Interdisciplinary Research and Education on the College Campus

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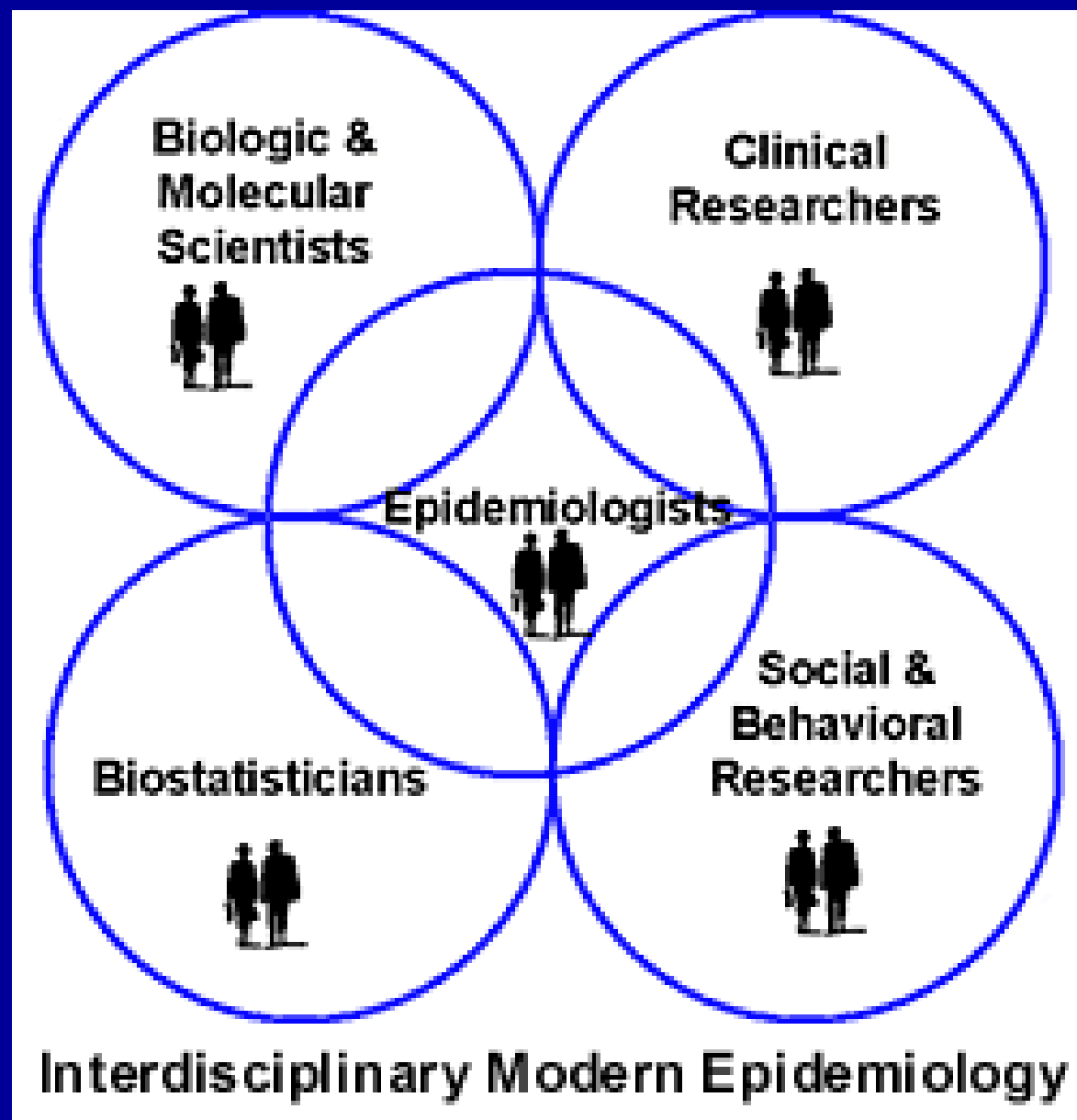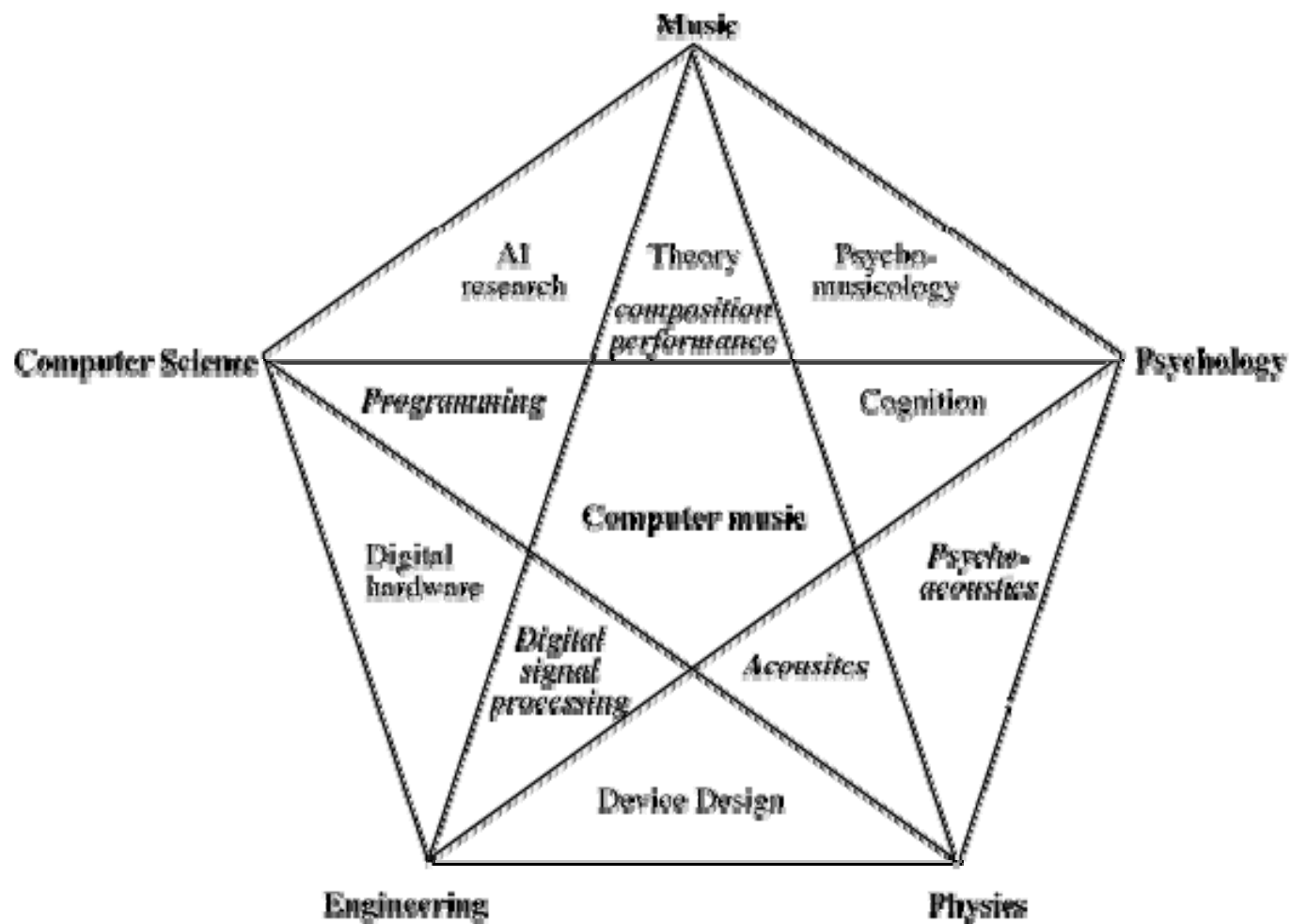Rochester Institute of Technology

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The Talk

- IDRE - What is it & Why should we want it?
- Anything worth something is worth fighting for - Why is it So Hard?
- Examples Beyond RIT
- Examples at RIT
- Moving forward at RIT - Barriers and Recommendations.
- Summary

Interdisciplinarity
(the world according to WIKI…)

- Interdisciplinarity is a type of academic collaboration in which specialists drawn from two or more academic disciplines work together in pursuit of common goals.
    - In multidisciplinarity, researchers from two or more disciplines work together on a common problem, but without altering their disciplinary approaches or developing a common conceptual framework.
    - True interdisciplinarity occurs when researchers from two or more disciplines pool their approaches and modify them so that they are better suited to the problem at hand.

Biologic & Molecular Scientists

Clinical Researchers

Epidemiologists

Biostatisticians

Social & Behavioral Researchers

Interdisciplinary Modern Epidemiology

Disciplinary context of computer music (essential subdisciplines are shown in *italics*).
Diagram by Dick Moore
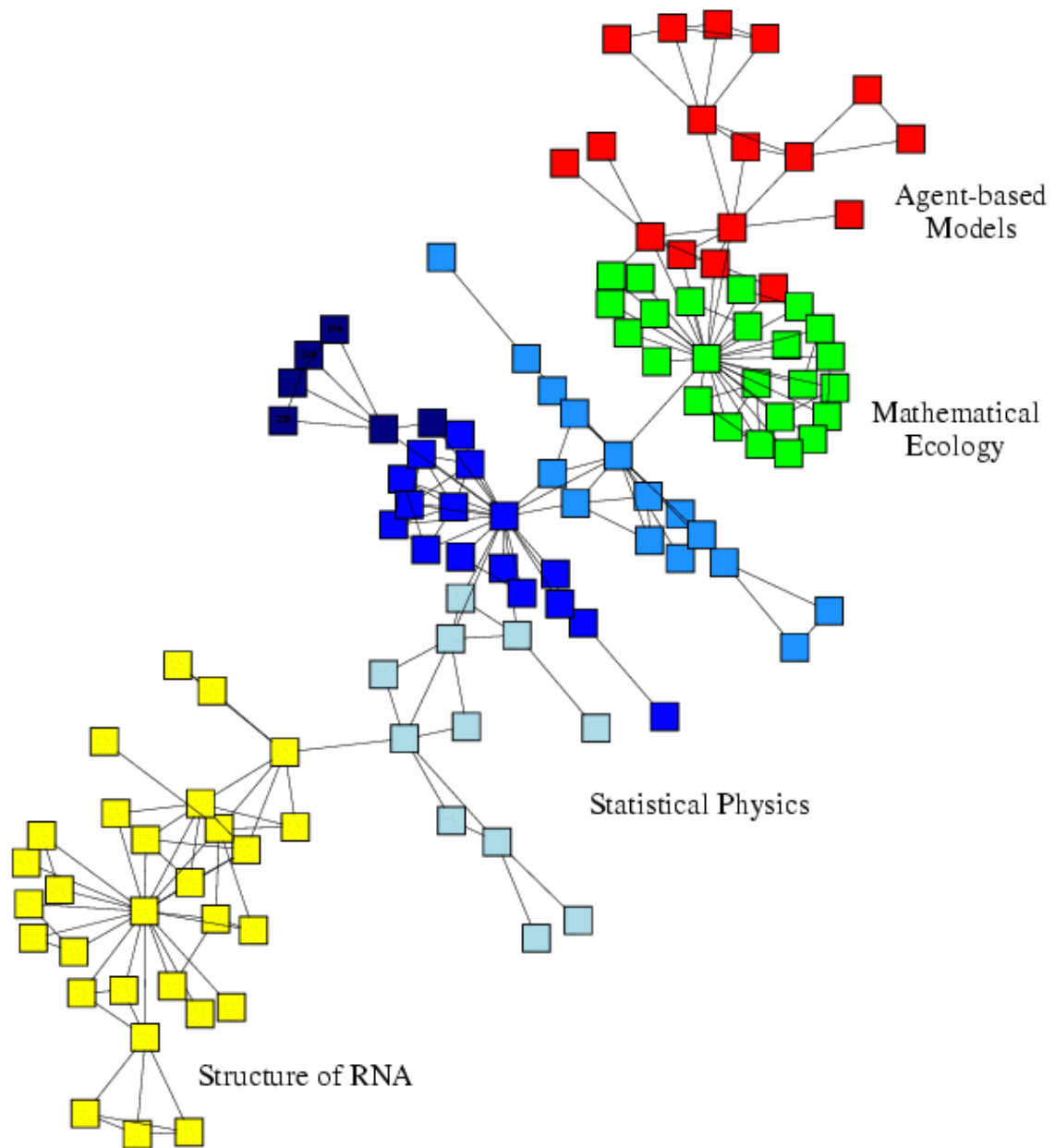
Agent-based
Models

Mathematical
Ecology

Statistical Physics

Structure of RNA

Interdisciplinarity
(the world according to WIKI…)

- Interdisciplinary programs arise from a conviction that the traditional disciplines are unable or unwilling to address an important problem.
    - For example, social science disciplines such as anthropology and sociology paid little attention to the social analysis of technology throughout most of the twentieth century. As a result, many social scientists with interests in technology have joined science and technology studies programs, which are typically staffed by scholars drawn from numerous disciplines (including anthropology, history, philosophy, sociology, and women's studies).

Interdisciplinarity

(the world according to WIKI…)

- Interdisciplinary programs arise from new research developments, such as nanotechnology, which cannot be addressed without combining the approaches of two or more disciplines.
  - Quantum information processing, which amalgamates elements of quantum physics and computer science,
  - Bioinformatics, which combines molecular biology with computer science.
  - Imaging science, amalgamates elements of engineering, physics, mathematics, *visual perception*, *color science*, and chemistry
  - Materials Science, amgamating physics, chemistry and engineering

The Value of IDR -
the world according to NAC

- "Interdisciplinary research (IDR) can be one of the most productive and inspiring of human pursuits - one that provides a format for conversations and connections that lead to new knowledge. *As a mode of discovery and education,* it has delivered much already and promises more - a sustainable environment, healthier and more prosperous lives, new dis-coveries and technologies to inspire young minds, and a deeper understanding of our place in space and time."

IDR Drivers -
the world according to NAC

- "Interdisciplinary thinking is rapidly becoming an integral feature of research as a result of four powerful drivers: the inherent complexity of nature and society, the desire to explore problems and questions that are not confined to a single discipline, the need to solve societal problems, and the power of new technologies."

The Barriers to IDRE -
the world according to NAC

- "Despite the apparent benefits of IDR, researchers interested in pursuing it often face daunting obstacles and disincentives. Some of them take the form of personal communication or "culture" barriers; others are related to the tradition in academic institutions of organizing research and teaching activities by discipline-based departments - a tradition that is commonly mirrored in funding organizations, professional societies, and journals. "

The Generic Barriers to IDR

- Students - eager, but untrained
- Faculty - untrained, tenure-scared, time limited, peer-inhibited, but natural curious
- Fields - tend to be conservative - "that's not physics!" "that's not economics!"
- Administration - designed to support college & departmental structure, discipline-centric
- Structure - Office space, teaching areas, research labs, all arranged by discipline
- Granting Agencies - designed to support disciplines

The Barriers to IDR -
Wiki returns

- "Due to … the barriers, interdisciplinary research areas are strongly motivated to become disciplines themselves. If they succeed, they can establish their own research funding programs and make their own tenure and promotion decisions. In so doing, they lower the risk of entry.
  - Examples of former interdisciplinary research areas that have become disciplines include neuroscience, biochemistry, materials science, and biomedical engineering.

IDR - NAC Recommendations

- **Students S-1:**
  - Undergraduate students should seek out interdisciplinary experiences, such as courses at the interfaces of traditional disciplines that address basic research problems, interdisciplinary courses that address societal problems, and research experiences that span more than one traditional discipline.
  - Graduate students should explore ways to broaden their experience by gaining requisite knowledge in one or more fields in addition to their primary field.

IDR   - NAC Recommendations

- **Researchers and Faculty Members**
  - Researchers and faculty members desiring to work on interdisciplinary research, education, and training projects should immerse them-selves in the languages, cultures, and knowledge of their collaborators in IDR.

IDR -
Recommendations from NAC

- Educators
  - Educators should facilitate IDR by providing educational and training opportunities for undergraduates, graduate students, and post- doctoral scholars, such as relating foundation courses, data gathering and analysis, and research activities to other fields of study and to society at large.

IDR -
Recommendations from NAC

- **Academic Institutions**
  - Academic institutions should develop new and strengthen existing policies and practices that lower or remove barriers to interdisciplinary research and scholarship...
  - institutions should experiment with more innovative policies and structures to facilitate IDR, making use of lessons learned from IDR in industrial and national laboratories.

IDR -
Recommendations from NAC

- **Academic Institutions**
  - Institutions should support interdisciplinary education and training for students, postdoctoral scholars, researchers, and faculty by providing such mechanisms as undergraduate research opportunities, faculty team-teaching credit, and IDR management training.
  - Institutions should develop equitable and flexible budgetary and cost-sharing policies that support IDR.

IDR -
Recommendations from NAC

- **Academic Institutional Structure**
  - Recruitment practices should be revised to include recruitment across department and college lines.
  - The traditional practices and norms in hiring of faculty members and in making tenure decisions should be revised to take into account more fully the values inherent in IDR activities.
  - Continuing social science, humanities, and information-science-based studies of the complex social and intellectual processes that make for successful IDR are needed.

IDR -
Recommendations from NAC

- **Academic Institutional Structure**
  - Institutions should explore alternative administrative structures and business models that facilitate IDR across traditional organizational structures.
  - Allocations of resources from high-level administration to inter-disciplinary units, to further their formation and continued operation, should be considered in addition to resource allocations of discipline- driven departments and colleges. Such allocations should be driven by the inherent intellectual values of the research and by the promise of IDR in addressing urgent societal problems.

Just a few Examples At RIT

- http://www.mpdrit.com (eng&business)
- http://www.rit.edu/~ppolicy/ (economics, history, political science, philosophy, and sociology)
- http://www.rit.edu/~mkbsma/analogy/ (math and poetry)
- http://bioinformatics.rit.edu/index.html (biology and information technology)
- http://cis.rit.edu/content/view/156/166/ (visual perception, imaging science+psychology)

Experience shows that the faculty, unimpeded, will freely develop fruitful IDRE collaborations, and find enormous value in them personally and for the students.

In the Wild World

- http://www.haverford.edu/biology/HHMI/biology.hughes.info.html (incentives help)
- http://www.ksg.harvard.edu/gea/index.html (a project oriented approach)
- http://www.evergreen.edu/ (a college formulated around the concept)
- http://biox.stanford.edu/ (doing it up right, infrastructure, commitment, $$s)

At RIT - IDRE in the Strategic Plan

- RIT will provide curricula that are application focused, practice-based and interdisciplinary in nature

- There can be, by design, a flow of ideas, opportunities, resources, facilities, equipment, and capabilities from the Ph.D. level into undergraduate scholarly activity. RIT Ph.D. programs are interdisciplinary, and so emphasize the scholarship of integration.

At RIT - Strategic Plan

- Objective A1.3: Our Ph.D. programs will be few in number, *unique and interdisciplinary in focus*...

- Objective A6.2: RIT liberal arts and sciences courses will become *more interdisciplinary* and international in scope.
    - An opportunity in the development of Gen Ed Requirements and Minors

RIT Working Group

- Barriers and Recommendations for Collaborative Research at RIT, subcommittee of the RIT Research Steering Committee
  - Many similar issues with developing interdisciplinary curriculum

RIT Barriers?

- This document identifies barriers to collaborative research at RIT and makes recommendations for overcoming those barriers.

- Barriers Subcommittee of the RIT Research Steering Committee. Members of this subcommittee include: John Albertini, Stefi Baum, Doug Merrill, and James Winebrake.

- In this report, we focus mainly on barriers to "inter-disciplinary, collaborative research."

RIT Solutions

- Faculty Time
  - extra effort needed for IDRE to flourish, accommodate and value.
- Information and Socialization of Faculty
  - Physical intersections across colleges should go up, - faculty lounge?
- Bureaucractic credit (financial model) structure
  - RIT's financial model, metrics & $$s, need to reward IDRE and cross-college collaboration, cutting across department and college boundaries.
- Sponsored Research, Development, etc. are Organized by College
  - develop mechanisms to facilitate X-cutting opportunities
- Administration Evolution-
  - To support IDRE through joint appointments across departments and college
  - To support IDRE by developing metrics and rewarding faculty, department heads, and Deans for Interdisciplinary Research and Education
  - To Assure $s flow to support and encourage IDRE across department & college lines.

RIT Solutions

- Faculty Standards -
  - Expectation must value both discipline research and education & IDRE where value earned.
  - Promotion schema needs to evolve to support high quality IDRE.
- Just the Way We Are - We do it to ourselves...
  - traditional faculty loyalty to discipline and department -
  - Culture change...
- Curriculum
  - curricular barriers & departmental allocation of resources impede IDRE
  - double majors, team-teaching, interdisciplinary minors, faculty (and departmental) credit for interdisciplinary team teaching all encourage IDRE.

RIT Solutions

- Funding
  - dedicate RIT $$s to stimulating interdisciplinarity in research and education in key areas.
- Graduate Students
  - Collaborative research across colleges requires strong graduate programs in all colleges.
- Physical infrastructure
  - need joint space for IDRE to take hold. Shoulder to Shoulder.
- Administrative Overhead
  - Normalize incentives X-college (where differnces for faculty exist across colleges, barriers can be created, and frustration grow).

Summary IDRE at RIT

- IDRE has much to offer faculty and students at RIT and the world at large
  - Must deliver value (IDRE for a purpose)
- Interdisciplinary Education and Research are joined at the hip
  - They reinforce and motivate each other.
- Faculty and students thrive when it works
  - A new level of "academic freedom and student creativity unleashed".
- It will happen naturally in a University setting, if barriers are removed.

Summary IDRE at RIT

Some Things Are Their Own Rewards...