

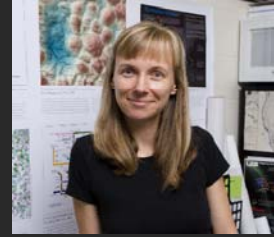
Envisioning and Communicating Science

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"Visualization in Science and Education"
Gordon Research Conference, Oxford, UK
July 27, 2009



Places & Spaces: Mapping Science

a science exhibit that introduces people to maps of sciences, their makers and users.

Exhibit Curators:

Dr. Katy Börner & Elisha Hardy
<http://scimaps.org>



Mapping Science Exhibit – 10 Iterations in 10 years

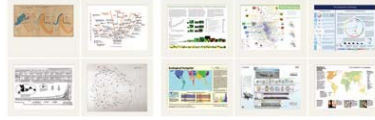
<http://scimaps.org/>



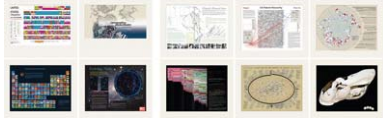
The Power of Maps (2005)



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)



How to Lie 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.



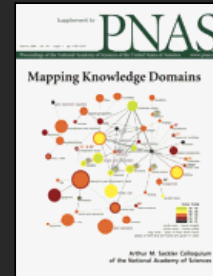
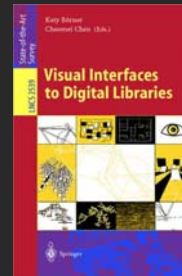
Debut of 5th Iteration of Mapping Science Exhibit at MEDIA X was on May 18, 2009 at Wallenberg Hall, Stanford University, <http://mediax.stanford.edu>, <http://scaleindependentthought.typepad.com/photos/scimaps>



Science Maps in “Expedition Zukunft” science train visiting 62 cities in 7 months, 12 coaches, 300 m long. Opening was on April 23rd, 2009 by German Chancellor Merkel, <http://www.expedition-zukunft.de>

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Computational Scientometrics: Studying Science by Scientific Means

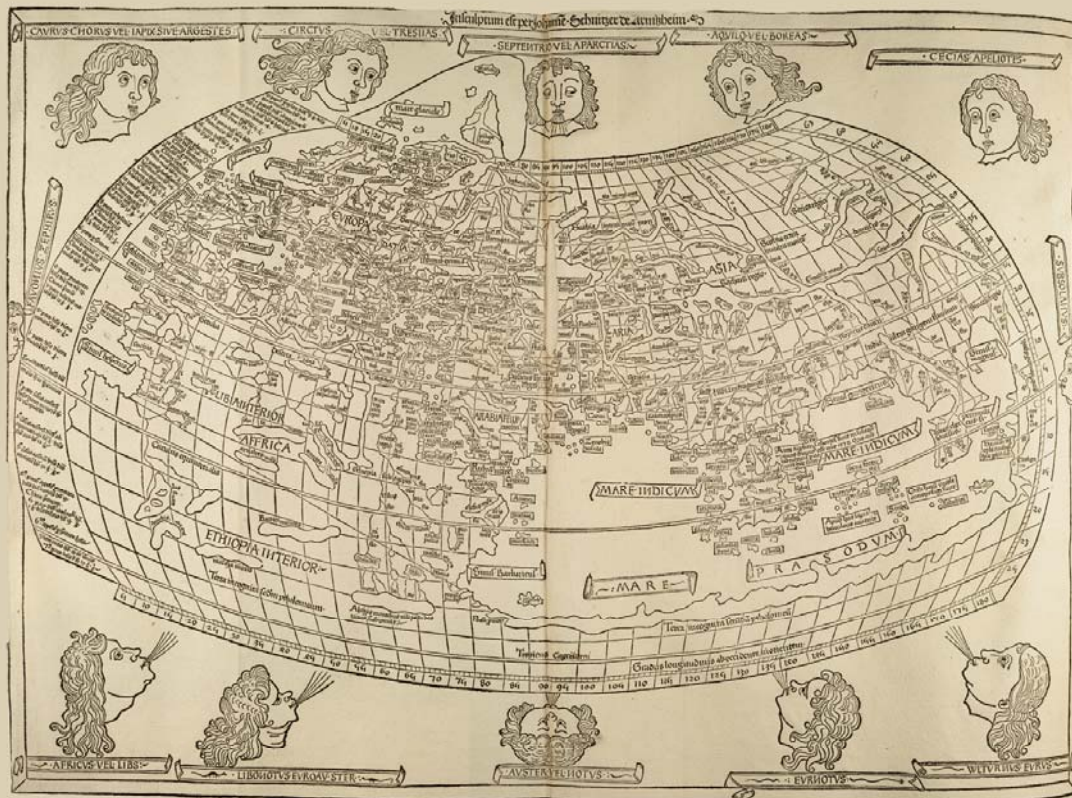


- Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains**. In Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Medford, NJ: Information Today, Inc./ American Society for Information Science and Technology, Volume 37, Chapter 5, pp. 179-255. <http://ivl.slis.indiana.edu/km/pub/2003-borner-arist.pdf>
- Shiffrin, Richard M. and Börner, Katy (Eds.) (2004). **Mapping Knowledge Domains**. *Proceedings of the National Academy of Sciences of the United States of America*, 101(Suppl_1). http://www.pnas.org/content/vol101/suppl_1/
- Börner, Katy, Sanyal, Soma and Vespignani, Alessandro (2007). **Network Science**. In Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Information Today, Inc./ American Society for Information Science and Technology, Medford, NJ, Volume 41, Chapter 12, pp. 537-607. <http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>
- Börner, Katy and Scharnhorst, Andrea (Eds.) (2009). **Science of Science: Conceptualizations and Models of Science**. *Special Issue of Journal of Informetrics*, 3(3).
- **Places & Spaces: Mapping Science** exhibit, see also <http://scimaps.org>.

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Science Maps

- For Science Navigation & Management (2005)
- As Reference System (2006)
- As Forecasts (2007)



Cosmographia World Map - Claudius Ptolemy - 1482

This map of science was constructed by sorting more than 7.2 million journals into disciplines, disciplines represented as nodes, and pairs of journals that share a common literature. A three-dimensional map was used to determine the position of each discipline on the surface of a sphere based on the linkage between disciplines. The nodes (journals) are color-coded according to their field, and the lines between nodes represent the connections between journals in different parts of the map.

The spherical map, which is not shown here, was used as a starting point for the same map used to show the contents of the earth on a two-dimensional map (to give the large map some depth). This projection gives a perspective of the entire map, in which all nodes and lines that the disciplines hold to share across the middle of the map. It is a map of the earth, it would be like a single colored map of the world. The map is a map of the earth, it would be like a single colored map of the world. The map is a map of the earth, it would be like a single colored map of the world. The map is a map of the earth, it would be like a single colored map of the world.

MAPS OF SCIENCE

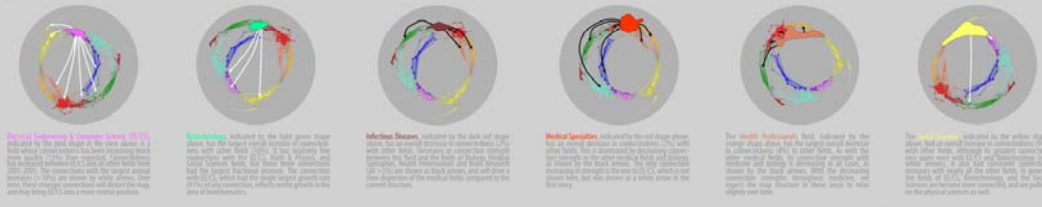
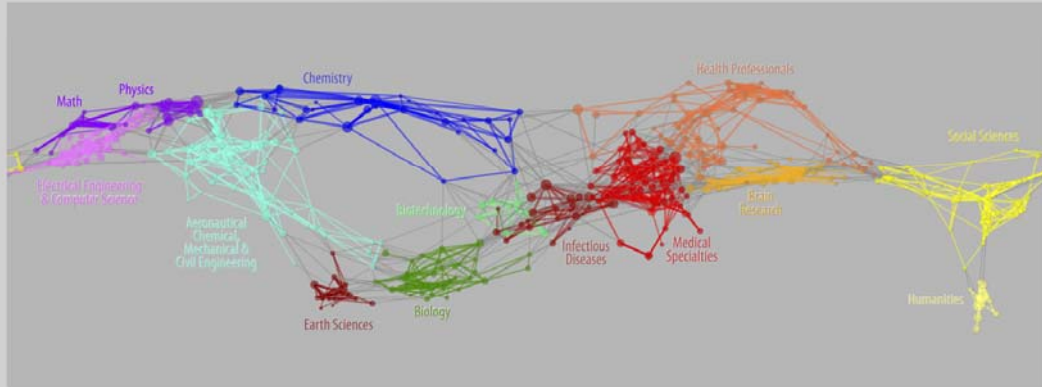
Forecasting Large Trends in Science

A visualization of 7.2 million scholarly documents appearing in over 16,000 journals, proceedings or symposia between Jan, 2001 and Dec, 2005

Calculations were performed using the large volume of journals (fields) to determine a set of three axes that could be used to change the structure of science over time. Correlation coefficients between fields were calculated for each individual year (2001-2005). A major regression analysis was conducted to see if there were significant changes in these correlation coefficients from year to year.

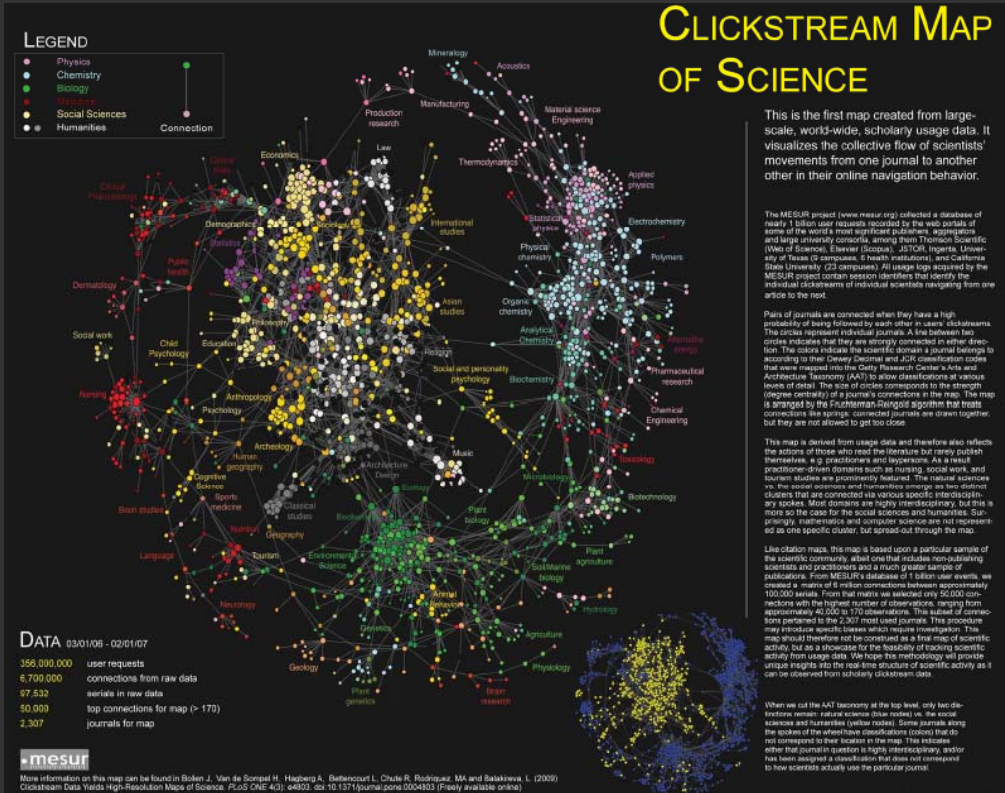
If all else failed, we would have used a simple regression analysis. We would expect some relations between disciplines to be stable and connections between disciplines to be dynamic. We would expect the fields to be stable, but the underlying structure is unstable and likely to change dramatically over the next decade.

So, changes representing how the structure is likely to change, are provided below. Maps with white areas represent increases of journal fields, and dark areas to indicate decreases. Maps with white areas represent increases of journal fields, and dark areas to indicate decreases. Maps with white areas represent increases of journal fields, and dark areas to indicate decreases. Maps with white areas represent increases of journal fields, and dark areas to indicate decreases.



Source: University of California, San Diego Knowledge Mapping Laboratory, San Diego; © Regents of the University of California. The starting data came from two sources: Thomson ISI and Scopus. Mapping methodology and description text by Dick Krieger, President, iScholar, Inc., and Anne Peacock, Senior Research Librarian, English & Geography at Ohio Wesleyan and Ohio State. Mapping methodology and description text by Dick Krieger, President, iScholar, Inc., and Anne Peacock, Senior Research Librarian, English & Geography at Ohio Wesleyan and Ohio State. © 2007 by Dick Krieger, all rights reserved.

Maps of Science: Forecasting Large Trends in Science - Richard Klavans, Kevin Boyack - 2007



CLICKSTREAM MAP OF SCIENCE

This is the first map created from large-scale, world-wide, scholarly usage data. It visualizes the collective flow of scientists' movements from one journal to another in their online navigation behavior.

The MESUR project (www.mesur.org) collected a database of nearly 1 billion user requests recorded by the web portals of some of the world's most significant publishers, aggregators and large university consortia, among them Thomson Scientific (Wiley, Science, Elsevier, Scopus), JSTOR, Inspec, University of Texas (5 campuses), iHealth (institutional), and California State University (23 campuses). All usage logs captured by the MESUR project contain person identifiers that identify the individual clickstreams of individual scientists navigating from one article to the next.

Pairs of journals are connected when they have a high probability of being followed by each other in users' clickstreams. The circles represent individual journals. A line between two circles indicates that they are strongly connected in either direction. The colors indicate the scientific domain a journal belongs to according to their Dewey (journal) and JSTOR (publication) codes that were mapped into the Getty Research Center's Arts and Architecture Thesaurus (AAT) to allow disambiguation at various levels of detail. The size of circles corresponds to the strength (degree centrality) of a journal's connections in the map. The map is arranged by the Fruchterman-Reingold algorithm that treats connections like springs; connected journals are drawn together, but they are not allowed to get too close.

The map is derived from usage data and therefore also reflects the actions of those who read the literature, but rarely publish themselves, e.g. practitioners and laypersons. As a result, practitioners and laypersons are prominently featured. The natural sciences on the most expensive and humanities among are less distinct clusters that are connected via highly interdisciplinary, but this is more so the case for the social sciences and humanities. Geography, mathematics and computer science are not represented as one specific cluster, but spread out through the map.

Like citation maps, this map is based upon a particular sample of the scientific community, albeit one that includes non-publishing scientists and practitioners and a much greater sample of publications. From MESUR's database of 1 billion user events, we created a matrix of 6 million connections between approximately 100,000 journals. From that matrix we selected 50,000 connections with the highest number of observations, ranging from approximately 40,000 to 170 observations. This subset of connections pertained to the 2,307 most used journals. The procedure may produce spurious links which require investigation. This map should therefore not be considered as a final map of scientific activity, but as a hypothesis for the possibility of tracing scientific activity from usage data. We hope this methodology will provide unique insights into the real-time structure of scientific activity as it can be inferred from scholarly clickstream data.

When we cut the AAT taxonomy at the top level, only few distinctions remain: natural sciences (blue nodes) vs. the social sciences and humanities (yellow nodes). Some journals along the borders of the wheels have classifications (colors) that do not correspond to their location in the map. The color indicates either the journal's question is highly interdisciplinary, and/or has been assigned a classification that does not correspond to how scientists actually use the particular journal.

LEGEND

- Physics
- Chemistry
- Biology
- Social Sciences
- Humanities
- Connection

DATA 03/01/06 - 02/01/07

- 358,000,000 user requests
- 6,700,000 connections from raw data
- 97,532 articles in raw data
- 50,000 top connections for map (> 170)
- 2,307 journals for map

mesur
More information on this map can be found in Bollen, J., Van de Sompel, H., Hagberg, A., Goltzschew, L., Chute, R., Rodriguez, M., and Balakireva, L. (2008) Clickstream Data Yields High-Resolution Maps of Science. PLoS ONE 3(4): e4003. doi:10.1371/journal.pone.0040033 (Peer-reviewed online)

Design layout by: Jeremy D. Chason

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

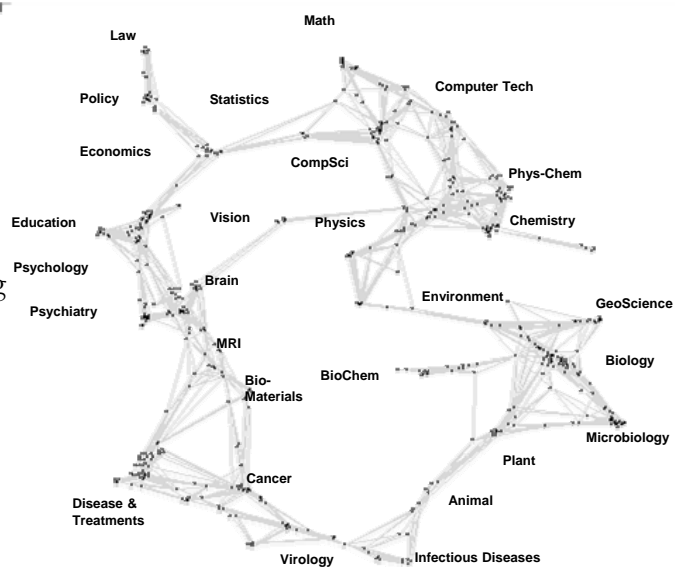
Science Maps

- For Economic Decision Makers (2008)
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- For Scholars (2010)
- As Visual Interfaces to Digital Libraries (2011)
- For Kids (2012)
- As Science Forecasts (2013)

2002 'Base Map' of Science

Kevin W. Boyack, Katy Börner, & Richard Klavans (2007). *Mapping the Structure and Evolution of Chemistry Research*. 11th International Conference on Scientometrics and Informetrics. pp. 112-123.

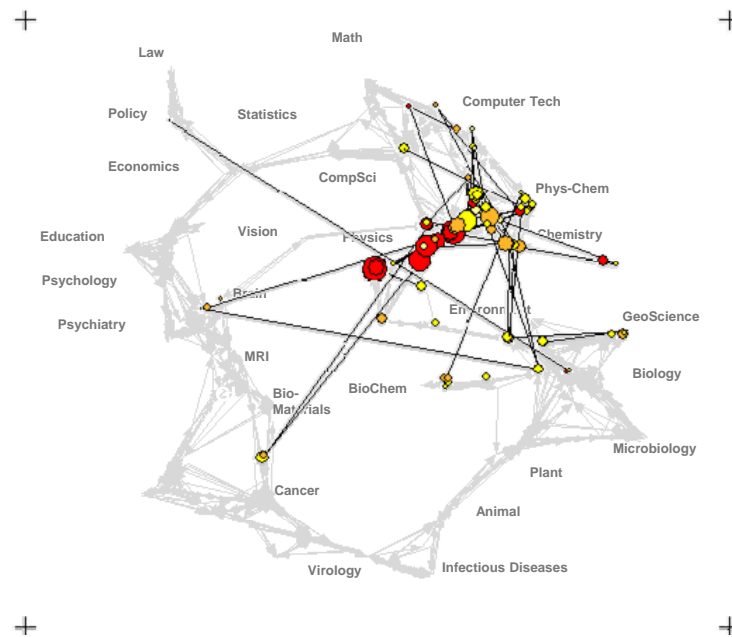
- Uses combined SCI/SSCI from 2002
 - 1.07M papers, 24.5M references, 7,300 journals
 - Bibliographic coupling of papers, aggregated to journals
- Initial ordination and clustering of journals gave 671 clusters
- Coupling counts were reaggregated at the journal cluster level to calculate the
 - (x,y) positions for each journal cluster
 - by association, (x,y) positions for each journal



Science map applications: Identifying core competency

Kevin W. Boyack, Katy Börner, & Richard Klavans (2007).

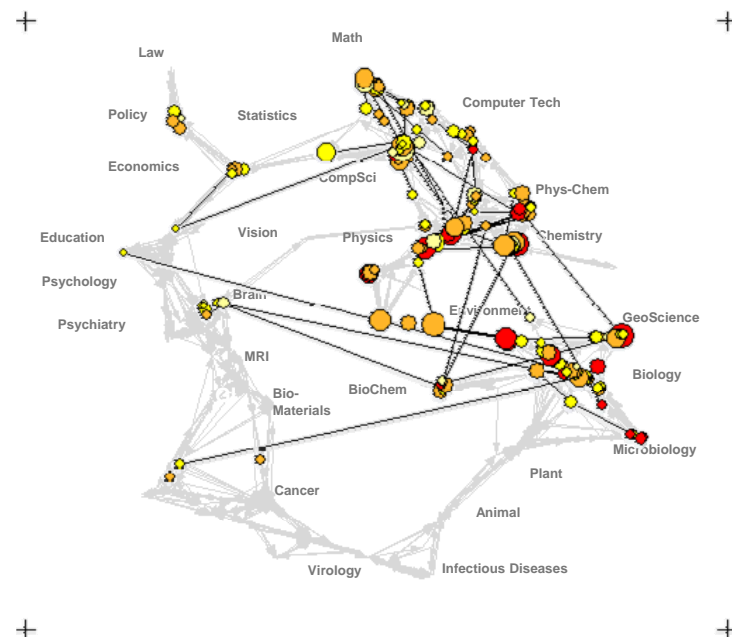
Funding patterns of the US Department of Energy (DOE)



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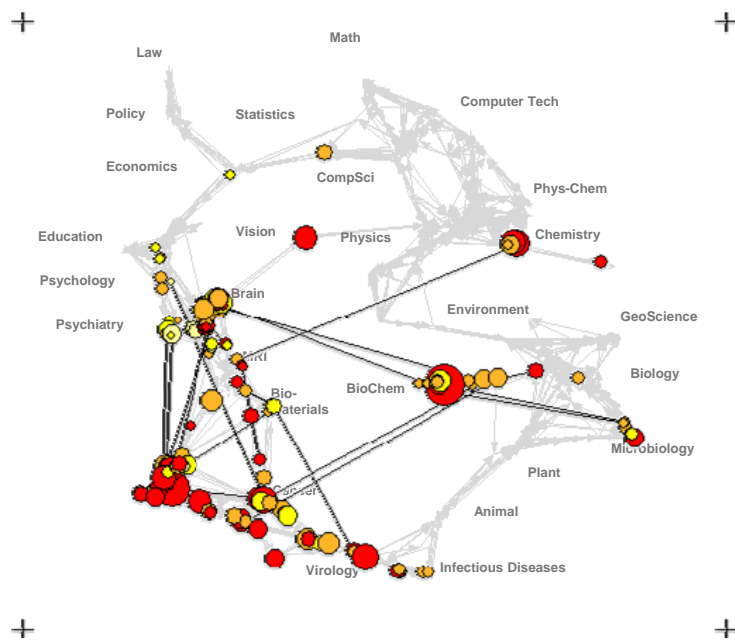
Funding Patterns of the National Science Foundation (NSF)



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Funding Patterns of the National Institutes of Health (NIH)

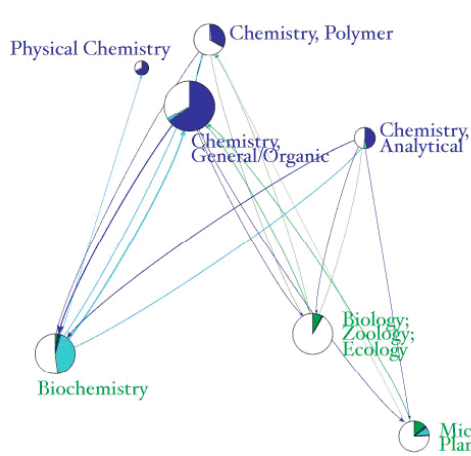


Topical Composition and Knowledge Flow Patterns in Chemistry Research for 1974 and 2004

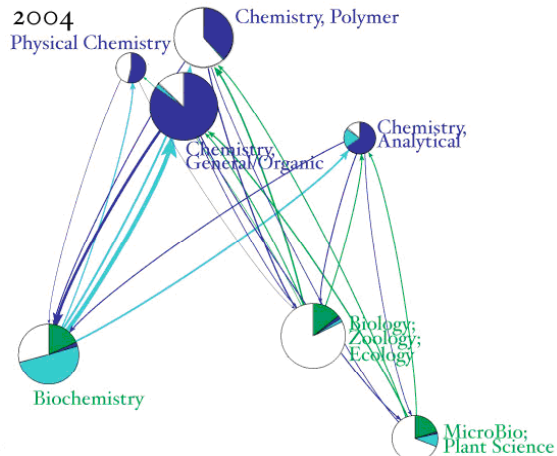
Kevin W. Boyack, Katy Börner, & Richard Klavans (2007)

Chemistry - Biology Interface

1974



2004



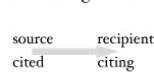
Number of papers by cluster



Fraction of papers by cluster



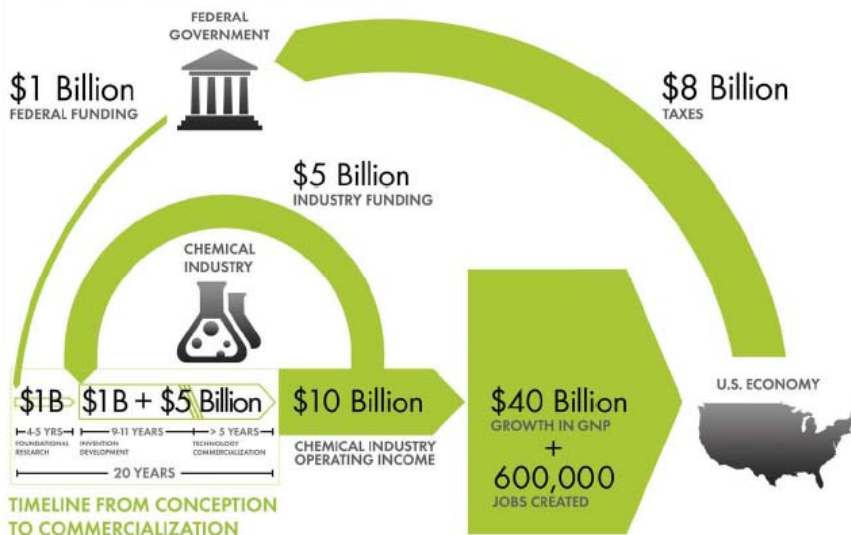
Knowledge flows cluster to cluster



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

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

INVESTMENT IN CHEMICAL SCIENCE R&D



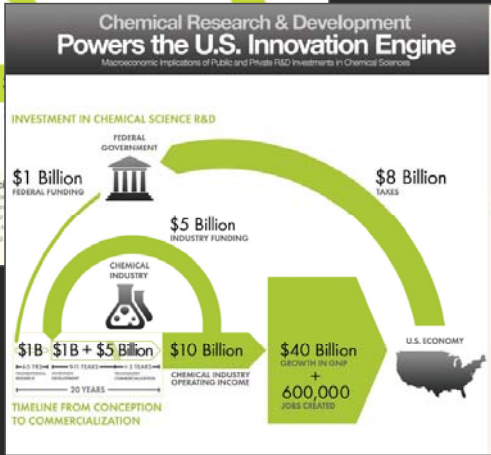
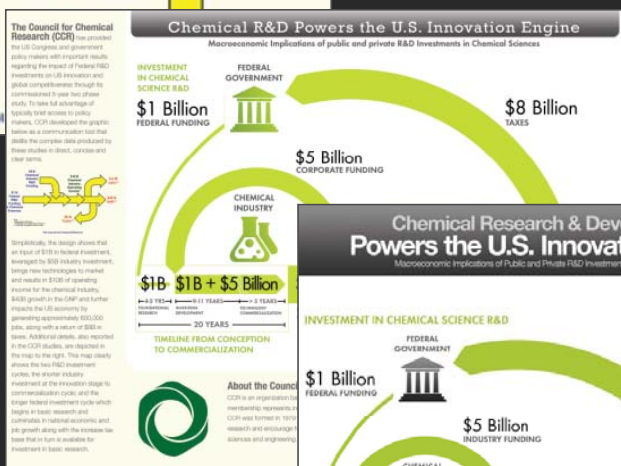
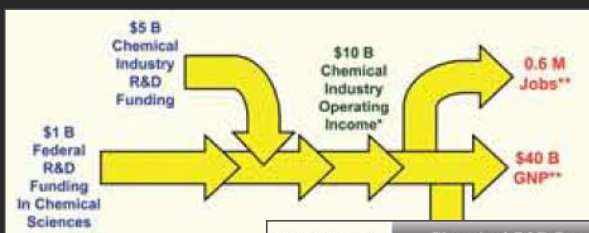
The Council for Chemical Research (CCR)

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.



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 in 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



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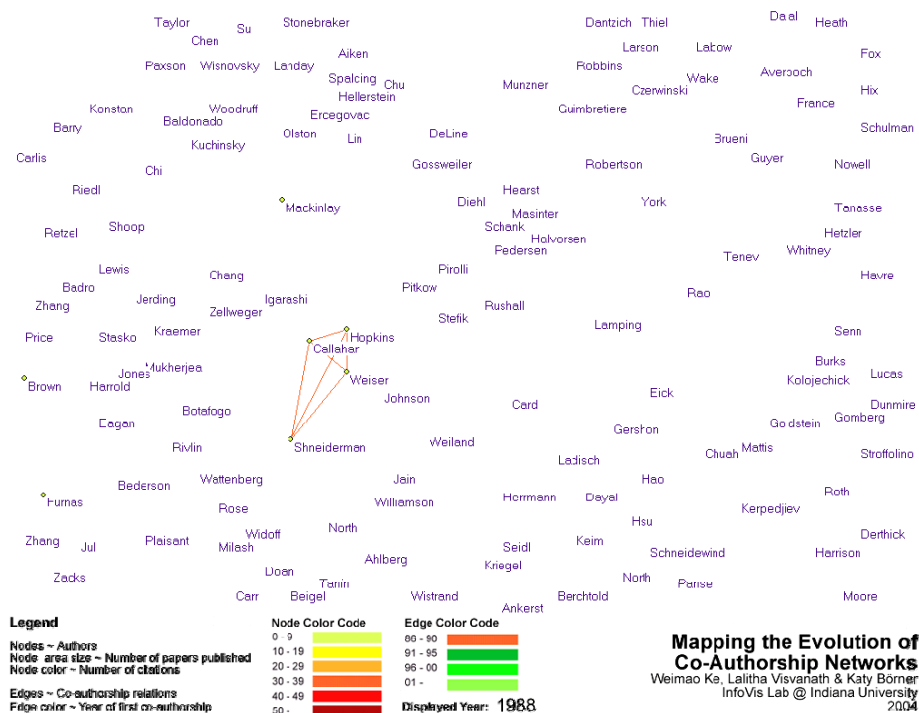
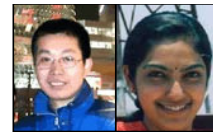
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Mapping the Evolution of Co-Authorship Networks

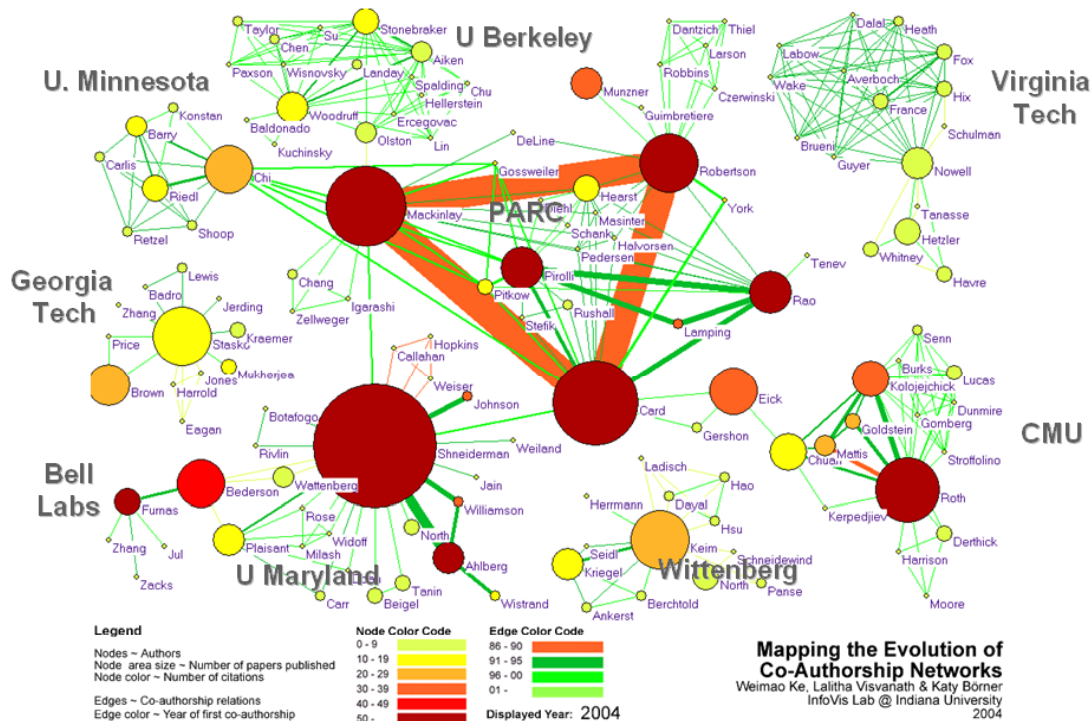
Ke, Visvanath & Börner, (2004) Won 1st prize at the IEEE InfoVis Contest.



Mapping the Evolution of Co-Authorship Networks
Weimao Ke, Lalitha Visvanath & Katy Börner
InfoVis Lab @ Indiana University
2004

Mapping the Evolution of Co-Authorship Networks

Ke, Viswanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest



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Studying the Emerging Global Brain: Analyzing and Visualizing the Impact of Co-Authorship Teams

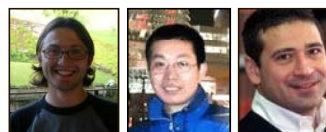
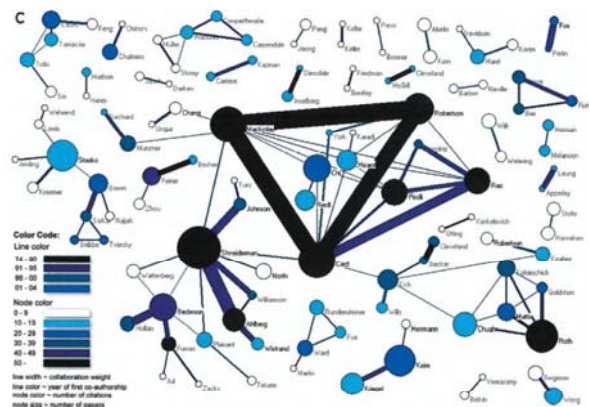
Börner, Dall'Asta, Ke & Vespignani (2005) *Complexity*, 10(4):58-67.

Research question:

- Is science driven by prolific single experts or by high-impact co-authorship teams?

Contributions:

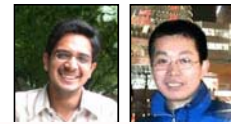
- New approach to allocate citational credit.
- Novel weighted graph representation.
- Visualization of the growth of weighted co-author network.
- Centrality measures to identify author impact.
- Global statistical analysis of paper production and citations in correlation with co-authorship team size over time.
- Local, author-centered entropy measure.



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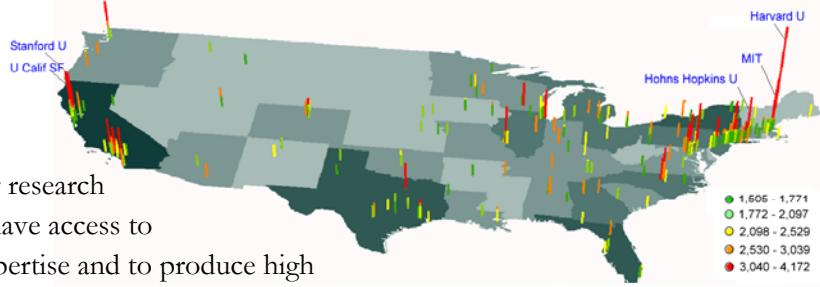
Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

Börner, Katy, Penumarty, Shashikant, Meiss, Mark and Ke, Weimao. (2006)
Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.



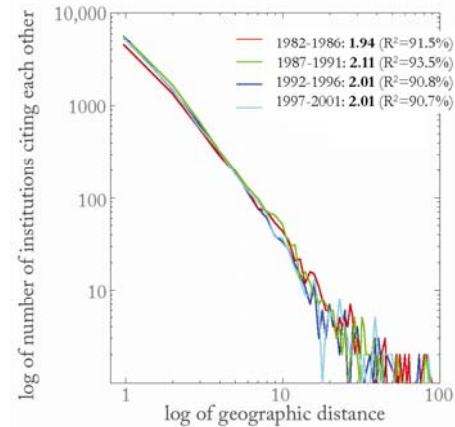
Research questions:

1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research institutions?



Contributions:

- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.



Illuminated Diagram Display

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



Questions:

- Who is doing research on what topic and where?
- What is the 'footprint' of interdisciplinary research fields?
- What impact have scientists?

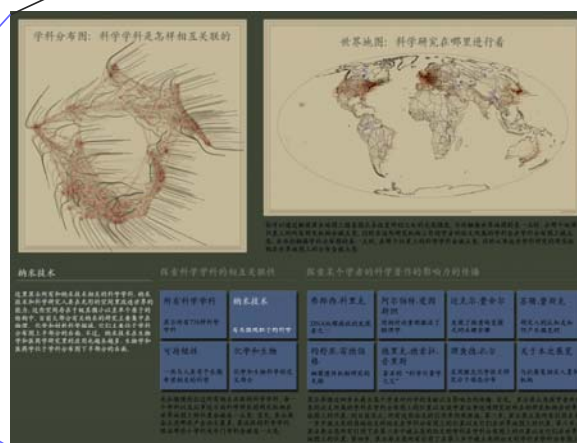


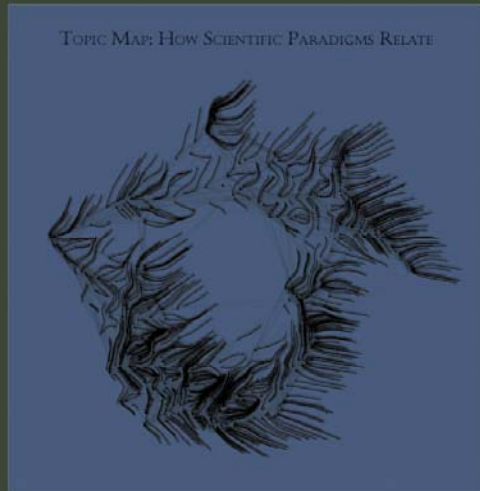
Large-scale, high resolution prints illuminated via projector or screen.

Interactive touch panel.

Contributions:

- Interactive, high resolution interface to access and make sense of data about scholarly activity.





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

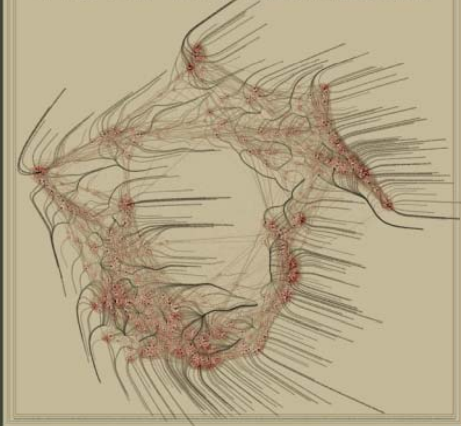
This overlay shows the distribution of nanotechnology within the paradigms of science. The majority of current work in nanotechnology takes place in physics, chemistry, and materials science, at the upper right portion of the map. However, an increasing amount of nanotechnology is being applied in the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

All Topics <i>Sweep through all 776 scientific paradigms</i>	Nanotechnology <i>Science on the tiny scale of molecules</i>	Francis H. C. CRICK <i>Co-discovered DNA's double helix</i>	Albert EINSTEIN <i>Revitalized physics with Relativity theories</i>	Michael E. FISHER <i>Models critical phase transitions of matter</i>	Susan T. FISKE <i>Connects perception and stereotypes</i>
Sustainability <i>The science behind our long-term hopes</i>	Biology & Chemistry <i>The interface between these two vital fields</i>	Joshua LEDERBERG <i>Pioneer in bacterial genetic mechanisms</i>	Derek J. de Solla PRICE <i>Known as the "Father of Scientometrics"</i>	Richard N. ZARE <i>Uses laser chemistry in molecular dynamics</i>	About this display <i>People & organizations that helped create it</i>

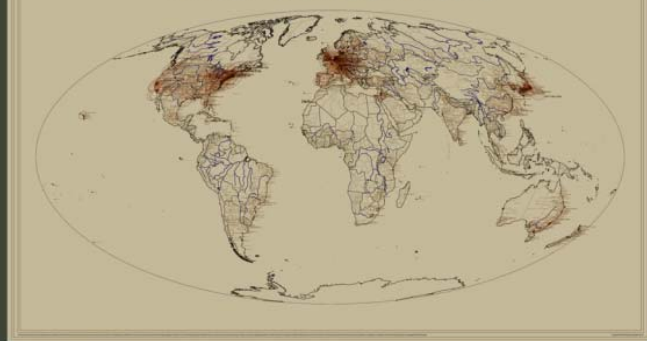
We sweep slowly through adjoining related topics, lighting up the places in the world that study each topic. You may select a subset of the topics that deal with these three interesting subjects by touching it.

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

探索某个学者的科学著作的影响力的传播

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

先往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。

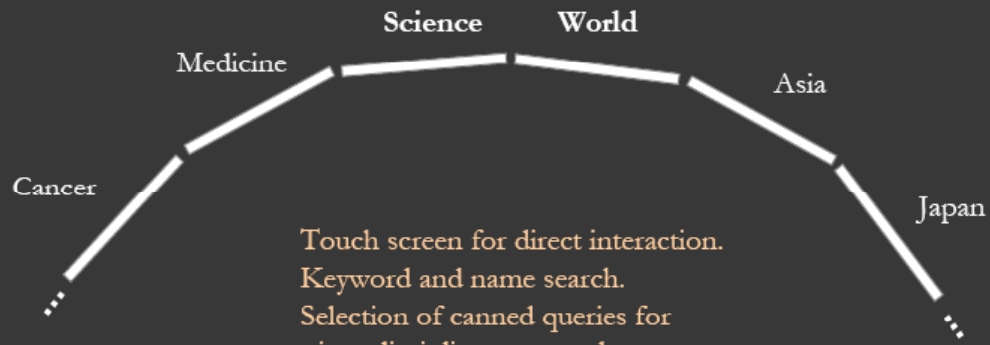
显示屏通过四步来展示某个学者对科学的贡献以及影响力的传播。首先，显示屏点亮该学者所发表的论文所属的学科在学科分布图上的位置以及该学者从事这项研究时所在的研究机构在世界地图上的位置。到目前为止，所有这些论文的引用率仍然很高。第二步，显示屏点亮所有引用在第一步中被点亮的原始论文的论文在学科分布图上的位置以及它们在世界地图上的位置。第三步，显示屏点亮所有引用了在第二步中被点亮的论文的论文在学科分布图上的位置以及它们在世界地图上的位置。第四步，显示屏点亮所有引用了在第三步中被点亮的论文的论文在学科分布图上的位置以及它们在世界地图上的位置。



Re-implementation of Illuminated Diagram Software

by *Advanced Visualization Lab, Indiana University*

Drives unlimited number of ID screens.



Touch screen for direct interaction.

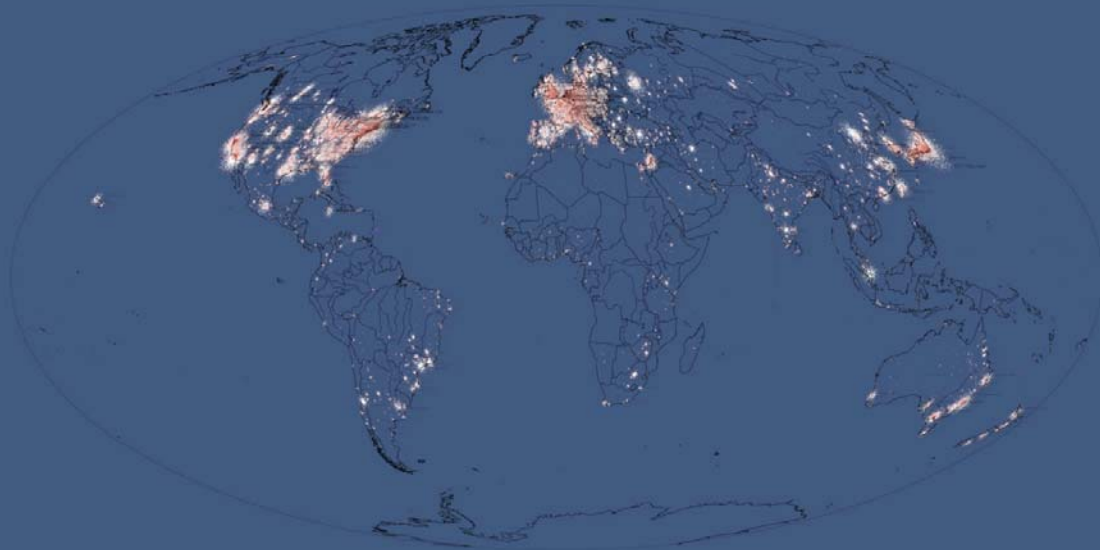
Keyword and name search.

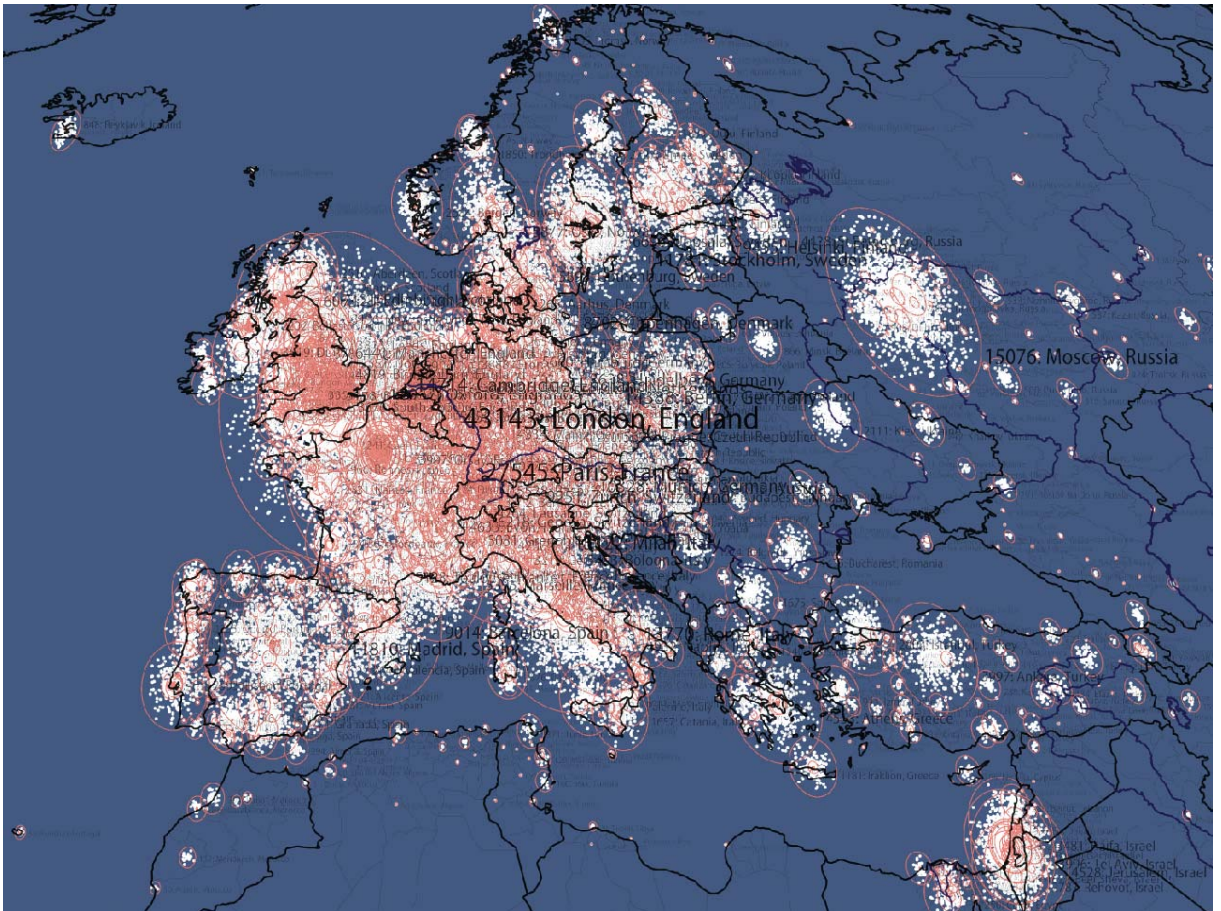
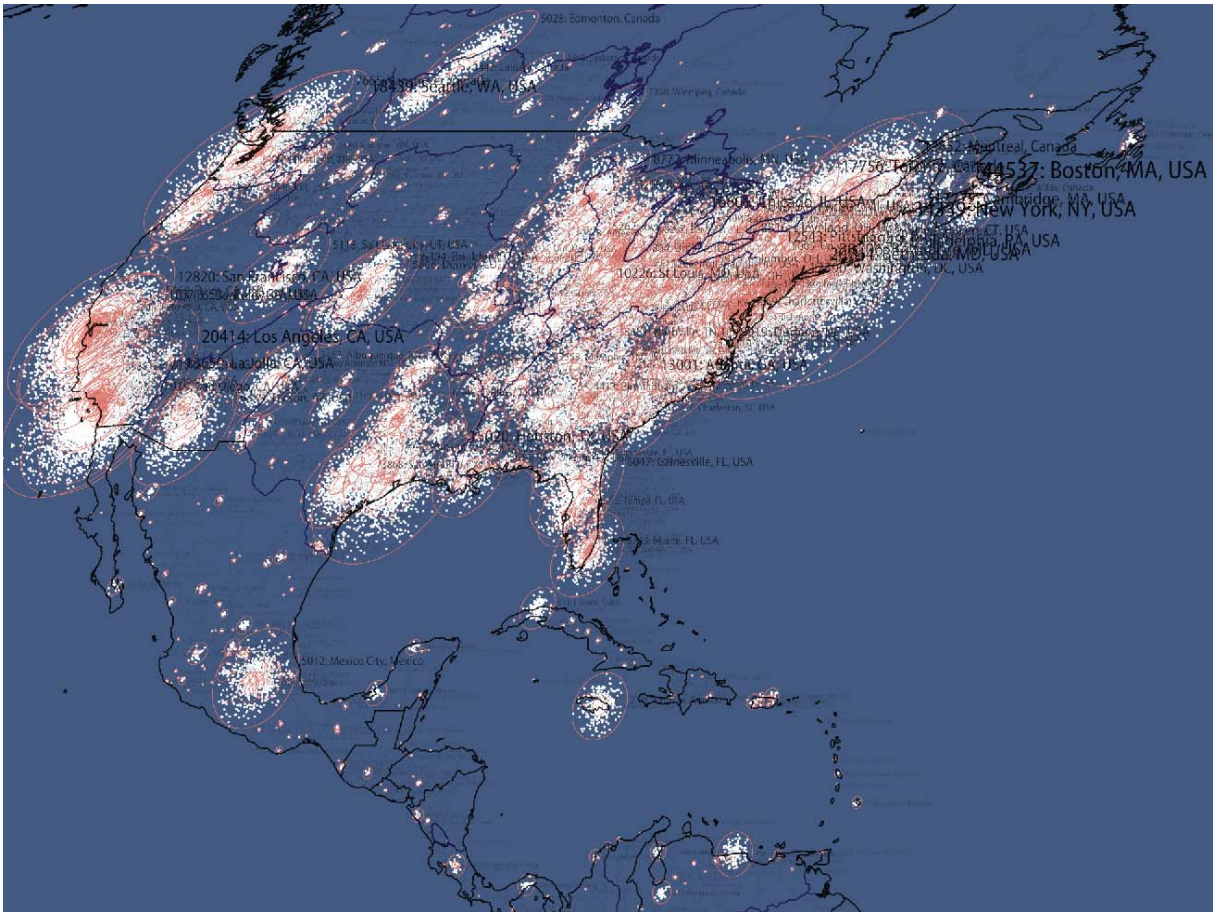
Selection of canned queries for

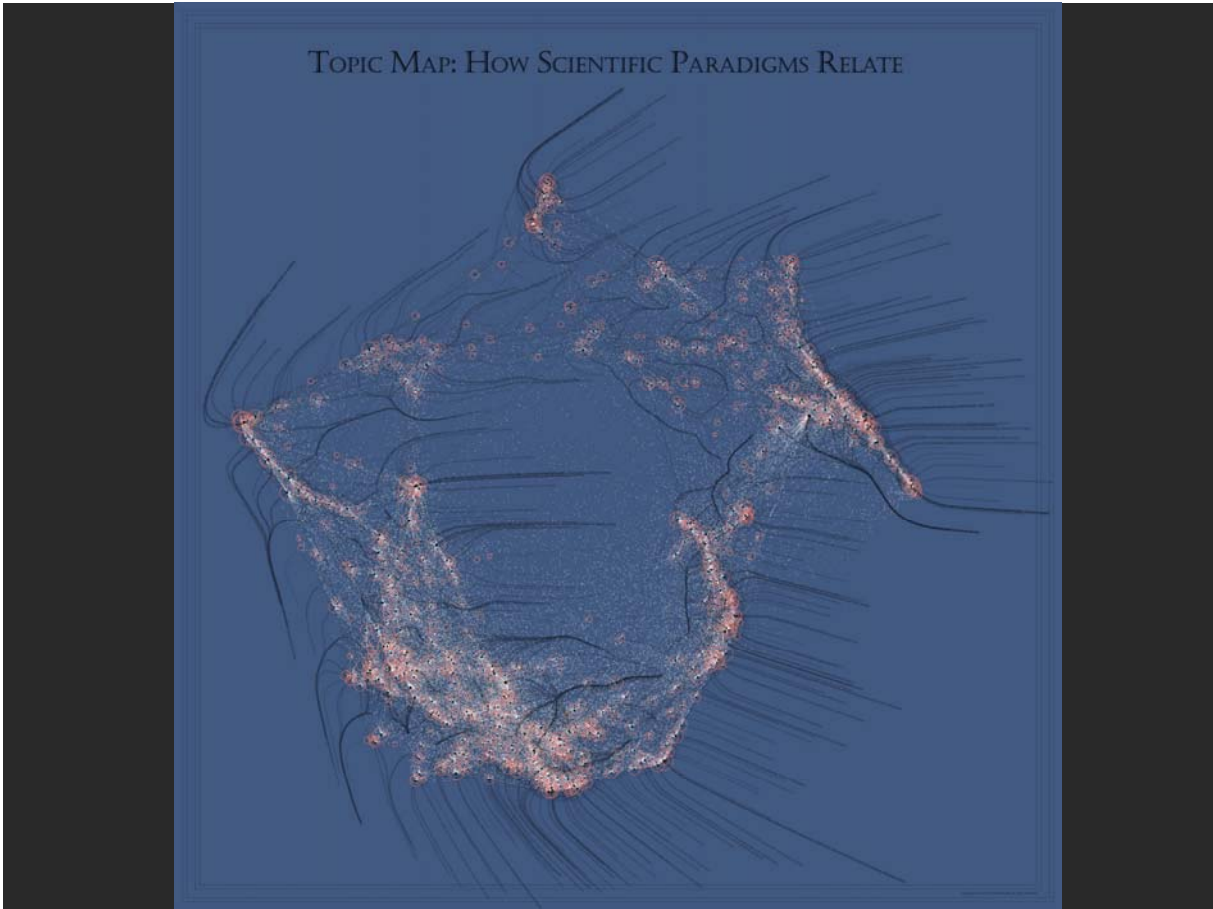
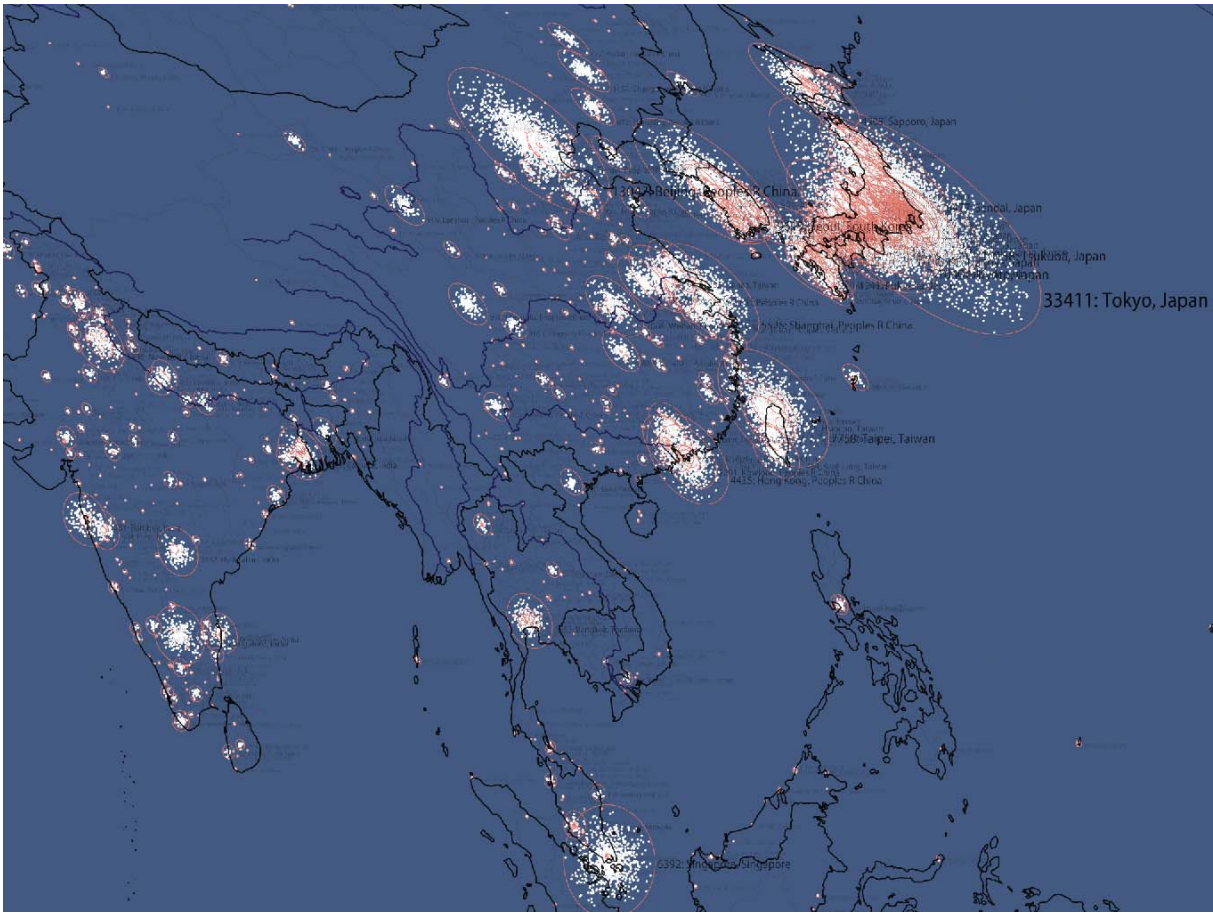
- interdisciplinary research areas
- famous people
- activity patterns, e.g., bursts, trends, etc.



GEOGRAPHIC MAP: WHERE SCIENCE GETS DONE







Teaching Children the Structure of Science

Börner, Katy, Palmer, Fileve, Davis, Julie M., Hardy, Elisha F., Uzzi, Stephen Miles & Hook, Bryan J. (2009). Teaching Children the Structure of Science. In SPIE Conference on Visualization and Data Analysis (Vol. 7243, pp. 724307: 1-14), SPIE.

- How can children start to understand the complex interplay of the different sciences?
- How can they get an intuitive understanding of the importance of math and how much it is needed to succeed in many if not all of the other sciences?
- What does it mean for teaching, learning, and job opportunities if the biomedical sciences account for 50% of all sciences?
- Can we make them see the central position of computer science and its evolving symbiosis with all other aptly named 'computational X' sciences?
- Can we offer them a means to see the emergence and evolution of new sciences, e.g., nano* or neuro*?
- How can we empower them to search for a certain expertise in the correct scientific discipline?
- How can we teach them to appreciate the very diverse cultures, research approaches, and languages that exist in the different sciences and enable them to 'speak' more than one science in order to collaborate across scientific boundaries?
- Last but not least, how can we engage children in the work of real scientists, have them share the excitement of discovery, and allow them to find their own 'place' in science?



Inventors & Inventions



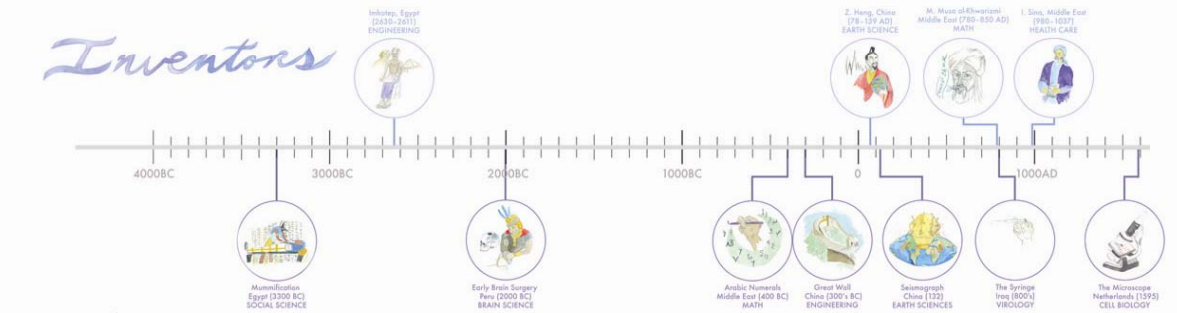
Hands-On Science Maps for Kids, by Fflew Palmer (Paintings), Julie Smith (Data Acquisition), Eloha Hardy and Katy Blener (Graphic Design), BEDDINGTON, IN, 2006. Courtesy of Indiana University. Learn more at www.scispace.org. This map plots the locations of where scientific papers were published: each light green dot represents 10 or fewer papers; they are scattered around the exact location for visibility, within a labelled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illumination diagram" display which used a computer and two projectors, projecting spots of light on the screen to highlight different kinds of scientific research: one a global map of scientific paradigms and the areas in the world where each

Inventors

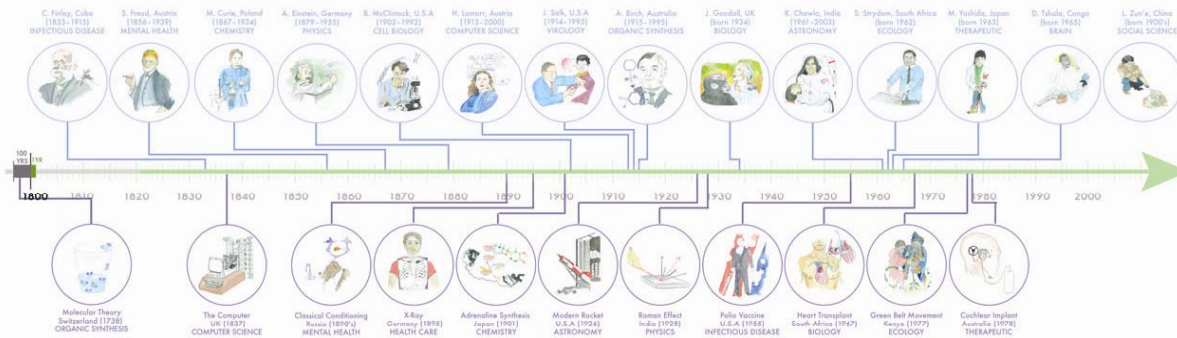


Hands-On Science Maps for Kids, by Fflew Palmer (Paintings), Julie Smith (Data Acquisition), Eloha Hardy and Katy Blener (Graphic Design), BEDDINGTON, IN, 2006. Courtesy of Indiana University. Learn more at www.scispace.org. This map plots the locations of where scientific papers were published: each light green dot represents 10 or fewer papers; they are scattered around the exact location for visibility, within a labelled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illumination diagram" display which used a computer and two projectors, projecting spots of light on the screen to highlight different kinds of scientific research: one a global map of scientific paradigms and the areas in the world where each

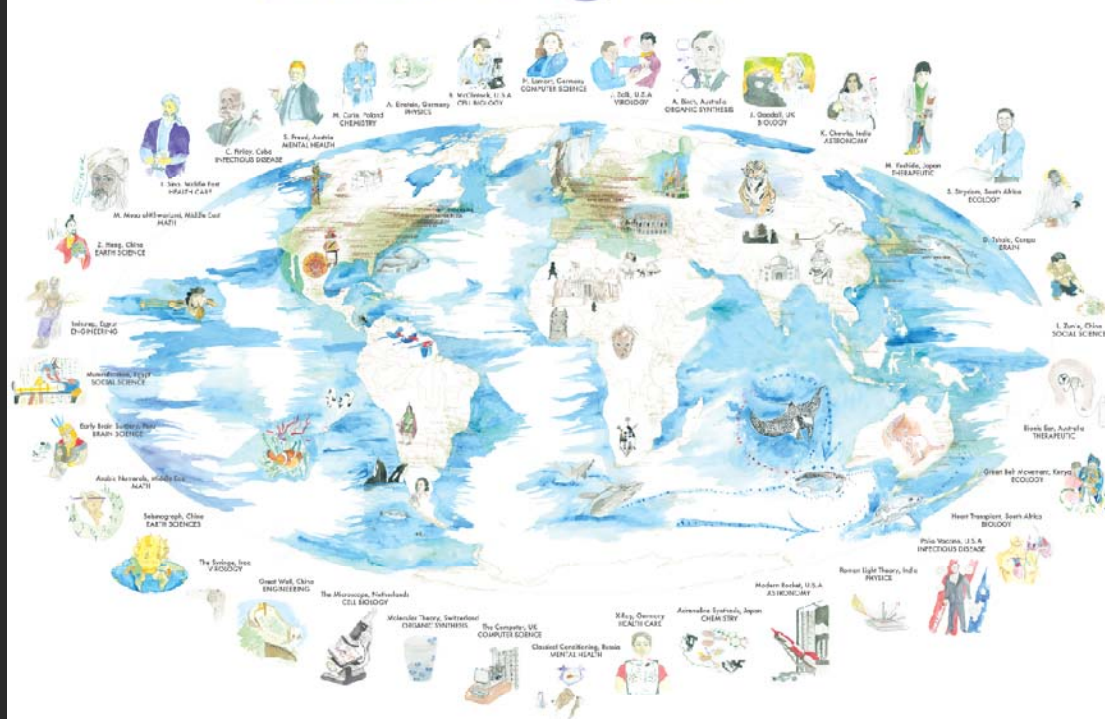
Inventors



Inventions



Inventors & Inventions

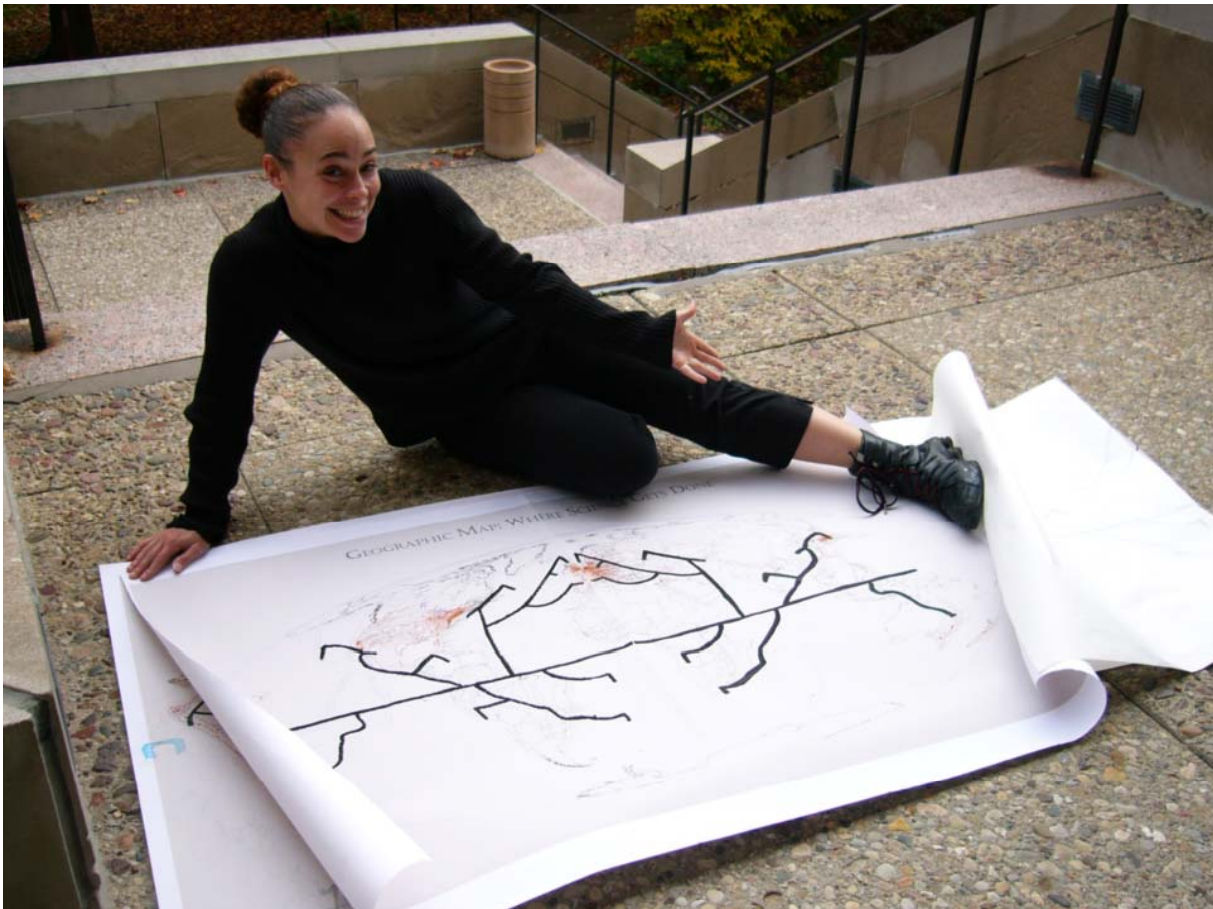


Science Puzzle Map for Kids by Filene Palmer, Julie Smith, Elisha Hardy and Katy Börner, Indiana University, 2006. (Base map taken from Illuminated Diagram display by Kevin Boyack, Richard Klavans, and W. Bradford Paley.)

Inventors



Hands-On Science Maps for Kids, by Filipe Palmer (Painting), Julia Smith (Data Acquisition), Eksha Hardy and Kitty Elmer (Graphic Design), BLOOMINGTON, IN, 2016, Courtesy of Indiana University. Learn more at 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 digram" display which used a computer and two projectors 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 Bakak and Dik Kluwer, cartography by John Duggan, data from Thompson ISI graphics and typography by It Bradford Poley. Copyright © 2006 It Bradford Poley, all rights reserved.

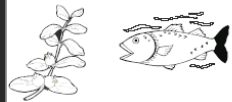






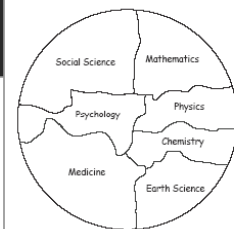
My Science Story

By _____



For more information about the map of science for kids or this exercise, please contact Katy Borvan (katy@indiana.edu) or Nikki Roberg (nroberg@indiana.edu) at the School of Library and Information Science, Indiana University. These materials were compiled by Nikki Roberg in 2006.

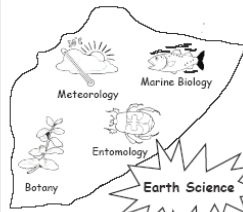
There are seven main fields of science. They are...



social science, mathematics, physics, chemistry, earth science, medicine, and psychology. I like to study earth science.

Color earth science green.

Earth scientists study the weather, plants and trees, marine life, insects, and much more.

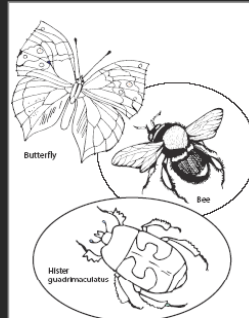


I like insects. They are interesting to look at and study.

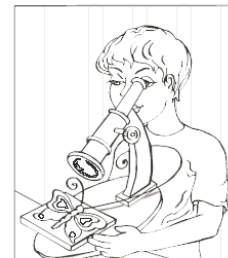
Color in the insect.

Activities:

- Solve the puzzle.
- Navigate to 'Earth Science'.
- Identify major inventions.
- Place major inventors.
- Find your dream job on the map.
- Why is mathematics important?



There are many types of insects in the world. Bees, butterflies, and beetles are just a few.



I want to be an entomologist when I grow up. Then I can study insects all the time.

What is Science? KIDS DRAWING CONTEST

WHAT

What is Science? Who does Science? What is Science to you? Design a picture of your favorite scientist or science experiment and tell us about it!

WHEN

October 1st - 30th: Submit entries
November 5th: Winners notified
November 5th - 30th: Winning entries and Top 50 on display at the American Museum of Science and Energy.

Judging Criteria

- 25% Appropriateness of contest theme
- 25% Creativity and quality of drawing
- 25% Originality of the story
- 25% Sensitivity of drawing and story

Requirements

Kids ages 4-15 are invited to submit their hand-drawn illustrations on 8.5 x 11 paper with a typed story of 25-100 words explaining their drawing and discussing their favorite scientist or experiment.

PRIZES

1 year family membership & Science Kit from AMSE

Science Kit from the AMSE Discovery Shop

Science Book from the AMSE Discovery Shop

Bring in your contest submission and get into AMSE for FREE

Consent

Required: Parental signature granting consent for child to enter contest and agreement that the submitted material will not be returned and will become the property of the Places & Spaces-Museum Science exhibit.

Submitting

Mail submissions to: The American Museum of Science and Energy, 600 S. Tulane Ave., Oak Ridge TN 37830. You may also bring in your submission to The American Museum of Science and Energy.

QUESTIONS? Ask Kim Poyes (kimpoyes@amse.org) | Phone 865-574-9584

Please attach this form to the back of submission



Artist's Name _____ Age _____ Parent's Name _____ Phone Number _____

Winners @ AMSE

JoHanna Sanders, age 12, a picture of someone enjoying nature and a theme that science is all around us.
Sascha Richey, age 8, drew a picture of her mother and explained why her mother is her favorite scientist.

My Favorite Scientist

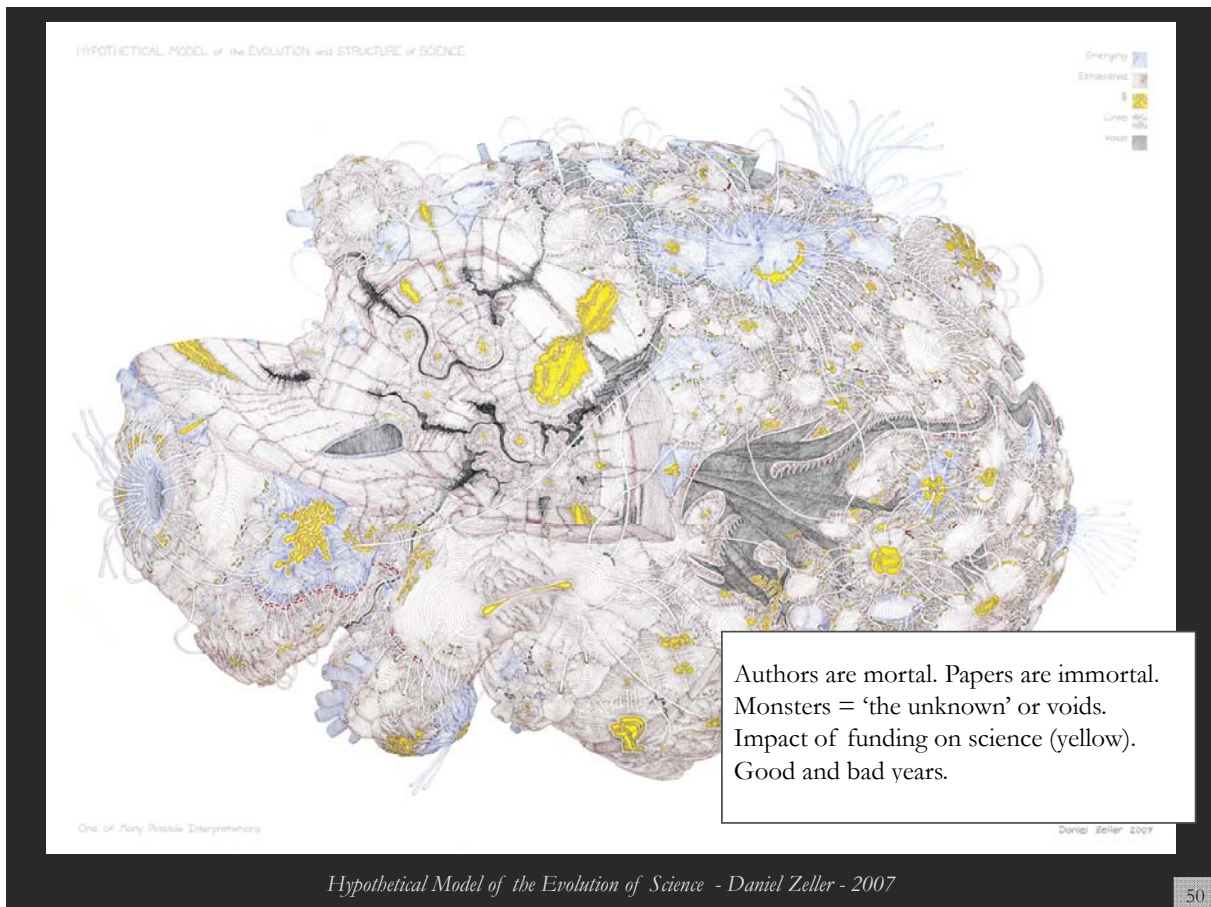


Observe
Discover
Understand
Learn
Science
Explore
Hypothesis
Experiment
Win or
Search

Science Maps

➤ As Conceptualization and Model of Science

Börner, Katy and Scharnhorst, Andrea (Eds.) (2009). Science of Science: Conceptualizations and Models of Science. *Special Issue of Journal of Informetrics*, 3(3).



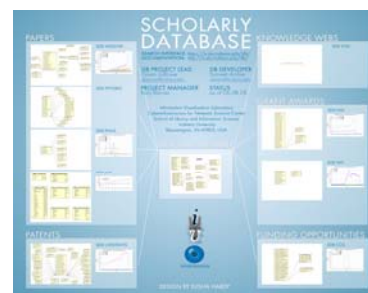
Science of Science Cyberinfrastructures

Science of Science Cyberinfrastructures



Scholarly Database of 23 million scholarly records

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



Information Visualization Cyberinfrastructure

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



Network Workbench Tool and Community Wiki

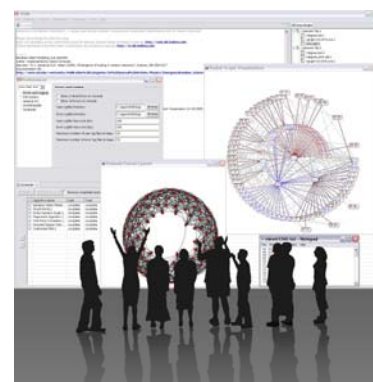
Over 120 plugins, ca. 45 Scientometrics plugins


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



Epidemics Cyberinfrastructure

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





Science of Science Cyberinfrastructure
— P O R T A L —

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 "TLS: 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, 20 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).

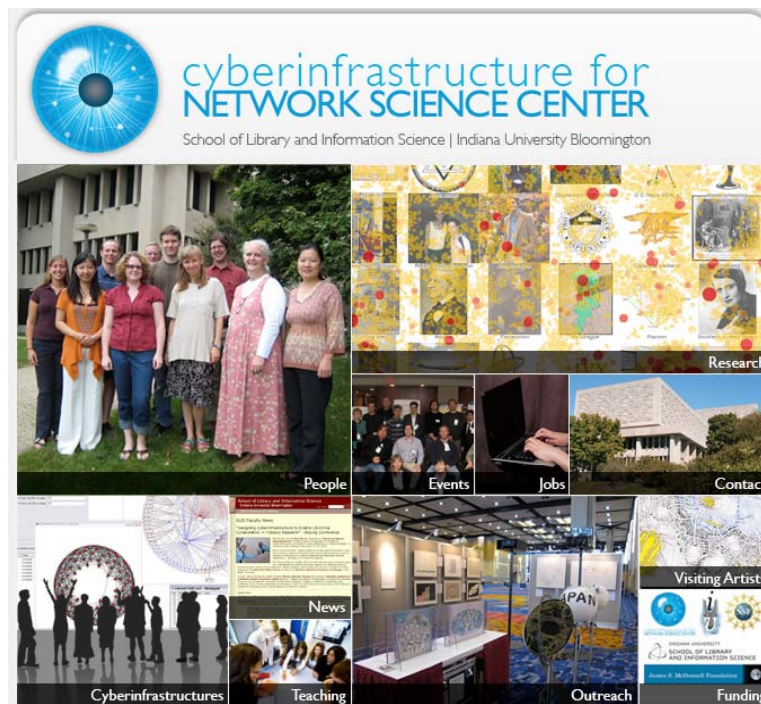
Conceptualization of Science
A 'science of science' requires a theoretically grounded and practically useful conceptualization of the structure and evolution of science. A special journal issue entitled "[Science of Science: Conceptualizations and Models of Science](#)" edited by [Katy Börner](#), Indiana 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>

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cyberinfrastructure for
NETWORK SCIENCE CENTER
School of Library and Information Science | Indiana University Bloomington

People

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News

Teaching

Cyberinfrastructures

Outreach

Funding

Visiting Artists

Papers, maps, cyberinfrastructures, talks, press are linked from
<http://cns.slis.indiana.edu>

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This talk draws on the works of several science map makers, see <http://scimaps.org> for details.



This is the only mockup in this slide show.

Everything else is available today.

The End.