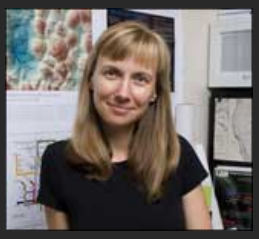
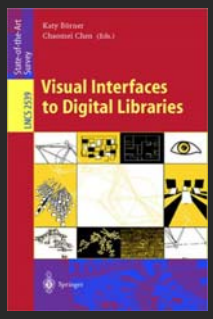
Science Maps in Action



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

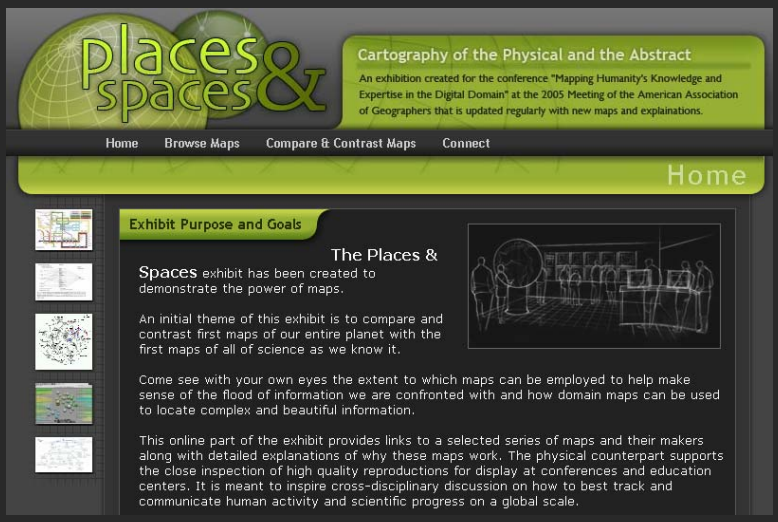
28th Annual CNLS Conference, Santa Fe, NM
9:00-9:50am, May 13, 2008

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

- ***Places & Spaces: Mapping Science*** *exhibit, see also http://scimaps.org.*



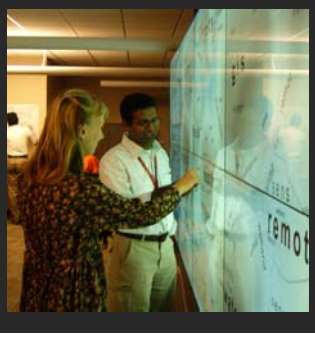
Places & Spaces: Mapping Science

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

http://scimaps.org.

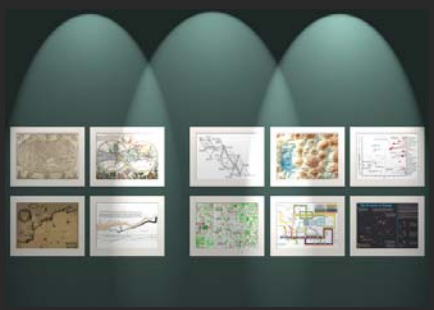
Exhibit Curators:

Dr. Katy Börner & Elisha Hardy

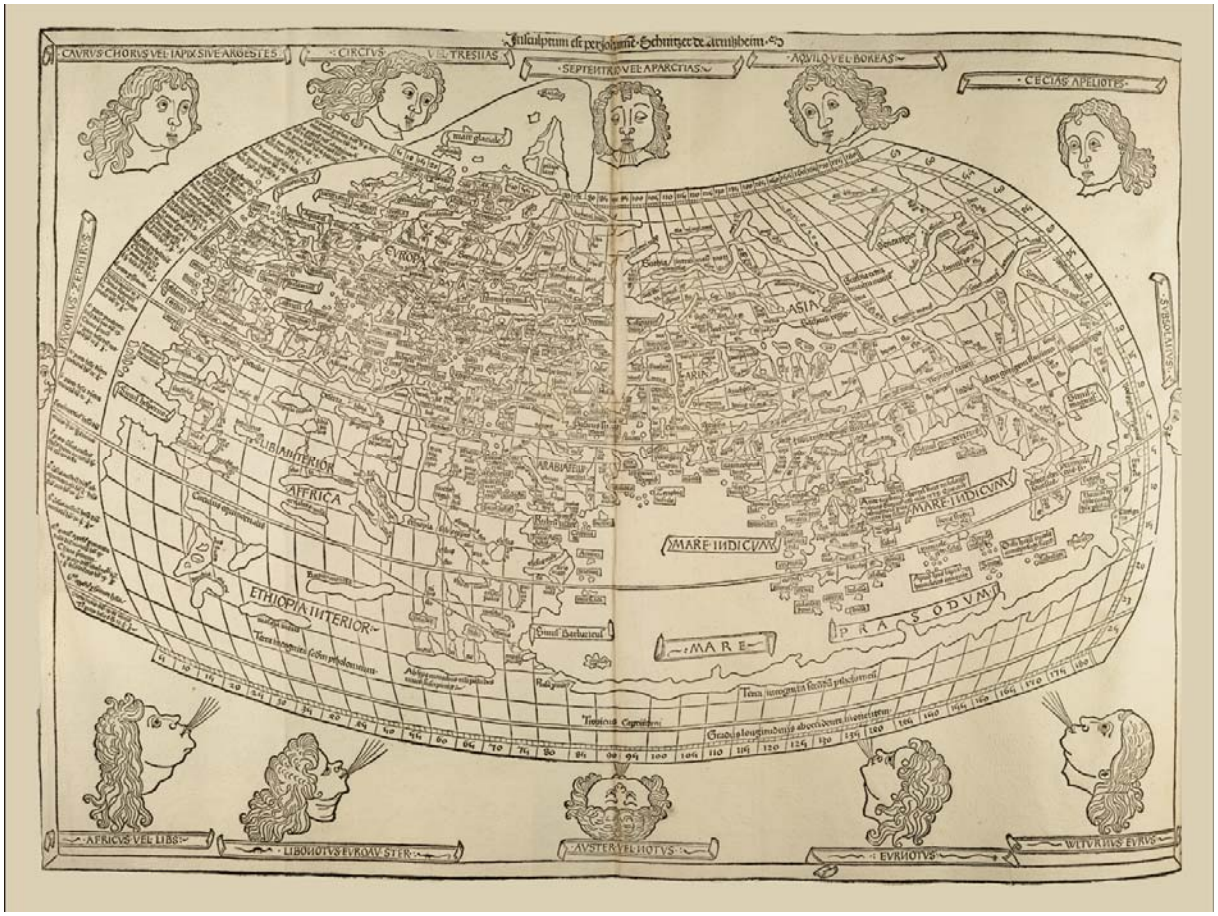


The Power of Maps

Four Early Maps of Our World
VERSUS
Six Early Maps of Science



(1st Iteration of Places & Spaces Exhibit - 2005)


CAVRVS CHORVS VEL IAPIX SIVE ARGESTES
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EVROPA
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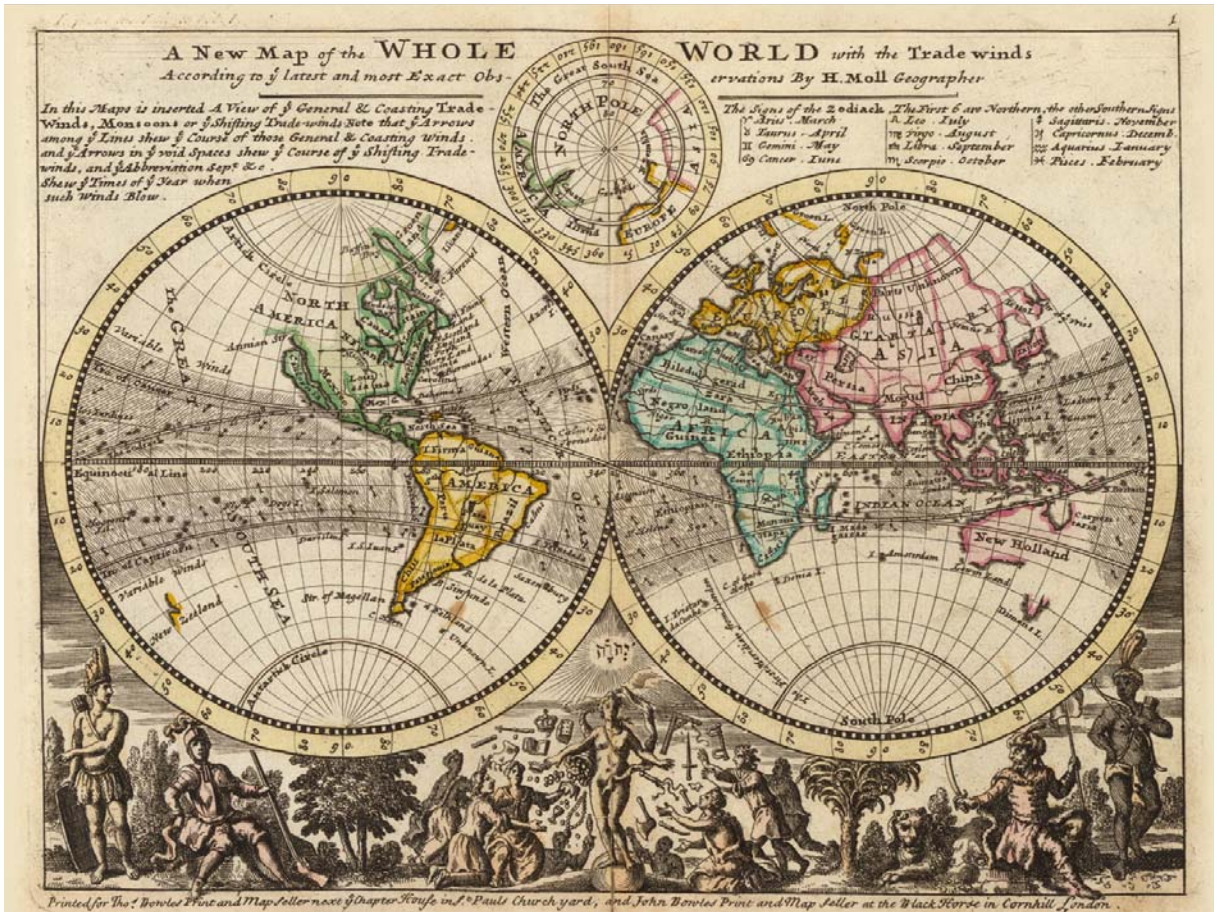
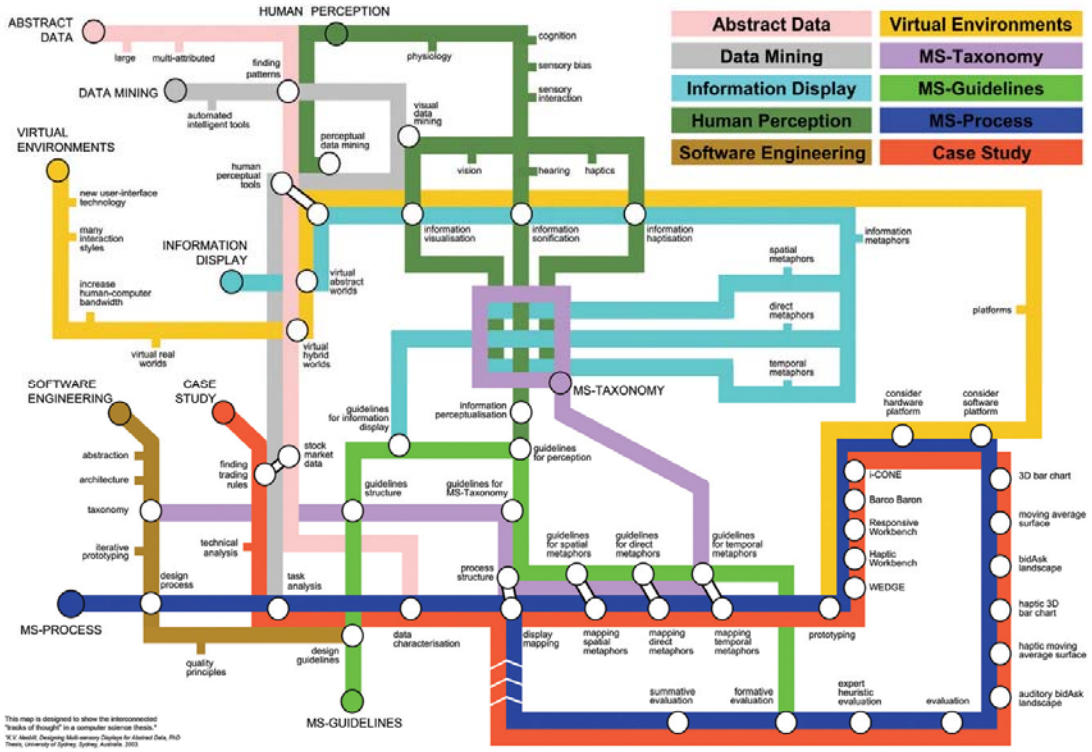
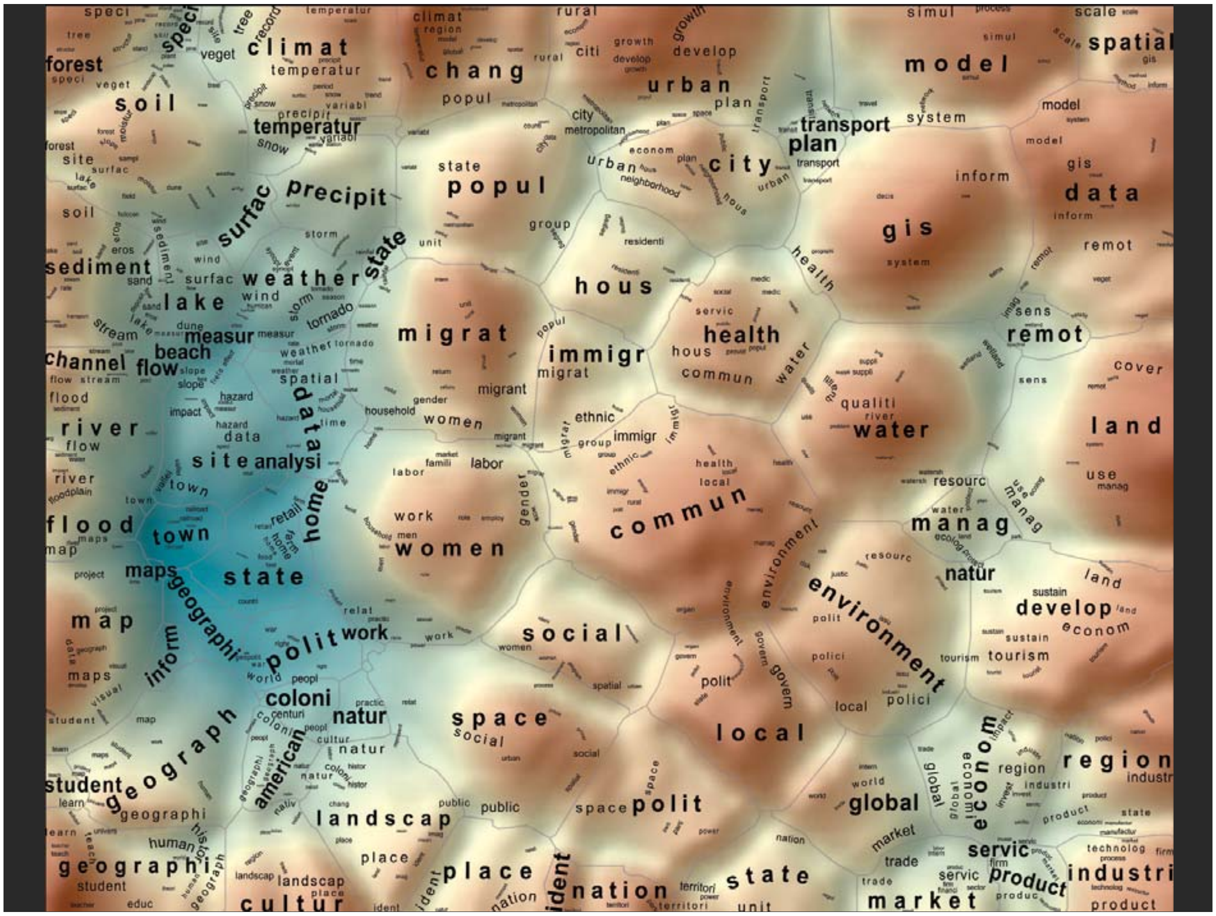

A New Map of the WHOLE WORLD with the Trade winds
According to ye latest and most Exact Obs- ervations By H. Moll Geographer
In this Maps is inserted A View of ye General & Coasting Trade-Winds, Monsoons or ye Shifting Trade-winds Note that ye Arrows among ye Lines shew ye Course of those General & Coasting Winds. and ye Arrows in ye mid Spaces shew ye Course of ye Shifting Trade-winds, and ye Abbreviation Sept.r &c. Shew ye Times of ye Year when such Winds Blow.
The Signs of the Zodiack The First 6 are Northern, the other Southern Signs
♈ Aries . March
♉ Taurus . April
♊ Gemini . May
♋ Cancer . June
♌ Leo . July
♍ Virgo . August
♎ Libra . September
♏ Scorpio . October
♐ Sagittarius . November
♑ Capricornus . Decemb.
♒ Aquarius . January
♓ Pisces . February
The Great South Sea
NORTH POLE
AMERICA
EUROPE
North Pole
NORTH AMERICA
SOUTH SEA
AFRICA
ASIA
INDIAN OCEAN
New Holland
South Pole
Printed for Tho.s Bowles Print and Map Seller next ye Chapter House in S.t Pauls Church yard, and John Bowles Print and Map Seller at the Black Horse in Cornhill, London.

How would a map of science look?

What metaphors would work best?

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water
land
river
site analysi
home
town
flood
manag
women
maps
state
environment
natur
map
develop
social
polit
tourism
coloni
natur
space
local
region
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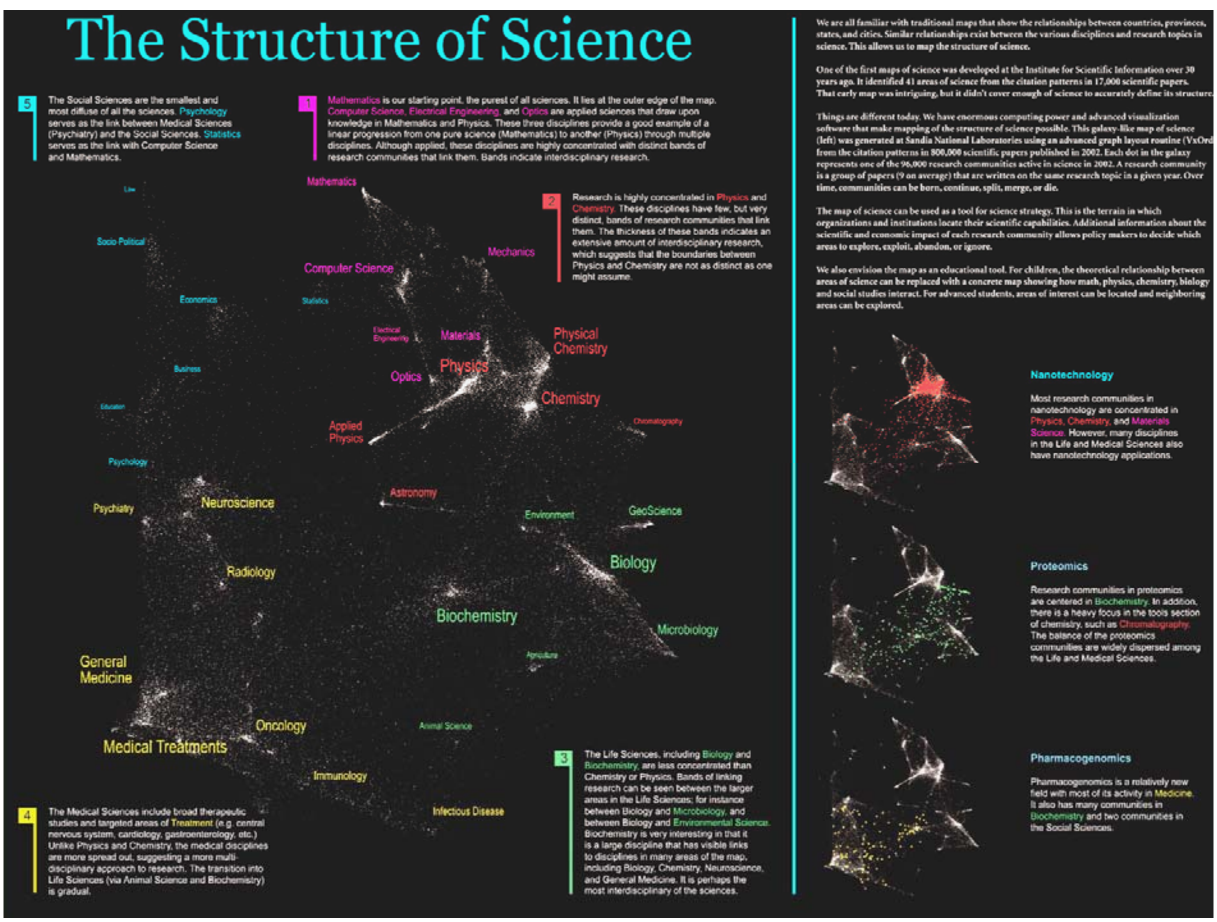
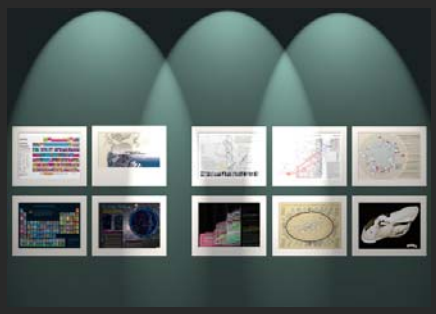
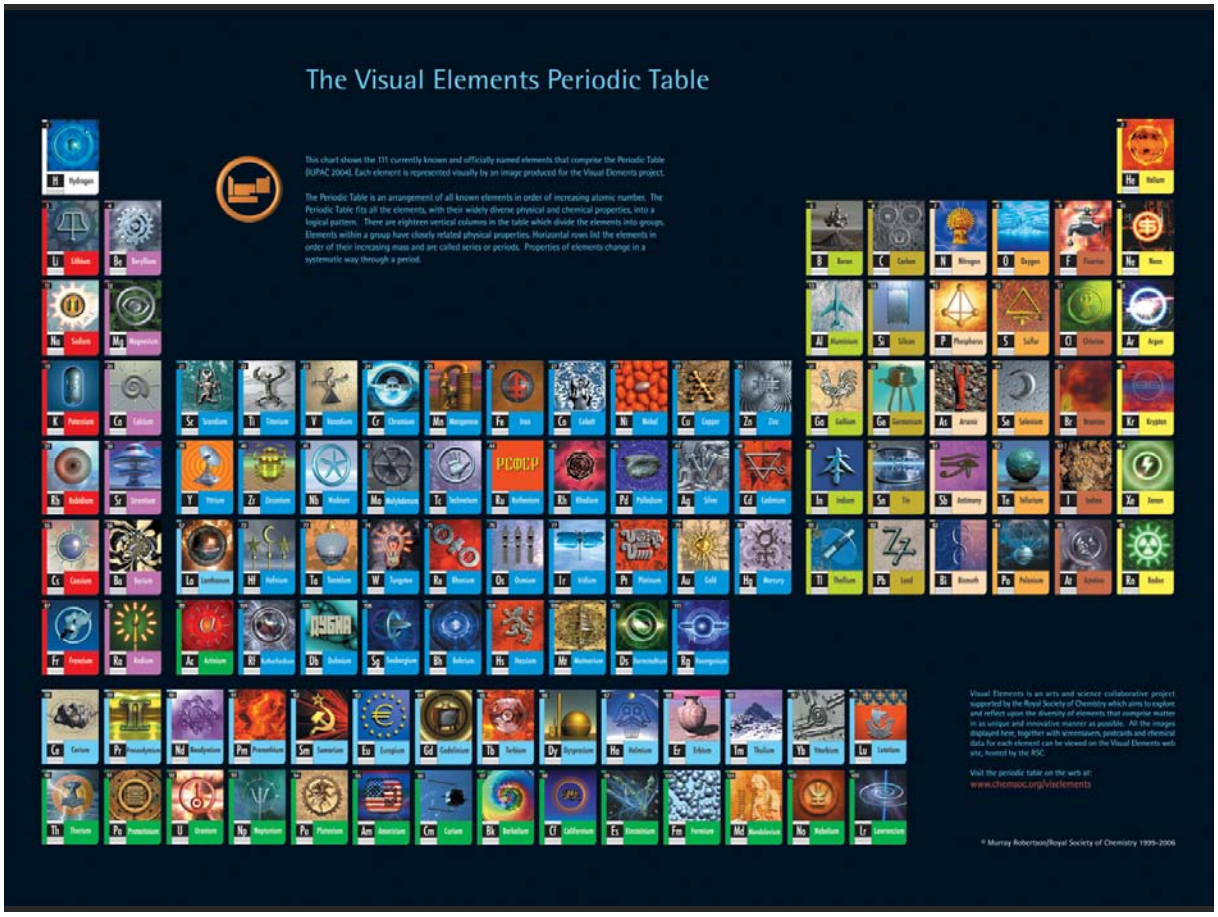

The Structure of Science
5 The Social Sciences are the smallest and most diffuse of all the sciences. Psychology serves as the link between Medical Sciences (Psychiatry) and the Social Sciences. Statistics serves as the link with Computer Science and Mathematics.
1 Mathematics is our starting point, the purest of all sciences. It lies at the outer edge of the map. Computer Science, Electrical Engineering, and Optics are applied sciences that draw upon knowledge in Mathematics and Physics. These three disciplines provide a good example of a linear progression from one pure science (Mathematics) to another (Physics) through multiple disciplines. Although applied, these disciplines are highly concentrated with distinct bands of research communities that link them. Bands indicate interdisciplinary research.
2 Research is highly concentrated in Physics and Chemistry. These disciplines have few, but very distinct, bands of research communities that link them. The thickness of these bands indicates an extensive amount of interdisciplinary research, which suggests that the boundaries between Physics and Chemistry are not as distinct as one might assume.
Law
Socio Political
Economics
Business
Education
Psychology
Psychiatry
Mathematics
Computer Science
Statistics
Mechanics
Electrical Engineering
Materials
Physics
Optics
Physical Chemistry
Chemistry
Applied Physics
Chromatography
Astronomy
Neuroscience
Radiology
Environment
GeoScience
Biology
Biochemistry
Microbiology
Agriculture
General Medicine
Oncology
Medical Treatments
Animal Science
Immunology
Infectious Disease
4 The Medical Sciences include broad therapeutic studies and targeted areas of Treatment (e.g. central nervous system, cardiology, gastroenterology, etc.) Unlike Physics and Chemistry, the medical disciplines are more spread out, suggesting a more multi-disciplinary approach to research. The transition into Life Sciences (via Animal Science and Biochemistry) is gradual.
3 The Life Sciences, including Biology and Biochemistry, are less concentrated than Chemistry or Physics. Bands of linking research can be seen between the larger areas in the Life Sciences; for instance between Biology and Microbiology, and between Biology and Environmental Science. Biochemistry is very interesting in that it is a large discipline that has visible links to disciplines in many areas of the map, including Biology, Chemistry, Neuroscience, and General Medicine. It is perhaps the most interdisciplinary of the sciences.
We are all familiar with traditional maps that show the relationships between countries, provinces, states, and cities. Similar relationships exist between the various disciplines and research topics in science. This allows us to map the structure of science.
One of the first maps of science was developed at the Institute for Scientific Information over 30 years ago. It identified 41 areas of science from the citation patterns in 17,000 scientific papers. That early map was intriguing, but it didn't cover enough of science to accurately define its structure.
Things are different today. We have enormous computing power and advanced visualization software that make mapping of the structure of science possible. This galaxy-like map of science (left) was generated at Sandia National Laboratories using an advanced graph layout routine (VxOrd from the citation patterns in 800,000 scientific papers published in 2002. Each dot in the galaxy represents one of the 96,000 research communities active in science in 2002. A research community is a group of papers (9 on average) that are written on the same research topic in a given year. Over time, communities can be born, continue, split, merge, or die.
The map of science can be used as a tool for science strategy. This is the terrain in which organizations and institutions locate their scientific capabilities. Additional information about the scientific and economic impact of each research community allows policy makers to decide which areas to explore, exploit, abandon, or ignore.
We also envision the map as an educational tool. For children, the theoretical relationship between areas of science can be replaced with a concrete map showing how math, physics, chemistry, biology and social studies interact. For advanced students, areas of interest can be located and neighboring areas can be explored.
Nanotechnology
Most research communities in nanotechnology are concentrated in Physics, Chemistry, and Materials Science. However, many disciplines in the Life and Medical Sciences also have nanotechnology applications.
Proteomics
Research communities in proteomics are centered in Biochemistry. In addition, there is a heavy focus in the tools section of chemistry, such as Chromalography. The balance of the proteomics communities are widely dispersed among the Life and Medical Sciences.
Pharmacogenomics
Pharmacogenomics is a relatively new field with most of its activity in Medicine. It also has many communities in Biochemistry and two communities in the Social Sciences.

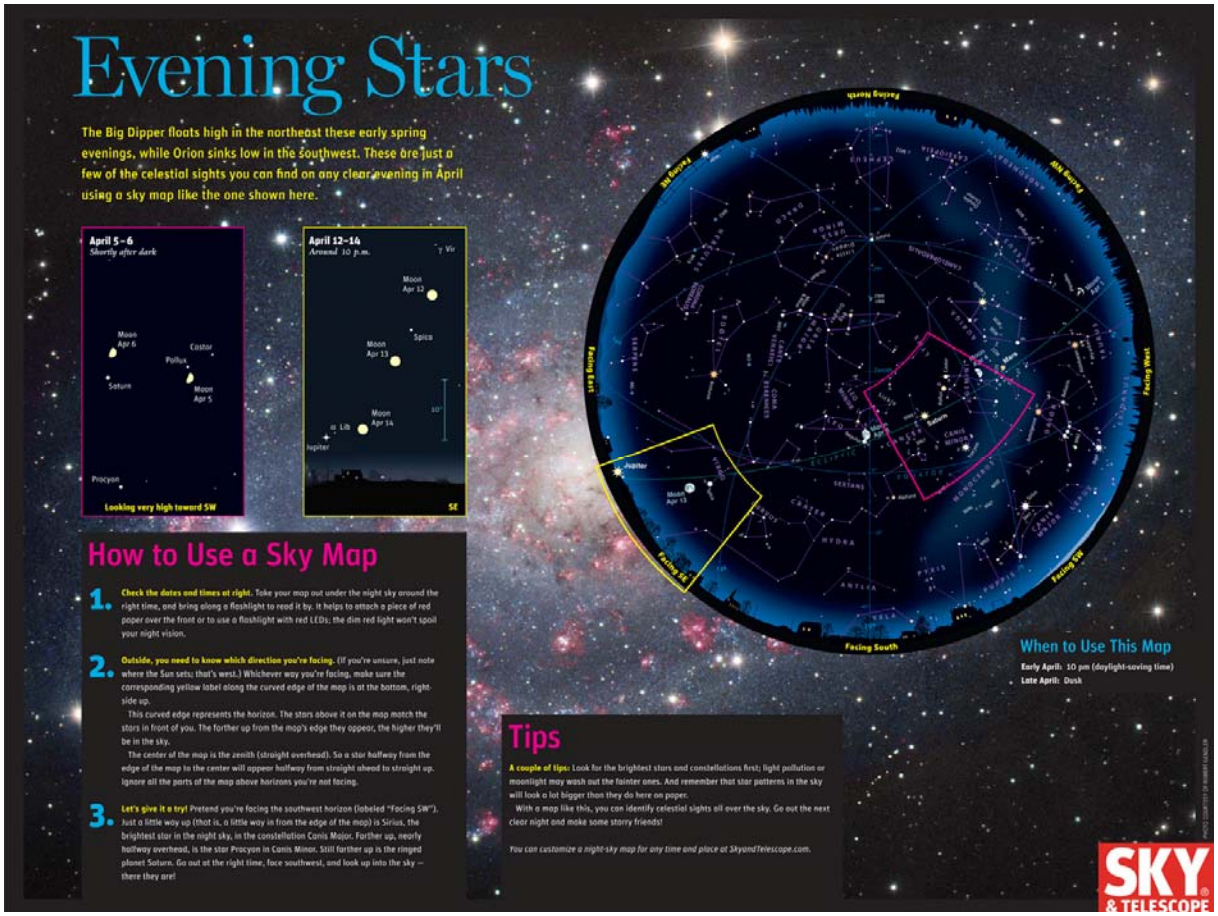
The Power of Reference Systems

Four Existing Reference Systems
VERSUS
Six Potential Reference Systems of Science



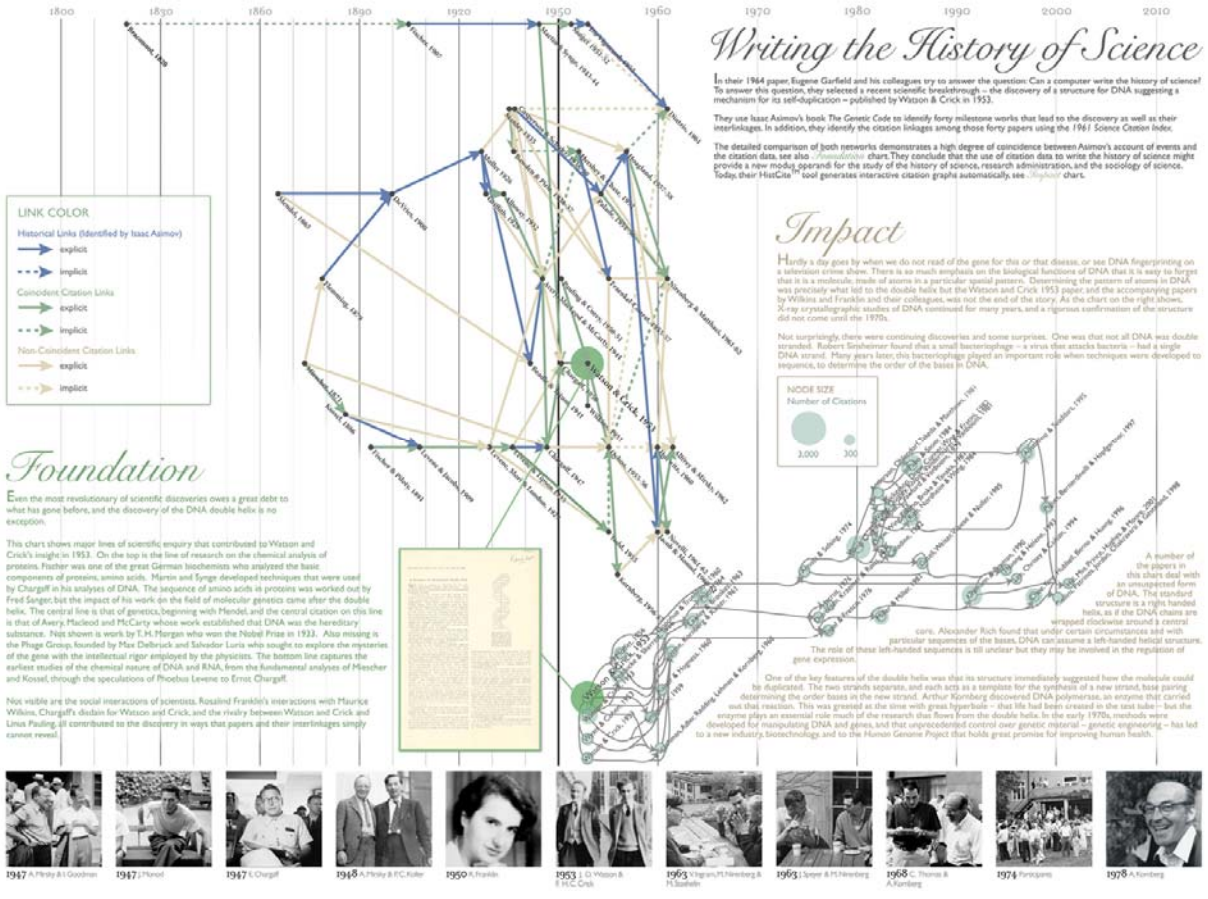
(2nd Iteration of Places & Spaces Exhibit - 2006)

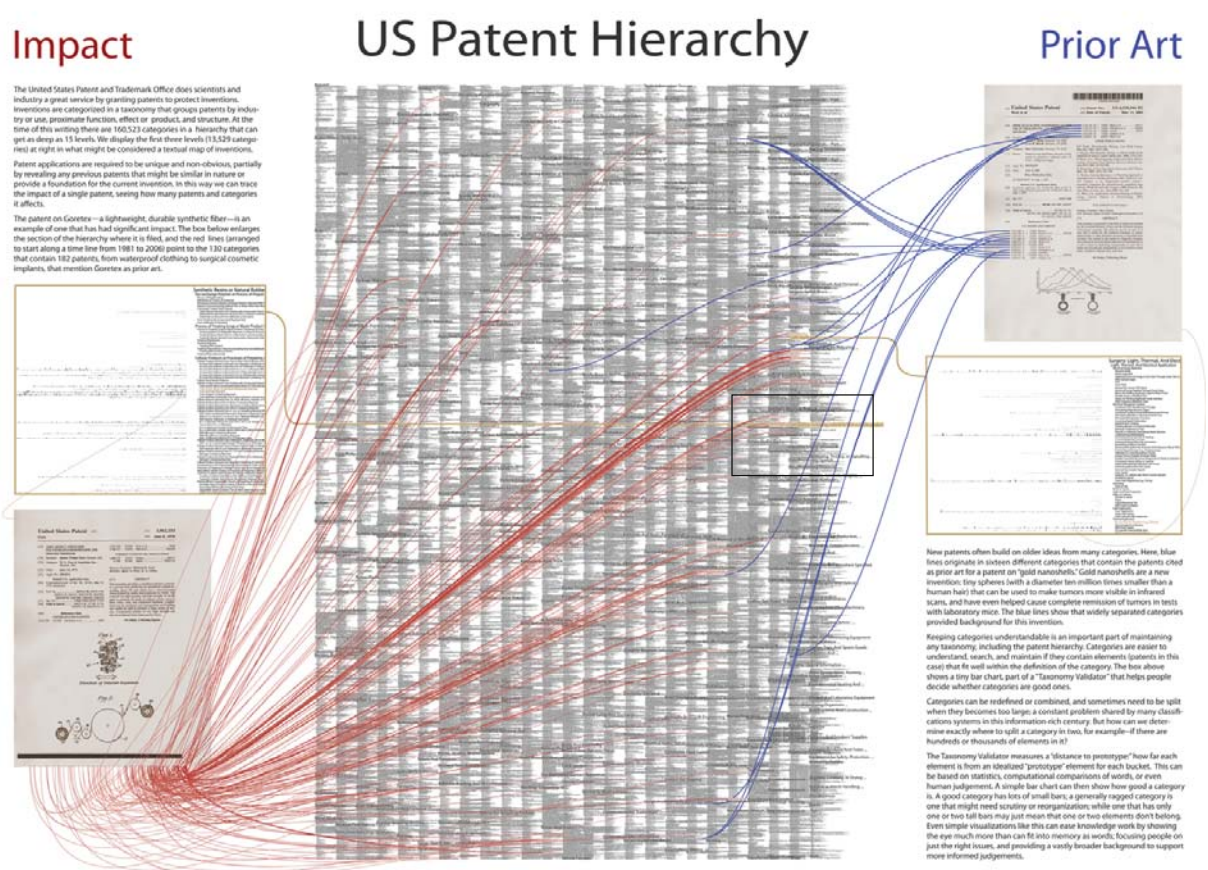


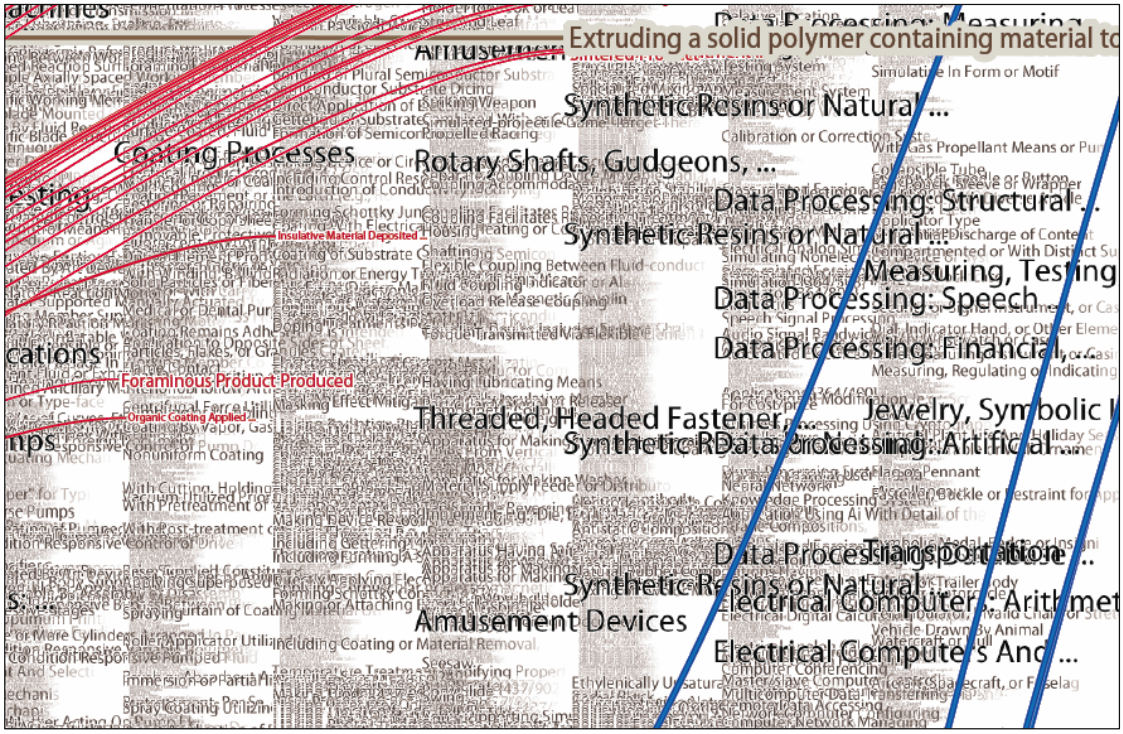


How would a reference system for all of science look?

What dimensions would it have?


1800
1830
1860
1890
1920
1950
1960
1970
1980
1990
2000
2010
LINK COLOR
Historical Links (Identified by Isaac Asimov)
explicit
implicit
Coincident Citation Links
explicit
implicit
Non-Coincident Citation Links
explicit
implicit
NODE SIZE
Number of Citations
3,000
300
Watson & Crick, 1953
Writing the History of Science
In their 1964 paper, Eugene Garfield and his colleagues try to answer the question: Can a computer write the history of science? To answer this question, they selected a recent scientific breakthrough – the discovery of a structure for DNA suggesting a mechanism for its self-duplication – published by Watson & Crick in 1953.
They use Isaac Asimov's book The Genetic Code to identify forty milestone works that lead to the discovery as well as their interlinkages. In addition, they identify the citation linkages among those forty papers using the 1961 Science Citation Index.
The detailed comparison of both networks demonstrates a high degree of coincidence between Asimov's account of events and the citation data, see also Foundation chart. They conclude that the use of citation data to write the history of science might provide a new modus operandi for the study of the history of science, research administration, and the sociology of science. Today, their HistCite™ tool generates interactive citation graphs automatically, see Impact chart.
Impact
Hardly a day goes by when we do not read of the gene for this or that disease, or see DNA fingerprinting on a television crime show. There is so much emphasis on the biological functions of DNA that it is easy to forget that it is a molecule, made of atoms in a particular spatial pattern. Determining the pattern of atoms in DNA was precisely what led to the double helix but the Watson and Crick 1953 paper, and the accompanying papers by Wilkins and Franklin and their colleagues, was not the end of the story. As the chart on the right shows, X-ray crystallographic studies of DNA continued for many years, and a rigorous confirmation of the structure did not come until the 1970s.
Not surprisingly, there were continuing discoveries and some surprises. One was that not all DNA was double stranded. Robert Sinsheimer found that a small bacteriophage – a virus that attacks bacteria – had a single DNA strand. Many years later, this bacteriophage played an important role when techniques were developed to sequence, to determine the order of the bases in DNA.
A number of the papers in this chart deal with an unsuspected form of DNA. The standard structure is a right handed helix, as if the DNA chains are wrapped clockwise around a central core. Alexander Rich found that under certain circumstances and with particular sequences of the bases, DNA can assume a left-handed helical structure. The role of these left-handed sequences is till unclear but they may be involved in the regulation of gene expression.
One of the key features of the double helix was that its structure immediately suggested how the molecule could be duplicated. The two strands separate, and each acts as a template for the synthesis of a new strand, base pairing determining the order bases in the new strand. Arthur Kornberg discovered DNA polymerase, an enzyme that carried out that reaction. This was greeted at the time with great hyperbole – that life had been created in the test tube – but the enzyme plays an essential role much of the research that flows from the double helix. In the early 1970s, methods were developed for manipulating DNA and genes, and that unprecedented control over genetic material – genetic engineering – has led to a new industry, biotechnology, and to the Human Genome Project that holds great promise for improving human health.
Foundation
Even the most revolutionary of scientific discoveries owes a great debt to what has gone before, and the discovery of the DNA double helix is no exception.
This chart shows major lines of scientific enquiry that contributed to Watson and Crick's insight in 1953. On the top is the line of research on the chemical analysis of proteins. Fischer was one of the great German biochemists who analyzed the basic components of proteins, amino acids. Martin and Synge developed techniques that were used by Chargaff in his analyses of DNA. The sequence of amino acids in proteins was worked out by Fred Sanger, but the impact of his work on the field of molecular genetics came after the double helix. The central line is that of genetics, beginning with Mendel, and the central citation on this line is that of Avery, Macleod and McCarty whose work established that DNA was the hereditary substance. Not shown is work by T.H. Morgan who won the Nobel Prize in 1933. Also missing is the Phage Group, founded by Max Delbruck and Salvador Luria who sought to explore the mysteries of the gene with the intellectual rigor employed by the physicists. The bottom line captures the earliest studies of the chemical nature of DNA and RNA, from the fundamental analyses of Miescher and Kossel, through the speculations of Phoebus Levene to Ernst Chargaff.
Not visible are the social interactions of scientists. Rosalind Franklin's interactions with Maurice Wilkins, Chargaff's disdain for Watson and Crick, and the rivalry between Watson and Crick and Linus Pauling, all contributed to the discovery in ways that papers and their interlinkages simply cannot reveal.
1947 A. Hershey & I. Goodman
1947 J. Monod
1947 E. Chargaff
1948 A. Hershey & F.C. Koller
1950 R. Franklin
1953 J. D. Watson & F. H. C. Crick
1963 V. Ingram, M. Nirenberg & H. Matthaei
1963 J. Speyer & M. Nirenberg
1968 C. Thomas & A. Kornberg
1974 Participants
1978 A. Kornberg


Impact
US Patent Hierarchy
Prior Art
The United States Patent and Trademark Office does scientists and industry a great service by granting patents to protect inventions. Inventions are categorized in a taxonomy that groups patents by industry or use, proximate function, effect or product, and structure. At the time of this writing there are 160,523 categories in a hierarchy that can get as deep as 15 levels. We display the first three levels (13,529 categories) at right in what might be considered a textual map of inventions.
Patent applications are required to be unique and non-obvious, partially by revealing any previous patents that might be similar in nature or provide a foundation for the current invention. In this way we can trace the impact of a single patent, seeing how many patents and categories it affects.
The patent on Goretex—a lightweight, durable synthetic fiber—is an example of one that has had significant impact. The box below enlarges the section of the hierarchy where it is filed, and the red lines (arranged to start along a time line from 1981 to 2006) point to the 130 categories that contain 182 patents, from waterproof clothing to surgical cosmetic implants, that mention Goretex as prior art.
New patents often build on older ideas from many categories. Here, blue lines originate in sixteen different categories that contain the patents cited as prior art for a patent on "gold nanoshells." Gold nanoshells are a new invention: tiny spheres (with a diameter ten million times smaller than a human hair) that can be used to make tumors more visible in infrared scans, and have even helped cause complete remission of tumors in tests with laboratory mice. The blue lines show that widely separated categories provided background for this invention.
Keeping categories understandable is an important part of maintaining any taxonomy, including the patent hierarchy. Categories are easier to understand, search, and maintain if they contain elements (patents in this case) that fit well within the definition of the category. The box above shows a tiny bar chart, part of a "Taxonomy Validator" that helps people decide whether categories are good ones.
Categories can be redefined or combined, and sometimes need to be split when they becomes too large; a constant problem shared by many classifications systems in this information-rich century. But how can we determine exactly where to split a category in two, for example–if there are hundreds or thousands of elements in it?
The Taxonomy Validator measures a "distance to prototype:" how far each element is from an idealized "prototype" element for each bucket. This can be based on statistics, computational comparisons of words, or even human judgement. A simple bar chart can then show how good a category is. A good category has lots of small bars; a generally ragged category is one that might need scrutiny or reorganization; while one that has only one or two tall bars may just mean that one or two elements don't belong. Even simple visualizations like this can ease knowledge work by showing the eye much more than can fit into memory as words, focusing people on just the right issues, and providing a vastly broader background to support more informed judgements.


Extruding a solid polymer containing material to
Synthetic Resins or Natural ...
Coating Processes
Rotary Shafts, Gudgeons, ...
Data Processing: Structural ...
Synthetic Resins or Natural ...
Measuring, Testing
Data Processing: Speech
Data Processing: Financial, ...
Foraminous Product Produced
Organic Coating Applied
Threaded, Headed Fastener
Synthetic R
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Jewelry, Symbolic
Data Processing: Transportation ...
Synthetic Resins or Natural ...
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Amusement Devices
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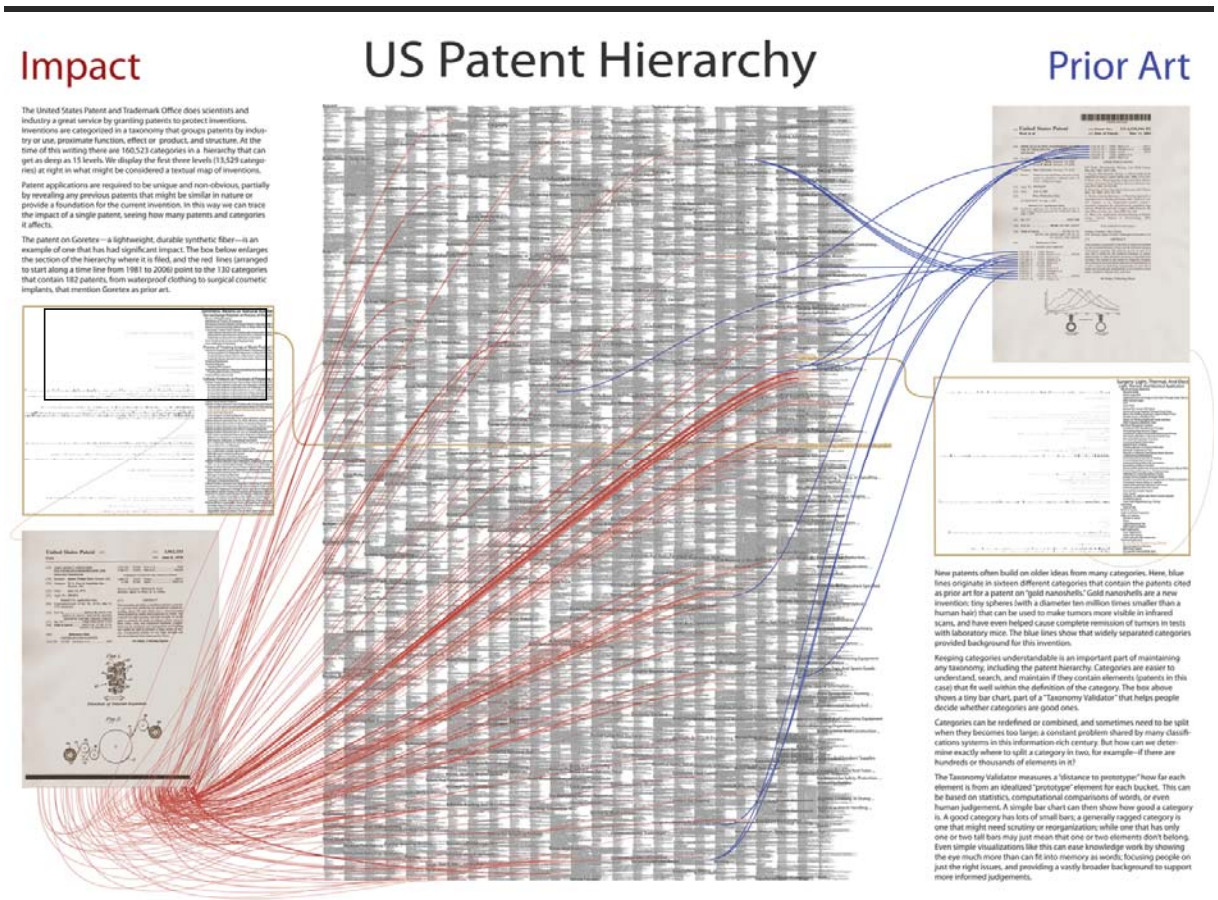
Impact
US Patent Hierarchy
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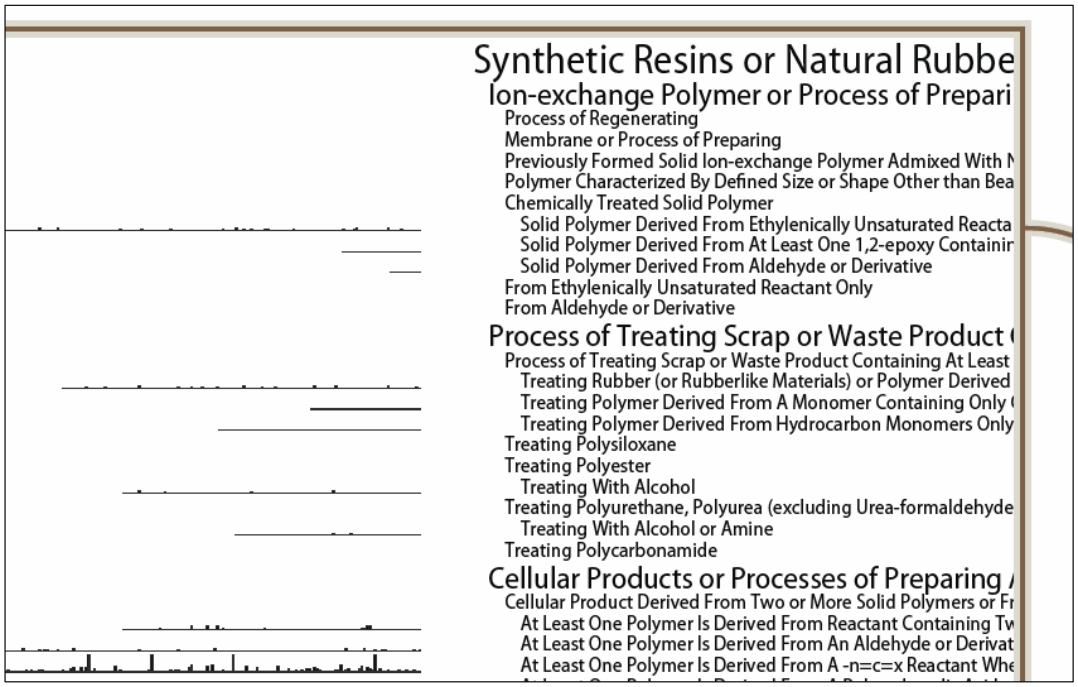
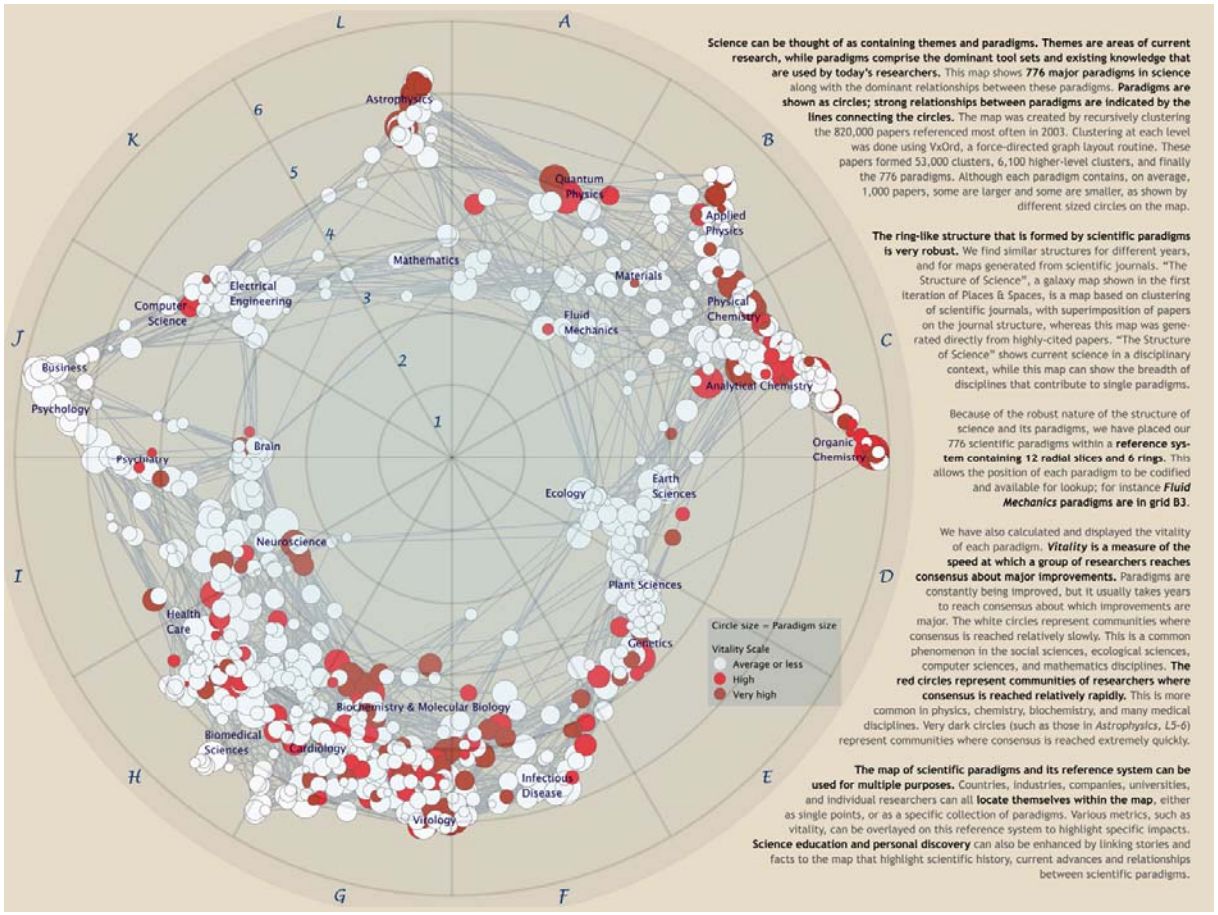




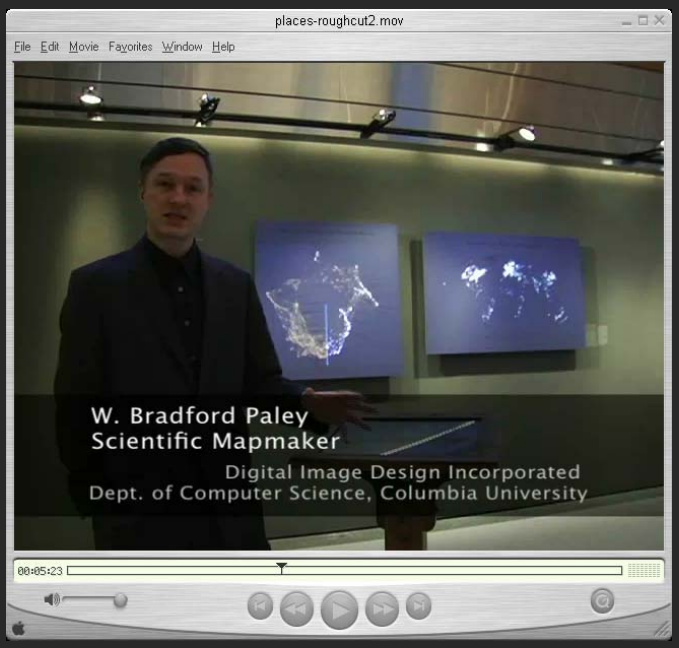
Science can be thought of as containing themes and paradigms. Themes are areas of current research, while paradigms comprise the dominant tool sets and existing knowledge that are used by today's researchers. This map shows **776 major paradigms in science** along with the dominant relationships between these paradigms. **Paradigms are shown as circles; strong relationships between paradigms are indicated by the lines connecting the circles.** The map was created by recursively clustering the 820,000 papers referenced most often in 2003. Clustering at each level was done using VxOrd, a force-directed graph layout routine. These papers formed 53,000 clusters, 6,100 higher-level clusters, and finally the 776 paradigms. Although each paradigm contains, on average, 1,000 papers, some are larger and some are smaller, as shown by different sized circles on the map.

The ring-like structure that is formed by scientific paradigms is very robust. We find similar structures for different years, and for maps generated from scientific journals. "The Structure of Science", a galaxy map shown in the first iteration of Places & Spaces, is a map based on clustering of scientific journals, with superimposition of papers on the journal structure, whereas this map was generated directly from highly-cited papers. "The Structure of Science" shows current science in a disciplinary context, while this map can show the breadth of disciplines that contribute to single paradigms.

Because of the robust nature of the structure of science and its paradigms, we have placed our 776 scientific paradigms within a **reference system containing 12 radial slices and 6 rings**. This allows the position of each paradigm to be codified and available for lookup; for instance ***Fluid Mechanics* paradigms are in grid B3**.

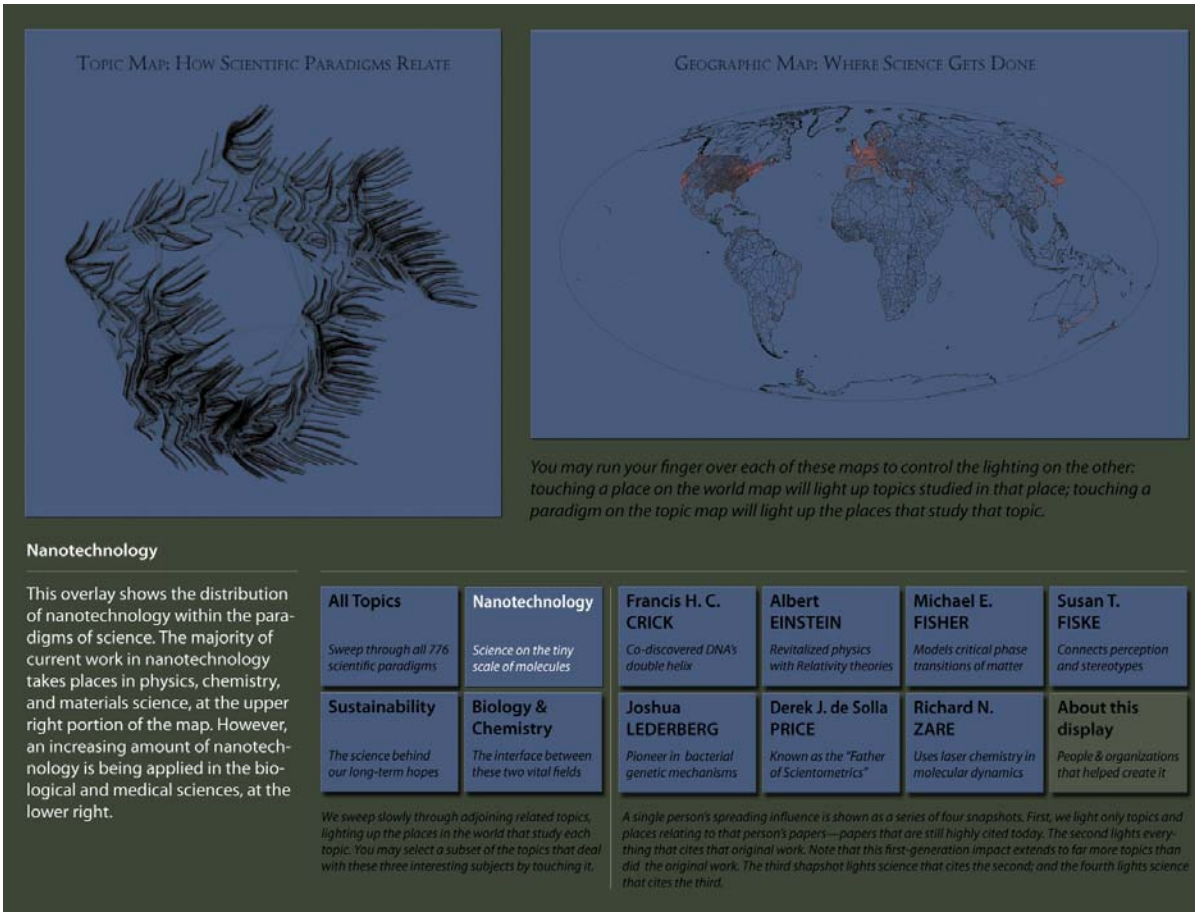
We have also calculated and displayed the vitality of each paradigm. ***Vitality* is a measure of the speed at which a group of researchers reaches consensus about major improvements.** Paradigms are constantly being improved, but it usually takes years to reach consensus about which improvements are major. The white circles represent communities where consensus is reached relatively slowly. This is a common phenomenon in the social sciences, ecological sciences, computer sciences, and mathematics disciplines. **The red circles represent communities of researchers where consensus is reached relatively rapidly.** This is more common in physics, chemistry, biochemistry, and many medical disciplines. Very dark circles (such as those in *Astrophysics*, *L5-6*) represent communities where consensus is reached extremely quickly.

The map of scientific paradigms and its reference system can be used for multiple purposes. Countries, industries, companies, universities, and individual researchers can all **locate themselves within the map**, either as single points, or as a specific collection of paradigms. Various metrics, such as vitality, can be overlayed on this reference system to highlight specific impacts. **Science education and personal discovery** can also be enhanced by linking stories and facts to the map that highlight scientific history, current advances and relationships between scientific paradigms.

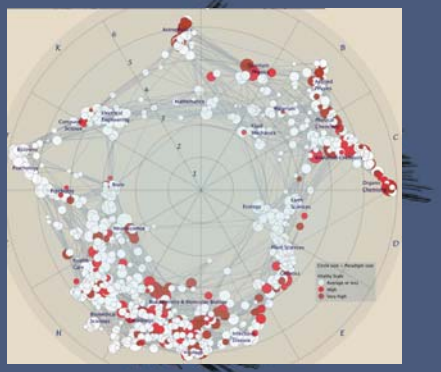


Illuminated Diagram Display

http://www.youtube.com/watch?v=bXABcOABG4E



Topic Map: How Scientific Paradigms Relate



Geographic Map: Where Science Gets Done

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

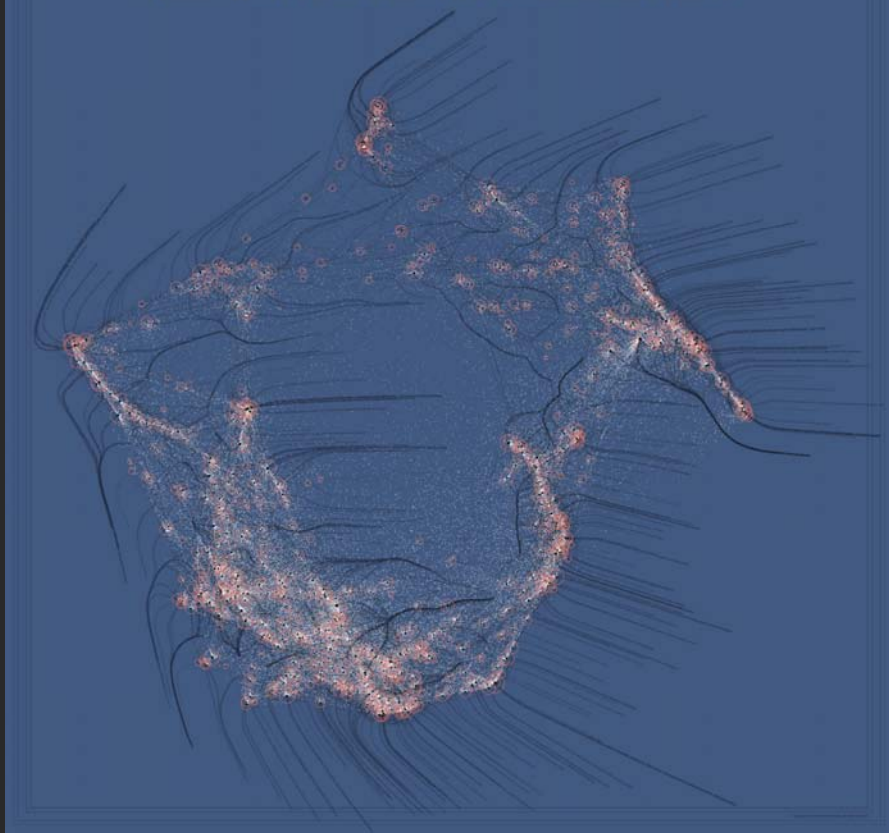
This overlay shows the distribution of nanotechnology within the paradigms of science. The majority of current work in nanotechnology takes places in physics, chemistry, and materials science, at the upper right portion of the map. However, an increasing amount of nanotechnology is being applied in the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

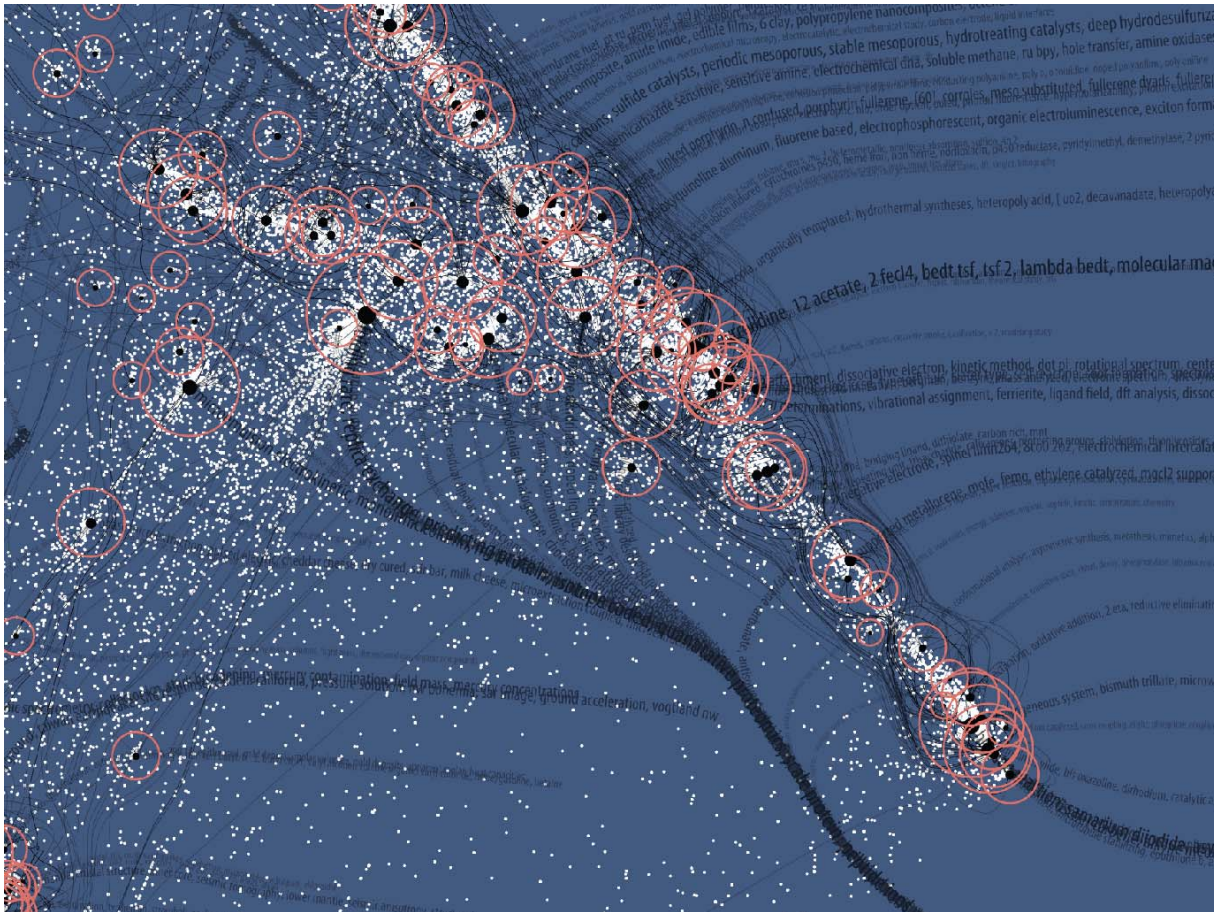
All Topics *Sweep through all 776 scientific paradigms*	**Nanotechnology** *Science on the tiny scale of molecules*	**Francis H. C. CRICK** *Co-discovered DNA's double helix*	**Albert EINSTEIN** *Revitalized physics with Relativity theories*	**Michael E. FISHER** *Models critical phase transitions of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

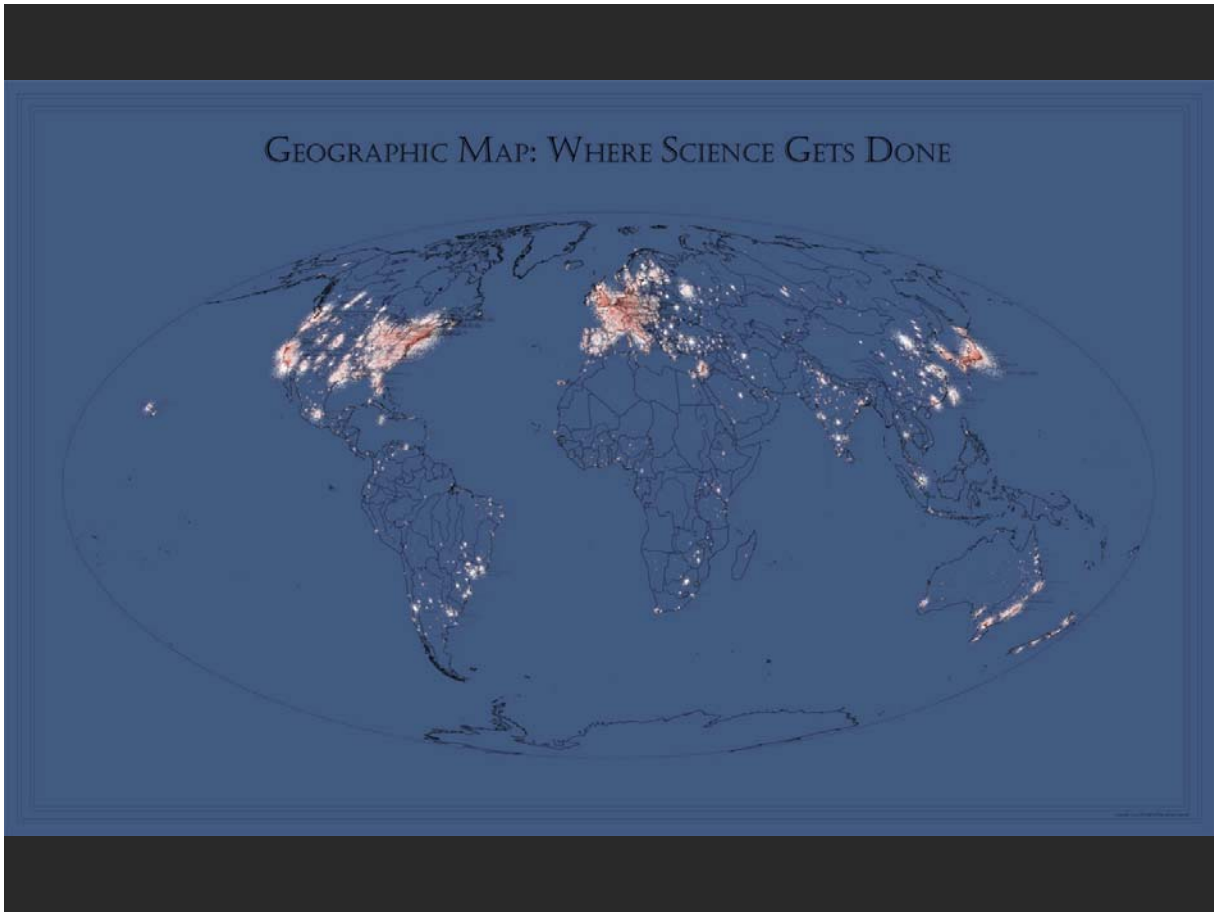
We sweep slowly through adjoining related topics, lighting up the places in the world that study each topic. You may select a subset of the topics that deal with these three interesting subjects by touching it.

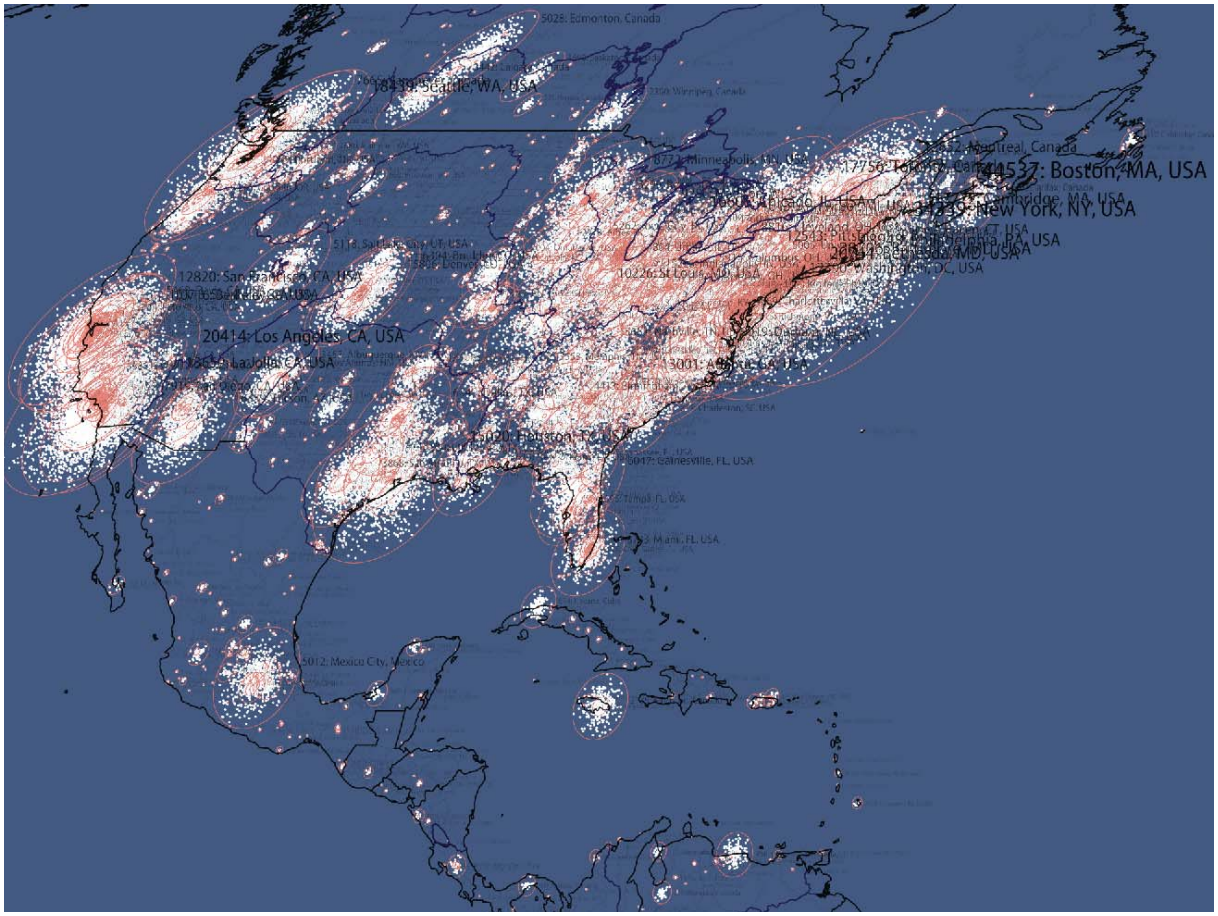
A single person's spreading influence is shown as a series of four snapshots. First, we light only topics and places relating to that person's papers—papers that are still highly cited today. The second lights everything that cites that original work. Note that this first-generation impact extends to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

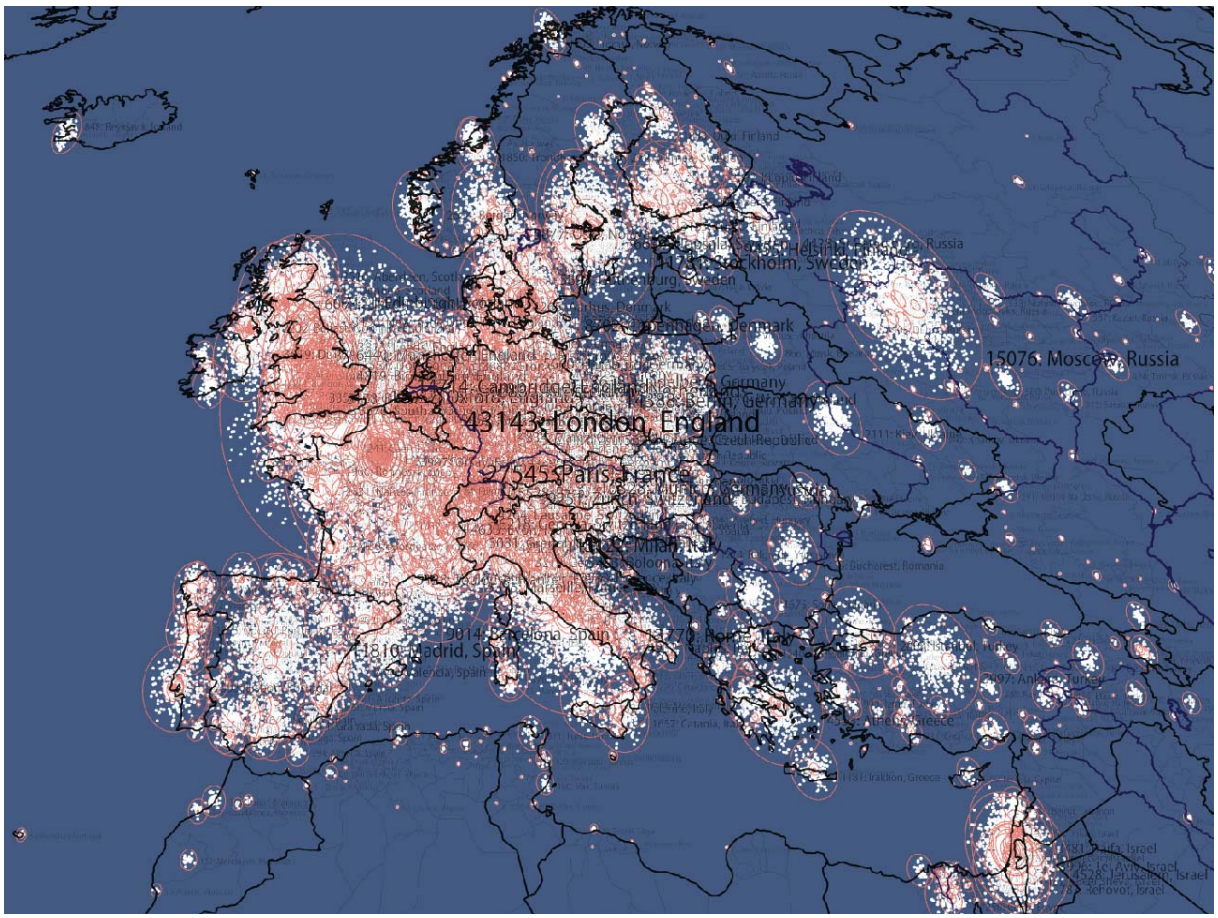
Topic Map: How Scientific Paradigms Relate

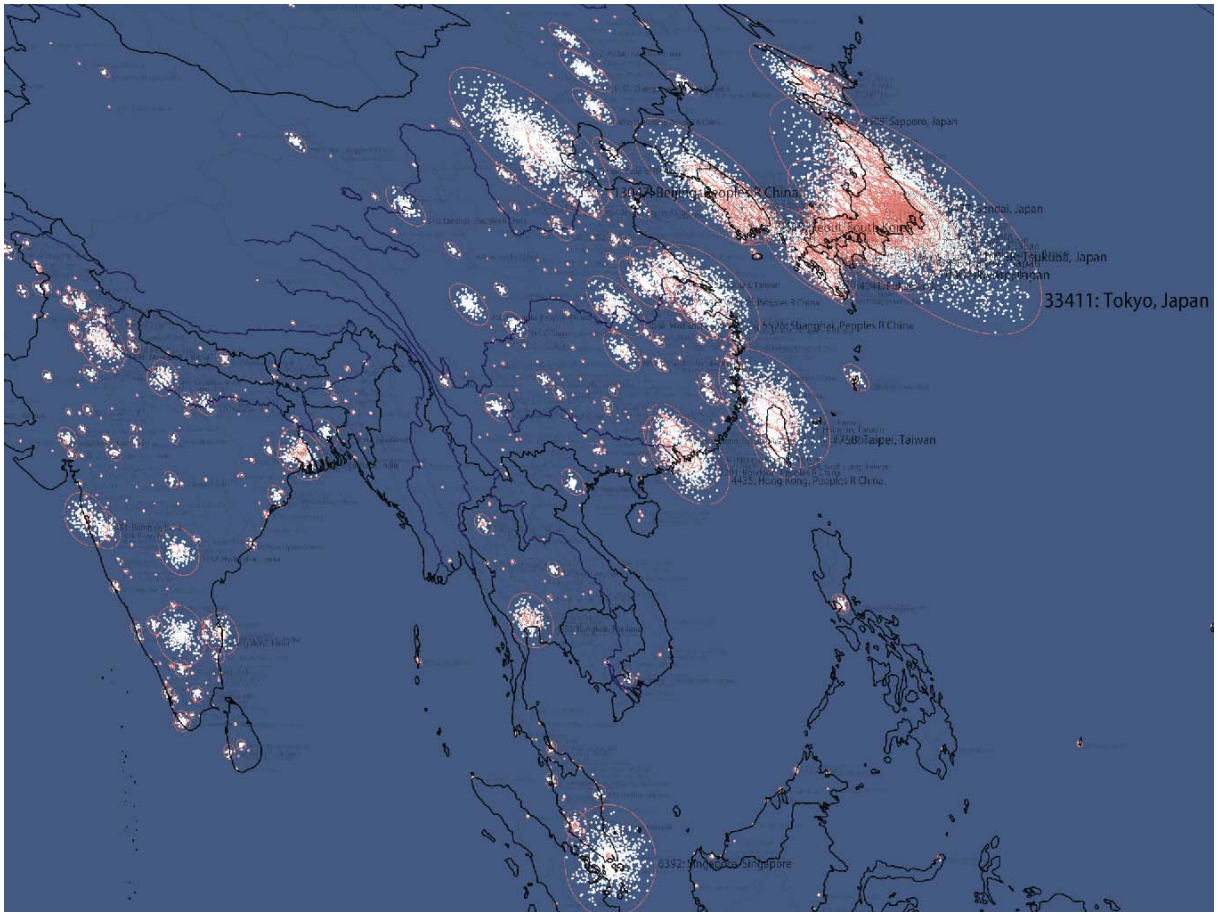


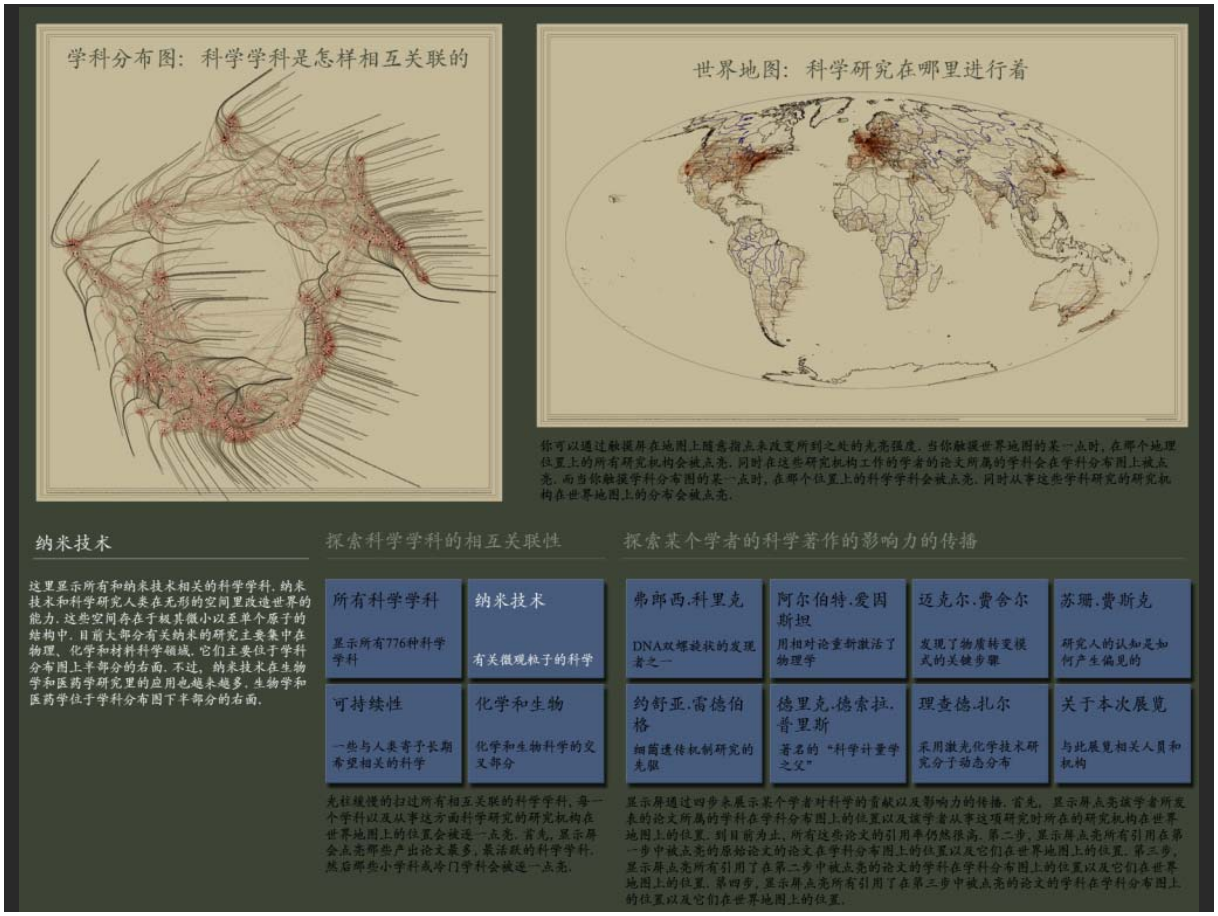



Geographic Map: Where Science Gets Done


5028: Edmonton, Canada
18439: Seattle, WA, USA
4537: Boston, MA, USA
New York, NY, USA
20414: Los Angeles, CA, USA
5012: Mexico City, Mexico

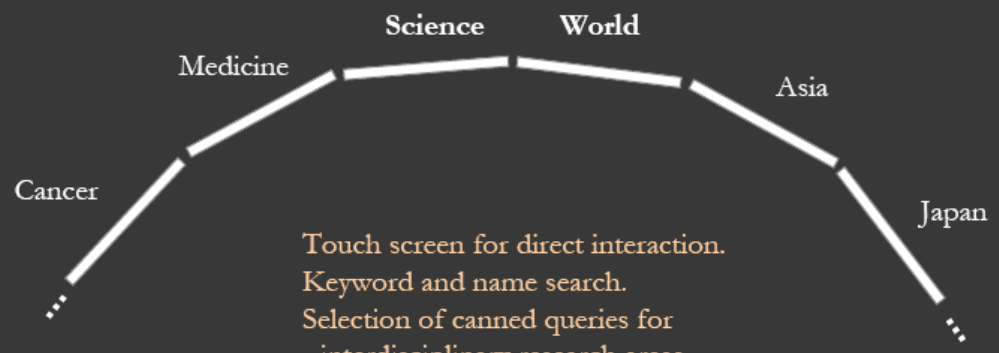

15076: Moscow, Russia
4314: London, England
27545: Paris, France
1810: Madrid, Spain


33411: Tokyo, Japan


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
光柱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，显示屏会点亮哪些产出论文最多，最活跃的科学学科，然后哪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双螺旋获的发现者之一
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
细菌遗传机制研究的先驱
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学科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学科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

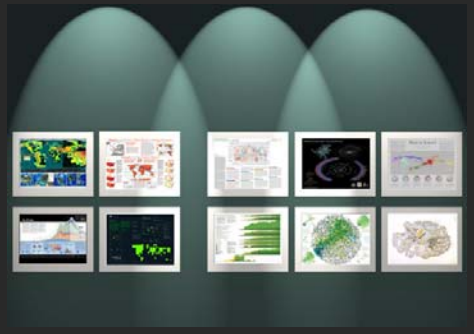
Drives unlimited number of ID screens.



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.

The Power of Forecasts

Four Existing Forecasts
VERSUS
Six Potential Science 'Weather' Forecasts

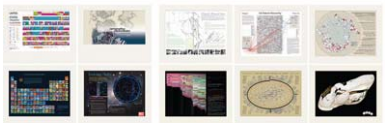


(3rd Iteration of Places & Spaces Exhibit - 2007)

Mapping Science Exhibit – 10 Iterations in 10 years

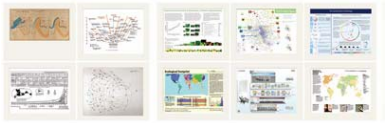
The Power of Maps (2005)

The Power of Reference Systems (2006)



The Power of Forecasts (2007)

Science Maps for Economic Decision Makers (2008)



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)

How to Lie with Science Maps (2014)

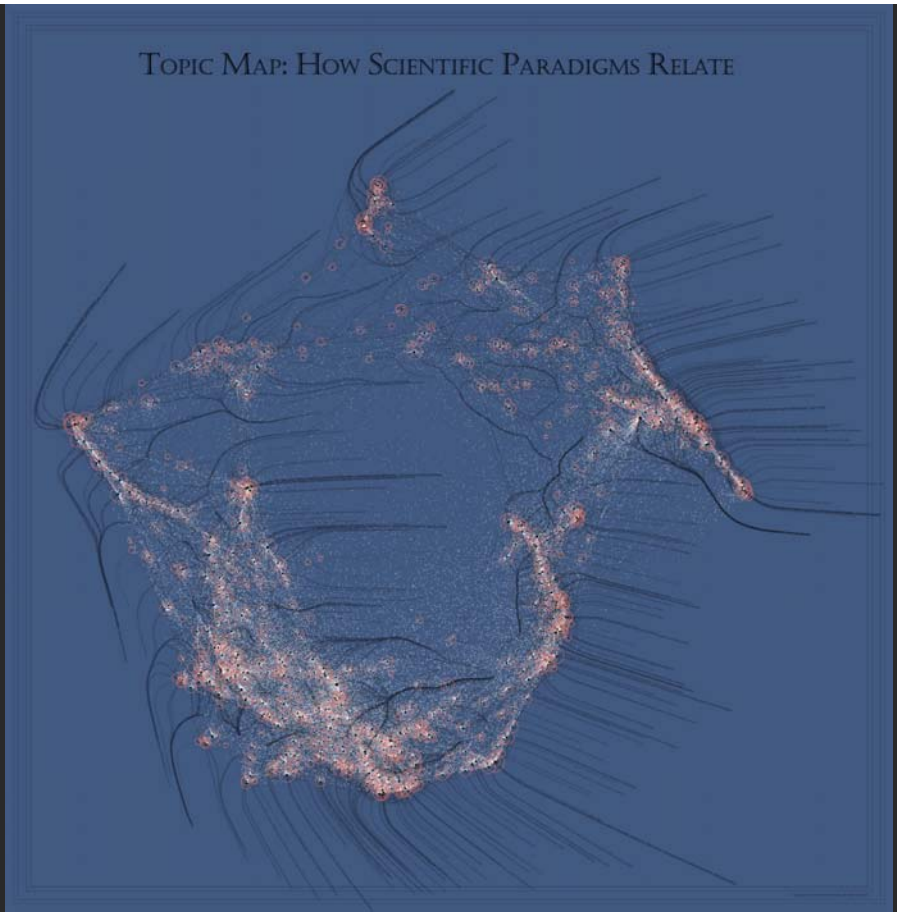
scimaps.org

Science Maps in Action

KIDS first …

All maps of science are on sale via

http://scimaps.org/ordermaps/



Hands-On Science Maps for Kids, by Fiévre Palmer (Painting), Julie Smith (Data Acquisition), Elisha Hardy and Katy Börner (Graphic Design), BLOOMINGTON, IN, 2006, Courtesy of Indiana University. Learn more at www.scimaps.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 "Illuminated Diagram" display which used a computer and two projectors, projecting spots of light on the prints to highlight different kinds of scientific research (on a sibling map of scientific paradigms) and the areas in the world where such

Hands-On Science Maps for Kids, by Fiévre Palmer (Painting), Julie Smith (Data Acquisition), Elisha Hardy and Katy Börner (Graphic Design), BLOOMINGTON, IN, 2006, Courtesy of Indiana University. Learn more at www.scimaps.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 "Illuminated Diagram" display which used a computer and two projectors, projecting spots of light on the prints to highlight different kinds of scientific research (on a sibling map of scientific paradigms) and the areas in the world where such

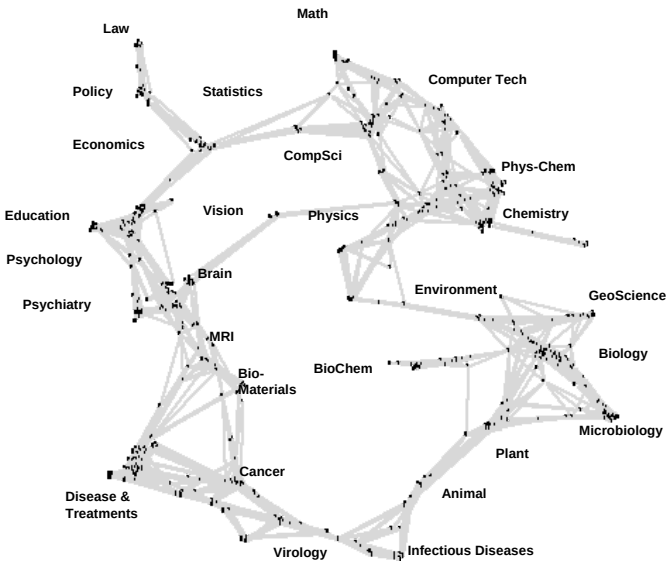

54
SOCCER

… our SPONSORS next …

Latest 'Base Map' of Science

Boyack, Kevin W, Börner, Katy & Klavans, Richard. (2007). Mapping the Structure and Evolution of Chemistry Research. Proceedings of ISSI 2007, pp. 112-123.

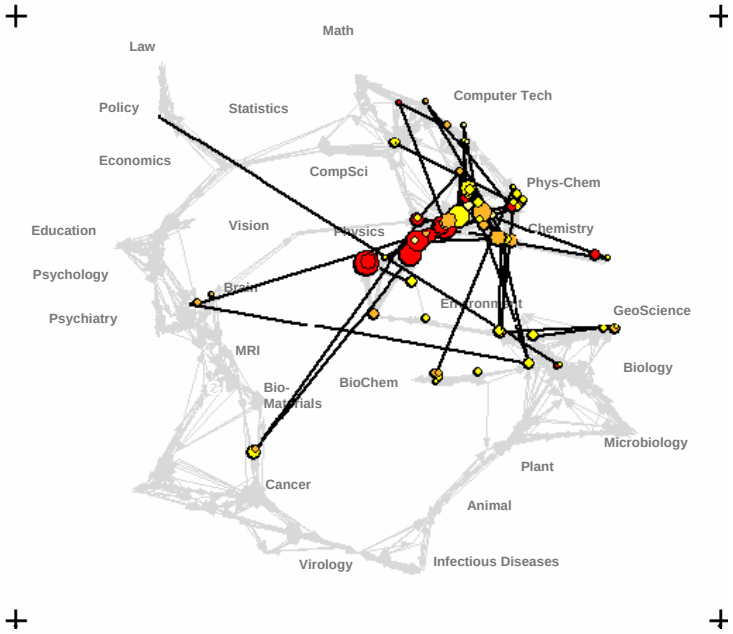
- Uses combined SCI/SSCI from 2002
  - 1.07M papers, 24.5M references, 7,300 journals
  - Bibliographic coupling of papers, aggregated to journals
- Initial ordination and clustering of journals gave 671 clusters
- Coupling counts were reaggregated at the journal cluster level to calculate the
  - (x,y)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



Science map applications: Identifying core competency

Boyack, Kevin W, Börner, Katy & Klavans, Richard. (2007). Mapping the Structure and Evolution of Chemistry Research. Proceedings of ISSI 2007, pp. 112-123.

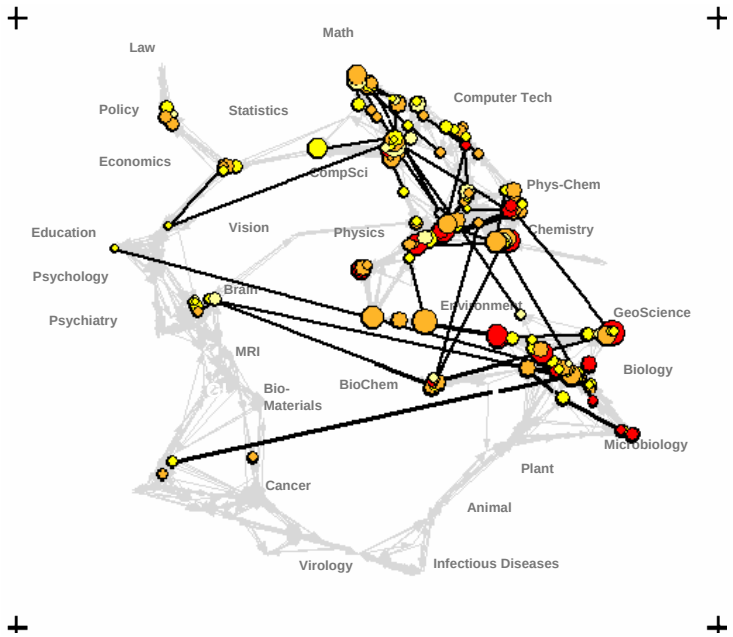
Funding patterns of the US Department of Energy (DOE)



Science map applications: Identifying core competency

Boyack, Kevin W, Börner, Katy & Klavans, Richard. (2007). Mapping the Structure and Evolution of Chemistry Research. Proceedings of ISSI 2007, pp. 112-123.

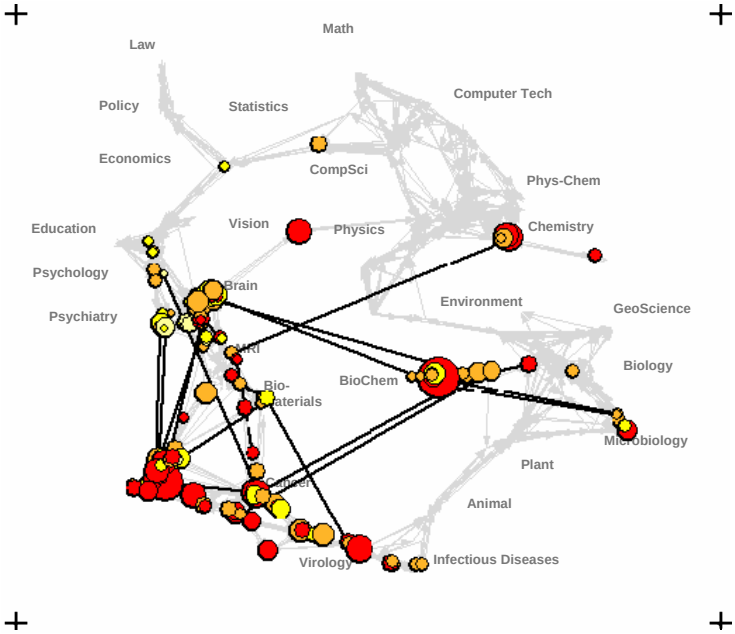
Funding Patterns of the National Science Foundation (NSF)



Science map applications: Identifying core competency

Boyack, Kevin W, Börner, Katy & Klavans, Richard. (2007). Mapping the Structure and Evolution of Chemistry Research. Proceedings of ISSI 2007, pp. 112-123.

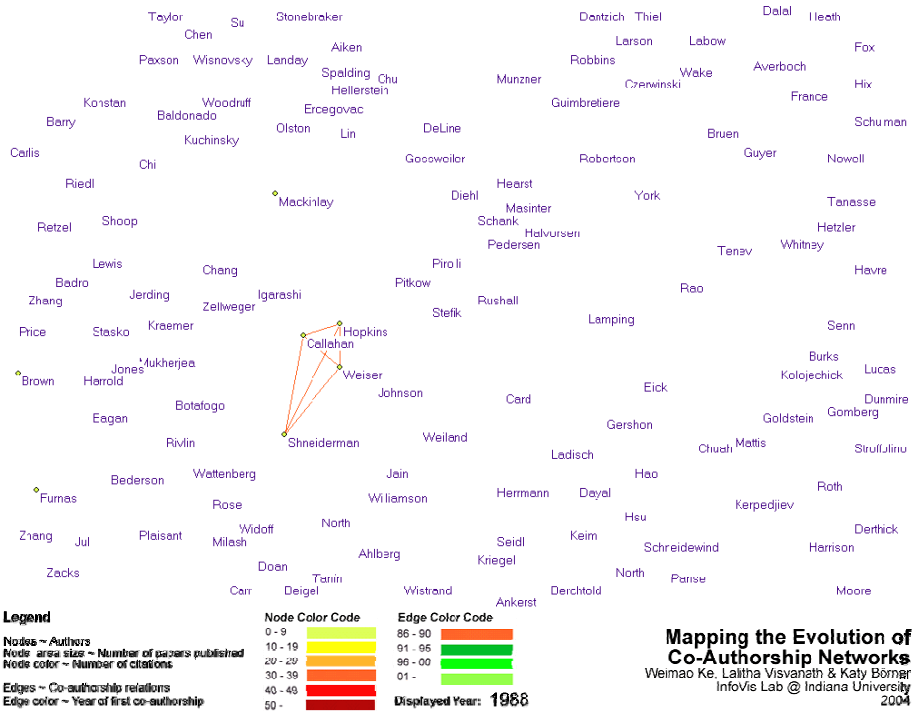
Funding Patterns of the National Institutes of Health (NIH)



… then SCIENTISTS …

Mapping the Evolution of Co-Authorship Networks

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



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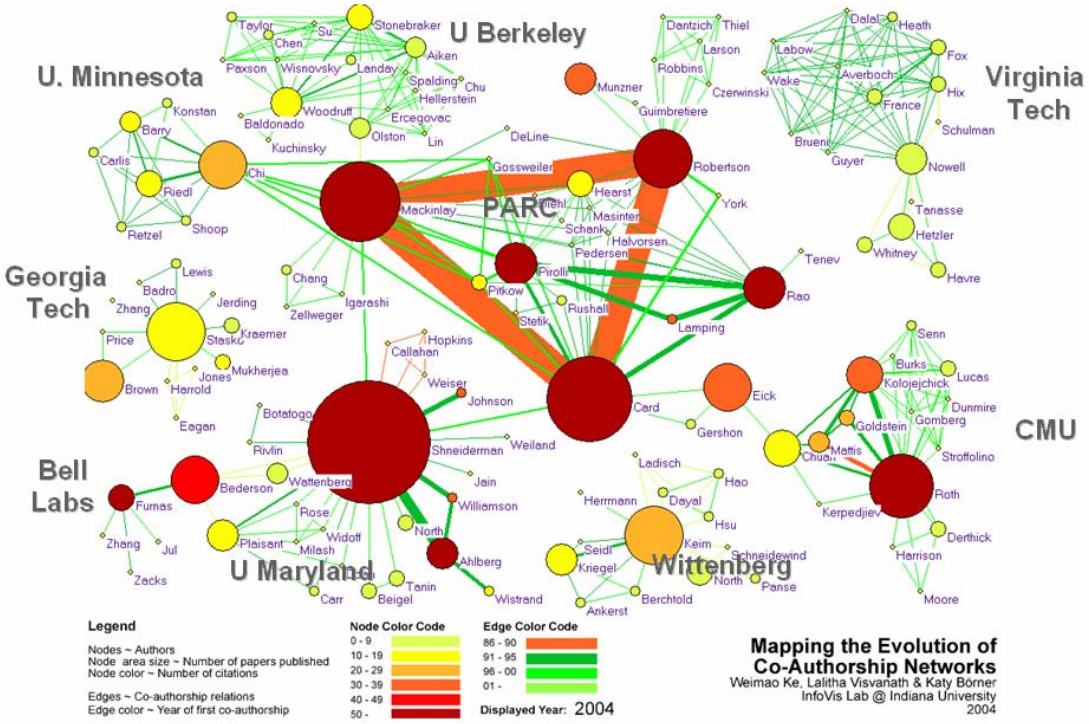
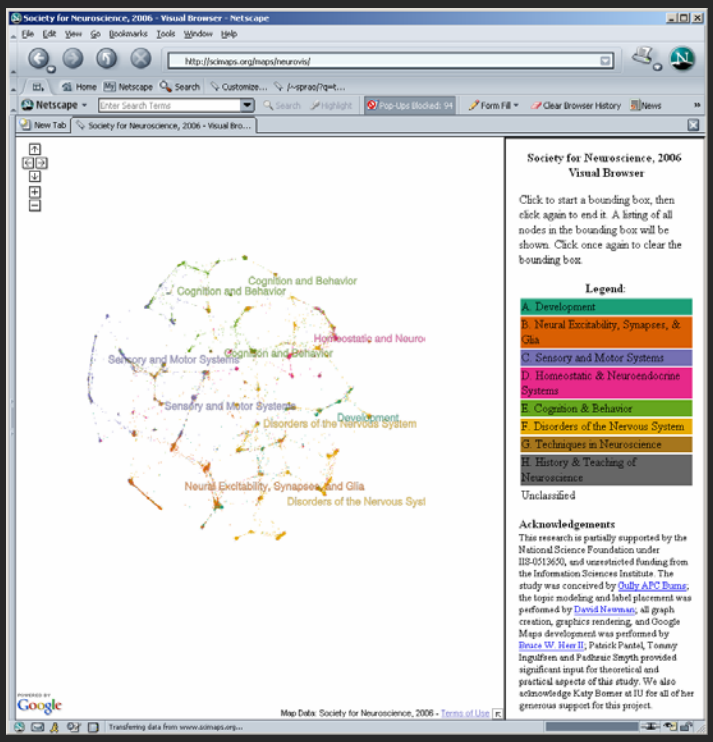
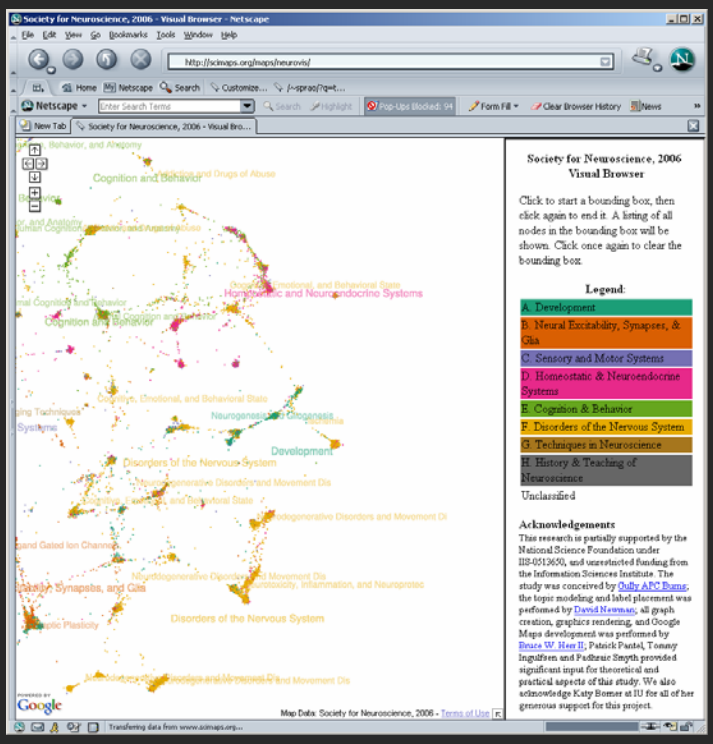
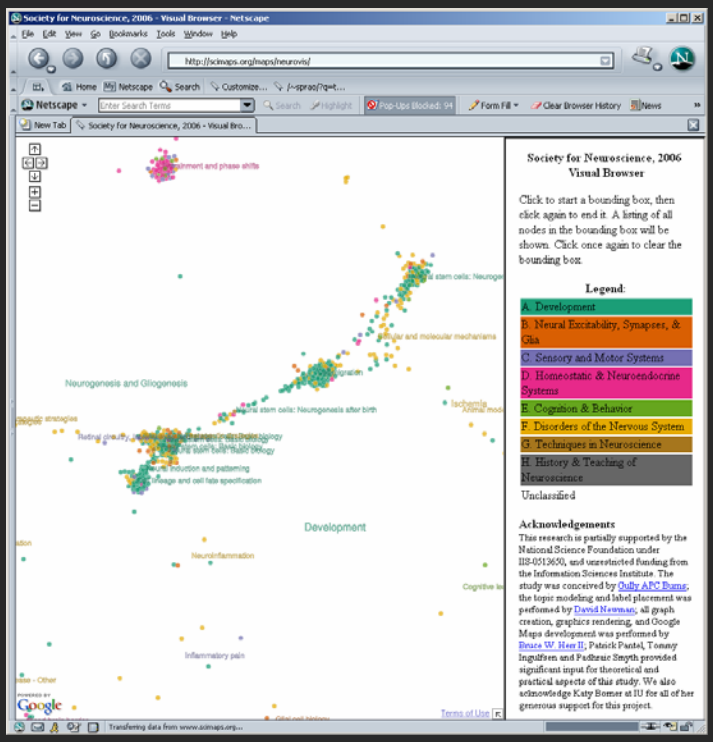




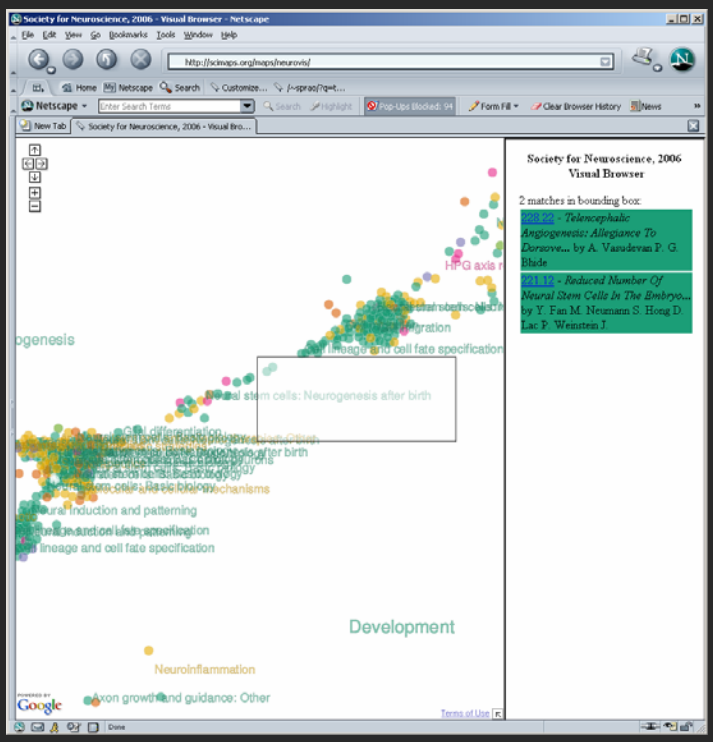
Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/



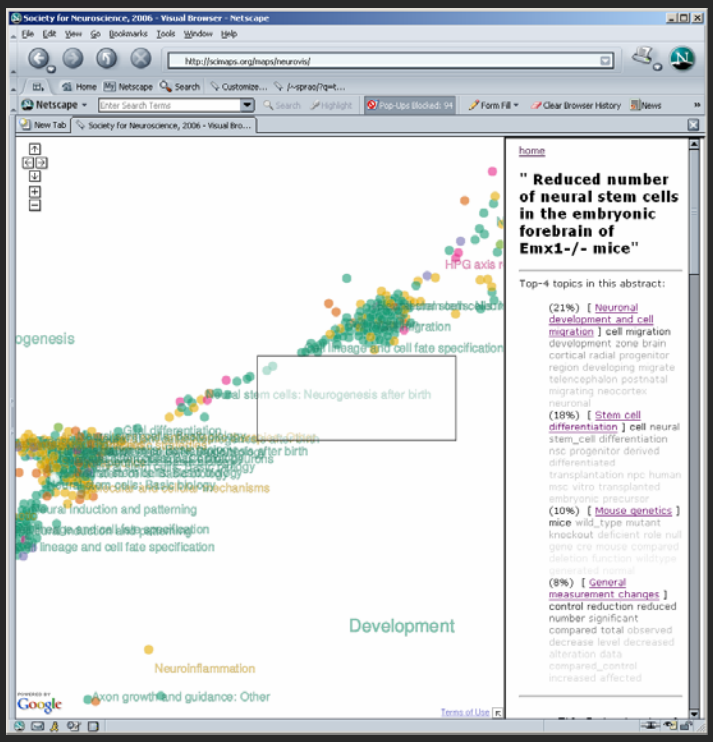
Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/



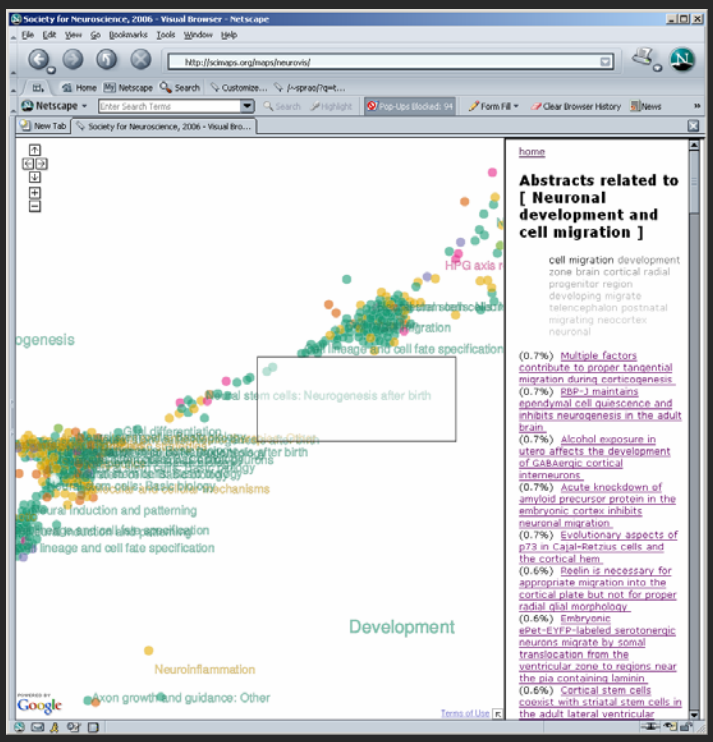
Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/



Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/



Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/



Bruce W. Herr II, Gully Burns (USC), David Newman (UCI), Society for Neuroscience, 2006 Visual Browser, 2007, http://scimaps.org/maps/neurovis/

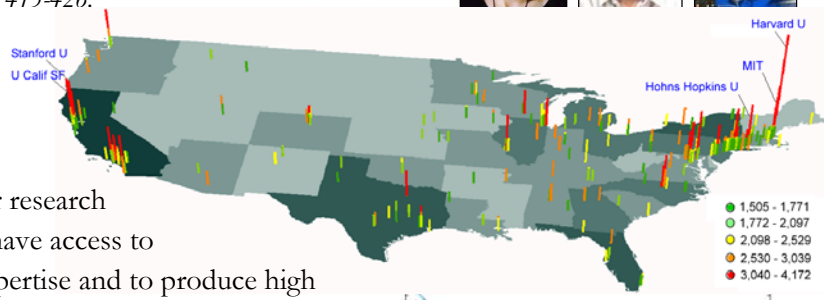
Spatio-Temporal Information Production and Consumption of Major U.S. Research Institutions

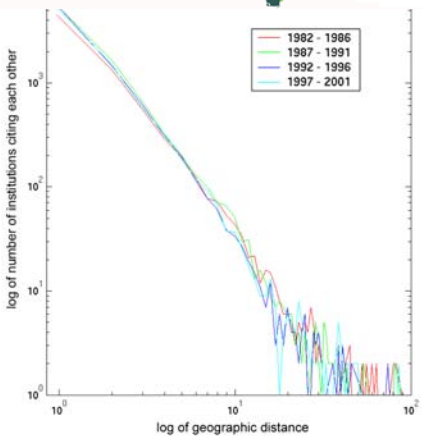


Börner, Katy, Penumarthy, Shashikant, Meiss, Mark and Ke, Weimao. (2006) Mapping the Diffusion of Scholarly Knowledge Among Major U.S. Research Institutions. Scientometrics. 68(3), pp. 415-426.

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 instructions?

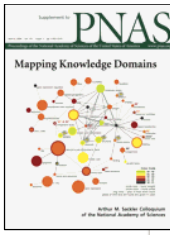




Contributions:

- 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.

Mapping Topic Bursts



Co-word space of the top 50 highly frequent and bursty words used in the top 10% most highly cited PNAS publications in 1982-2001.

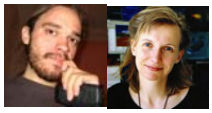
Mane & Börner. (2004) PNAS, 101(Suppl. 1): 5287-5290.

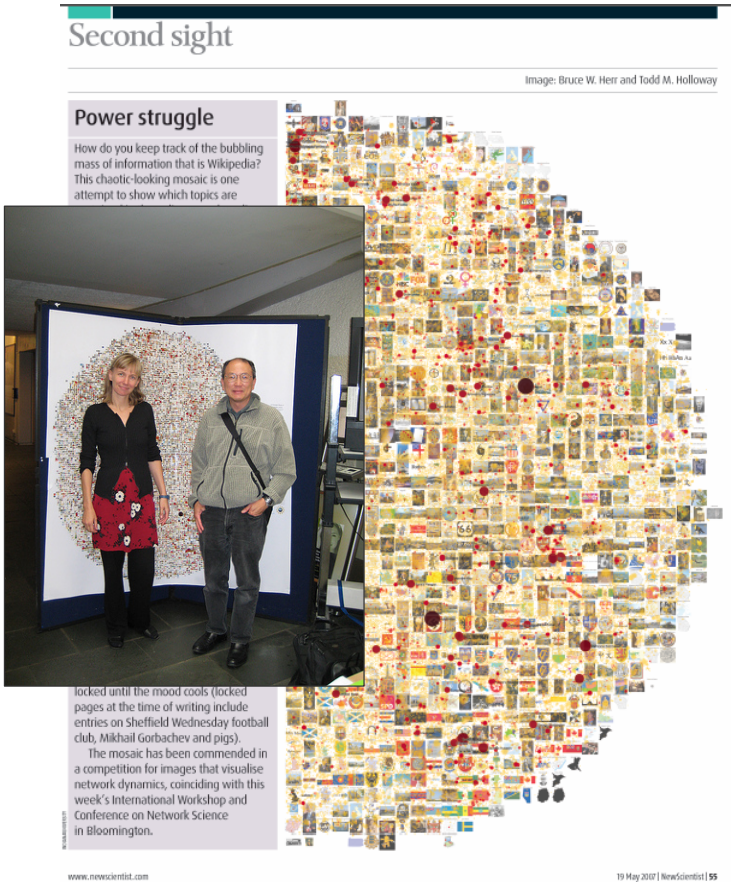
Wikipedian Activity

Studying large scale social networks such as Wikipedia

Vizzards 2007 Entry

Second Sight: An Emergent Mosaic of Wikipedian Activity, The NewScientist, May 19, 2007





Second sight

Image: Bruce W. Herr and Todd M. Holloway

Power struggle

How do you keep track of the bubbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are

locked until the mood cools (locked pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs).

The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.

www.newscientist.com

19 May 2007 | NewScientist | 55

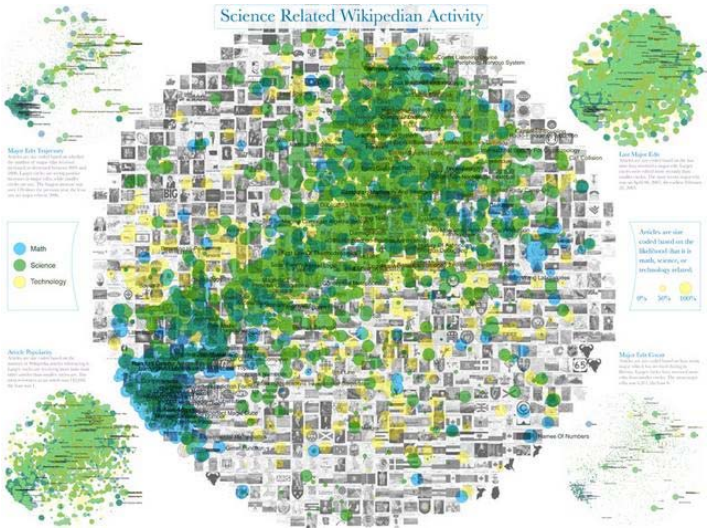
Science Related Wikipedian Activity

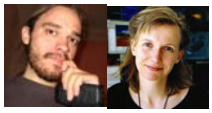
http://scimaps.org/dev/map_detail.php?map_id=165

Same base map.

Overlaid are 3,599 math (blue), 6,474 science (green), and 3,164 technology relevant articles (yellow).
All other articles are given in grey.

Corners show articles size coded according to
-article edit activity (top left),
- number of major edits (top right),
- number of bursts in edit activity (bottom, right)
- indegree (bottom left).

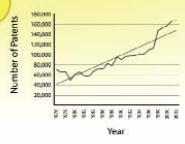




… and INDUSTRY too.

Examining the Evolution and Distribution of Patent Classifications

1 Patents Granted Over the Last 20 Years



Top Classes 1978 - 1982

Class	Title	Patents
260	Chemistry of Carbon Compounds	13,349
424	Drug, Bio-Affecting and Body Treating Compositions	9,021
252	Compositions	5,868
128	Surgery	5,304
428	Stock Material or Miscellaneous Articles	4,984
75	Metallurgy and Treating	4,895
123	Internal-Combustion Engines	4,142
340	Communications: Electrical	4,043
364	Electrical Computers and Data Processing Systems	3,780
29	Metal Working	3,684
	Total	59,426

Top Classes 1998 - 2002

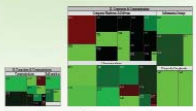
Class	Title	Patents
514	Drug, Bio-Affecting and Body Treating Compositions	16,778
438	Semiconductor Device Manufacturing Process	15,775
435	Chemistry: Molecular Biology and Microbiology	15,404
424	Drug, Bio-Affecting and Body Treating Compositions	15,037
428	Stock Material or Miscellaneous Articles	13,516
257	Active Solid-State Devices (e.g., Transistors, Solid-state Diodes	12,304
395	Information Processing System Organization	9,955
345	Computer Graphics Processing, Operator Interface Processing, and Selective Visual Display Systems	9,010
359	Optical: Systems and Elements	8,151
365	Static Information Storage and Retrieval	8,052
	Total	140,993

In the United States, each patent gets assigned to one out of more than 450 classes covering broad application domains. An examination of the size and growth of patent classes provides insight about patenting trends.

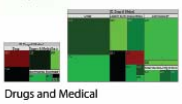
Treemaps, a space filling technique developed in the HCI Lab at the University of Maryland, are used to communicate major results. Treemaps represent a tree structure as nested rectangles with each rectangle representing a node. A rectangular area is first allocated to hold the representation of the tree, and this area is then subdivided into a set of rectangles that represent the top level of the tree. This process continues recursively on the resulting rectangles to represent each lower level of the tree. The parent-child relationship is indicated by enclosing the child rectangle by its parent rectangle. Typically, the size of each rectangle corresponds to the size of the node. Additional information about a node, e.g., its age or value, can be represented by the color of the respective rectangle.

Fast Growth Domains
1983 - 1987 / 1998 - 2002

Electrical and Electronic



Computers and Communications

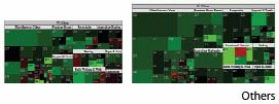


Drugs and Medical

Slow Growth Domains
1983 - 1987 / 1998 - 2002

Mechanical

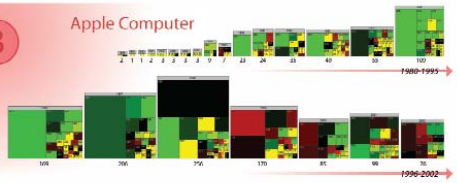
Chemical



Others

Shown is a comparison of the patent class space for 1983 to 1987 and 1998 to 2002. There is a predominance of growth in the 1998 to 2002 patent space, which correlates to the increase in patent grants during this period. By comparing the growth in categories, one can distinguish between domains that have been receiving a larger amount of patent grants.

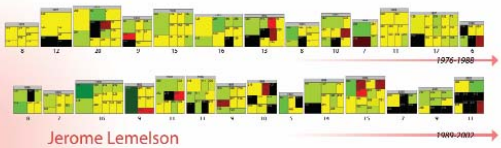
3 Apple Computer



Depicted above is how Apple Computers' portfolio has changed in yearly increments from 1980 to 2002.

Lemelson's patent holdings below show a more even distribution over multiple classes. No class dominates over a majority of the years for granted patents; instead they are distributed more broadly over the intellectual space.

Legend:
Green = Increase in number of patent grants in particular class.
Red = Decrease in number of patent grants in particular class.
Yellow = No patents granted in that class in the past five years.
Size = Number of patent grants in a particular class.

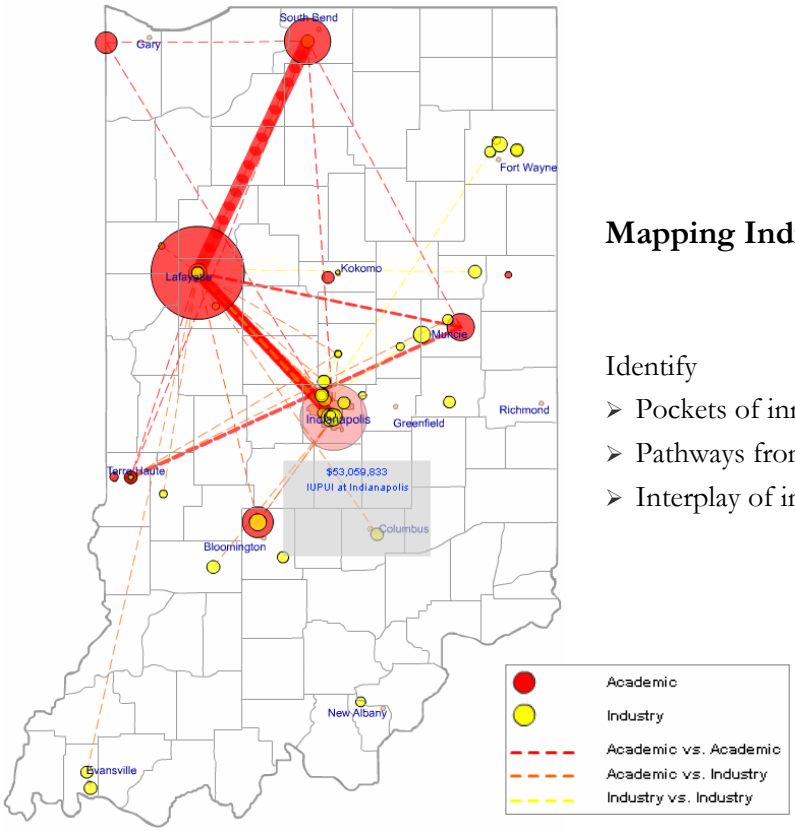


Jerome Lemelson

Kutz, Daniel O. Examining the Evolution and Distribution of Patent Classifications. Accepted for the Information Visualization Conference, London, UK, July 2004.

The material is based upon work supported bythe National Science Foundation under Grant No. IIS-0238261.

For more Information, contact Katy Borner at katy@indiana.edu.



Mapping Indiana's Intellectual Space

Identify

- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

How to Make a Science Map

DATA EXTRACTION	UNIT OF ANALYSIS	MEASURES	LAYOUT (often one code does both similarity and ordination steps)		DISPLAY
			SIMILARITY	ORDINATION	

SEARCHES
- ISI
- INSPEC
- Eng Index
- Medline
- ResearchIndex
- Patents
- etc.

BROADENING
- By citation
- By terms

COMMON CHOICES
- Journal
- Document
- Author
- Term

COUNTS/FREQUENCIES
- Attributes (e.g. terms)
- Author citations
- Co-citations
- By year

THRESHOLDS
- By counts

SCALAR (unit by unit matrix)
- Direct citation
- Co-citation
- Combined linkage
- Co-word / co-term
- Co-classification

VECTOR (unit by attribute matrix)
- Vector space model (words/terms)
- Latent Semantic Analysis (words/terms) incl. Singular Value Decomp (SVD)

CORRELATION (if desired)
- Pearson's R on any of above

DIMENSIONALITY REDUCTION
- Eigenvector/ Eigenvalue solutions
- Factor Analysis (FA) and Principal Components Analysis (PCA)
- Multi-dimensional scaling (MDS)
- LSA
- Pathfinder networks (PFNet)
- Self-organizing maps (SOM) includes SOM, ET-maps, etc.

CLUSTER ANALYSIS

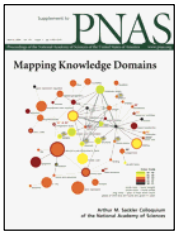
SCALAR
- Triangulation
- Force-directed placement (FDP)

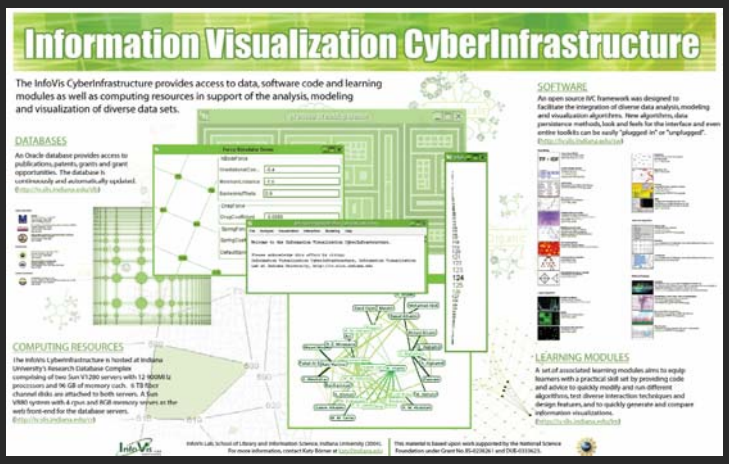
INTERACTION
- Browse
- Pan
- Zoom
- Filter
- Query
- Detail on demand

ANALYSIS

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).

Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). Visualizing Knowledge Domains. In Blaise Cronin (Ed.), Annual Review of Information Science & Technology, Volume 37, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, chapter 5, pp. 179-255.





CAREER: Visualizing Knowledge Domains. NSF IIS-0238261 award (Katy Börner, $451,000) Sept. 03-Aug. 08.
http://iv.slis.indiana.edu/

SDB | SCHOLARLY DATABASE

Scholarly Database
http://sdb.slis.indiana.edu

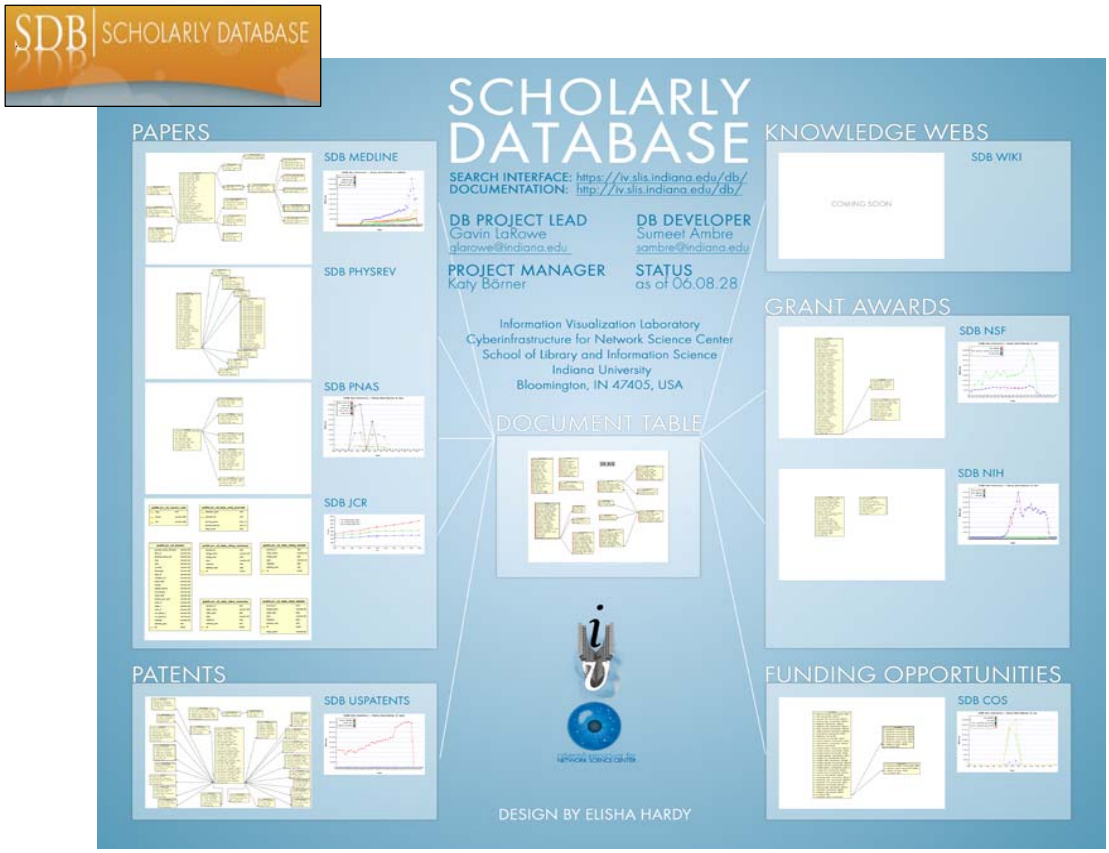
CIShell
cyberinfrastructure shell

Cyberinfrastruwcture Shell
http://cishell.org

NetworkWorkbench
A Workbench for Network Scientists

NSF SBC Sun microsystems HPNAP High Performance Network Applications Program INDIANA 21st Century Research & Technology Fund

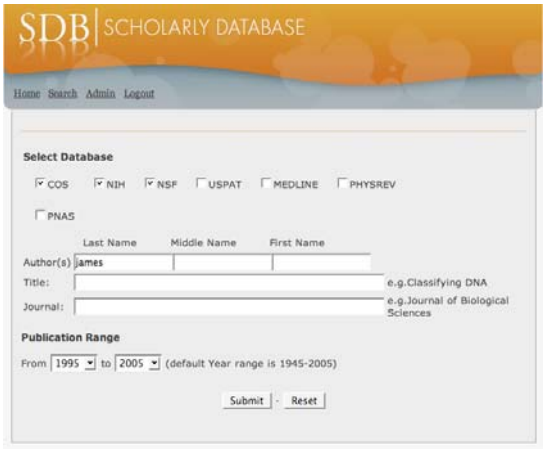
SEI: Network Workbench: A Large-Scale Network Analysis, Modeling and Visualization Toolkit for Biomedical, Social Science and Physics Research. NSF IIS-0513650 award (Katy Börner, Albert-Laszlo Barabasi, Santiago Schnell, Alessandro Vespignani & Stanley Wasserman, Eric Wernert (Senior Personnel), $1,120,926) Sept. 05 - Aug. 09. http://nwb.slis.indiana.edu

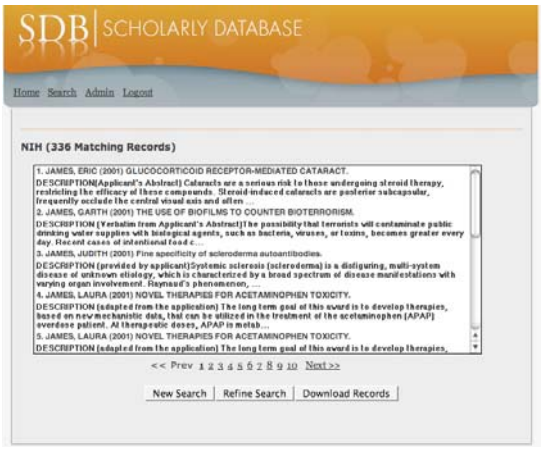


Scholarly Database: Web Interface

Search across publications, patents, grants.

Download records and/or (evolving) co-author, paper-citation networks.



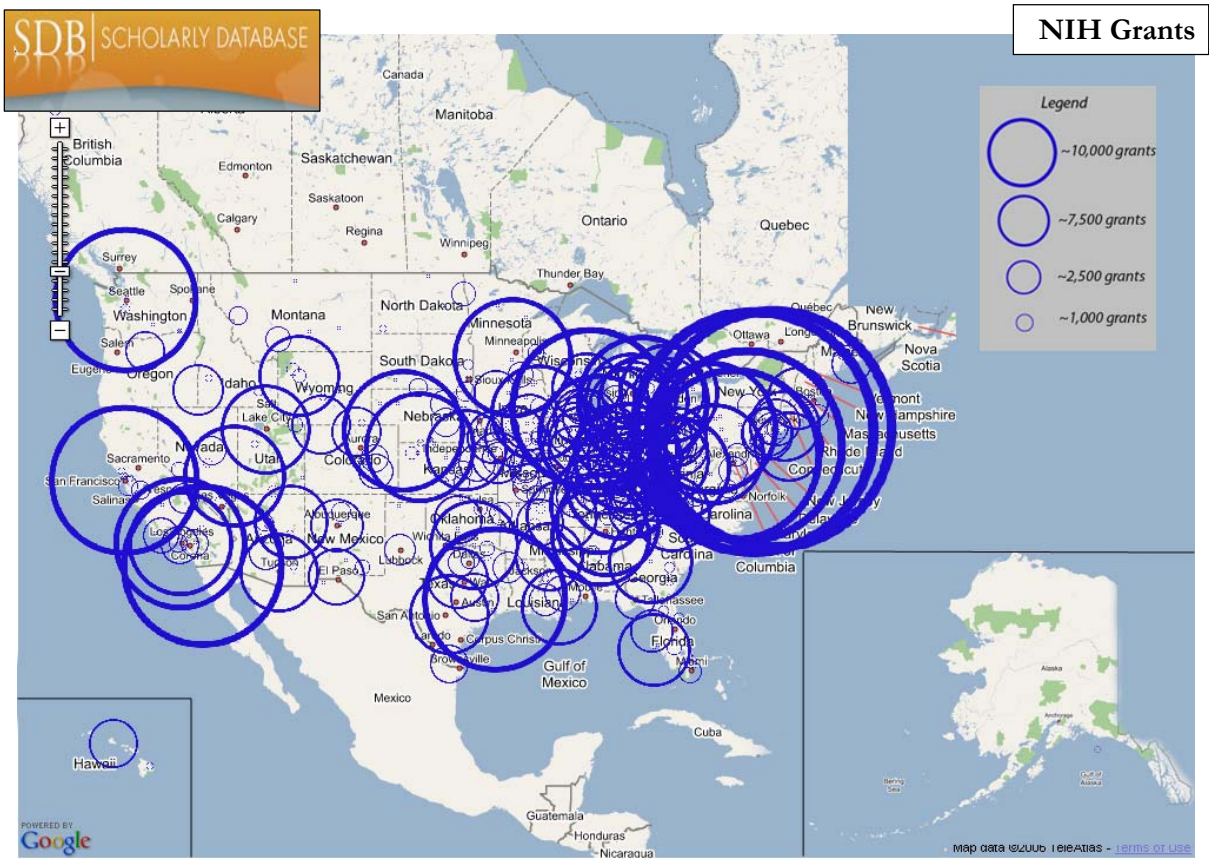


Scholarly Database: # Records & Years Covered

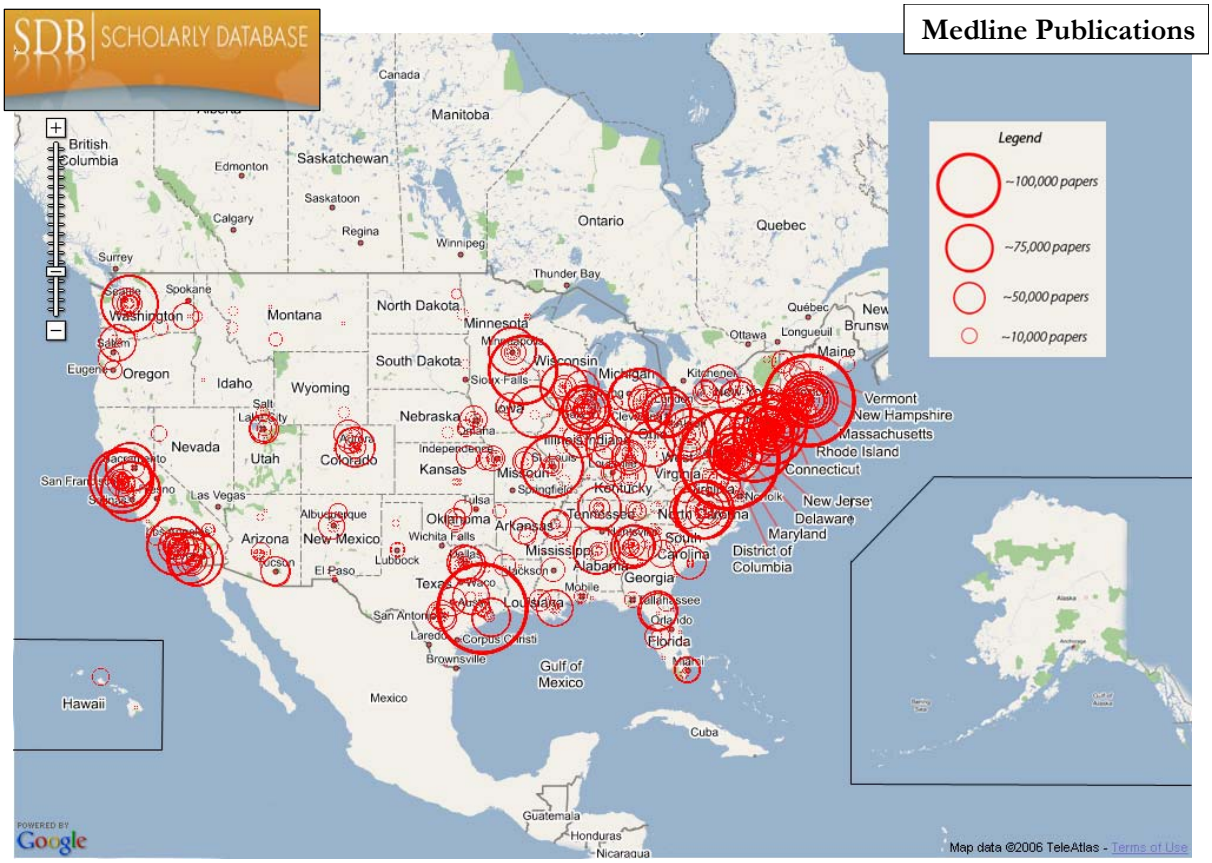
Datasets available via the Scholarly Database (* future feature)

Dataset	# Records	Years Covered	Updated	Restricted Access
Medline	13,149,741	1965-2005	Yes	
PhysRev	398,005	1893-2006		Yes
PNAS	16,167	1997-2002		Yes
JCR	59,078	1974, 1979, 1984, 1989 1994-2004		Yes
USPTO	3,179,930	1976-2004	Yes*	
NSF	174,835	1985-2003	Yes*	
NIH	1,043,804	1972-2002	Yes*	
Total	**18,021,560**	**1893-2006**	**4**	**3**

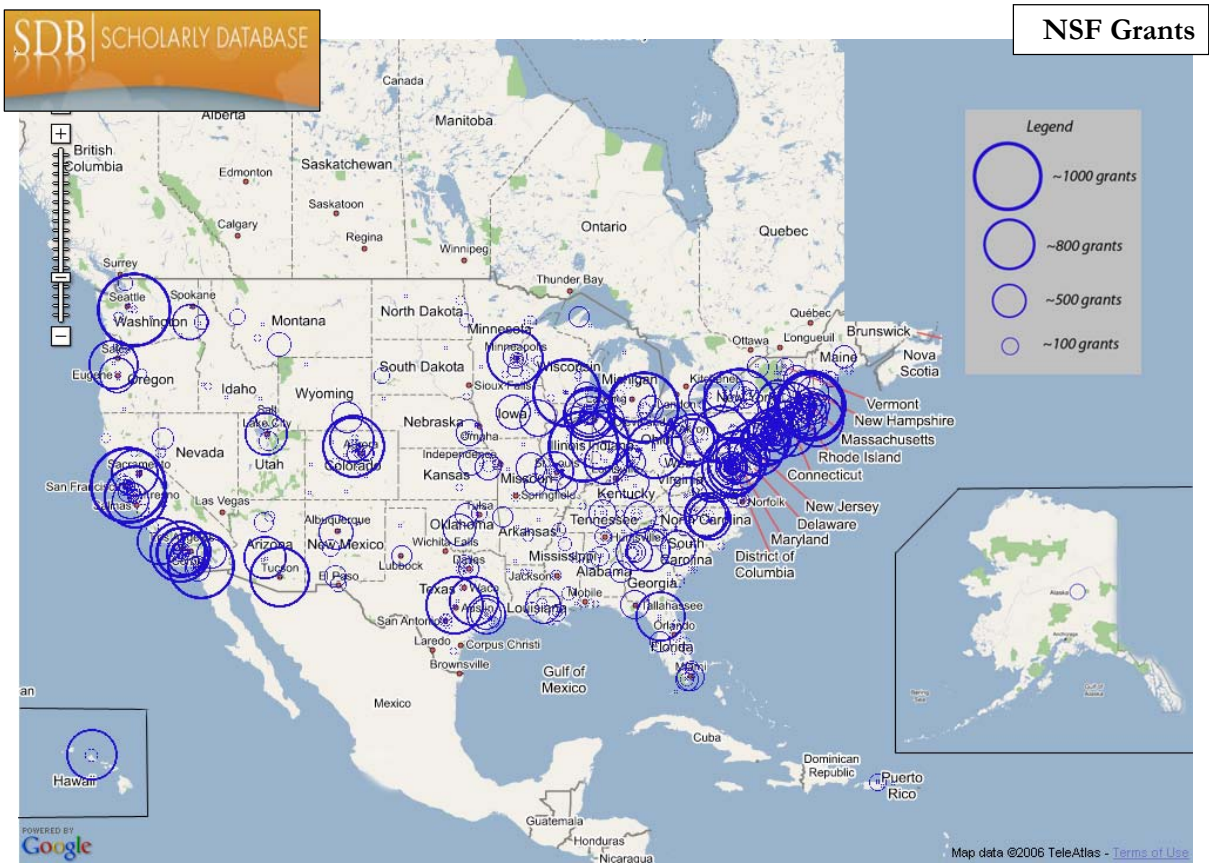
Aim for comprehensive time, geospatial, and topic coverage.



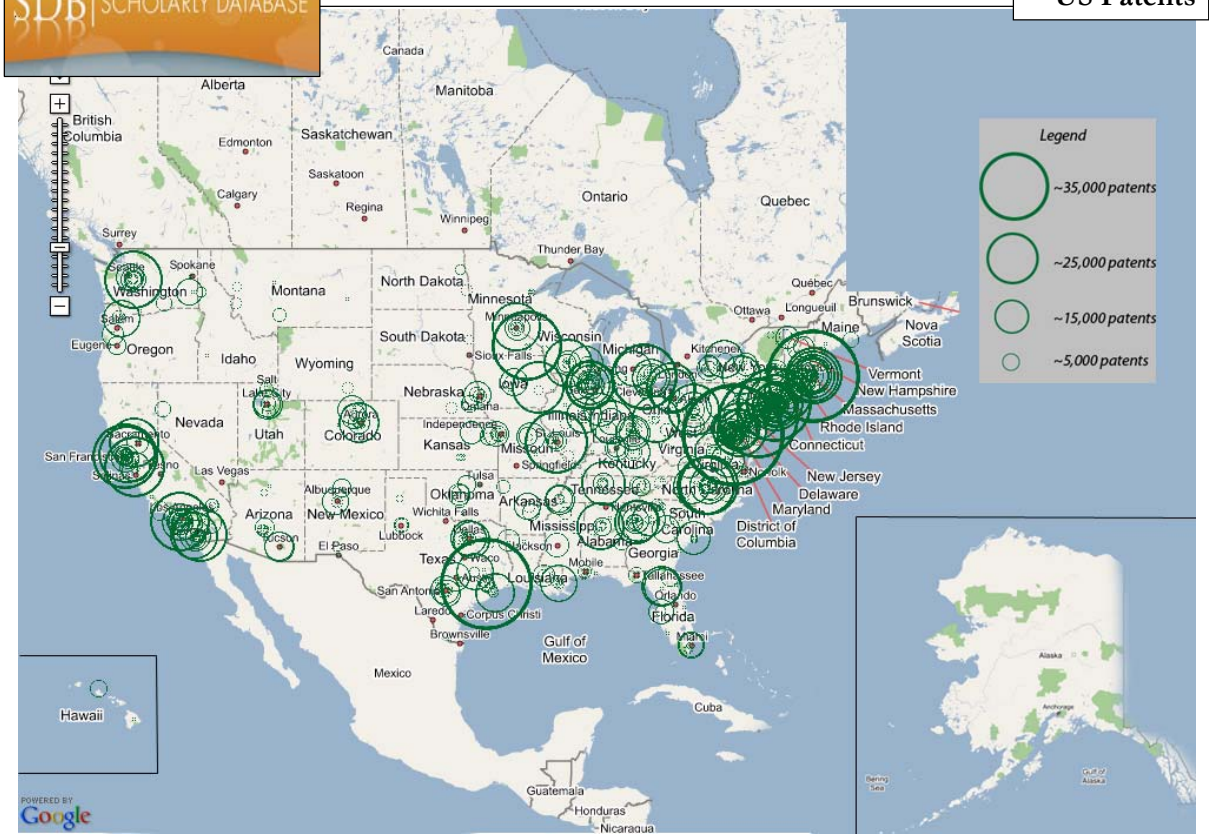
Medline Publications



NSF Grants



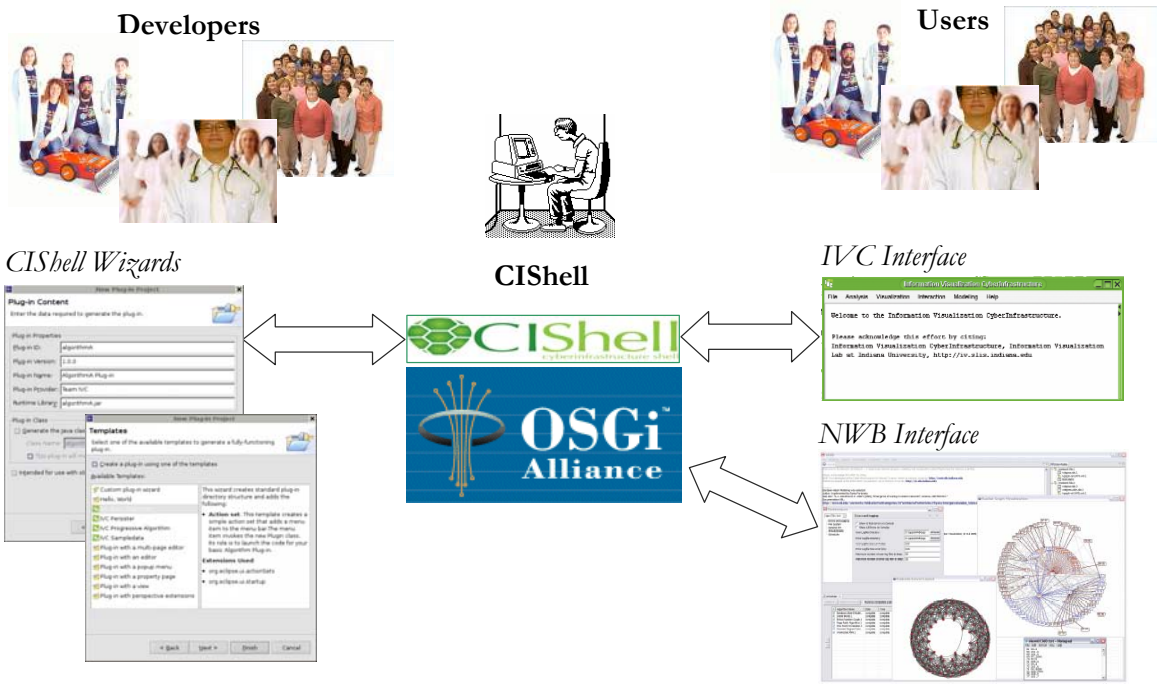
US Patents



Building Market Places not Cathedrals

- 'Software glue' has to interlink datasets and algorithms written in different languages using different data formats.
- The smaller the glue or 'CI Shell', the more likely it can be maintained.

CIShell – Serving Non-CS Algorithm Developers & Users



CIShell – Build on OSGi Industry Standard

CIShell is built upon the Open Services Gateway Initiative (OSGi) Framework.

OSGi (http://www.osgi.org) is

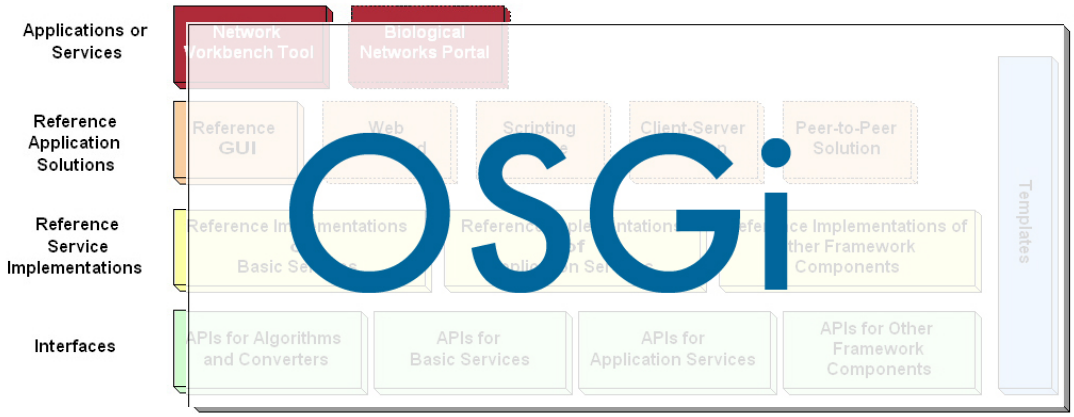
- A standardized, component oriented, computing environment for networked services.
- Successfully used in the industry from high-end servers to embedded mobile devices since 7 years.
- Alliance members include IBM (Eclipse), Sun, Intel, Oracle, Motorola, NEC and many others.
- Widely adopted in open source realm, especially since Eclipse 3.0 that uses OSGi R4 for its plugin model.

Advantages of Using OSGi

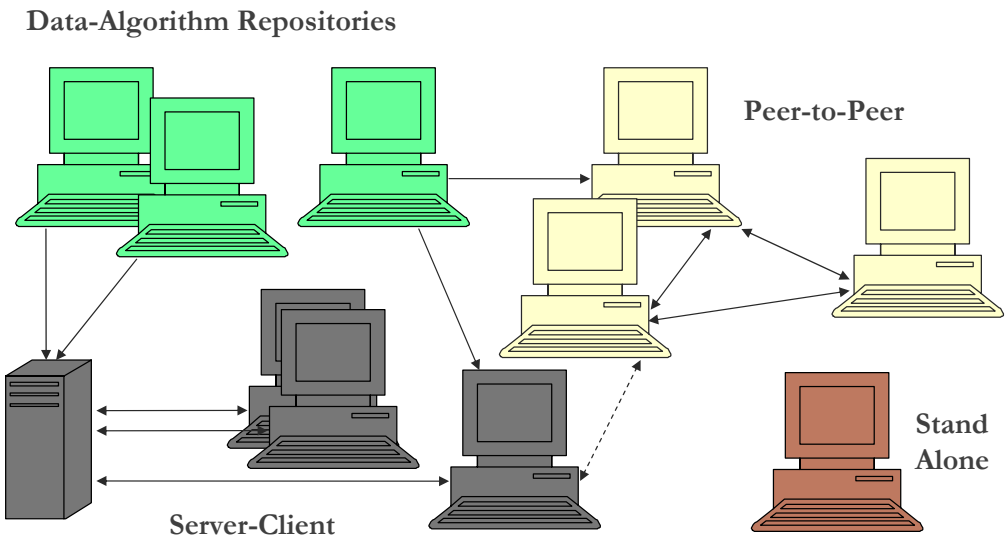
- Any CIShell algorithm is a service that can be used in any OSGi-framework based system.
- Using OSGi, running CIShells/tools can connected via RPC/RMI supporting peer-to-peer sharing of data, algorithms, and computing power.

Ideally, CIShell becomes a standard for creating OSGi Services for algorithms.

CIShell – Layer Cake



CIShell – Deployment



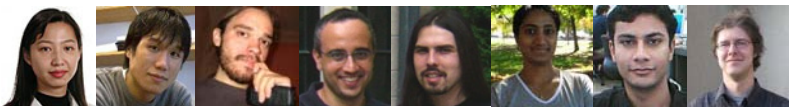
CIShell applications can be deployed as distributed data and algorithm repositories, stand alone applications, peer-to-peer architectures, and server-client architectures.

Network Workbench (NWB)

Investigators: Katy Börner, Albert-Laszlo Barabasi, Santiago Schnell, Alessandro Vespignani & Stanley Wasserman, Eric Wernert

Software Team: Lead: Weixia (Bonnie) Huang

Developers: Bruce Herr, Ben Markines, Santo Fortunato, Cesar Hidalgo, Ramya Sabbineni, Vivek S. Thakre, & Russell Duhon



Goal: Develop a large-scale network analysis, modeling and visualization toolkit for biomedical, social science and physics research.

Amount: $1,120,926 NSF IIS-0513650 award.

Duration: Sept. 2005 - Aug. 2009

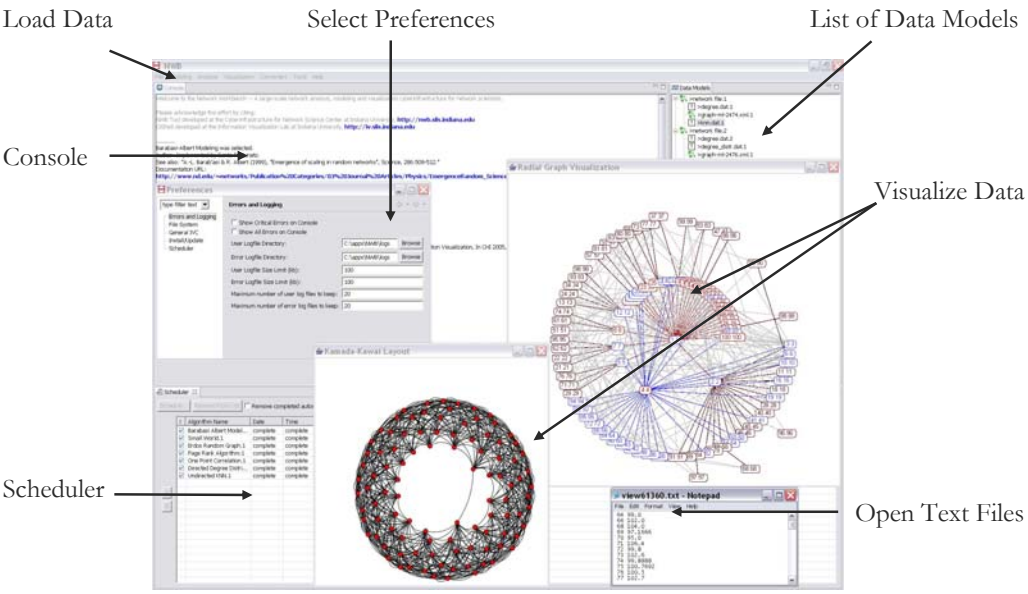
Website: http://nwb.slis.indiana.edu

NWB Advisory Board

- Ulrik Brandes, University of Konstanz, Germany (Graph Theory)
- Noshier Contractor, Northwestern University (Communication Theory)
- Mark Gerstein, Yale University (Bioinformatics)
- James Hendler, Rensselaer Polytechnic Institute (Semantic Web)
- Jason Leigh, Electronic Visualization Laboratory, University of Illinois at Chicago (Visualization & CI)
- Neo Martinez, Pacific Ecoinformatics and Computational Ecology Lab (Biology)
- Michael Macy, Cornell University (Sociology)
- Stephen North, AT&T (Graph Visualization)
- Tom Snijders, University of Groningen (Social Network Analysis)

NWB Tool: Interface Elements

http://nwb.slis.indiana.edu

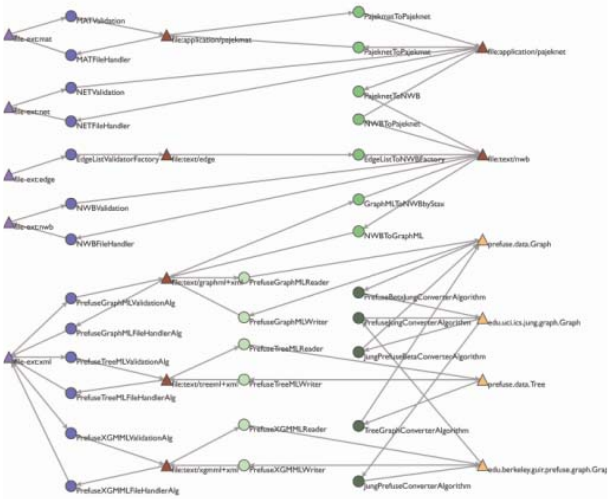


NWB Ecology of Data Formats and Converters

*Not shown are **24** sample datasets, **51** data preprocessing, analysis, modeling and visualization algorithms, **9** services.*

5

Supported data formats



5

Output formats for diverse visualization algorithms

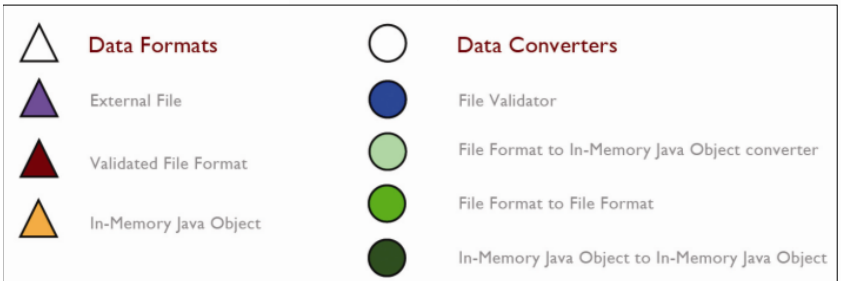
8

Intermediate data formats

Supported by

35

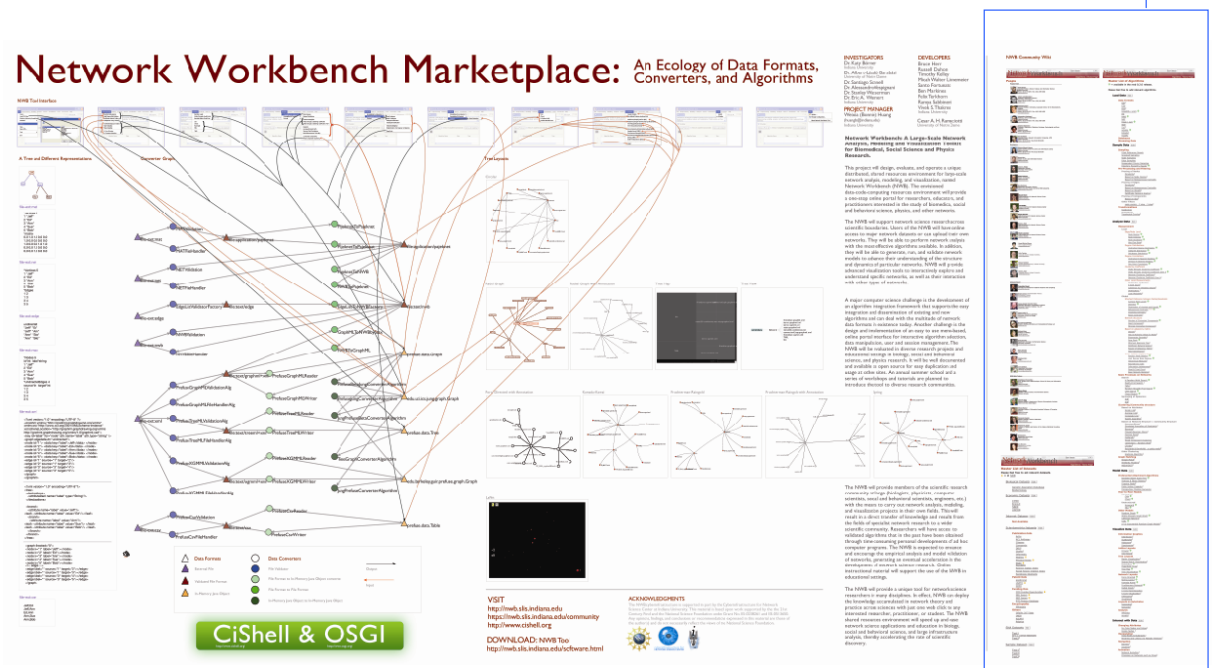
data converters.



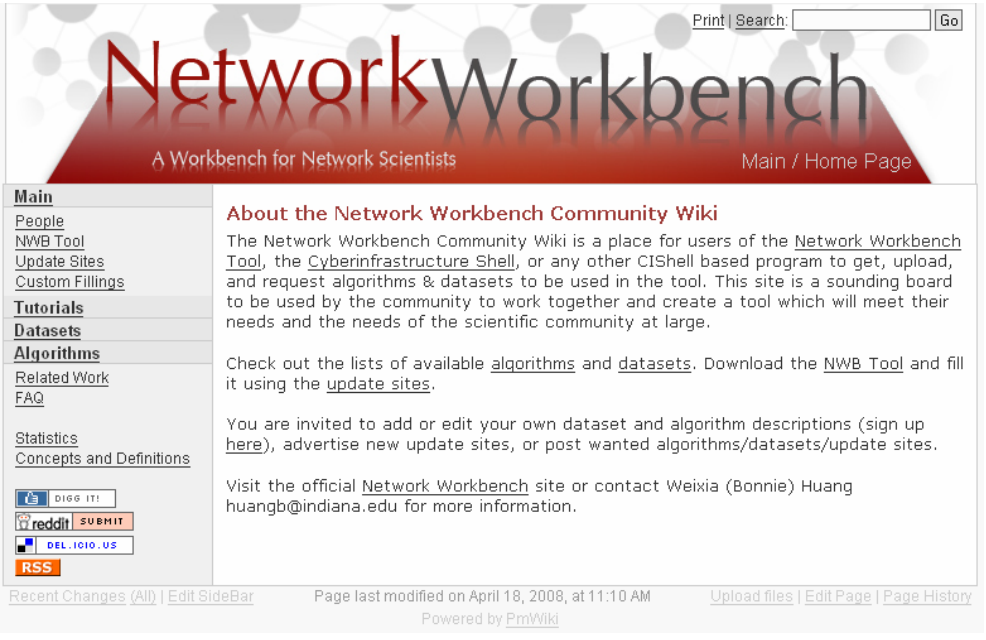
VISIT
http://nwb.slis.indiana.edu
https://nwb.slis.indiana.edu/community
http://www.cishell.org

DOWNLOAD: NWB Tool
http://nwb.slis.indiana.edu/software.html

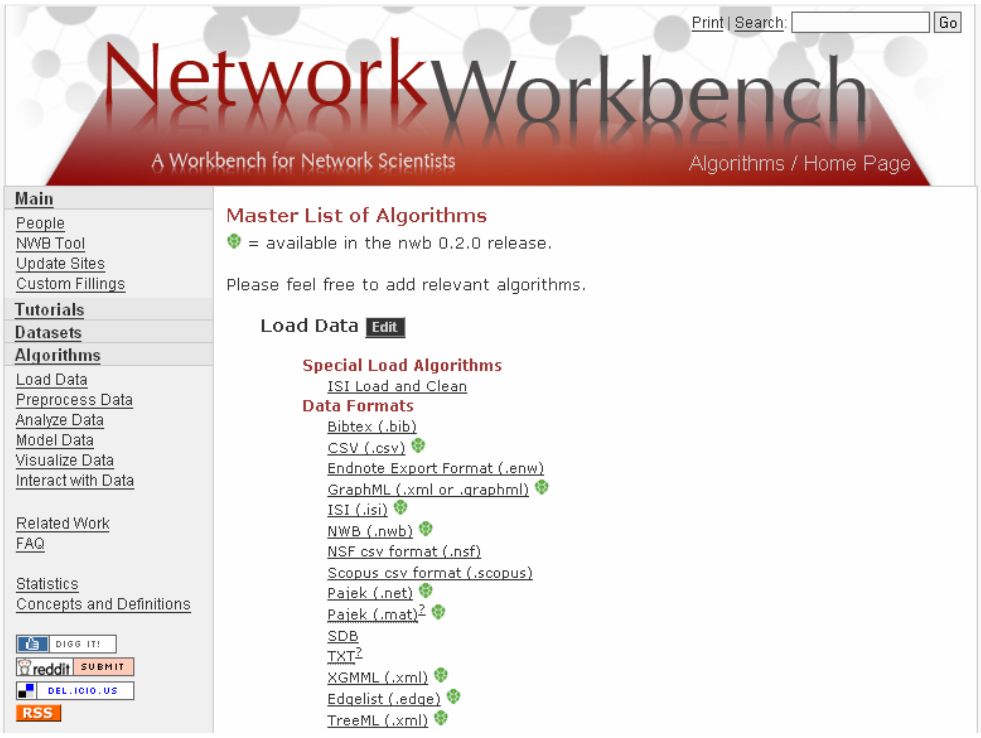
NWB
Community Wiki



https://nwb.slis.indiana.edu/community/



https://nwb.slis.indiana.edu/community/



https://nwb.slis.indiana.edu/community/

Growing a Community of Network Science Researchers

Users come from Social Science, Physics, Biology, Information Science, Telecommunications, Internet Research, Economics, Science Policy, etc.

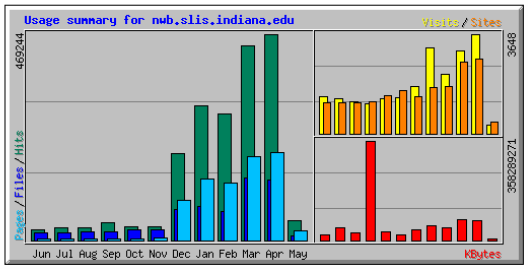
It takes **9 months** to give birth to a human baby and **21 years** to raise it.

It takes **3-5 years** to build a CI and **???** years to build a vibrant, self-sustaining community.

Quickly identify and serve continuously changing needs of evolving community.

Usage Statistics for nwb.slis.indiana.edu

Summary Period: Last 12 Months
Generated 04-May-2008 05:05 EDT



Top 30 of 33830 Total NWB Tool URLs Tracked – Last 30 days

	5	599	0.13%	20532984	28.71%	/nightly/0.9.0.200802261543NGT/installers/nwb-installer-0.9.0-win32.win32.jar
	6	518	0.11%	1656		/svn/nwb/tags/pre-v1.0.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.beta/src/edu/iu/nwb/visualization/prefuse/beta/
	7	398	0.08%	124934	0.17%	/Docs/NWB_Getting_Started.pdf
	8	377	0.08%	847		/svn/nwb/tags/v0.6.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.beta/src/edu/iu/nwb/visualization/prefuse/beta/comm
	9	341	0.07%	1467		/svn/nwb/tags/v0.6.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	10	337	0.07%	1629		/svn/nwb/tags/pre-v1.0.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/p
	11	336	0.07%	590		/svn/nwb/tags/v0.4.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.beta/src/edu/iu/nwb/visualization/prefuse/beta/comm
	12	332	0.07%	1416	0.00%	/doc.html
	13	327	0.07%	1763	0.00%	/download.html
	14	315	0.07%	1468		/svn/nwb/tags/v0.7.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	15	306	0.07%	1222		/svn/nwb/tags/v0.5.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	16	300	0.06%	1225		/svn/nwb/tags/v0.9.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	17	299	0.06%	1389		/svn/nwb/tags/v0.4.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	18	296	0.06%	159823	0.22%	/papers/arist02.pdf
	19	293	0.06%	1341		/svn/nwb/tags/v0.3.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	20	286	0.06%	934813	1.31%	/downloads/nwbflyer.pdf
	21	285	0.06%	1171		/svn/nwb/tags/v0.8.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefu
	22	284	0.06%	1057		/svn/nwb/trunk/plugins/visualization/edu.iu.nwb.visualization.prefuse.alpha.smallworld/src/edu/iu/nwb/visualization/prefuse/alp
	23	274	0.06%	614		/svn/nwb/tags/v0.9.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.beta/src/edu/iu/nwb/visualization/prefuse/beta/comm
	24	268	0.06%	181184	0.25%	/Docs/NWB_VisualizingTree.pdf
	25	253	0.05%	8592053	12.01%	/nightly/1.0.0.200804011946NGT/installers/nwb-installer-1.0.0-pre1-win32.win32.jar
	26	250	0.05%	58556	0.08%	/Docs/Thomson_Tutorial.pdf
	27	220	0.05%	89987	0.13%	/papers/2006-borner-arist.pdf
	28	217	0.05%	83388	0.12%	/papers/2007-colizza-epidmod.pdf
	29	209	0.04%	3602	0.01%	/people.html
	30	203	0.04%	509		/svn/nwb/tags/v0.8.0/plugins/visualization/edu.iu.nwb.visualization.prefuse.beta/src/edu/iu/nwb/visualization/prefuse/beta/comm

TotalCounter statistics

Page views

Pages	Percent	Count
1. Main.HomePage	8%	1608
2. Algorithms.HomePage	6%	1271
3. VisualizeData.XMGrace	6%	1159
4. VisualizeData.Kamada-Kawaii	4%	921
5. VisualizeData.Fruchterman-Rheingold	4%	917
6. Main.NWBTool	4%	877
7. Datasets.HomePage	4%	797
8. VisualizeData.ForceDirected	3%	690
9. Tutorials.HomePage	2%	409
10. Main.People	2%	400
11. Main.RelatedWork	2%	364
12. Main.FAQ	2%	329
13. VisualizeData.SpringLayout	1%	
14. AnalyzeData.ClusteringCoefficientWattsStrogatz	1%	
15. VisualizeData.RadialTree	1%	
16. AnalyzeData.BetweennessCentralitySiteAmpEdge	1%	
17. VisualizeData.HomePage	1%	
18. AnalyzeData.NodeDegree	1%	
19. CustomFillings.HomePage	1%	
20. CustomFillings.AnalysisOfBiologicalNetworks	1%	

Users

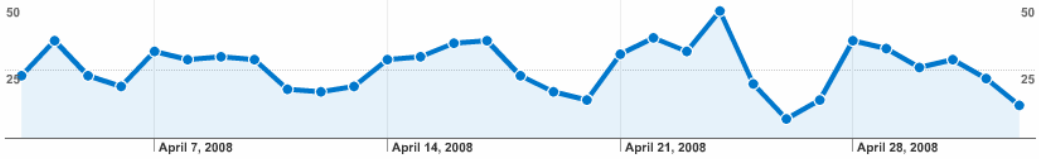
Users	Percent	Count
1. 0	50%	10560
2. Guest (not authenticated)	45%	9415
3. mwlinnem	1%	159
4. rduhon	1%	147
5. bhook	1%	119
6. bh2	0%	95
7. mlinnem	0%	69
8. sanditf	0%	65
9. katy	0%	36
10. cesar	0%	32
11. kelleyt	0%	29
12. karthikp	0%	26
13. mclements6	0%	25
14. kieblerc	0%	24
15. June Young Lee	0%	24
16. springying	0%	22

Visitors Overview

Export | Email | Add to Dashboard

Apr 3, 2008 - May 3, 2008
Comparing to: Site

Beta Graph by: Day | Week | Month | Visitors



660 people visited this site

930 Visits
660 Absolute Unique Visitors
2,989 Pageviews
3.21 Average Pageviews
00:03:19 Time on Site

Visitor Segmentation

Visitors Profile: languages, network locations, user defined

Browser Profile: browsers, operating systems, browser and operating systems, screen colors, screen resolutions, java support, Flash

Map Overlay
Geolocation visualization

Technical Profile

Browser	Visits	% visits
Firefox	449	48.28%
Internet Explorer	343	36.88%
Safari	67	7.20%
Mozilla	26	2.80%
Netscape	23	2.47%

view full report

Connection Speed	Visits	% visits
T1	354	38.06%
Unknown	225	24.19%
Cable	163	17.53%
DSL	163	17.53%
Dialup	22	2.37%

view full report

Map Overlay

Export | Email | Add to Dashboard

Apr 3, 2008 - May 3, 2008
Comparing to: Site

Visits

930 visits came from 57 countries/territories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IU News from all eight campuses
Sunday, May 4, 2008
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Last modified: Tuesday, April 8, 2008
$1.2 million NIH project will help track and predict epidemics
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FOR IMMEDIATE RELEASE
April 8, 2008
BLOOMINGTON, Ind. -- The National Institutes of Health has given $1.2 million to Indiana University researchers to build the ultimate international epidemic research tool.
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The End.