovery**
- **Apply novel methods** to solve old problems
- **Apply specialized knowledge** to new problems
- **Promote breadth** of knowledge
How Do We Turn a TEAM of Experts into an EXPERT Team?

“We like to bring together people from radically different fields and wait for the friction to produce heat, light and magic. Sometimes it takes a while.”
What factors are required to form a successful research team?
What is the Science of Team Science?

*What makes them work?*

The study of collaborative processes grounded in scientific collaborations

**The Science-of-Team-Science**

Cross-Disciplinary Research

Collaborations

Team Science

[https://www.inscits.org/2020-scits-conference](https://www.inscits.org/2020-scits-conference)
• The **Science of Team Science** (SciTS) is a cross disciplinary field of study that aims to...

• **(1) Build an evidence base**

• **(2) Develop translational applications**

....to help maximize the efficiency & effectiveness of team-based research
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<thead>
<tr>
<th><strong>Trust</strong></th>
<th>identity-based trust, competence-based trust, calculus-based trust</th>
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<tbody>
<tr>
<td>SELF-AWARENESS</td>
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<td>EMOTIONAL INTELLIGENCE</td>
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<td>COMMUNICATION</td>
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<td>MENTORING</td>
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<td>TEAM EVOLUTION AND DYNAMICS</td>
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<td>EFFECTIVE LEADERSHIP</td>
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<td>RECOGNITION AND SHARING SUCCESS</td>
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<td>CONFLICT AND DISAGREEMENT</td>
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<td>NAVIGATING AND LEVERAGING NETWORKS AND SYSTEMS</td>
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Key Team Science Concepts You Can Use Today

• Bring together diverse backgrounds and experiences
  • **Clarify** roles, responsibilities, and contributions
• Define milestones and success
• Develop an **environment of openness**
• Establish a schedule of meetings
• **Discuss** processes for sharing data and managing authorship
• **Prepare** for disagreements
• Have a policy for bringing on new members
Developing Grant Proposals - Key Team Science Concepts

• Create a shared vision
• Present the proposal in a unified voice
• Demonstrate commitment to leveraging available expertise and resources toward problem solving
• Consider coordination, interrelationships, cohesiveness, and synergy among the research projects and cores as they relate to the common theme
• Define appropriate leadership/management/administrative structures
• Define roles and responsibilities; include logistics, operations, and administration
• Develop mechanisms for regular communication, dispute resolution, and recognition and credit assignment
• Discuss day-to-day operations of the program
Resources:

Websites, articles, and online documents about Team Science:

• **Team Science Toolkit**: This is “an interactive website to help you support, conduct, and study team-based research.” The website is open-access and allows individuals to add resources to the site’s searchable database.

• **Science of Team Science**: Website for the Northwestern University Clinical and Translational Sciences Institute (NUCATS). This institute holds an annual “Science of Team Science” conference, and provides online resources for individuals interested in becoming involved in team-based research.

• **Team Science**: This website (created by NUCATS) offers excellent video training modules that provide guidance on collaboration processes inherent to team-based research. The training modules also include interactive components intended to answer researchers’ specific questions about team-based research.

• **Collaboration & Team Science; A field guide** (PDF, 2.23MB). National Institutes of Health, Office of the Ombudsman. This guide provides a great deal of information on getting started with team science.

• **Team Science: Heaving Walls & Melding Silos** (PDF, 2.06MB). A White Paper produced by Sigma Xi (The Scientific Research Society). This paper provides an excellent description of Team Science, its history, and benefits.

• **Profiles in Team Science**. This website was developed with support from the National Science Foundation (NSF) Discovery Corps Program, and provides excellent examples of Team Science “in action.”


• Science of Team Science Mendeley Group. A forum for cross-disciplinary and inter-professional information exchange and other resources

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

• Coalesce [Teamspace.net]. Learning modules, including an introduction to Team Science,

Dialogue and shared decision making, evidence-based practices, and community engagement with emphasis on healthcare and research.

[https://www.teamspace.net](https://www.teamspace.net)
The Team Science Toolkit is an interactive website that provides resources to help users support, engage in, and study team-based research.
References


Any ????

Thank you!

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<thead>
<tr>
<th>Dimension</th>
<th>Skills/Processes</th>
<th>Type of training</th>
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</thead>
<tbody>
<tr>
<td>Diversity</td>
<td>Communication and interpersonal interactions</td>
<td>ID educational seminars, interpersonal skills training</td>
</tr>
<tr>
<td>Integration</td>
<td>Coordination and communication, shared mental models</td>
<td>Cross-training, knowledge-sharing training, coordination training</td>
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<tr>
<td>Size</td>
<td>Compositional, taskwork, and teamwork transactive memory</td>
<td>Positional clarification, communication, coordination training</td>
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<tr>
<td>Proximity</td>
<td>Compilational, compositional transactive memory, team cohesion/self-efficacy</td>
<td>Team reflexivity training, positional clarification training</td>
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<tr>
<td>Boundaries</td>
<td>Team-specific knowledge/goals</td>
<td>Cross-training, knowledge development</td>
</tr>
<tr>
<td>Task interdependance</td>
<td>Taskwork transactive memory</td>
<td>Team reflexivity training</td>
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</tbody>
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National Research Council (2015) *Enhancing Effectiveness of Team Science*

Conceptual Framework of Team Effectiveness

Enhancing the Effectiveness of Team Science. The National Academy Press:2015