

# Interdisciplinarity: How & Why

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**CIRAR LECTURE  
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## Outline

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- **Rationale: Why do we conduct interdisciplinary research?**
- **Background: History of interdisciplinarity in education and the sciences**
- **Mini-case studies**

## Why do we conduct interdisciplinary research?

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## Why do we conduct interdisciplinary research?

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“Solving the **puzzle of complex diseases**, from obesity to cancer, will require a **holistic understanding of the interplay between factors** such as genetics, diet, infectious agents, environment, behavior, and social structures.”

Elias Zerhouni, MD  
Former Director, NIH

“The NIH Roadmap,” 2003, Science 302: 63.

## What if we DON'T?

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- **Research institutions that fail to embrace interdisciplinary approaches may be viewed as “at risk” of becoming less competitive.**
- “The best institutions of the future are those that can reorganize themselves to address scientific and educational questions in an interdisciplinary way. The institutions that will have difficulty are those that keep the same rigid structure that prevents pollination among disciplines.”

*Richard M. Reis*

*“Interdisciplinary Research and Your Scientific Career”  
The Chronicle of Higher Education; Sept 29<sup>th</sup>, 2000*



"I'M ON THE VERGE OF A MAJOR BREAKTHROUGH,  
BUT I'M ALSO AT THAT POINT WHERE CHEMISTRY  
LEAVES OFF AND PHYSICS BEGINS, SO I'LL HAVE TO  
DROP THE WHOLE THING."

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## The silo problem

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“Health research traditionally has been organized much like a series of cottage industries, **lumping researchers into broad areas of scientific interest** and then grouping them into distinct, departmentally based specialties...

“But, as science has advanced over the past decade and the molecular secrets of life have become more accessible, two fundamental themes are apparent:

1. The study of human biology and behavior is a **wonderfully dynamic** process, and
2. The **traditional divisions** within health research may in some instances **impede the pace of scientific discovery.**”

<http://nihroadmap.nih.gov/interdisciplinary/>

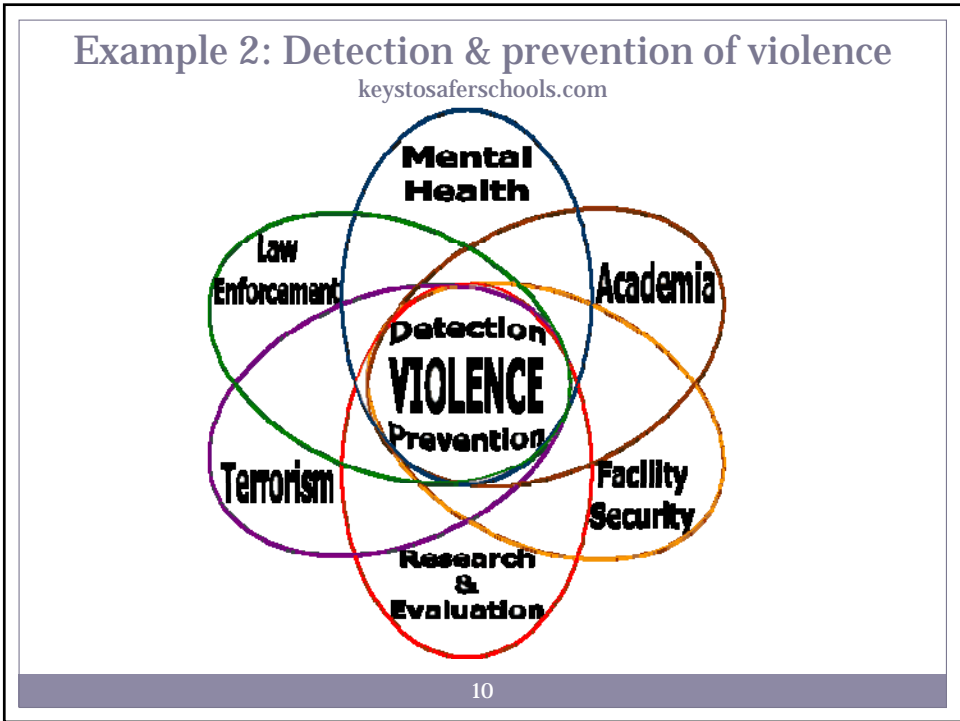
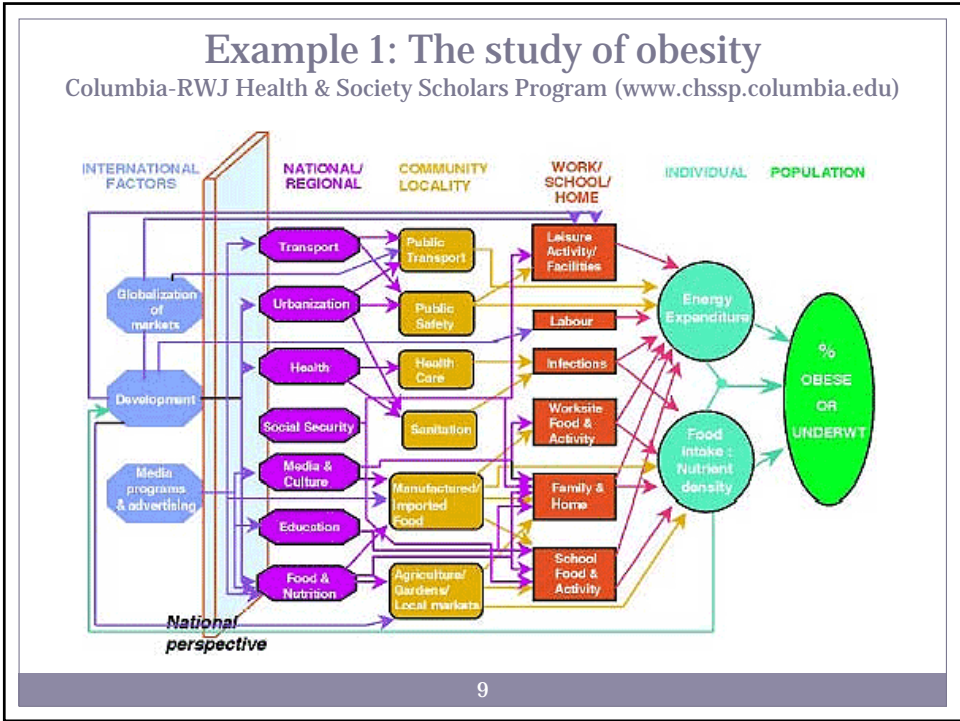
## It takes a village...

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- **Today’s research problems are seen as so broad, there is little chance that a single researcher working alone can solve them.**
- “Such [interdisciplinary] partnerships are proliferating in academe – and slowly changing the face of science – because they offer the **best hope** for answering some of the **thorniest research subjects**, including climate change, biodiversity, and cancer.””

*Jeffrey Brainard*

*“U.S. Agencies Look to Interdisciplinary Science”  
The Chronicle of Higher Education; June 14<sup>th</sup>, 2002*



### Example 3: NIH's research teams of the future

nidcr.nih.gov

## Research Teams of the Future



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## Funding agencies are interested

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- Funding agencies are **FASCINATED BY** and **HEAVILY INVESTED** in interdisciplinary team research efforts.
  - NIH: Search for grant opportunities that include the keywords interdisciplinary, multidisciplinary, transdisciplinary, and cross-disciplinary (some overlap, but far from total)
    - × N=186 matching records for interdisciplinary!
    - × N=200 for multidisciplinary
    - × N=28 for transdisciplinary
    - × N=35 for cross-disciplinary
    - × Covering such diverse areas as AIDS, cystic fibrosis, Alzheimer's disease, infertility, aging, cancer, alcohol abuse, kidney disease, diabetes, obesity, health care delivery, ...

## WHY we conduct interdisciplinary research

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- The reasons have been summarized very nicely by Julie Thompson Klein (*Interdisciplinarity: History, Theory, & Practice*, 1990)
  - To answer complex questions
  - To address broad issues
  - To explore disciplinary and professional relations
  - **To solve problems that are beyond the scope of any one discipline**
  - To achieve unity of knowledge, whether on a limited or grand scale

## History of interdisciplinarity

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## What IS interdisciplinary research?

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- **Defining interdisciplinary research:**  
P Rosenfield (*Social Science & Medicine*, 1992) proposed the following definitions:
  - **Multidisciplinarity:** When researchers **work in parallel** or sequentially from disciplinary-specific bases to address common problems
  - **Interdisciplinarity:** When researchers **work jointly** but from disciplinary-specific bases to address a common problem
  - **Transdisciplinarity:** When researchers **work jointly using a shared conceptual framework** that draws together concepts, theories, and approaches from the parent disciplines.

## Background & history of interdisciplinarity

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- Klein (1990) looks through history for the study and promotion of interdisciplinarity
- General theme: Synthesis & integration of knowledge
- Time periods considered:
  - Early Greeks and Romans
  - 13<sup>th</sup>-16<sup>th</sup> centuries
  - 16<sup>th</sup>-19<sup>th</sup> centuries
  - Late 19<sup>th</sup>-Early 20<sup>th</sup> centuries
  - 20<sup>th</sup> century developments in detail

## Early Greeks and Romans

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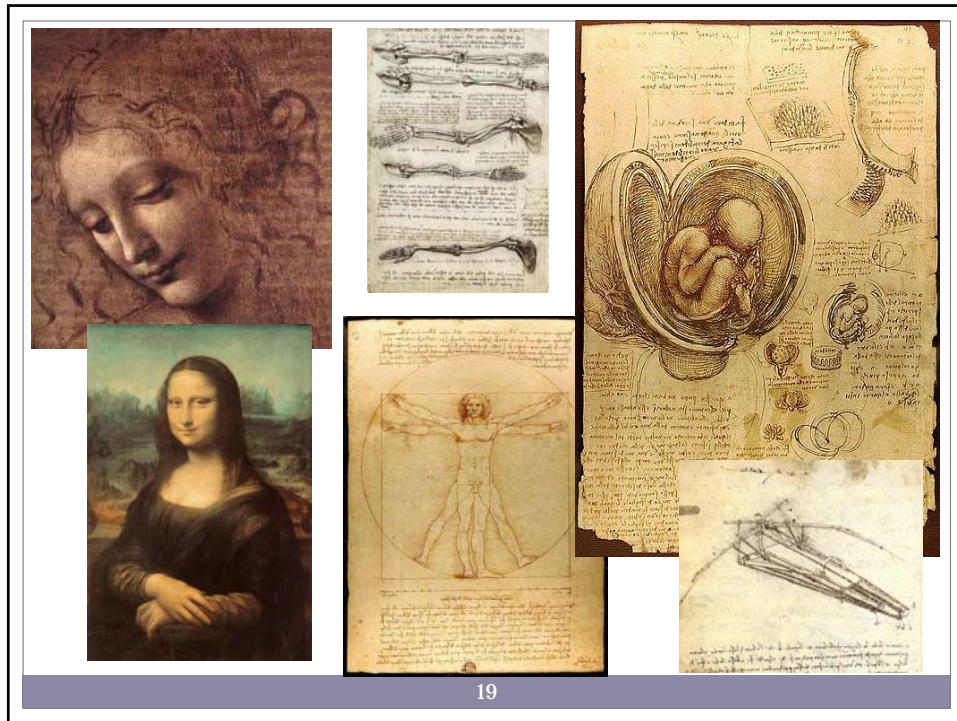
- **Early Greeks:**
  - Plato saw the philosopher as “one who is capable of synthesizing knowledge.”
  - Aristotle endorsed moving towards greater specificity, but also saw the philosopher as having “the ability to collect all forms of knowledge.”
- **Early Romans:**
  - Cicero promoted the notion of a “broad, general education.”
  - Quintilian differed somewhat, arguing for more focused, more advanced studies.

## 1200-1600: The Renaissance Man

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- **1200-1600: Saw the development of the “Renaissance Man”**
- **One who excels in a wide range of subjects or fields**
- **Leon Battista Alberti (1404-1472): “A man can do all things if he will.”**
- **Examples: Alberti, Leonardo da Vinci, Imhotep, Galileo, Isaac Newton, Ben Franklin**



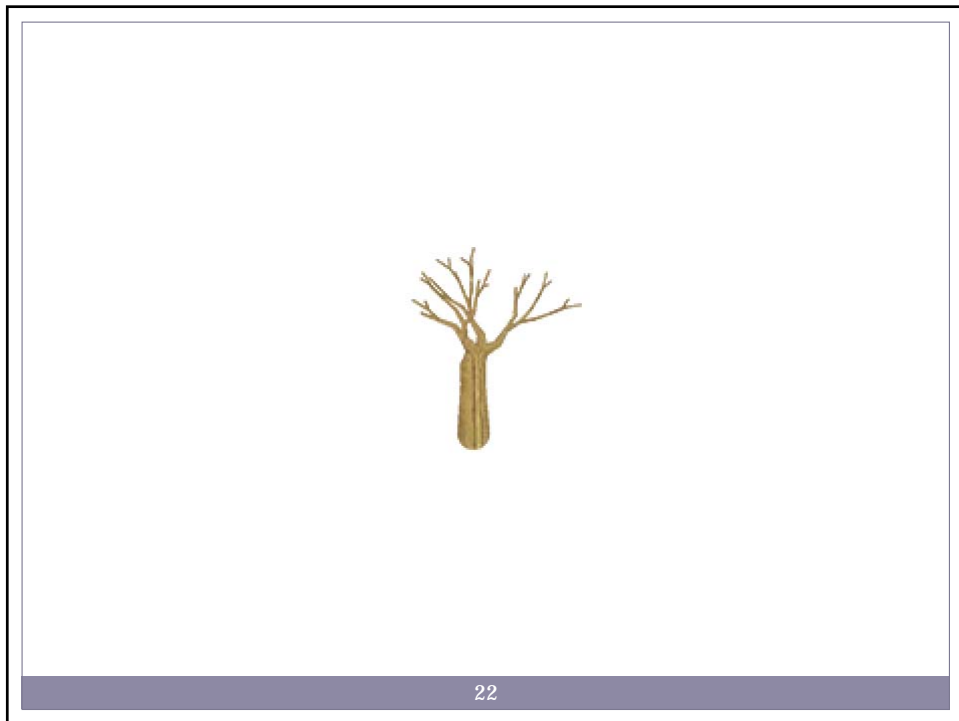
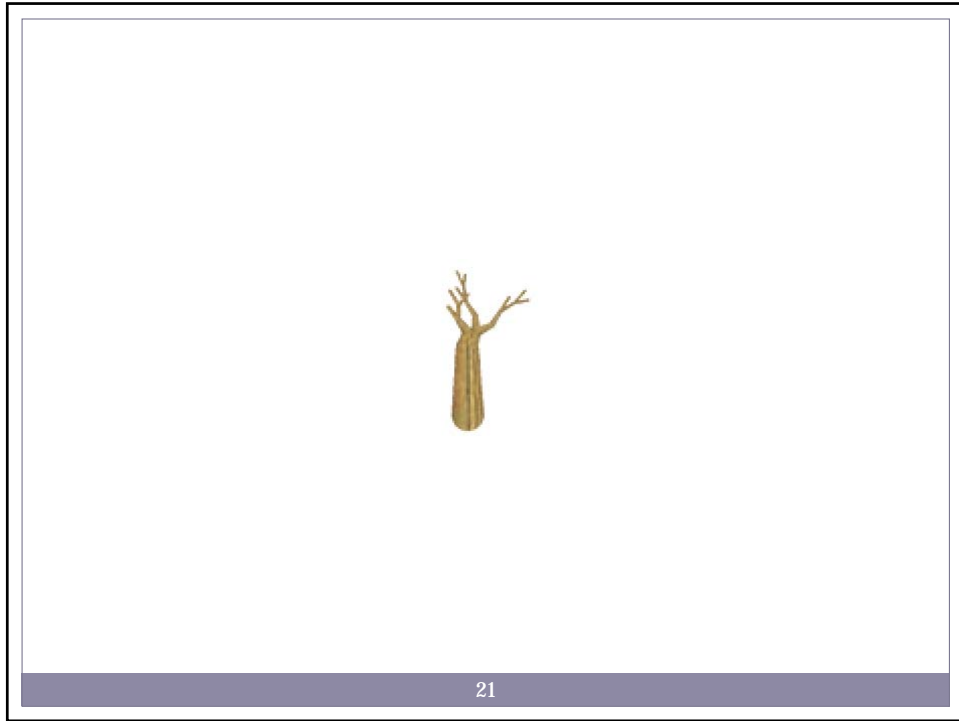


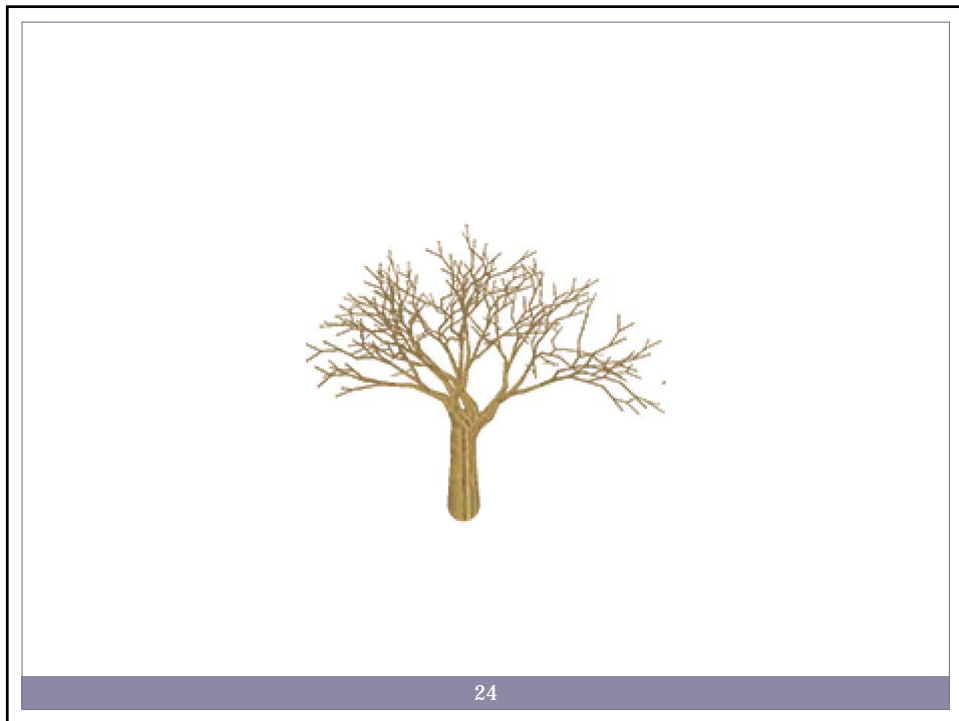
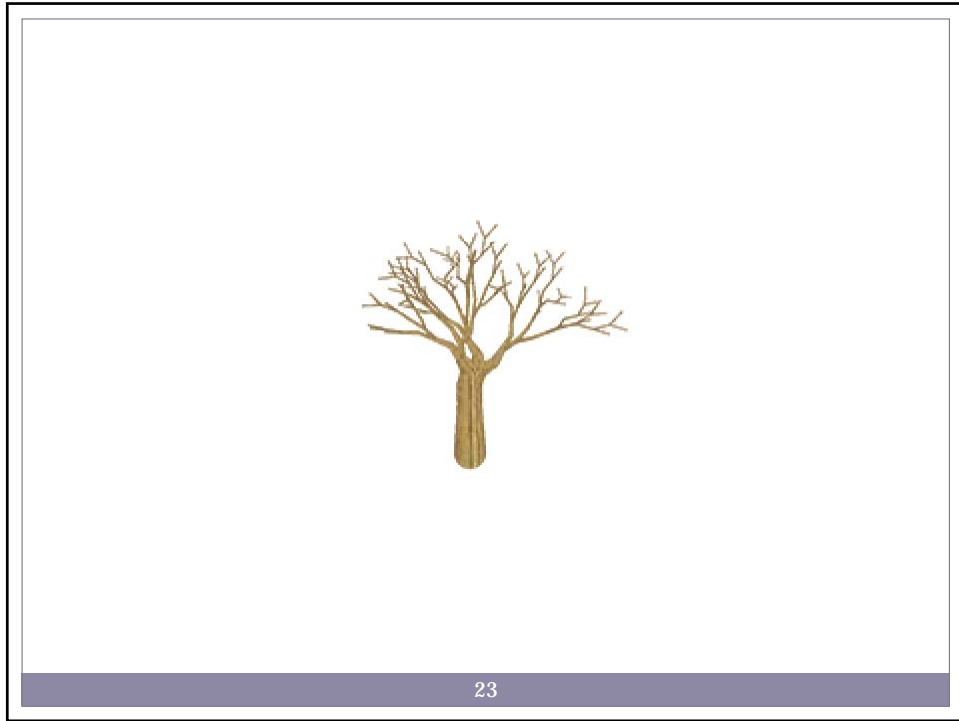
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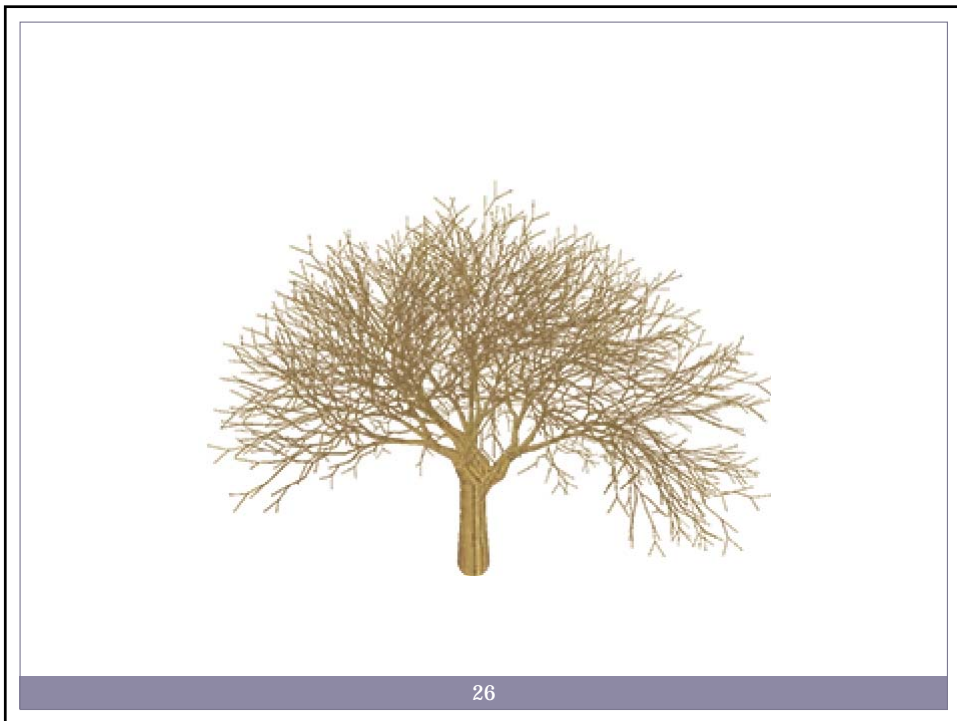
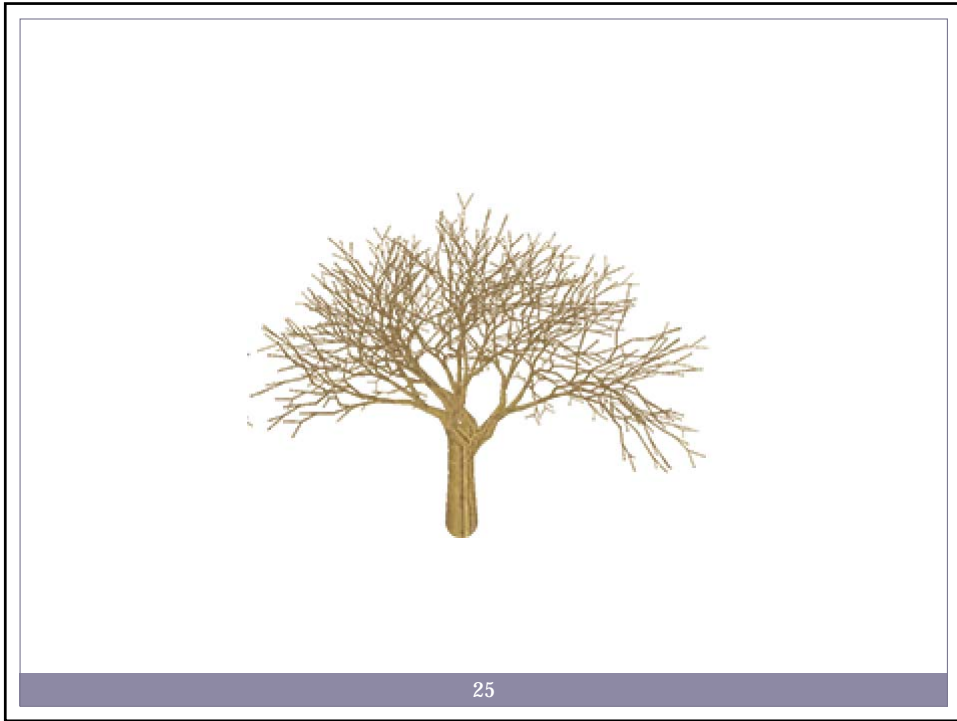
## 16<sup>th</sup>-19<sup>th</sup> centuries

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- Increasing specialization resulted in the growth of separate disciplines in universities, as a result of industry's demand for specialists, and those disciplines' competition to attract students
- Growing concern over the “fragmentation of knowledge”
  - Francis Bacon, Descartes, Kant, Hegel, Comte
- Pitted “specialization” against “unity of knowledge”
- Knowledge explosion: *“The tree of knowledge has become magnificently brachiated”* – JT Klein.







## Late 19<sup>th</sup> – early 20<sup>th</sup> centuries

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- Questioning of the “Renaissance Man” ideal.
- “Jack of All Trades” was originally complimentary, a master of integration.
- Then “Jack of All Trades, Master of None” became pejorative, implying someone who is reasonably competent in a number of areas, but outstanding in none of them.
- “Renaissance Man” notion remained for the baccalaureate, but specialization dominated for the modern research scholar.
- Universities established disciplinary structures and departments in order to support the increased differentiation required for disciplinary progress.

## The 1920's

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- The 1920's saw a reaction to hyper-specialization, and viewed a “liberal arts education” as the antidote to the problem.
- Launch of the “Great Books” programs at Columbia University and the University of Chicago
- Boyer (1981) describes the liberal arts/general education movement of the 1920's as a response to:
  - Misplaced vocational emphasis in education
  - Overemphasis on individual interests
  - Disillusionment among the youth of America
  - Need for national sense of unity

## 1920's – 1930's – 1940's

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- Continued tension between specialization and synthesis (depth versus breadth)
- 1920's: SSRC (Social Science Research Council) is established to promote integration across disciplines
- 1930's-1940's:
  - Increased efforts to integrate scientific inquiry
  - Development of the “area” approach in education: research and scholarship based on geographic (or cultural) area
  - Examples: American Studies, African Studies, European Studies, Latin American Studies, Slavic Studies, ...

## 1950's: Educational reform

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- Call for broader undergraduate education models, based on “General Education in a Free Society,” the report of a group of Harvard educators (James Bryant Conant, 1945).
- Noted the “staggering growth of knowledge,” and “increasing complexity of society.”
- Emphasized that education should give “young people the tools on which civilization depends.”
- “AAC&U sees liberal education as a philosophy of education that empowers individuals with **broad knowledge and transferable skills**, and a strong sense of **value, ethics, and civic engagement.**”

## 1950's: Research imperatives

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- In the era following WWII, demand grew for technological advances that depended on **greater cooperation** among scientific fields.
- It also led to the birth of “hyphenated sciences.”
  - Biophysics
  - Biochemistry
  - Biomedical engineering
  - Radioastronomy
  - Plate tectonics (paleontology, geochemistry, marine geology, seismology, volcanology, paleomagnetism)

## 1950's: Research imperatives

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- **NEW APPROACH:**
  - Mission-oriented projects
  - **Problem-centered** research  
*“We are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline.” Karl Popper, 1963.*
- **Examples**
  - Manhattan Project
  - Sputnik
  - NIH (1930)
  - NSF (1950)
  - Rand Corporation
  - Private industry efforts

## 1950's: Impact on universities

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- Universities began to support “problem-centered” research in force.
- Why?
  - Financial incentives (funding agency mandates)
  - Inevitability, as reflected in this quote from Rustom Roy (1979): interdisciplinarity developed because of the “the inexorable logic that the real problems of society do not come in **discipline-shaped blocks**.”

## 1960's – 1970's

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- Period of **tremendous reform** in universities
- Some consider this period almost synonymous with the growth of modern interdisciplinarity
- 1968: The OECD (Organization for Economic Cooperation and Development) establishes CERI (Centre for Educational Research & Innovation), and CERI organizes the **first international seminar** to investigate the **concept of interdisciplinarity**
- Led to the **1972 publication**:  
*Interdisciplinarity: Problems of Teaching and Research in Universities*

## And today

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- **Quickly expanding literature on interdisciplinarity**
  - Doubling from 1969 to 1972
  - 120% increase from 1972 to 1977
  - 95% increase from 1978-1982
- **More and more organizations and web resources to support ID research**
  - <http://nihroadmap.nih.gov/interdisciplinary/index.asp>
  - <http://www.units.muohio.edu/aisorg/>
  - <http://www.keckfutures.org/>
  - <http://www.interdisciplines.org/interdisciplinarity>
- **Much more attention from funders (NIH, NSF, Robert Wood Johnson, Doris Duke, etc)**

## Are we ready?

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