

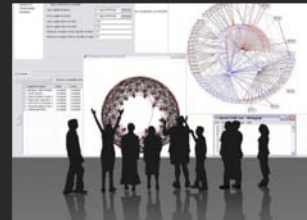
# STEM: Individual, Local, and Global Flows and Activity Patterns

**Dr. Katy Börner**

Cyberinfrastructure for Network Science Center, Director  
Information Visualization Laboratory, Director  
School of Library and Information Science  
Indiana University, Bloomington, IN  
[katy@indiana.edu](mailto:katy@indiana.edu)

With special thanks to Kevin W. Boyack, Micah Linnemeier,  
Russell J. Duhon, Patrick Phillips, Joseph Biberstine, Chintan Tank  
Nianli Ma, Angela M. Zoss, Hanning Guo, Mark A. Price,  
Scott Weingart

*Workshop on STEM Enterprise: Measures for Innovation and Competitiveness*  
George Washington University, Washington, D.C.  
October 21, 2009



## Three Arguments

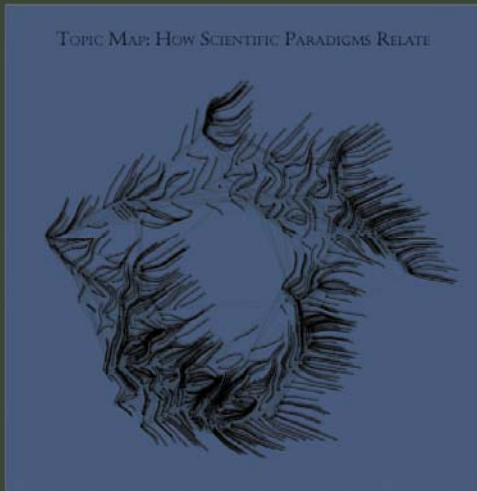
1. **Science/Economy/STEM is Global** and needs to be understood globally (but optimized locally).
2. **STEM is Evolving Dynamically** and has to be studied using dynamically evolving (not static) datasets and complex systems approaches.
3. **Open Data (also teaching materials) and Open Code** empowers many to help increase our understanding of what works and why.



## (1) Science/Economy/STEM is Global

### Illuminated Diagram Display

*W. Bradford Paley, Kevin W. Boyack, Richard Kalvans, and Katy Börner (2007) Mapping, Illuminating, and Interacting with Science. SIGGRAPH 2007, San Diego, CA.*



You may run your finger over each of these maps to control the lighting on the other: touching a place on the world map will light up topics studied in that place; touching a paradigm on the topic map will light up the places that study that topic.

#### Nanotechnology

This overlay shows the distribution of nanotechnology within the paradigms of science. The majority of current work in nanotechnology takes place in physics, chemistry, and materials science, at the upper right portion of the map. However, an increasing amount of nanotechnology is being applied in the biological and medical sciences, at the lower right.

#### All Topics

Sweep through all 376 scientific paradigms

#### Sustainability

The science behind our long-term hopes

#### Nanotechnology

Science on the tiny scale of molecules

#### Biology & Chemistry

The interface between these two vital fields

#### Francis H. C. CRICK

Co-discovered DNA's double helix

#### Joshua LEDERBERG

Pioneer in bacterial genetic mechanisms

#### Albert EINSTEIN

Revitalized physics with Relativity theories

#### Derek J. de Solla PRICE

Known as the "Father of Scientometrics"

#### Michael E. FISHER

Models critical phase transitions of matter

#### Richard N. ZARE

Uses laser chemistry in molecular dynamics

#### Susan T. FISKE

Connects perception and stereotypes

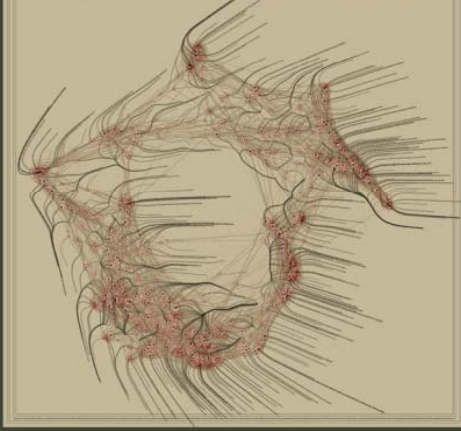
#### About this display

People & organizations that helped create it

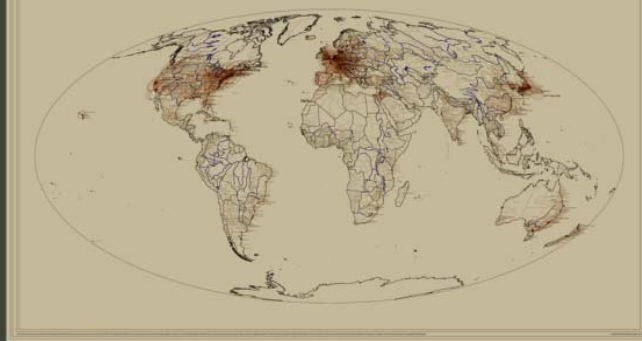
We sweep slowly through adjoining related topics, lighting up the places in the world that study each topic. You may select a subset of the topics that deal with these three interesting subjects by touching it.

A single person's spreading influence is shown as a series of four snapshots. First, we light only topics and places relating to that person's papers—papers that are still highly cited today. The second lights everything that cites that original work. Note that this first-generation impact extends to far more topics than did the original work. The third snapshot lights science that cites the second, and the fourth lights science that cites the third.

学科分布图：科学学科是怎样相互关联的



世界地图：科学研究在哪里进行着



你可以通过触摸屏在地图上随意指点来改变所到之处的光亮强度。当你触摸世界地图的某一点时，在那个地理位置上的所有研究机构会被点亮。同时在这些研究机构工作的学者的论文所属的学科会在学科分布图上被点亮。而当你触摸学科分布图的某一点时，在那个位置上的科学学科会被点亮，同时从事这些学科研究的研究机构在世界地图上的分布会被点亮。

纳米技术

这里显示所有和纳米技术相关的科学学科。纳米技术和科学研究人类在无形的空间里改造世界的的能力。这些空间存在于极其微小以至单个原子的结构中。目前大部分有关纳米的研究主要集中在物理、化学和材料科学领域。它们主要位于学科分布图上半部分的右面。不过，纳米技术在生物学和医药学研究里的应用也越来越多。生物学和医药学位于学科分布图下半部分的右面。



探索科学学科的相互关联性

所有科学学科 显示所有776种科学学科	纳米技术 有关微观粒子的科学
可持续性 一些与人类寄予长期希望相关的科学	化学和生物 化学和生物科学的交叉部分

光标缓慢的扫过所有相互关联的科学学科，每一个学科以及从事这方面科学研究的研究机构在世界地图上的位置会被逐一点亮。首先，显示屏会点亮那些产出论文最多、最活跃的科学学科，然后那些小学科或冷门学科会被逐一点亮。

探索某个学者的科学著作的影响力的传播

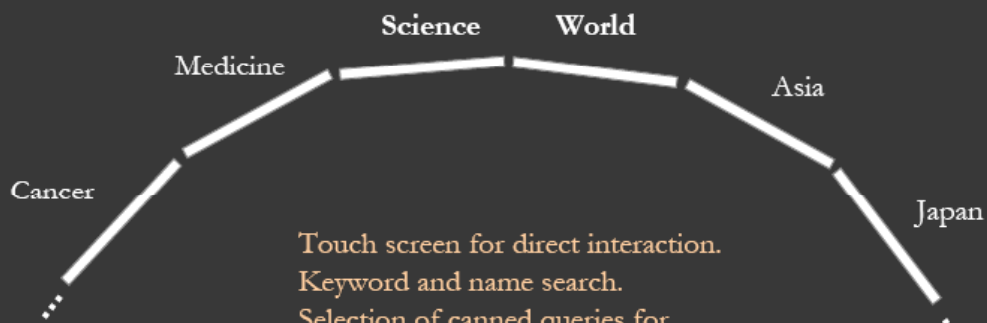
弗郎西·科里克 DNA双螺旋结构的发现者之一	阿尔伯特·爱因斯坦 用相对论重新激活了物理学	迈克尔·费舍尔 发现了物质转变模式的关键步骤	苏珊·费斯克 研究人的认知是如何产生偏见的
约舒亚·雷德伯格 细菌遗传机制研究先驱	德里克·德索拉·普里斯 著名的“科学计量学之父”	理查德·扎尔 采用激光化学技术研究分子动态分布	关于本次展览 与此展览相关人员和机构

显示屏通过四步来展示某个学者对科学的贡献以及影响力的传播。首先，显示屏点亮该学者所发表的论文所属的学科在学科分布图上的位置以及该学者从事这项研究时所在的研究机构在世界地图上的位置。到目前为止，所有这些论文的引用率仍然很高。第二步，显示屏点亮所有引用在第一步中被点亮的原始论文的论文在学科分布图上的位置以及它们在世界地图上的位置。第三步，显示屏点亮所有引用了在第二步中被点亮的论文的论文在学科分布图上的位置以及它们在世界地图上的位置。第四步，显示屏点亮所有引用了在第三步中被点亮的论文的论文在学科分布图上的位置以及它们在世界地图上的位置。

Re-implementation of Illuminated Diagram Software

by Advanced Visualization Lab, Indiana University

Drives unlimited number of ID screens.



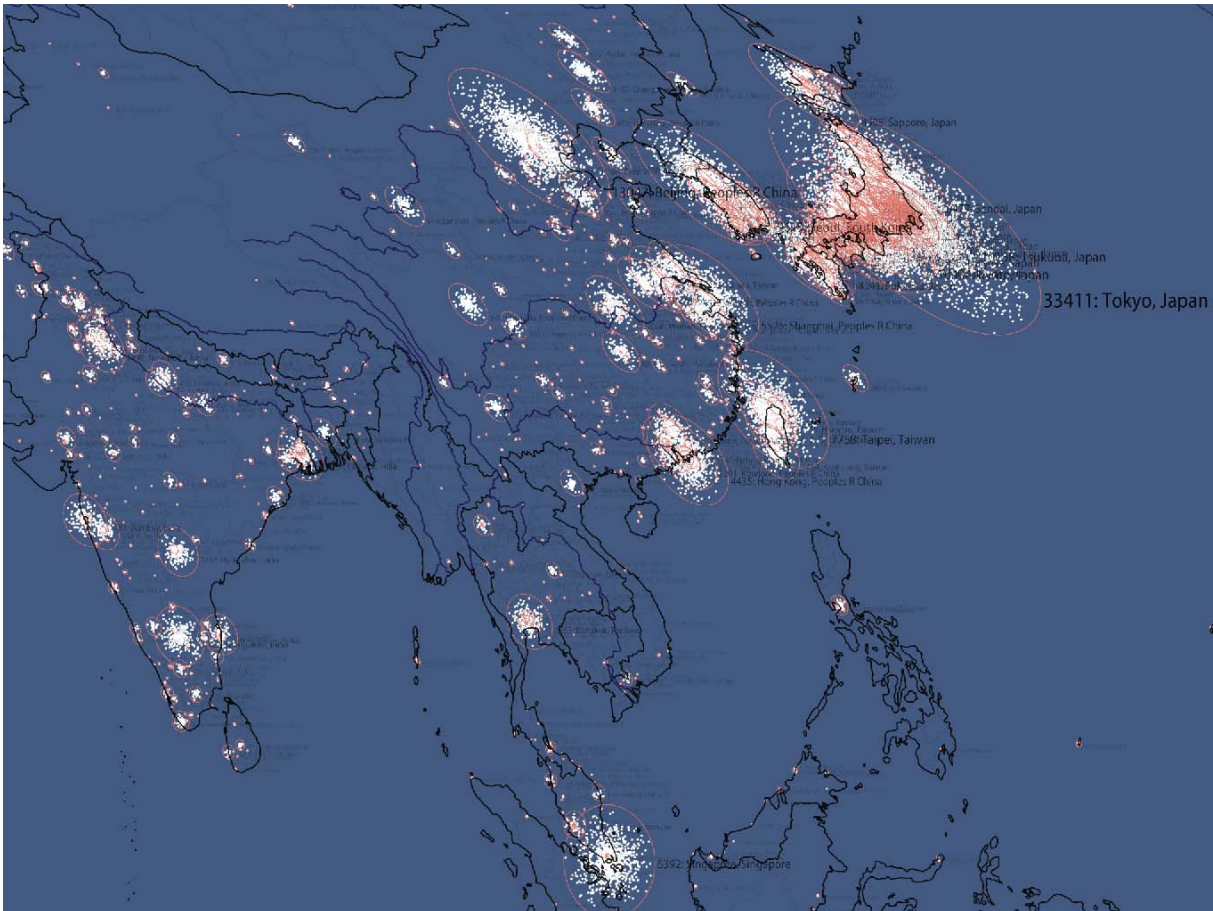
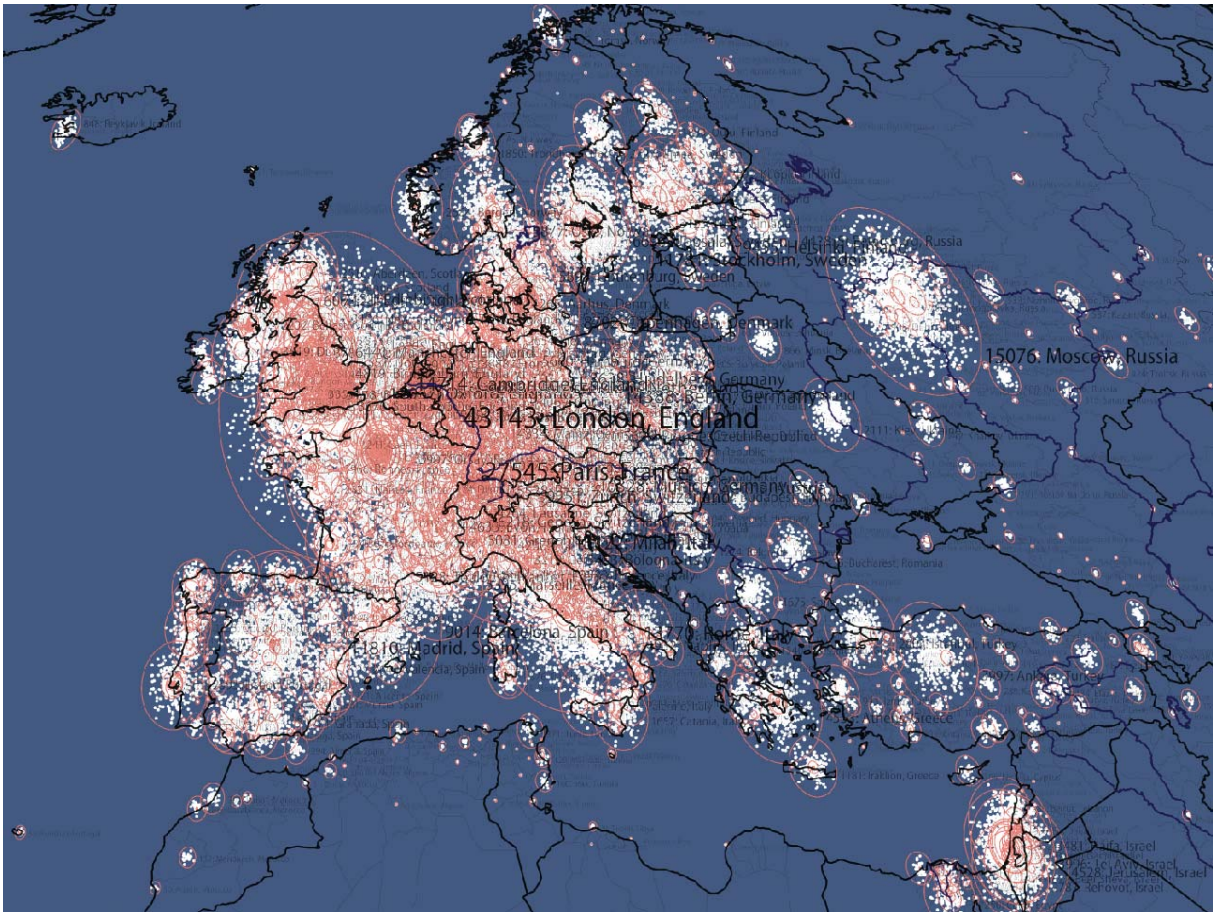
- Touch screen for direct interaction.  
 Keyword and name search.  
 Selection of canned queries for
- interdisciplinary research areas
  - famous people
  - activity patterns, e.g., bursts, trends, etc.























# Inventors



Hands-On Science Maps for Kids, by Filipe Palmer (Painting), Julia Smith (Plans Acquisition), Eksha Hardy and Kitty Elmer (Graphic Design), BLOOMINGTON, IN, 2006. Courtesy of Indiana University. Learn more at [www.scmmaps.org](http://www.scmmaps.org). This map plots the locations of where scientific papers were published; each light green dot represents 10 or fewer papers; they are scattered around the exact location for visibility, within a labeled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illuminated diagram" display which used a computer and two projectors, projecting spots of light on the panel to highlight different kinds of scientific research on a sliding map of scientific paradigms and the areas in the world where such science was performed. Base map research by Kevin Baskin and Dik Kluwer, cartography by John Dugovic, data from Thompson ISI graphics and typography by its Bradford Peleg. Copyright © 2006 by Bradford Peleg, all rights reserved.





## Mapping Science Exhibit – 10 Iterations in 10 years

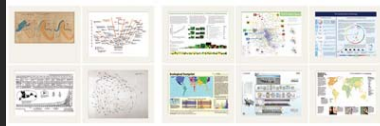
<http://scimaps.org>



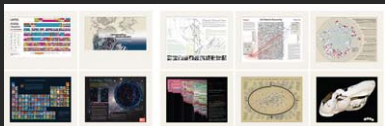
### The Power of Maps (2005)



### Science Maps for Economic Decision Makers (2008)



### The Power of Reference Systems (2006)



### Science Maps for Science Policy Makers (2009)

### Science Maps for Scholars (2010)

### Science Maps as Visual Interfaces to Digital Libraries (2011)

### Science Maps for Kids (2012)

### Science Forecasts (2013)

### The Power of Forecasts (2007)



### Telling Lies With Science Maps (2014)



Exhibit has been shown in 72 venues on four continents. Currently at  
 - NSF, 10th Floor, 4201 Wilson Boulevard, Arlington, VA  
 - Wallenberg Hall, Stanford University, CA  
 - Center of Advanced European Studies and Research, Bonn, Germany  
 - Science Train, Germany.







Debut of 5<sup>th</sup> Iteration of Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University, <http://mediax.stanford.edu>, <http://scaleindependentthought.typepad.com/photos/scimaps>



## (2) STEM is Evolving Dynamically



Self amplifying downward spiral | ‘systemic’ meltdown with intertwined breakdowns | ‘war room’ analyses | market wind tunnel | power market test bed | Regulators feel duty-bound to adhere to generally accepted and well-vetted techniques

*“... while any new technical device or medical drug has extensive testing for efficiency, reliability and safety before it ever hits the market, we still implement new economic measures without any prior testing.” Dirk Helbing*



## Monitor and Analyze/Visualize STEM in Real Time

Design a 'STEM Wind Tunnel' or 'STEM Knowledge Collider'

That empowers anybody to see what new

- Research results
- Policy decisions
- Teaching material
- Jobs exist

Together with

- Bursts of activity
- Evolving communities of research/practice
- Positive/negative feedback cycles

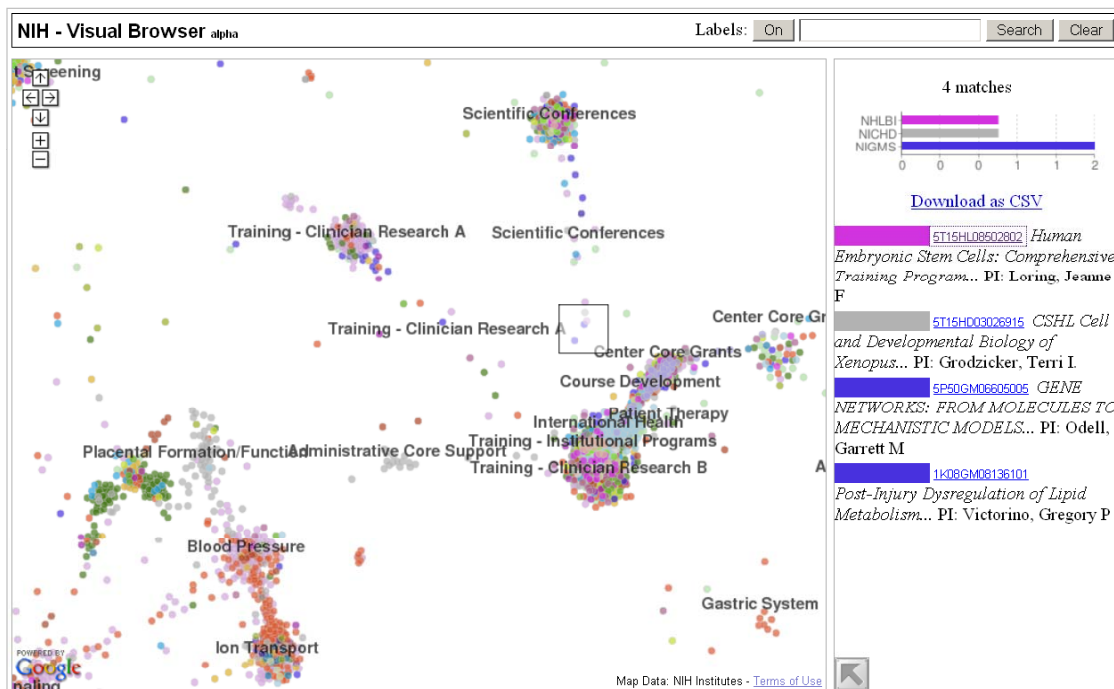
Ideally,

- what-if scenarios could be modeled.



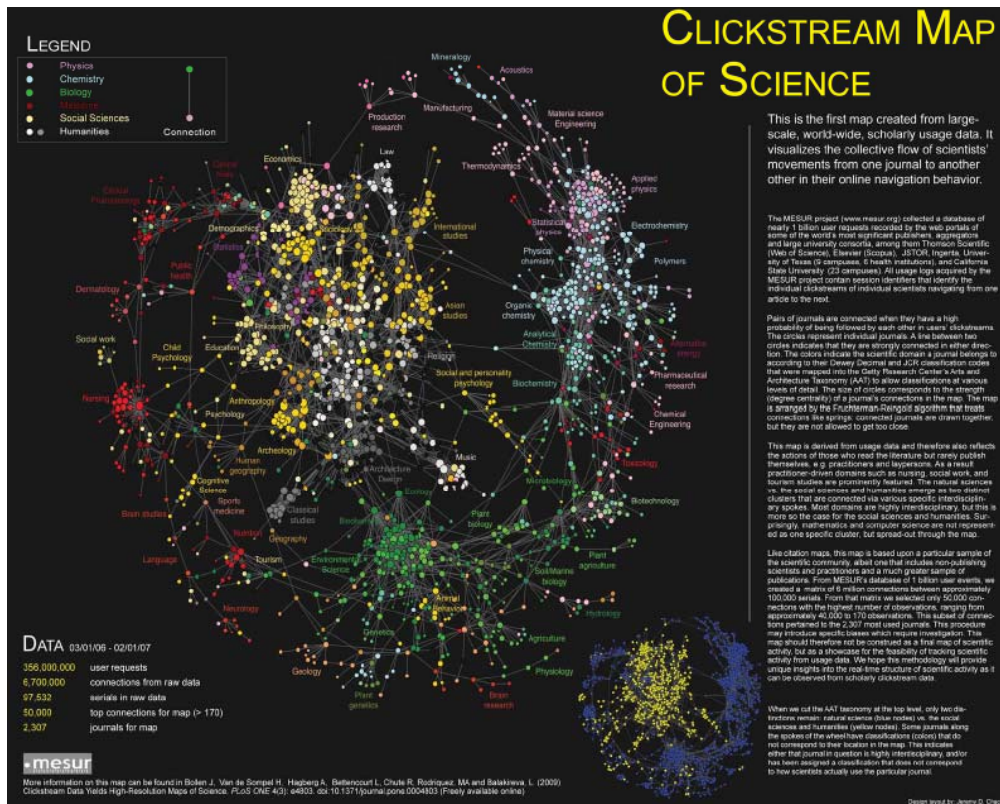
## Interactive Maps of Science – NIH Funding

*Google maps with charts and tables*



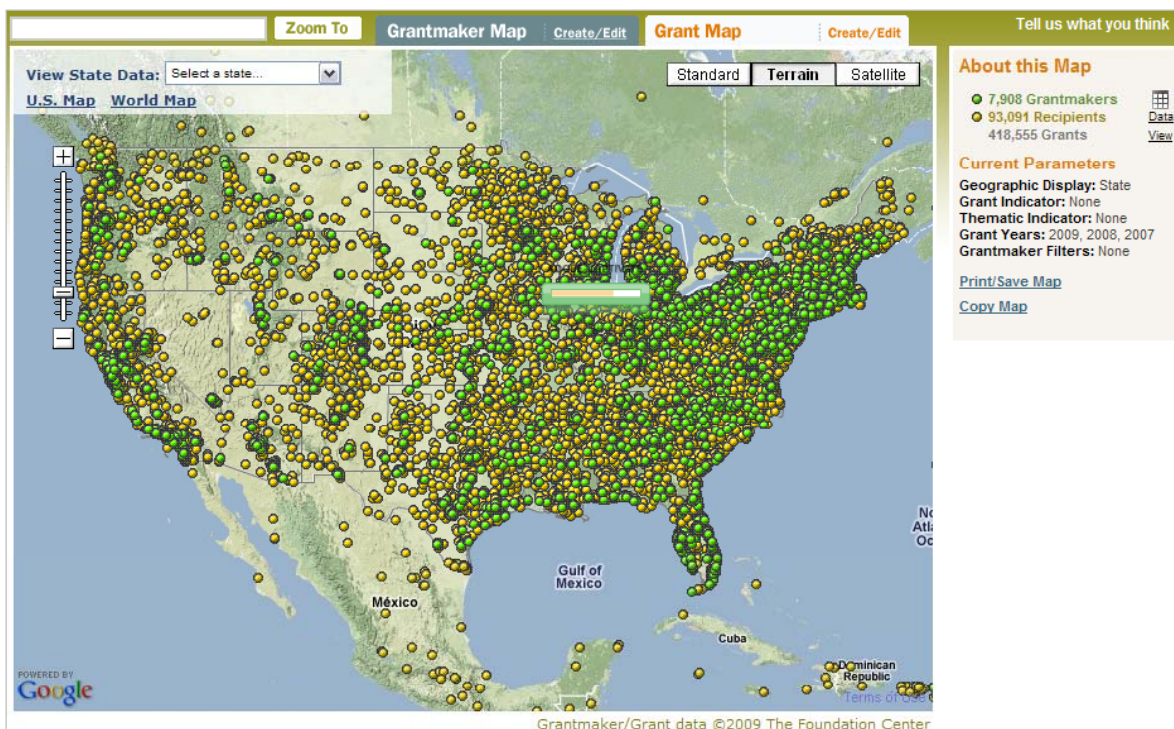
<http://scimaps.org/maps/nih/2007>





A Clickstream Map of Science – Bollen, Johan, Herbert Van de Sompel, Aric Hagberg, Luis M.A. Bettencourt, Ryan Chute, Marko A. Rodriguez, Lyudmila Balakireva - 2008

## Interactive Maps of Science – Philanthropy



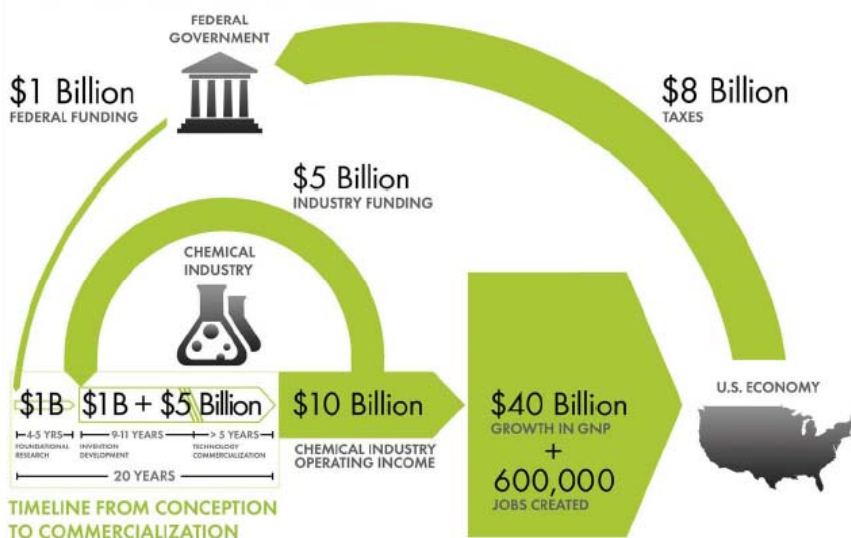
# Chemical Research & Development Powers the U.S. Innovation Engine

Macroeconomic Implications of Public and Private R&D Investments in Chemical Sciences

The Council for Chemical Research (CCR)

has provided the U.S. Congress and government policy makers with important results regarding the impact of Federal Research & Development (R&D) investments on U.S. innovation and global competitiveness through its commissioned 5-year two phase study. To take full advantage of typically brief access to policy makers, CCR developed the graphic below as a communication tool that distills the complex data produced by these studies in direct, concise and clear terms.

## INVESTMENT IN CHEMICAL SCIENCE R&D



The design shows that an input of \$1B in federal investment, leveraged by \$5B industry investment, brings new technologies to market and results in \$10B of operating income for the chemical industry, \$40B growth in the Gross National Product (GNP) and further impacts the US economy by generating approximately 600,000 jobs, along with a return of \$8B in taxes. Additional details, also reported in the CCR studies, are depicted in the map to the left. This map clearly shows the two R&D investment cycles: the shorter industry investment at the innovation stage to commercialization cycle; and the longer federal investment cycle which begins in basic research and culminates in national economic and job growth along with the increase tax base that in turn is available for investment in basic research.

Council for Chemical Research - Chemical R&D Powers the U.S. Innovation Engine. Washington, DC. Courtesy of the Council for Chemical Research - 2009



## Mapping S&T Job Market Data in Real Time – GeoMap

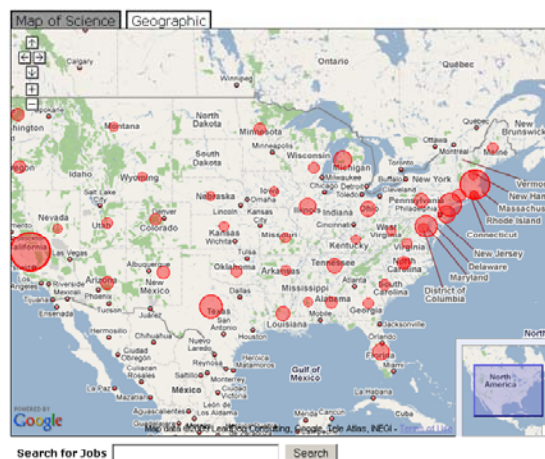
Angela Zoss, Michael Conover

### Data

Thousands of full-text, location-specific, time stamped job postings from [Nature Jobs](#) and [Science Careers](#) RSS feeds. The posts have been parsed and stored in a relational MySQL database.

Jobs have been geolocated on a Google map.

### Visualization of Job Postings

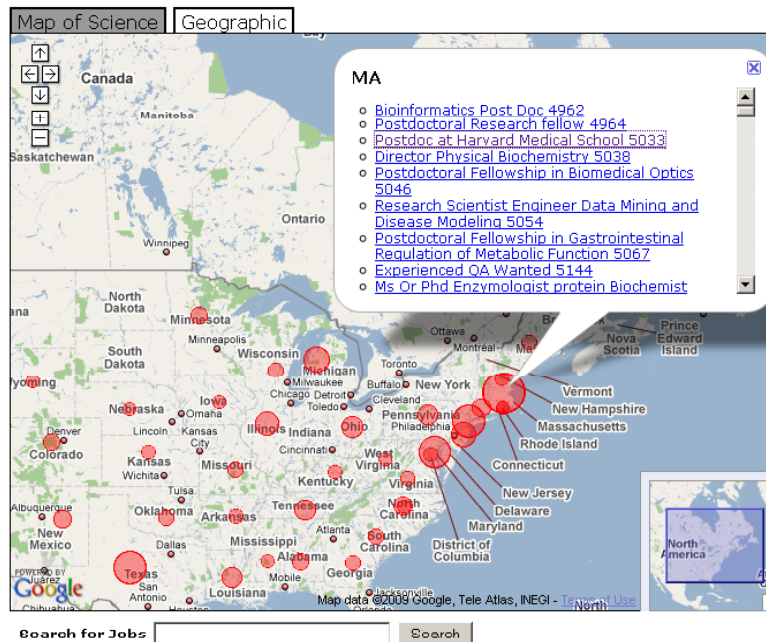


### Geographic Visualization

Here we have a more traditional view of job postings - a geographic overlay. Featured here are the job postings that list both a city and state in the United States. Feel free to search, zoom, pan, and click on job descriptions.



## Visualization of Job Postings



**Postdoc at Harvard Medical School**  
[Link to Post](#)

Harvard Medical School, Massachusetts General Hospital, Gastrointestinal Unit, One Post-doctoral Position Available

We are now looking for an additional post-doctoral fellow who wants to study in the area of cellular and molecular mechanisms during the development of inflammatory bowel disease (ulcerative colitis and Crohn's disease). The successful candidate will be involved in studies on physiological functions of key molecules (including Toll-like receptors and tumor necrosis factor receptors) in colonic epithelial cells/microbial interactions.

Candidates need to have MD, PhD, MD/PhD, or equivalent degree(s) with research training in the field of immunology, pathology, microbiology, biochemistry, and/or molecular biology. Actual starting date will be July or August 2009. An initial appointment will be for 2 years, but the term can be extended depending on the research accomplishment. Salary will be competitive and commensurate with experience.

Massachusetts General Hospital is the third oldest general hospital in the United States and the oldest and largest hospital in New England. The



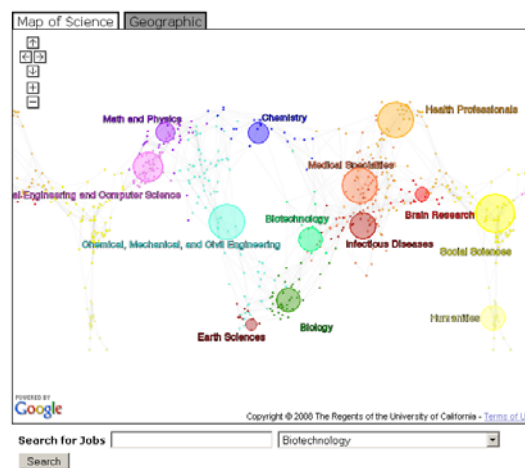
## Mapping S&T Job Market Data in Real Time – SciMap

Angela Zoss, Michael Conover

The **UCSD Map of Science** used here is the product of a large study by researchers at the University of California - San Diego using 7.2 million papers and over 16,000 separate journals, proceedings, and series from Thomson Scientific and Scopus over the five year period from 2001 to 2005.

Jobs were associated with nodes in the Map of Science by way of keyword extraction.

### Visualization of Job Postings



**Map of Science**

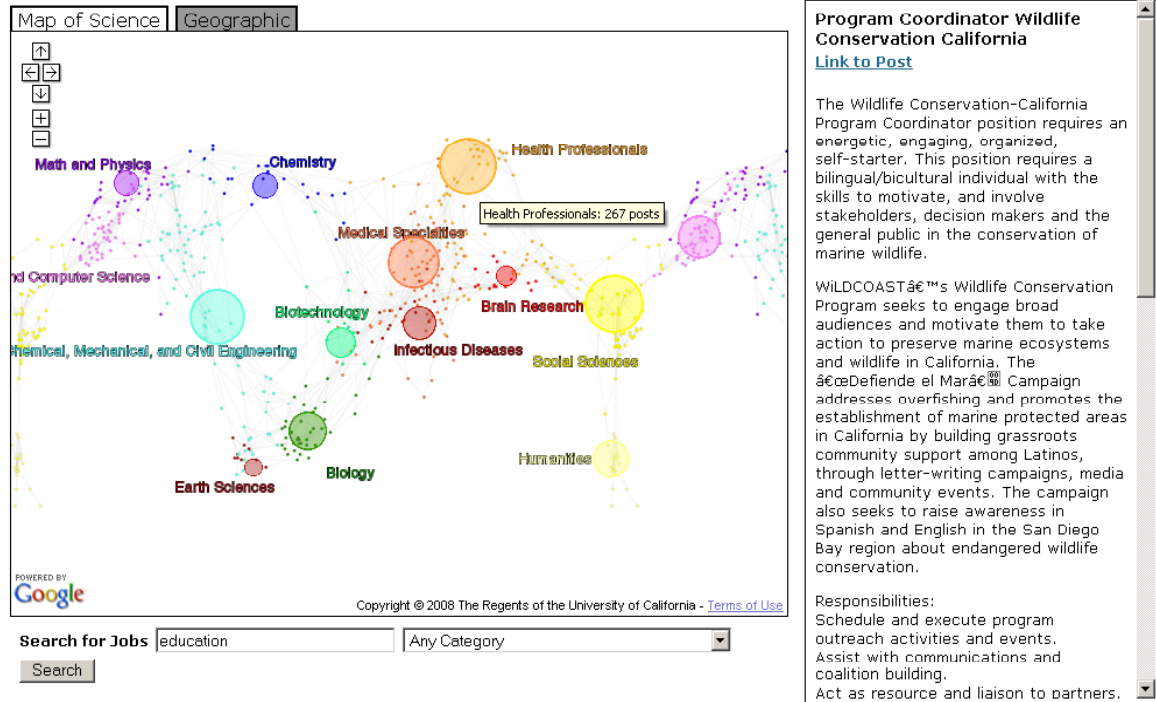
Scientific domains are highly interconnected. The boundaries between different domains are often fuzzy. One way of thinking about the relationships between domains is to conceptualize all scientific domains as existing within a large network of research.

Creating a network of scientific research can be accomplished by looking at scientific journals and their articles. The UCSD Map of Science used here is the product of a large study by researchers at the University of California San Diego using 7.2 million papers and over 16,000 separate journals, proceedings, and series from Thomson Scientific and Scopus over the five year period from 2001 to 2005. The researchers used citations between the papers and journals to cluster journals into small groups of highly related journals.

Those clusters are represented by 554 individual nodes in the network. The links between the clusters show that some clusters are related to other clusters but are not as tightly connected as the journals that make up each cluster. Then the clusters are labeled both by the content area shared by the journals in the cluster and by the overarching scientific domain for that cluster (represented by one of 13 colors).

Maps of science like this one can be used to understand many different data sets and how they can be represented by topic. Here we are looking at the topics that appear in link postings from larua job

## Visualization of Job Postings



### (3) Open Data and Open Code

Studying Individual, Local, and Global STEM Flows and Activity Patterns

Design **comprehensive databases** that capture relevant data and **cyberinfrastructures** that can be used to make sense of this data(stream).

STEM studies can be conducted at different levels:

- *local* (individual),
- *meso* (local, e.g., one institute, one funding agency), or
- *global* level (all of science or world wide).

Using

- Statistical Analysis/Profiling
- Temporal Analysis (When)
- Geospatial Analysis (Where)
- Topical Analysis (What)
- Network Analysis (With Whom?)



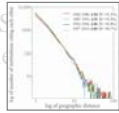




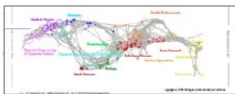



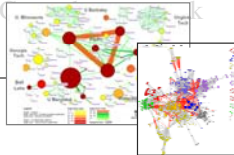
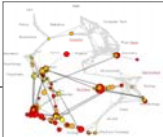


## Type of Analysis vs. Scale of Level of Analysis

	<i>Micro/Individual</i> (1-100 records)	<i>Meso/Local</i> (101–10,000 records)	<i>Macro/Global</i> (10,000 < records)
<b>Statistical Analysis/Profiling</b>	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of USA, all of science.
<b>Temporal Analysis (When)</b>	Funding portfolio of one individual	Mapping topic bursts in 20-years of PNAS	113 years of physics research
<b>Geospatial Analysis (Where)</b>	Career trajectory of one individual	Mapping a states intellectual landscape	PNAS publications
<b>Topical Analysis (What)</b>	Base knowledge from which one grant draws.	Knowledge flows in Chemistry research	Topic maps of NIH funding
<b>Network Analysis (With Whom?)</b>	NSF Co-PI network of one individual	Co-author network	NSF's core competency



## Type of Analysis vs. Scale of Level of Analysis

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<b>Statistical Analysis/Profiling</b>	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSF, all of USA, all of science. 
<b>Temporal Analysis (When)</b>	Funding portfolio of one individual	Mapping topic bursts in 20-years of PNAS 	113 Years of physics research 
<b>Geospatial Analysis (Where)</b>	Career trajectory of one individual	Mapping a states intellectual landscape 	PNAS publications 
<b>Topical Analysis (What)</b>	Base knowledge from which one grant draws. 	Knowledge flows in Chemistry research 	Topic maps of NIH funding 
<b>Network Analysis (With Whom?)</b>	NSF Co-PI network of one individual 	Co-author network 	NSF's core competency 



## CI for a Science of Science Studies



Scholarly Database: 23 million scholarly records

<http://sdb.slis.indiana.edu>



Information Visualization Cyberinfrastructure

<http://iv.slis.indiana.edu>



Network Workbench Tool + Community Wiki

<http://nwb.slis.indiana.edu>



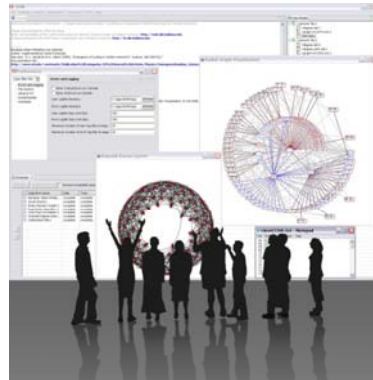
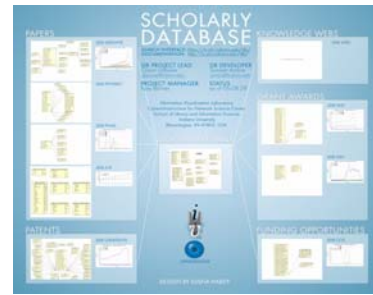
Sci<sup>2</sup> Tool and Science of Science CI Portal

<http://sci.slis.indiana.edu>



Epidemics Cyberinfrastructure

<http://epic.slis.indiana.edu/>

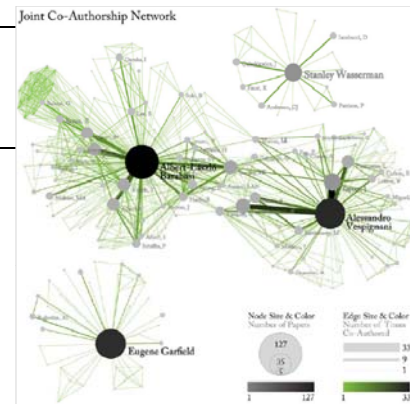
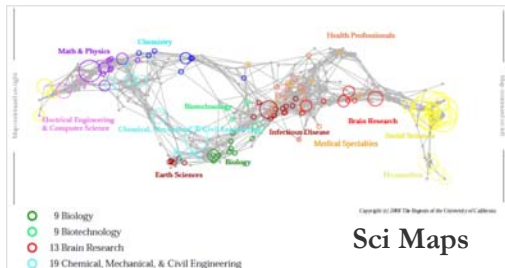


## Sci<sup>2</sup> Tool

<http://sci.slis.indiana.edu>

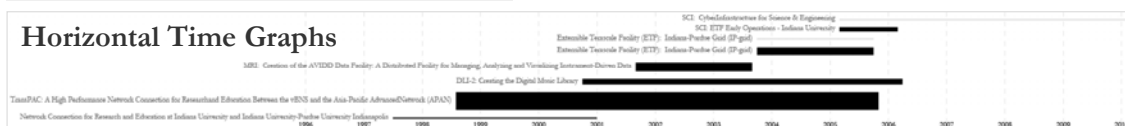
### “Open Code for S&T Assessment”

Branded OSGi/CIShell based tool with NWB plugins and many new plugins.



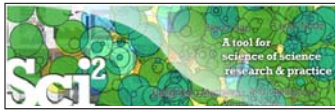
GUESS Network Vis

### Horizontal Time Graphs

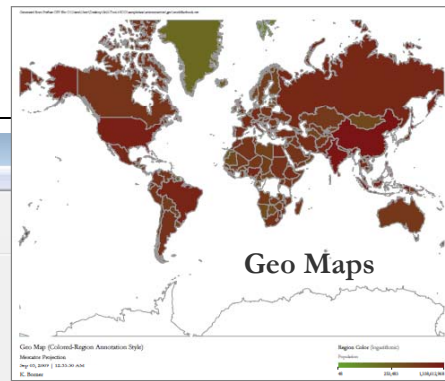


Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Dubon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). *Retz-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool*. Proceedings of ISSI 2009: 12th International Conference on Scientometrics and Informetrics, Rio de Janeiro, Brazil, July 14-17. Vol. 2, pp. 619-630.





## Sci² Tool



The screenshot shows the Sci² Tool interface with the following components:

- Visualization Menu:**
  - GUESS
  - GnuPlot
  - Radial Tree/Graph (prefuse alpha)
  - Radial Tree/Graph with Annotation (prefuse beta)
  - Tree View (prefuse beta)
  - Tree Map (prefuse beta)
  - Force Directed with Annotation (prefuse beta)
  - Fruchterman-Reingold with Annotation (prefuse beta)
  - DrL (VxOrd)
  - Specified (prefuse beta)
  - Horizontal Line Graph
  - Circular Hierarchy
  - Geo Map (circle annotations)
  - Geo Map (region coloring annotations)
  - Image Viewer
  - RefMapper
- Scheduler:**
  - Buttons: Remove From List, Remove completed
  - Table:

!	Algorithm Name	Date	Time	% Cor
<input checked="" type="checkbox"/>	Extract Co-Author Netw...	09/03/2009	00:15:20 AM	<div style="width: 100%; height: 10px; background-color: green;"></div>
<input checked="" type="checkbox"/>	Load and Clean ISI File	09/03/2009	00:15:05 AM	<div style="width: 100%; height: 10px; background-color: green;"></div>

Circular Hierarchy



## Sci² Tool: Supported Data Formats

### **Personal Bibliographies**

- Bibtext (.bib)
- Endnote Export Format (.enw)

### **Data Providers**

- Web of Science by Thomson Scientific/Reuters (.isi)
- Scopus by Elsevier (.scopus)
- Google Scholar (access via *Publish or Perish* save as CSV, Bibtext, EndNote)
- Awards Search by National Science Foundation (.nsf)

### **Scholarly Database** (all text files are saved as .csv)

- Medline publications by National Library of Medicine
- NIH funding awards by the National Institutes of Health (NIH)
- NSF funding awards by the National Science Foundation (NSF)
- U.S. patents by the United States Patent and Trademark Office (USPTO)
- Medline papers – NIH Funding

### **Network Formats**

- NWB (.nwb)
- Pajek (.net)
- GraphML (.xml or .graphml)
- XGMML (.xml)

### **Burst Analysis Format**

- Burst (.burst)

### **Other Formats**

- CSV (.csv)
- Edgelist (.edge)
- Pajek (.mat)
- TreeML (.xml)



## Sci<sup>2</sup> Tool: Algorithms

See <https://nwb.slis.indiana.edu/community>

### Preprocessing

Extract Top N% Records  
Extract Top N Records  
Normalize Text  
Slice Table by Line

-----  
Extract Top Nodes  
Extract Nodes Above or Below Value  
Delete Isolates

-----  
Extract top Edges  
Extract Edges Above or Below Value  
Remove Self Loops  
Trim by Degree  
MST-Pathfinder Network Scaling  
Fast Pathfinder Network Scaling

-----  
Snowball Sampling (in nodes)  
Node Sampling  
Edge Sampling

-----  
Symmetrize  
Dichotomize  
Multipartite Joining

-----  
Geocoder

-----  
Extract ZIP Code

### Modeling

Random Graph  
Watts-Strogatz  
Small World  
Barabási-Albert Scale-Free  
TARL

### Analysis

Network Analysis Toolkit (NAT)  
Unweighted & Undirected

Node Degree  
Degree Distribution

-----  
K-Nearest Neighbor (Java)  
Watts-Strogatz Clustering Coefficient  
Watts Strogatz Clustering Coefficient over K

-----  
Diameter  
Average Shortest Path  
Shortest Path Distribution  
Node Betweenness Centrality

-----  
Weak Component Clustering  
Global Connected Components

-----  
Extract K-Core  
Annotate K-Coreeness

-----  
HTTS

### Weighted & Undirected

Clustering Coefficient  
Nearest Neighbor Degree  
Strength vs Degree  
Degree & Strength  
Average Weight vs End-point Degree  
Strength Distribution  
Weight Distribution  
Randomize Weights

-----  
Blondel Community Detection

-----  
HTTS

### Unweighted & Directed

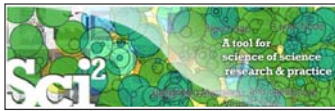
Node Indegree  
Node Outdegree  
Indegree Distribution  
Outdegree Distribution

-----  
K-Nearest Neighbor  
Single Node in-Out Degree Correlations

-----  
Dyad Reciprocity  
Arc Reciprocity  
Adjacency Transitivity

-----  
Weak Component Clustering  
Strong Component Clustering

39



## Sci<sup>2</sup> Tool: Algorithms cont.

See <https://nwb.slis.indiana.edu/community>

-----  
Extract K-Core  
Annotate K-Coreeness

-----  
HTTS

PageRank

Weighted & Directed

HTTS

Weighted PageRank

### Textual

Burst Detection

### Visualization

GnuPlot  
GUESS  
Image Viewer

-----  
Radial Tree/Graph (prefuse alpha)  
Radial Tree/Graph with Annotation  
(prefuse beta)  
Tree View (prefuse beta)  
Tree Map (prefuse beta)  
Force Directed with Annotation  
(prefuse beta)  
Fruchterman-Reingold with Annotation  
(prefuse beta)

-----  
DrL (VxOrd)  
Specified (prefuse beta)

-----  
Horizontal Line Graph  
Circular Hierarchy  
Geo Map (Circle Annotation Style)  
Geo Map (Colored-Region Annotation Style)

### Scientometrics

Remove ISI Duplicate Records  
Remove Rows with Multitudinous Fields  
Detect Duplicate Nodes  
Update Network by Merging Nodes

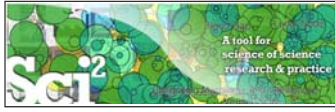
-----  
Extract Directed Network  
Extract Paper Citation Network  
Extract Author Paper Network

-----  
Extract Co-Occurrence Network  
Extract Word Co-Occurrence Network  
Extract Co-Author Network  
Extract Reference Co-Occurrence  
(Bibliographic Coupling) Network

-----  
Extract Document Co-Citation Network

40

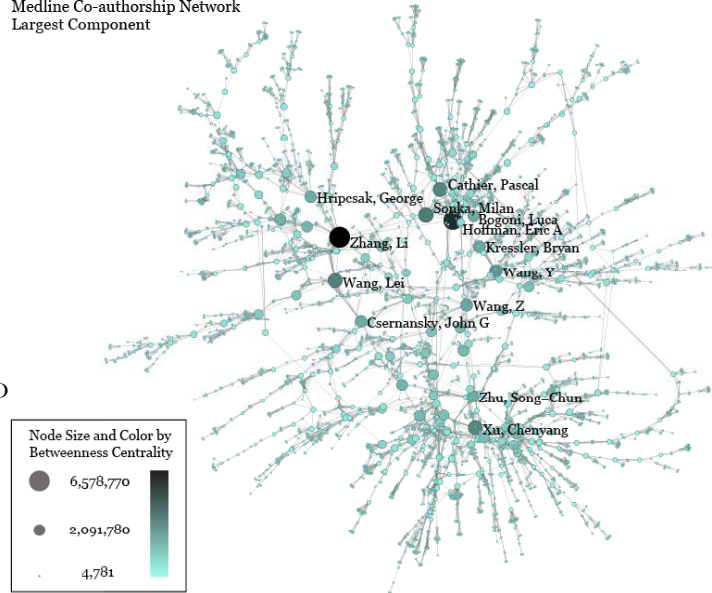




## NWB=Sci<sup>2</sup> Tool: Output Formats

- NWB tool can be used for data conversion. Supported output formats comprise:
  - CSV (.csv)
  - NWB (.nwb)
  - Pajek (.net)
  - Pajek (.mat)
  - GraphML (.xml or .graphml)
  - XGMML (.xml)
- GUESS
  - Supports export of images into common image file formats.
- Horizontal Bar Graphs
  - saves out raster and ps files.

Medline Co-authorship Network  
Largest Component

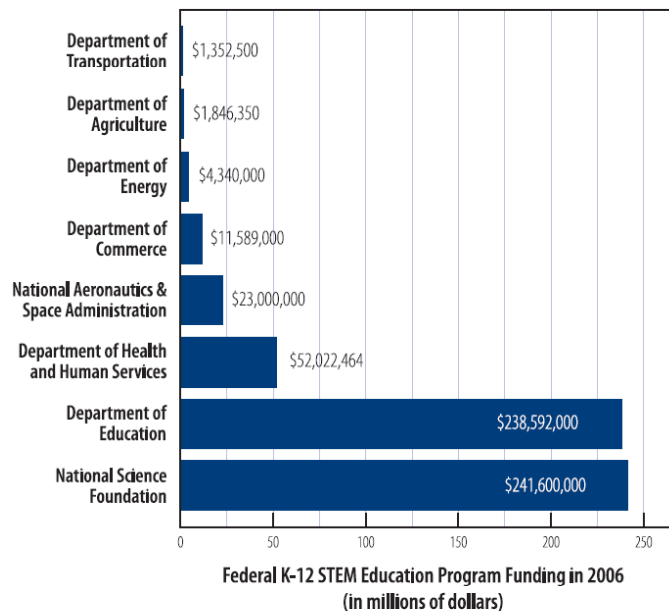


## Sample Study – NSF Funding of STEM

Using NSF Awards Search:  
<http://www.nsf.gov/awardsearch>  
 download relevant NSF awards that have “stem” and “education” in title, abstract, and awards.  
 Active awards only.

Number of awards: 1,340  
 Total awarded amount to date:  
 \$1,347,802,833

*Retrieved on Oct 18, 2009*



*Federal K-12 STEM Education Program Funding in 2006*

*SOURCE: Department of Education, Report of the Academic Competitiveness Council, 2007*

NSF - Award Search - Search All Fields - Mozilla Firefox

http://www.nsf.gov/awardsearch/afSearch.do?SearchType=afSearch&page=4&QueryText="stem"+and

NSF Web Site

HOME | FUNDING | AWARDS | DISCOVERIES | NEWS | PUBLICATIONS | STATISTICS | ABOUT | FastLane

**Award Search** Send Comments | Award Search Help

Awardee Information Program Information Search All Free-Text Search All Fields More Options

Hint: The text field below 'Search Award For' searches the title, abstract, and award number fields.

Search Award For: "stem" and "education"

Restrict to Title Only:

Awardee Information

Principal Investigator

**Search for awards that have “stem” and “education” in title, abstract, and awards. Active awards only. Query run on 10/18/2009.**

NSF - Award Search - Search All Fields - Mozilla Firefox

http://www.nsf.gov/awardsearch/afSearch.do?SearchType=afSearch&page=4&QueryText="stem"+and

NSF Web Site

HOME | FUNDING | AWARDS | DISCOVERIES | NEWS | PUBLICATIONS | STATISTICS | ABOUT | FastLane

**Search Results**

Back

Results are sorted by award date, with the most recent awards at the top. Click on a column heading to re-sort the results. The up/down arrows at the right of each column title control whether the sort is ascending or descending. To view the abstract, click on the award number or title. Click on the data in other columns to perform a new search with that parameter.

Refine Search

1,340 awards found, displaying 1 to 50.

[First/Prev] 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 [Next/Last]

Award Number	Title	NSF Organization	Program(s)	Start Date	Principal Investigator	State	Organization
0941971	Self-Efficacy and Student Characteristics as Predictors of Success for Supplemental Instruction	DUE	CCLI-Phase 1 (Exploratory), S-STEM: SCHLR SCI	09/01/2010	Feakes, Debra	TX	Texas State U Marcos

**Top-10 Projects with highest Award Amount to Date**

Title	NSF Org	Program(s)	PI	State	Organization	\$ Awarded to Date
Next Generation Biometrics: Achieving Strength in Molecu	EPS	RESEARCH INFRASTRUCTURE	Paul Hill	WV	Higher Education Policy Commission	10,799,903
UMBC-BCPS STEM Project	DUE	Teaching & Mstr Tchng Fellows	Anne Spence	MD	University of Maryland Baltimore County	11,410,713
MRSEC: MRSEC on Nanostructured Interfaces	DMR	MATERIALS RSCH SCI & ENG	Juan De Pablo	WI	University of Wisconsin-Madison	11,694,150
Spatial Intelligence and Learning Center (GILC)	3DC	GLC: ACT MTIC 3 G SCIENCE O	Nora Newcombe	PA	Temple University	12,570,415
Project Pathways: Opening Routes to Math & Science Suc	DUE	Teaching & Mstr Tchng Fellows	Marilyn Carlson	AZ	Arizona State University	13,392,614
NCLT: A Center to Develop Nanoscale Science and Engine	DRL	NANO CTR FOR LEARN & TEA	R. P. H. Chang	IL	Northwestern University	15,988,084
Enabling a Giant Segmented Mirror Telescope for the Unite	AST	MID-SCALE INSTRUMENTATION	William Smith	DC	AURA/National Optical Astronomy Obser	18,000,000
Support of Synchrotron Radiation Center Operations	DMR	MPS DMR INSTRUMENTATION	Martin Cadwallader	WI	University of Wisconsin-Madison	19,526,500
TeraGrid Extension: Bridging to XD	OCI	ETF	Ian Foster	IL	University of Chicago	30,207,358
System-Wide Change for All Learners and Educators	DUE	Teaching & Mstr Tchng Fellows	Terrence Millar	WI	University of Wisconsin-Madison	35,900,000



# 1340 Funded Projects

## Horizontal Bar Graphs

Horizontal Line Graph was selected.

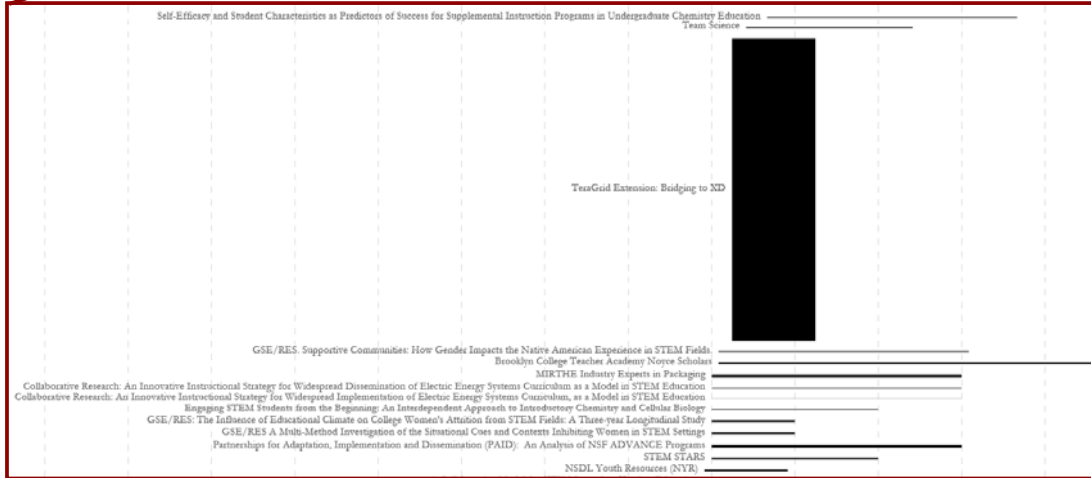
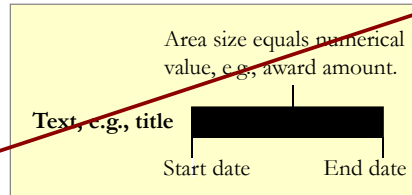
Input Parameters:

Start Date: Start Date

Size By: Awarded Amount to Date

Label: Title

End Date: Expiration Date



# 1,340 Funded Projects

## Geographic Maps

Geocoder was selected.

Input Parameters:

Place Name Column: Organization State

Place Type: STATE

Geo Map (Circle Annotation Style) was selected.

Input Parameters:

Longitude: Longitude

Size Circles By: Awarded Amount to Date

Color Circle Exteriors By: Awarded Amount to Date

Color Circle Interiors By: None (no inner color)

Exterior Color Scaling: Linear

Exterior Color Range: Green to Red

Interior Color Range: Green to Red

Size Scaling: Linear

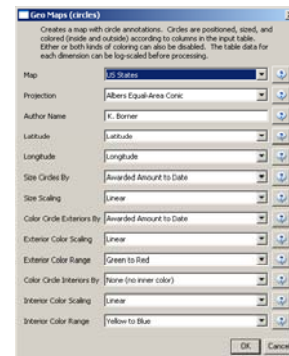
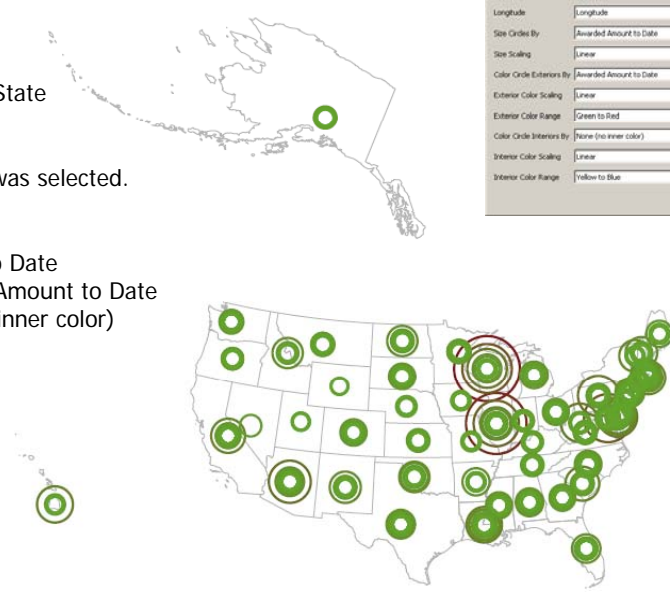
Projection: Albers Equal-Area Conic

Map: US States

Author Name: K. Borner

Interior Color Scaling: Linear

Latitude: Latitude



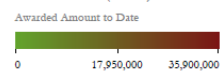
Geo Map (Circle Annotation Style)

Albers Equal-Area Conic Projection

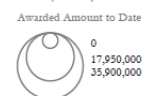
Oct 18, 2009 | 11:34:57 AM

K. Borner

Exterior Color (Linear)



Area (Linear)



## What Co-PI Networks Exist?

Extract Directed Network was selected.

Input Parameters:

Source Column: Principal Investigator

Text Delimiter: |

Target Column: Co-PI Name(s)

.....  
Network Analysis Toolkit (NAT) was selected.

Nodes: 3225

Isolated nodes: 276

Edges: 2265

Average total degree: 1.4047

Average in degree: 0.7023

Average out degree: 0.7023

.....  
Delete Isolates was selected.

.....  
Node Degree was selected.

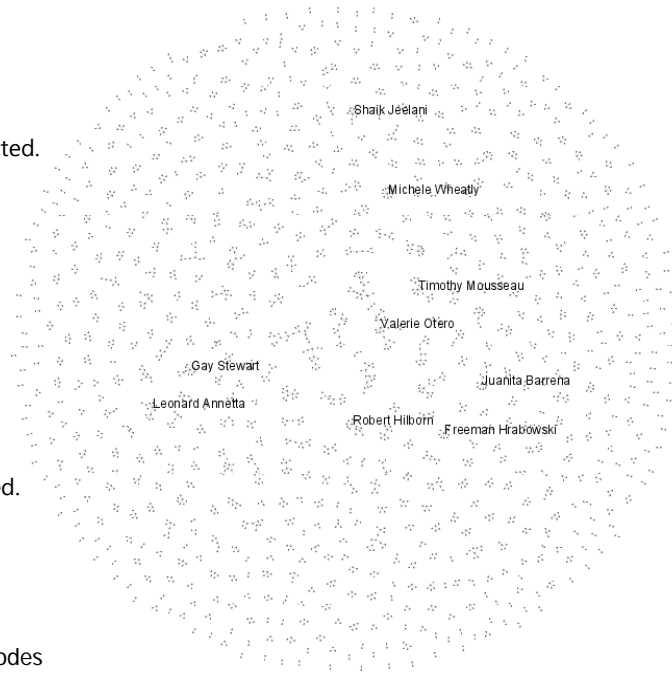
.....  
Weak Component Clustering was selected.

Number of top clusters: 10

722 clusters found, generating graphs  
for the top 10 clusters.

Giant component has 39 nodes

Next largest networks have 35, 17, 16 nodes

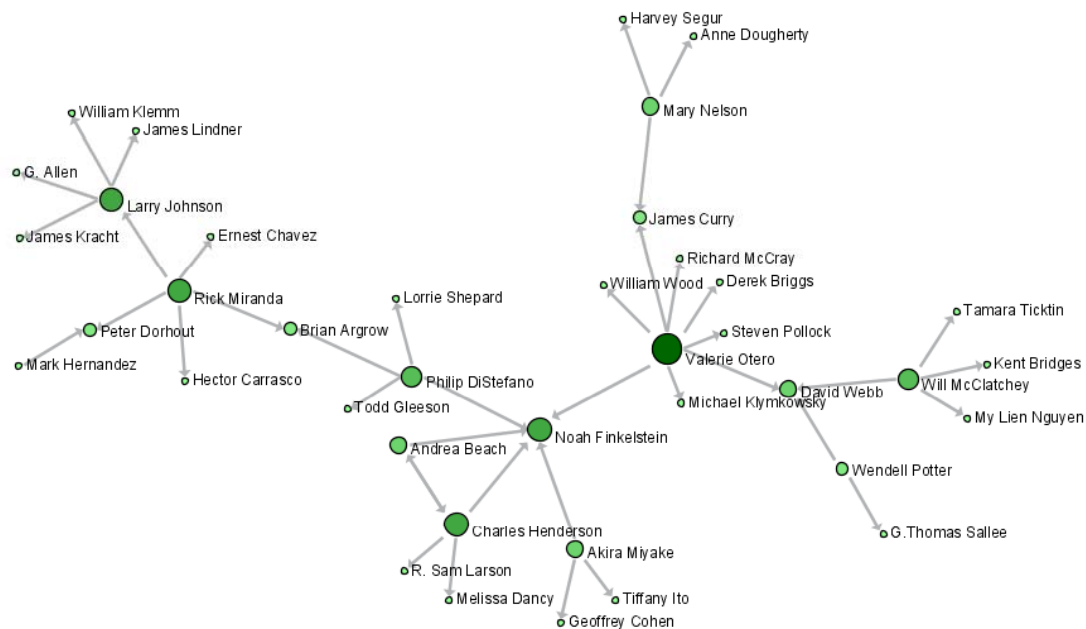


## Co-PI Networks – Giant Component

Nodes = investigators

Size and color coded by number of collaborators (degree)

Directed edges from PI to Co-PI





## What Projects Fund Which PIs?

Extract Directed Network was selected.

Input Parameters:

Source Column: Title

Text Delimiter: |

Target Column: Principal Investigator

.....  
Network Analysis Toolkit (NAT) was selected.

Nodes: 2478

Isolated nodes: 0

Edges: 1337

Average total degree: 1.0791

Average in degree: 0.5395

Average out degree: 0.5395

This graph is not weakly connected.

There are 1144 weakly connected components.

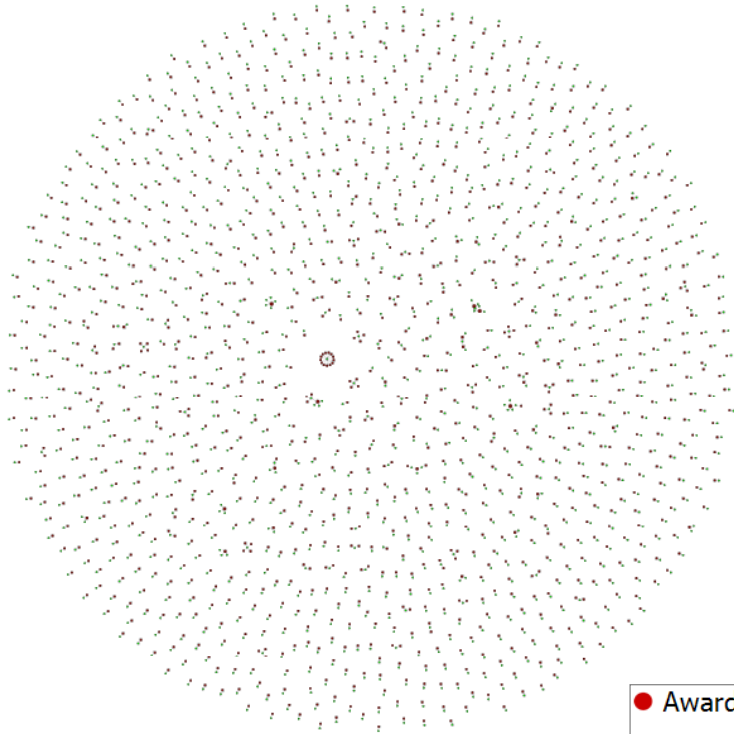
The largest connected component consists of 1144 nodes.

Density (disregarding weights): 0.0002

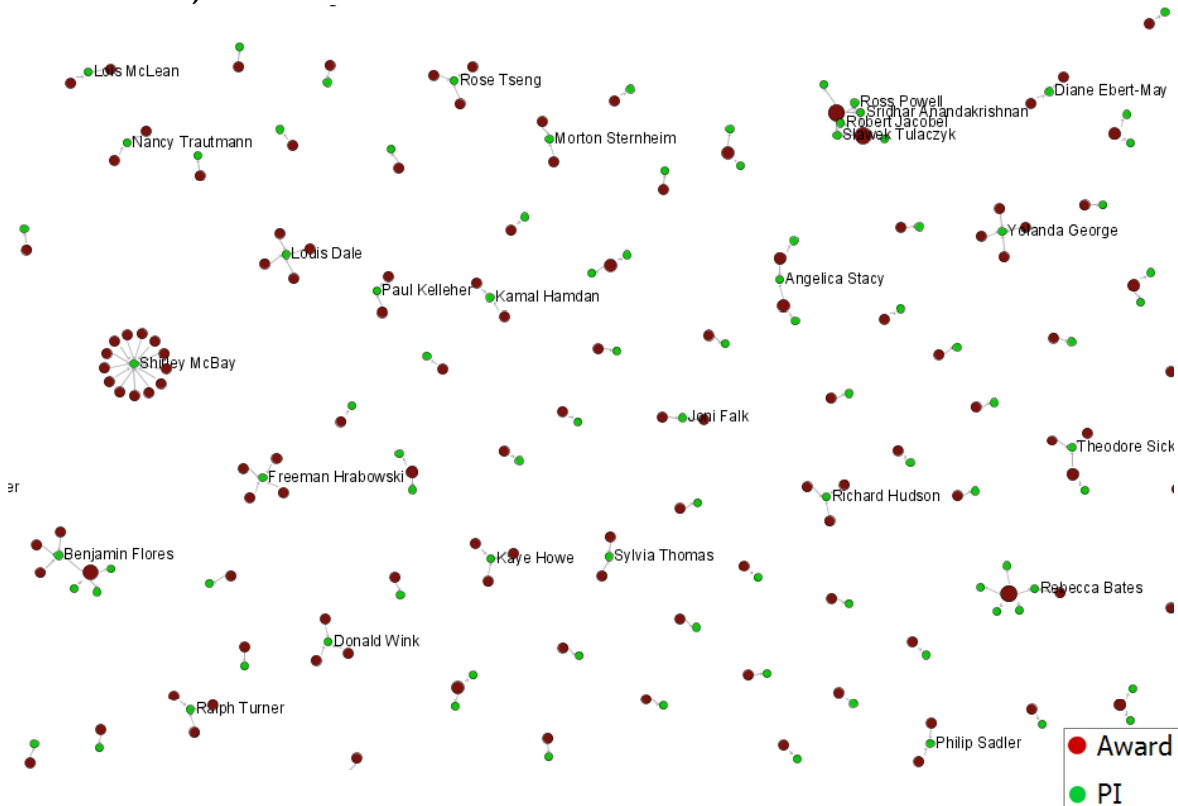
.....  
Node Indegree was selected.

.....  
Node Outdegree was selected.

.....  
GUESS



## What Projects Fund Which PIs - Zoom



## What Programs at NSF are Co-Funding STEM?

Extract Co-Occurrence Network was selected.

Input Parameters:

Text Delimiter: |

Column Name: Program(s)

.....

Node Degree was selected.

.....

Network Analysis Toolkit (NAT) was selected.

Nodes: 226

Isolated nodes: 71

Edges: 483

No self loops were discovered.

Average degree: 4.2743

Density (disregarding weights): 0.019

.....

GUESS

.....

Weak Component Clustering was selected.

79 clusters found

.....

Network Analysis Toolkit (NAT) was selected.

Nodes: 135

Isolated nodes: 0

Edges: 467

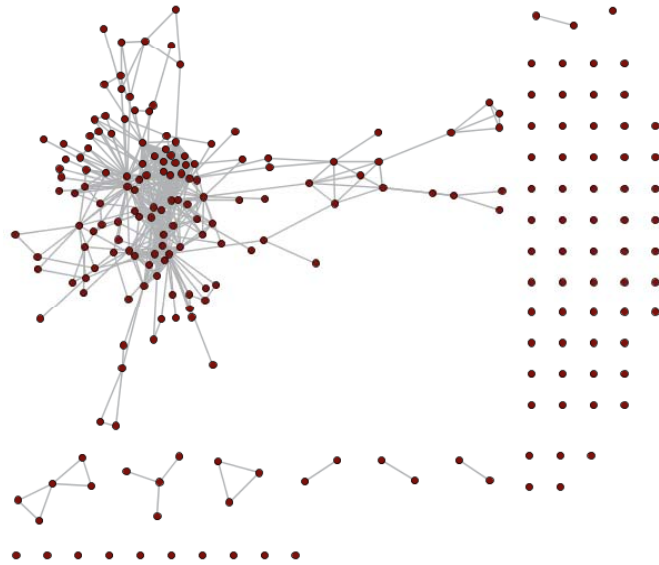
No self loops were discovered.

Average degree: 6.9185

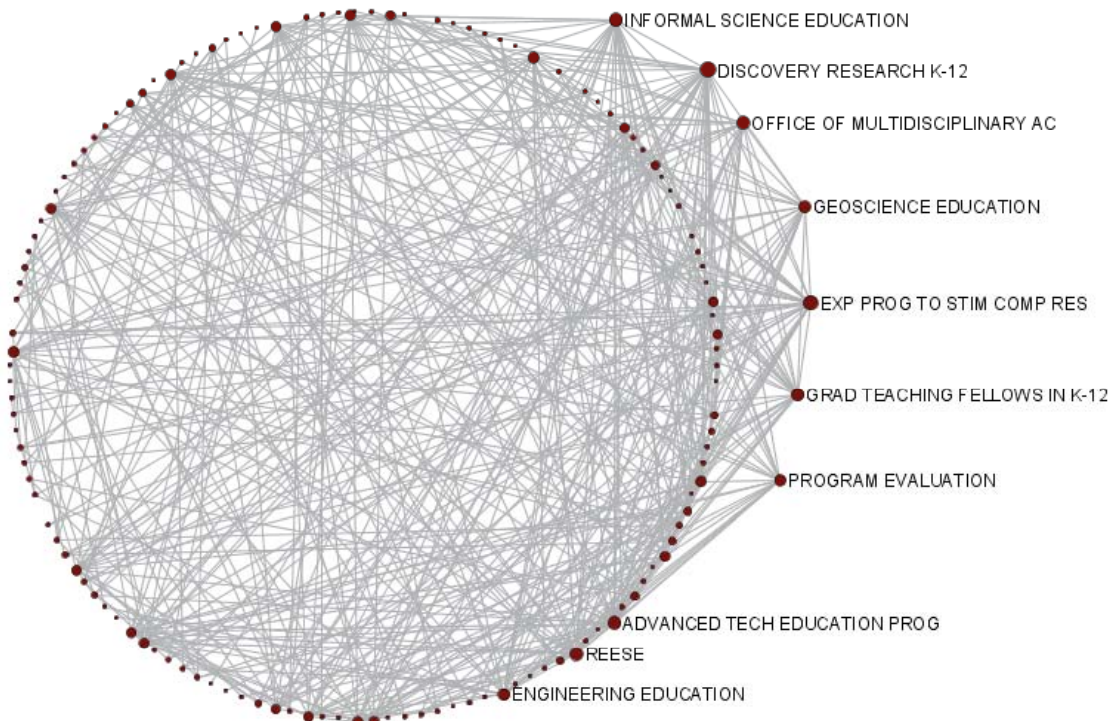
Density (disregarding weights): 0.0516

.....

GUESS



## What Programs at NSF are Co-Funding STEM – Giant Component



## What Organizations are funded by what NSF Programs?

Extract Directed Network was selected.

Input Parameters:

Source Column: Organization

Text Delimiter: |

Target Column: Program(s)

.....  
Network Analysis Toolkit (NAT) was selected.

Nodes: 794

Isolated nodes: 1

Edges: 1592

Average total degree: 4.0101

Average in degree: 2.005

Average out degree: 2.005

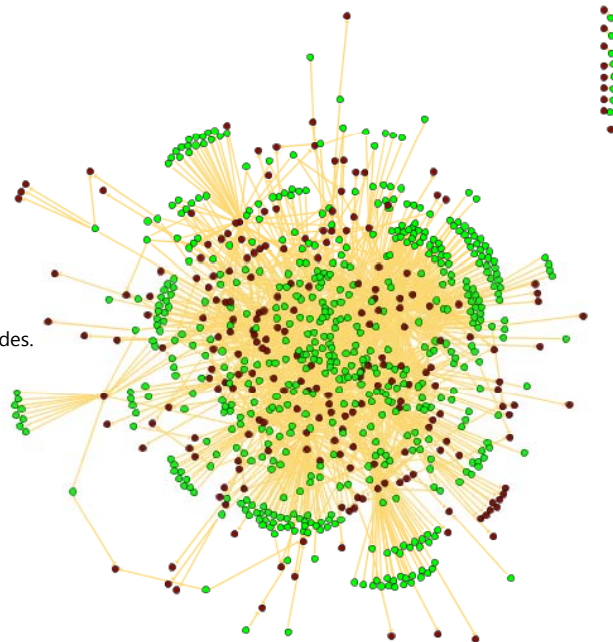
The largest connected component consists of 777 nodes.

Density (disregarding weights): 0.0025

.....  
Node Indegree was selected.

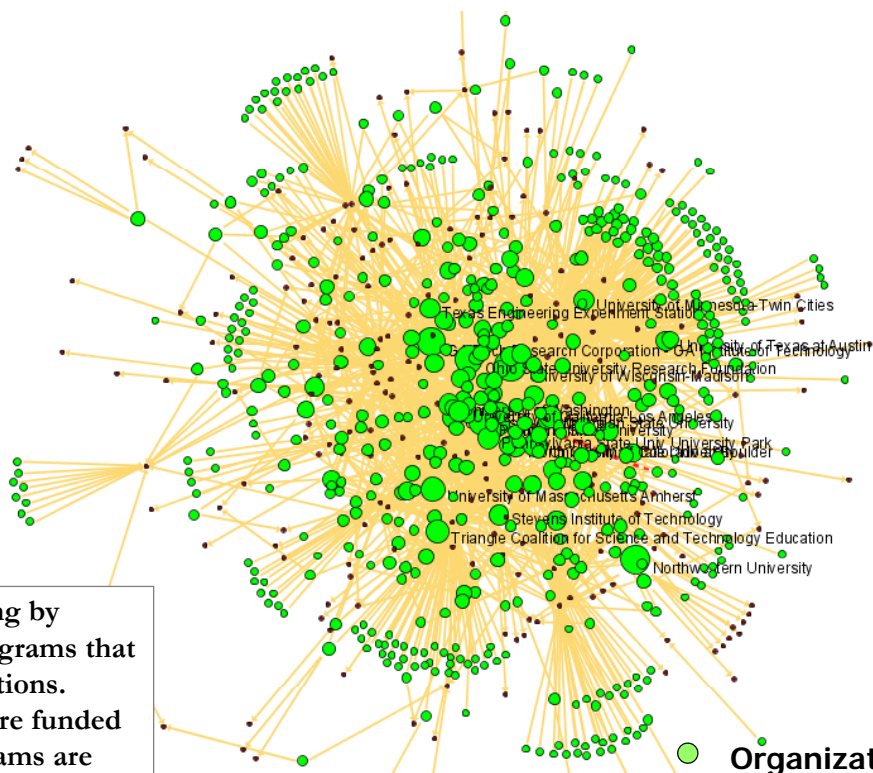
.....  
Node Outdegree was selected.

.....  
GUESS



● Organization  
● NSF Program

## What Organizations are funded by what NSF Programs?

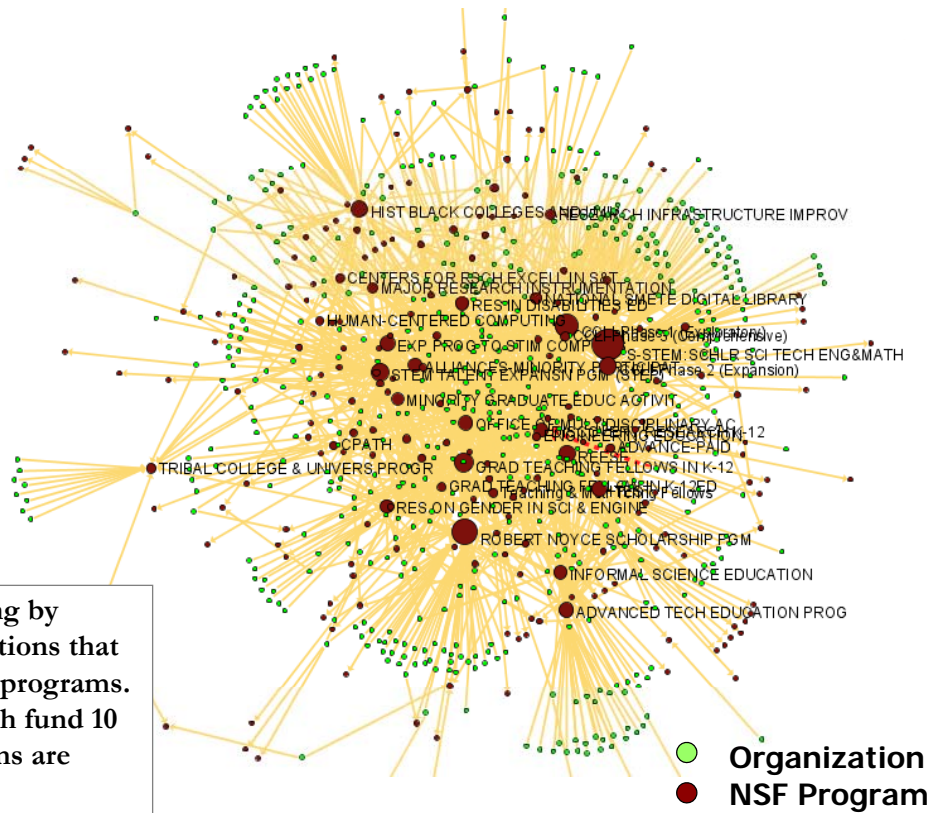


Color and size coding by number of NSF programs that fund these organizations. Institutions which are funded by 10 or more programs are labeled.

● Organization  
● NSF Program



## What NSF Programs fund how many Organizations?



Color and size coding by number of organizations that are funded by these programs. NSF programs which fund 10 or more organizations are labeled.

### Science of Science Cyberinfrastructure PORTAL

Provided by the [Cyberinfrastructure for Network Science Center](#) at Indiana University.

**Introduction**  
E. O. Wilson writes in *Consilience: The Unity of Knowledge* (1998): "Features that distinguish science from pseudoscience are repeatability, economy, mensuration, heuristics, and consilience." Please see Börner's [recent presentation](#) at the *A Deeper Look at the Visualization of Scientific Discovery* NSF Workshop for a general introduction of the needs and the resources provided here.

**Needs Analysis**  
As part of the "TL1: Towards a Macroscopic for Science Policy Decision Making" NSF SBE-0738111 award, interviews with science policy makers are conducted to identify what science of science research results and tools might be most desirable and effective. So far, 30 formal, one-hour interviews have been conducted with science policy makers at university campus level, program officer level, and division director level for governmental, state, and private foundations. Data compilation will start in October 2008 and resulting report can be ordered by sending a request to Mark Price ([maaprice@indiana.edu](mailto:maaprice@indiana.edu)).

**Conceptualization of Science**  
A science of science requires a theoretically grounded and practically useful conceptualization of the structure and evolution of science. A special journal issue entitled "*Science of Science: Conceptualizations and Models of Science*" edited by [Katy Börner](#), Indiana University & [Andrea Scharnhorst](#), Royal Netherlands Academy of Arts and Sciences invites contributions on this topic. It will be published in the *Journal of Informetrics* 3(1) in January 2009.

**Scholarly Database**  
The [Scholarly Database \(SDB\)](#) at Indiana University aims to serve researchers and practitioners interested in the analysis, modeling, and visualization of large-scale scholarly datasets. The database currently provides access to over 20 million papers, patents and grants. Resulting datasets can be downloaded in bulk. Register for free access at <https://sdb.slis.indiana.edu/>.

**Cyberinfrastructures**  
The Scientometrics filling of the [Network Workbench \(NWB\) Tool](#) provides a unique distributed, shared resources environment for large-scale network analysis, modeling, and visualization. Thomson Scientific/ISI, Scopus and Google Scholar data, EndNote and Bibtext files, or NSF awards can be read and diverse networks can be extracted and studied. Download [User Manual with focus on Scientometrics](#).

<http://sci.slis.indiana.edu>

