Dr. Katy Börner, Curator
Indiana University, CNS, SLIS

Timothy Utter, Access & Information Services Librarian
University of Michigan, Hatcher Graduate Library

International Places & Spaces Exhibit Coming to Michigan

Mapping science like you've never seen

Ann Arbor, Michigan, February 8, 2011 – From March 7 through May 24, 2011, the University of Michigan Library will host the exhibit *Places & Spaces: Mapping Science* in the Hatcher Graduate Library Gallery. An opening reception will be held March 10 from 4:00-6:00 pm in the Library Gallery, with guest speaker Dr. Katy Börner speaking from 4:00-4:30 pm.

Are you interested in seeing science from above? Curious to see what impact one single person or invention can have? Keen to find pockets of innovation? Desperate for better tools to manage the information flood? Or are you simply fascinated by maps?

The *Places & Spaces: Mapping Science* exhibit was created to demonstrate the power of maps to navigate and manage physical places but also abstract topic spaces. It introduces knowledge mapping techniques to the general public. It is meant to inspire cross-disciplinary discussion on how to best track and communicate human activity and scientific progress on a global scale.

Several University of Michigan faculty created maps included in the exhibit: Santiago Schnell, Molecular and Integrative Physiology; Lada Adamic, School of Information; M. E. J. Newman, Physics; Jeff Horon, Medical School; Helena Buhr, Natalie Cotton, and Jason Owen-Smith, Sociology and Organizational Studies.

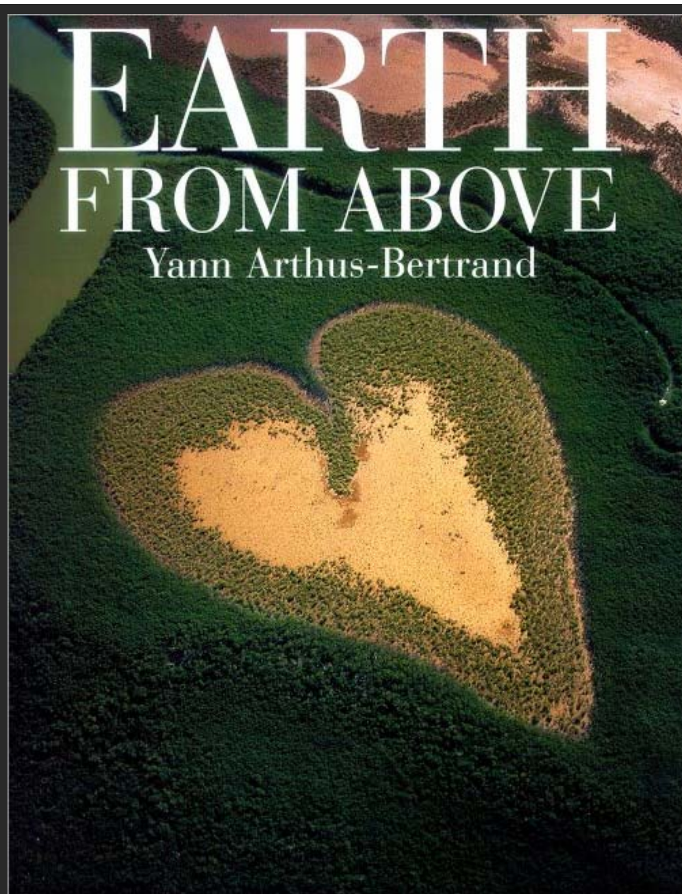
From March 7 through May 24 the Hatcher Graduate Library Gallery will display the exhibit, which has over 60 maps, interactive globes, illuminated diagrams, hands-on activities for children (and adults, too!), and a wealth of information for researchers and map enthusiasts, alike.

Places & Spaces: Mapping Science
Opening Reception at the University of Michigan

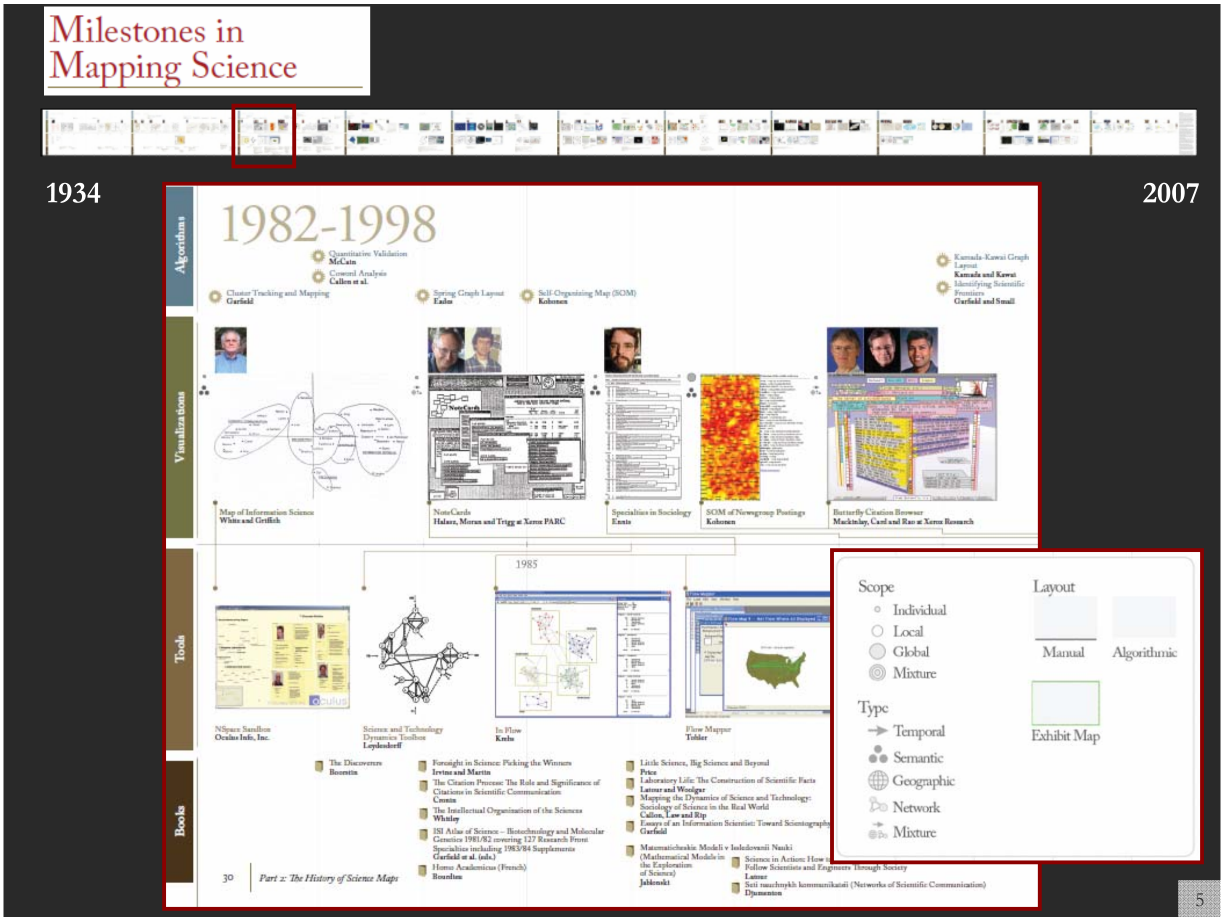
Dr. Katy Börner
Cyberinfrastructure for Network Science Center, Director
School of Library and Information Science
Indiana University, Bloomington, IN
katy@indiana.edu

With special thanks to Michael J. Stamper (exhibit co-curator), members at the Cyberinfrastructure for Network Science Center, the Mapping Science exhibit map makers, and the exhibit advisory board.

Hatcher Graduate Library Gallery, University of Michigan, Ann Arbor, MI
March 10, 2011

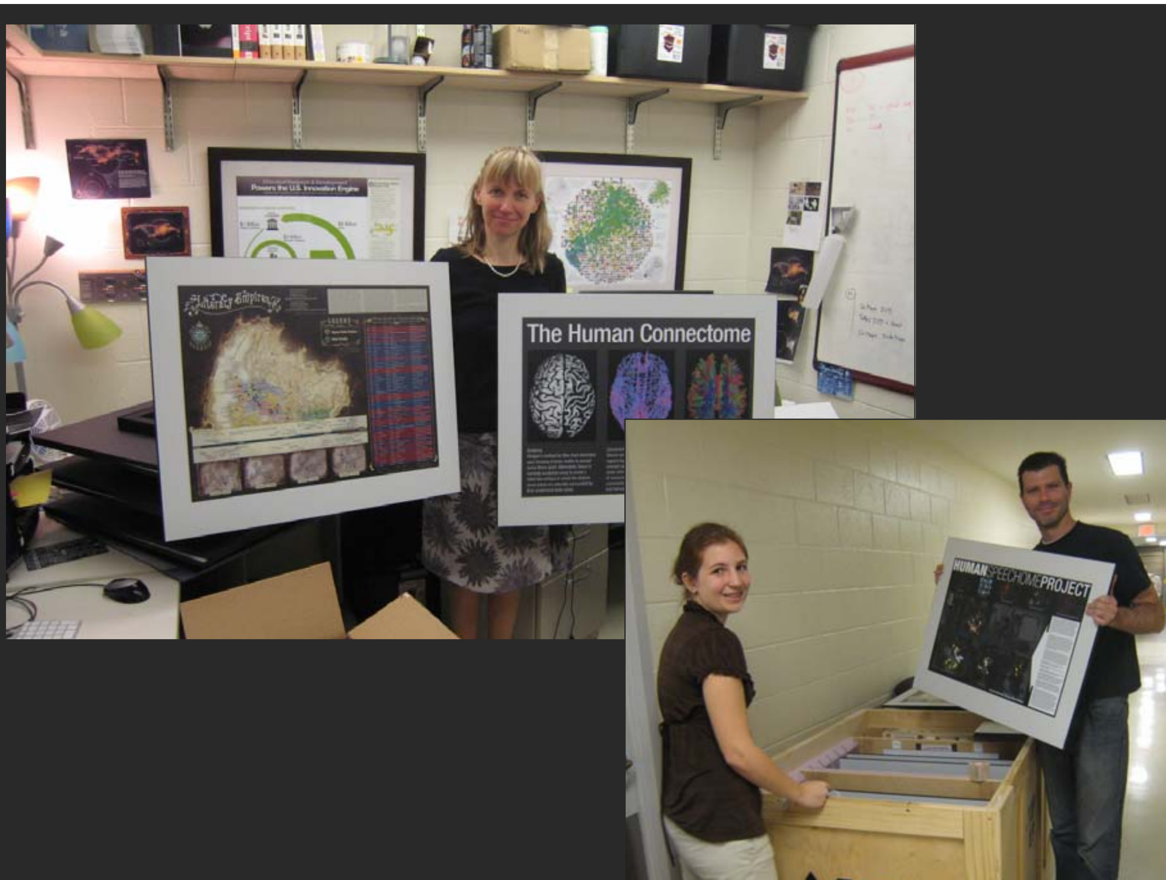


How can we communicate the beauty, structure, and dynamics of science to a general audience?


Milestones in Mapping Science
1934
2007
1982-1998
Algorithms
Visualizations
Tools
Books
1985
Scope
Individual
Local
Global
Mixture
Type
Temporal
Semantic
Geographic
Network
Mixture
Layout
Manual
Algorithmic
Exhibit Map
30
Part 2: The History of Science Maps
5

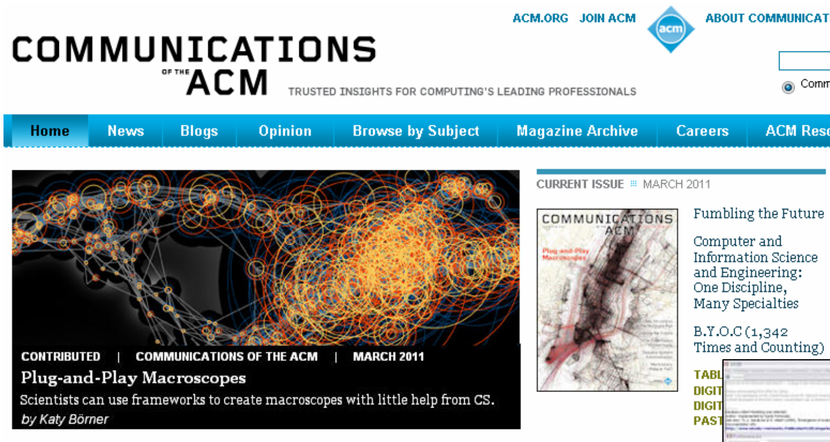

The Structure of Science
5 – 9, 2005: 101st Annual Meeting of
n of American Geographer, Denver, C


INDIANA
UNIVERSITY
PLACES AND SPACES
EXHIBIT


The Human Connectome
HUMANSPEECHOMEPROJECT

Debut of 5th Iteration of the Mapping Science Exhibit at MEDIA X was in 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*



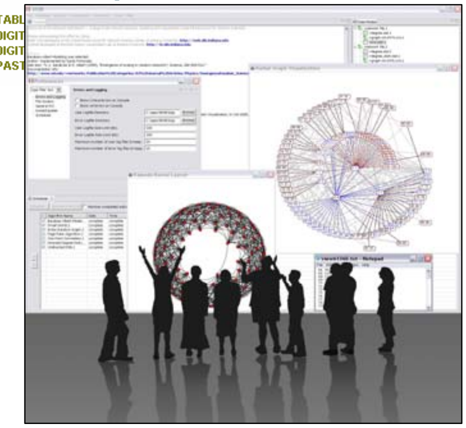
http://cacm.acm.org

VIVO Research Networking
http://vivoweb.org

Network Workbench Tool & Community Wiki
http://nwb.cns.iu.edu

Science of Science (Sci^2) Tool
http://sci2.cns.iu.edu

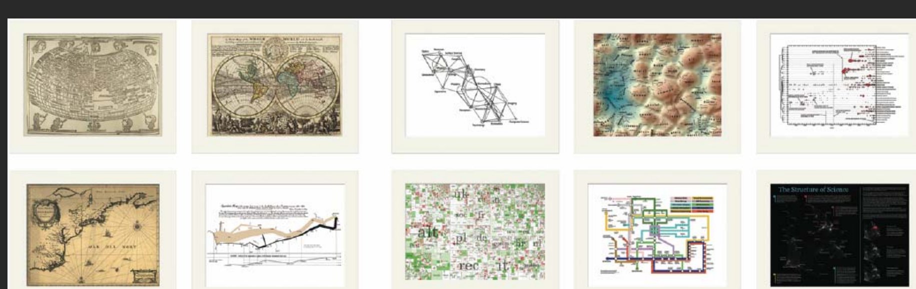
Epidemics Cyberinfrastructure
http://epic.cns.iu.edu



OSGi Alliance CIShell cyberinfrastructure shell

The Power of Maps

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

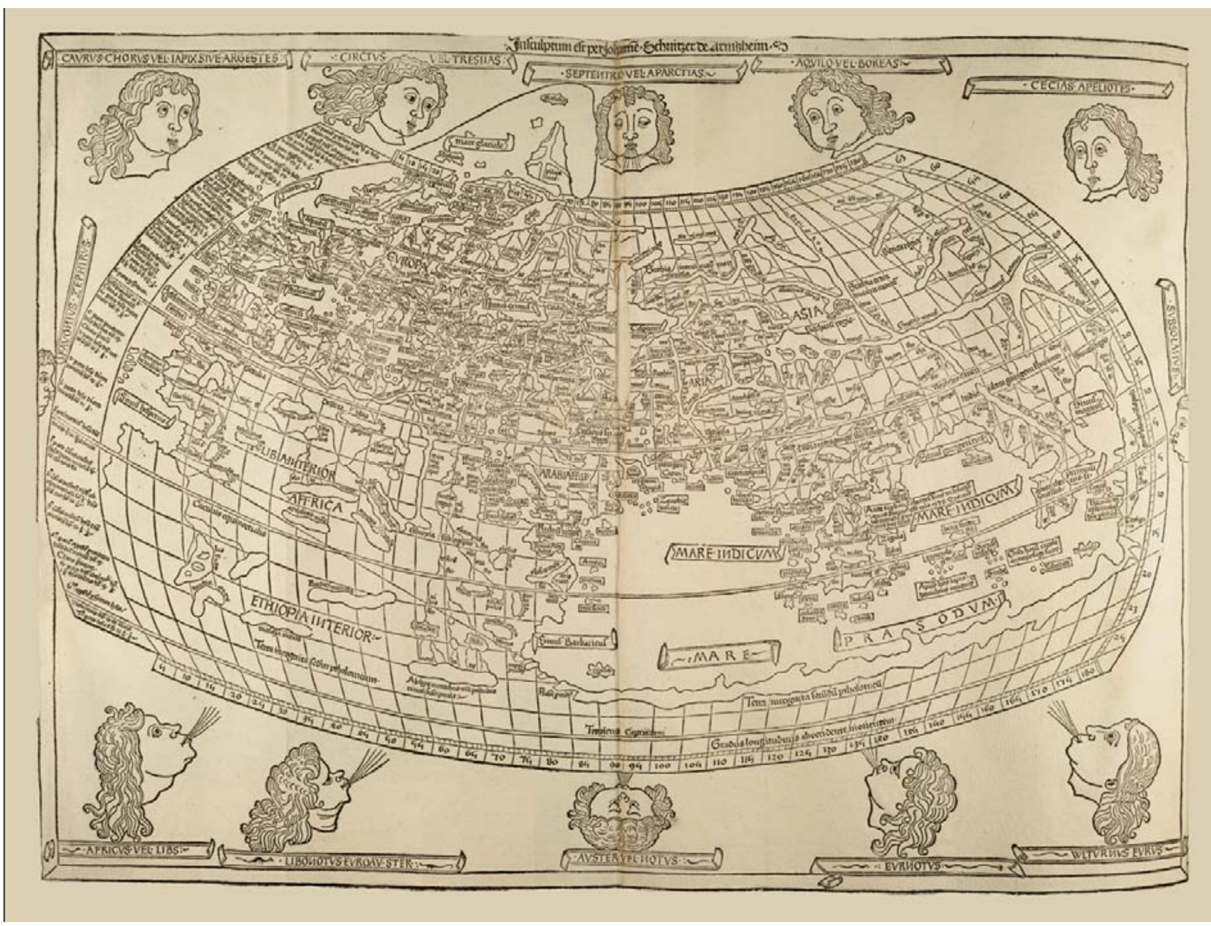


(1st Iteration of Places & Spaces Exhibit - 2005)

[Cartographic maps](#) of physical places have guided mankind's explorations for centuries.

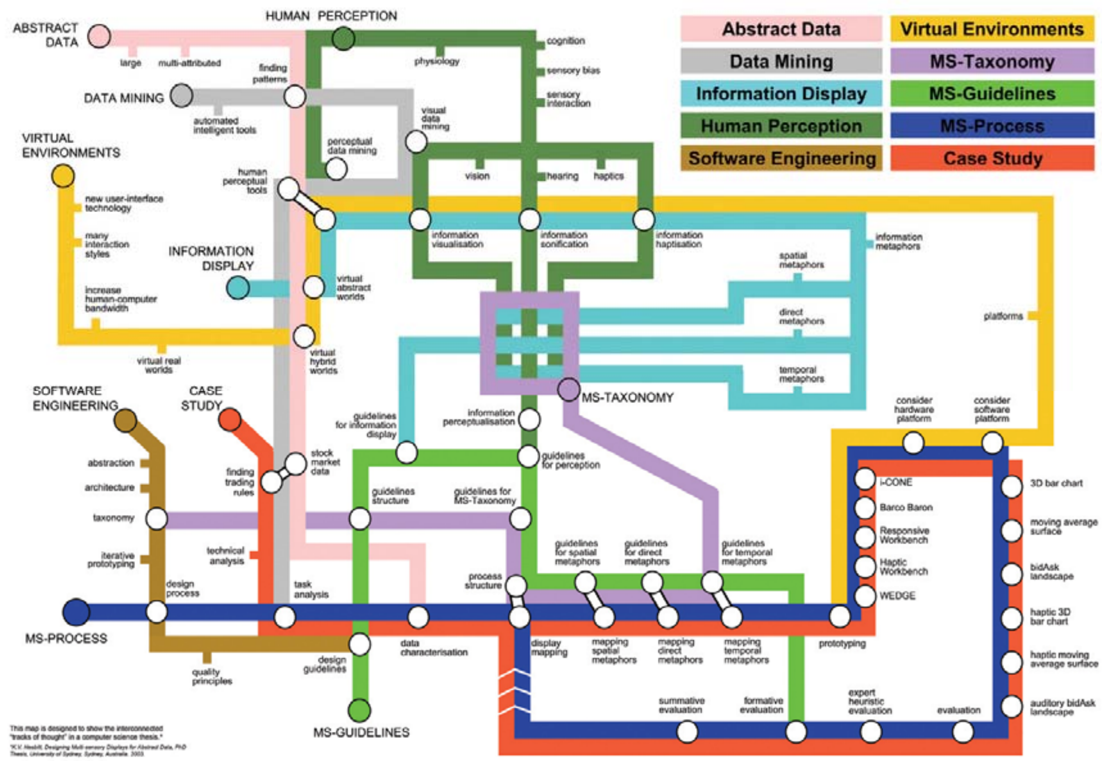
They enabled the discovery of new worlds while also marking territories inhabited by the unknown.

Without maps, we would be lost.

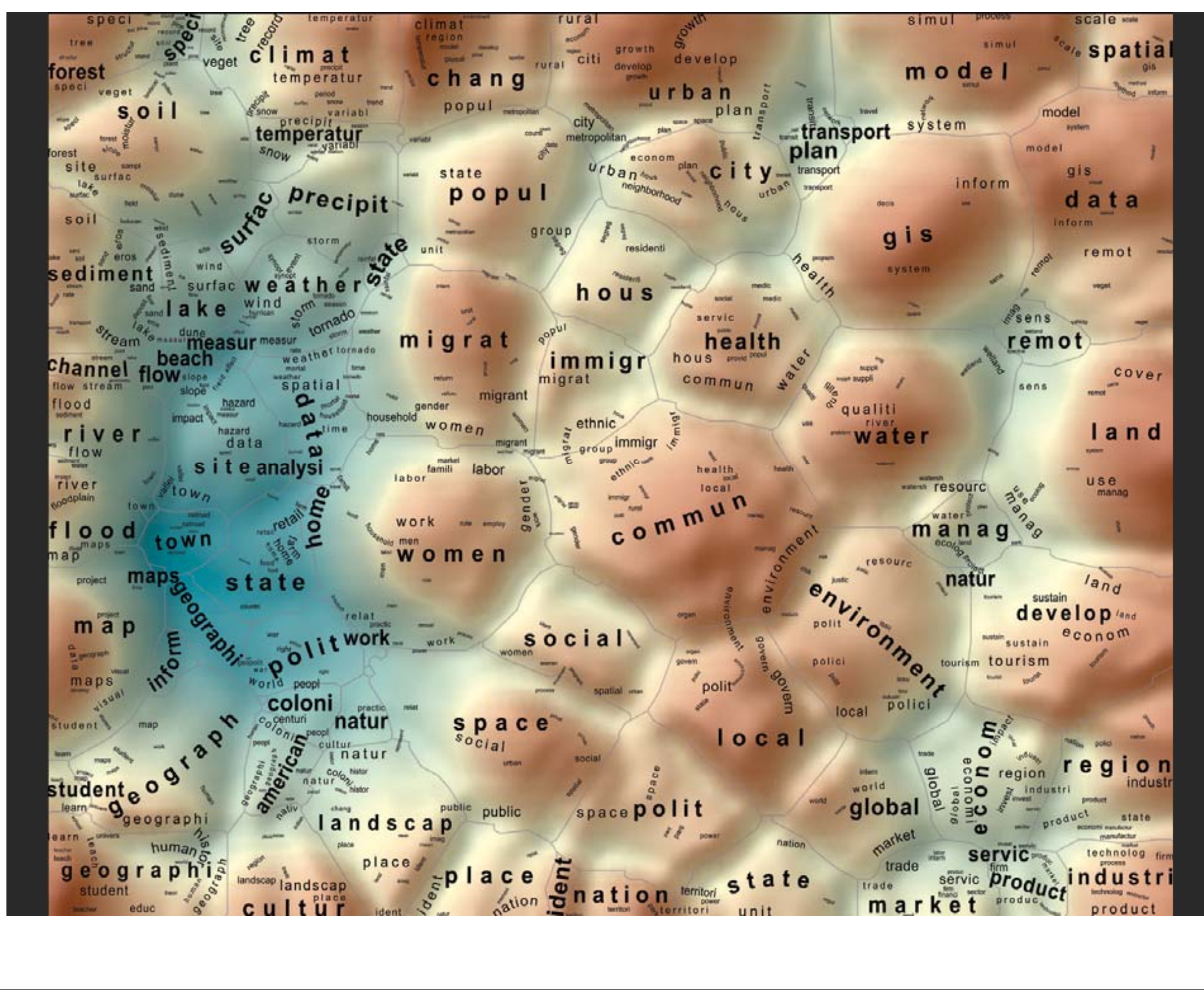


How would a map of science look?

What metaphors would work best?



ABSTRACT DATA
HUMAN PERCEPTION
DATA MINING
VIRTUAL ENVIRONMENTS
INFORMATION DISPLAY
SOFTWARE ENGINEERING
CASE STUDY
MS-TAXONOMY
MS-PROCESS
MS-GUIDELINES
Abstract Data
Virtual Environments
Data Mining
MS-Taxonomy
Information Display
MS-Guidelines
Human Perception
MS-Process
Software Engineering
Case Study
large
multi-attributed
finding patterns
physiology
cognition
sensory bias
sensory interaction
automated intelligent tools
visual data mining
perceptual data mining
human perceptual tools
vision
hearing
haptics
new user-interface technology
many interaction styles
increase human-computer bandwidth
information visualisation
information sonification
information haptisation
information metaphors
spatial metaphors
direct metaphors
temporal metaphors
platforms
virtual abstract worlds
virtual hybrid worlds
virtual real worlds
guidelines for information display
information perceptualisation
guidelines for perception
consider hardware platform
consider software platform
abstraction
architecture
taxonomy
iterative prototyping
finding trading rules
stock market data
technical analysis
guidelines structure
guidelines for MS-Taxonomy
guidelines for spatial metaphors
guidelines for direct metaphors
guidelines for temporal metaphors
i-CONE
Barco Baron
Responsive Workbench
Haptic Workbench
WEDGE
3D bar chart
moving average surface
bidAsk landscape
haptic 3D bar chart
haptic moving average surface
auditory bidAsk landscape
design process
task analysis
process structure
data characterisation
display mapping
mapping spatial metaphors
mapping direct metaphors
mapping temporal metaphors
prototyping
quality principles
design guidelines
summative evaluation
formative evaluation
expert heuristic evaluation
evaluation
This map is designed to show the interconnected "tracks of thought" in a computer science thesis.*
*K.V. Nesbitt, Designing Multi-sensory Displays for Abstract Data, PhD Thesis, University of Sydney, Sydney, Australia, 2003.



forest
soil
climat
temperatur
chang
urban
model
spatial
precipit
popul
city
transport
plan
data
gis
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weather
state
hous
lake
health
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immigr
remot
channel
measur
beach
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commun
water
river
site analysi
land
flood
town
women
commun
manag
maps
state
environment
map
geographi
polit
social
develop
econom
coloni
natur
space
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geograph
landscap
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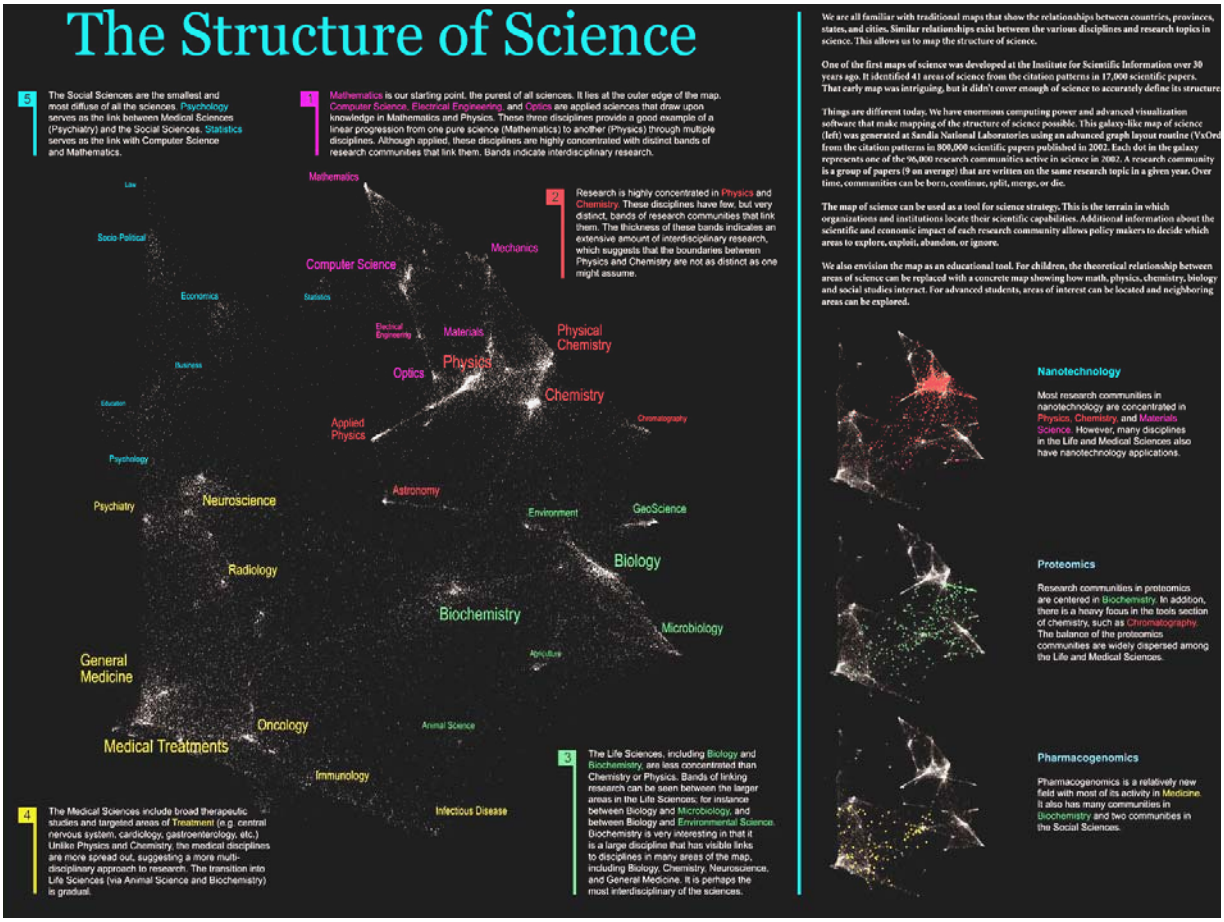
product
industri
market
cultur



<u>Domain maps</u> of abstract semantic spaces aim to serve today's explorers navigating the world of science.

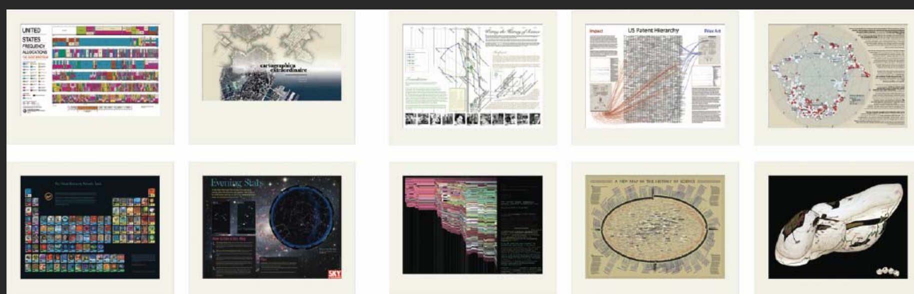
These maps are generated through a scientific analysis of large-scale scholarly datasets in an effort to connect and make sense of the bits and pieces of knowledge they contain.

They can be used to identify objectively major research areas, experts, institutions, collections, grants, papers, journals, and ideas in a domain of interest. Science maps can provide overviews of "all-of-science" or of a specific area.

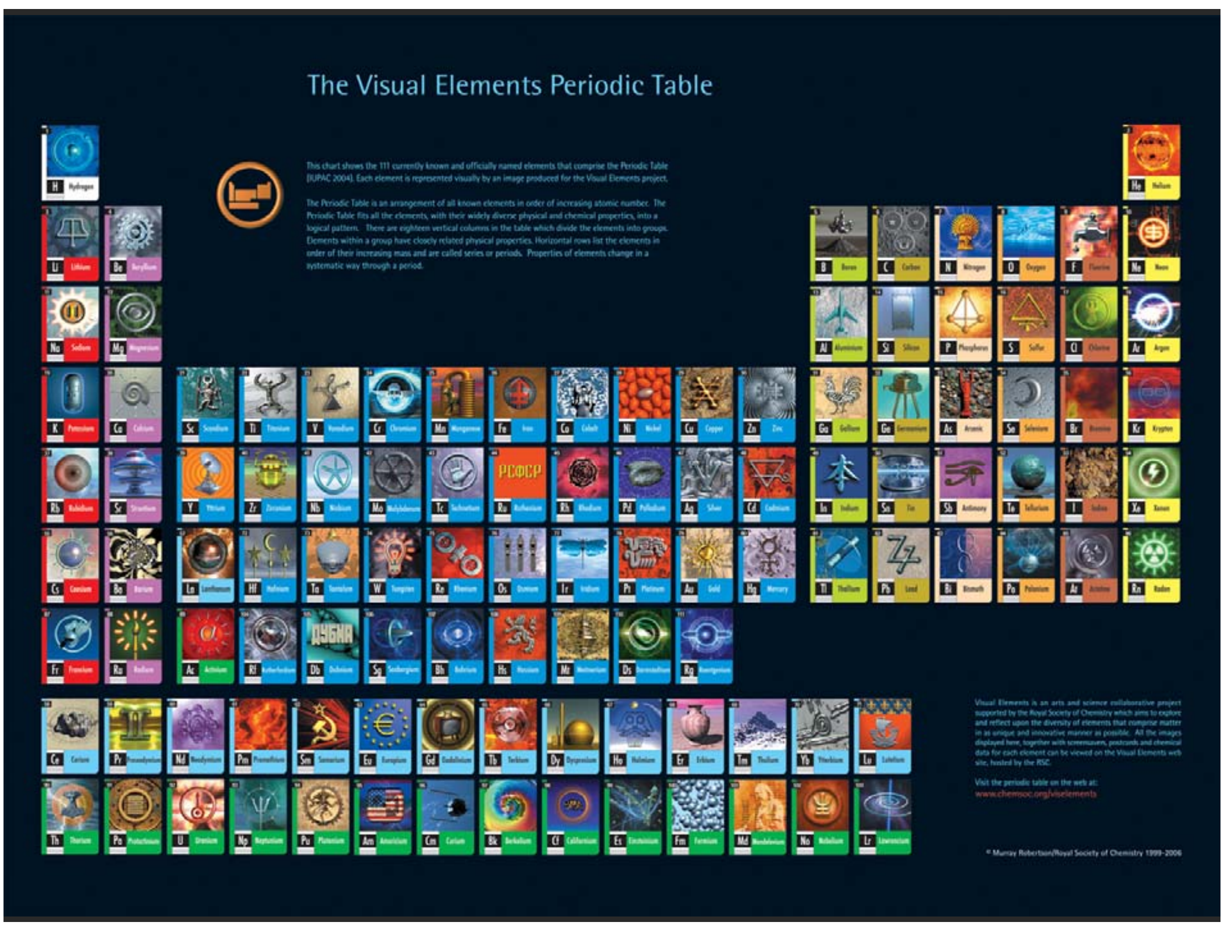
They can show homogeneity vs. heterogeneity, cause and effect, and relative speed. They allow us to track the emergence, evolution, and disappearance of topics and help to identify the most promising areas of research.

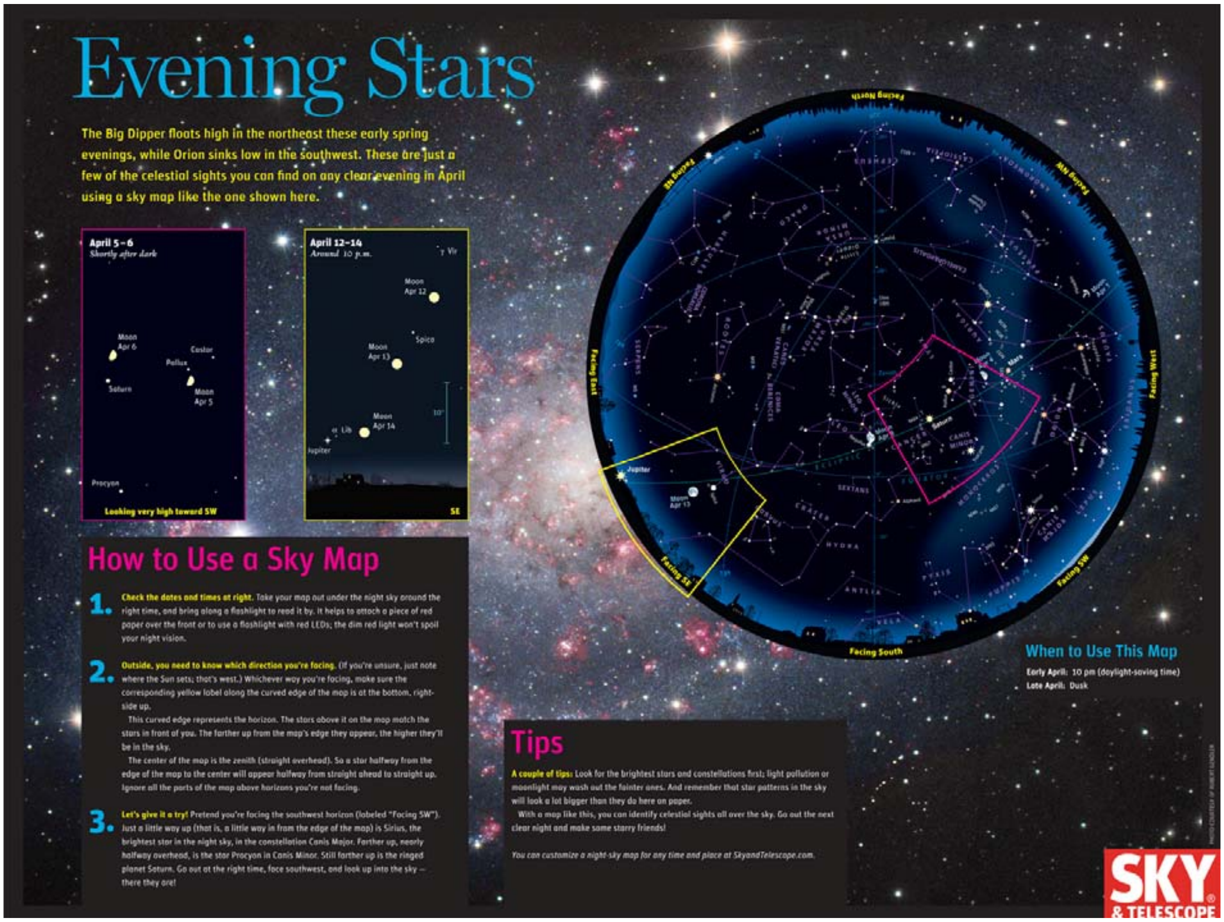
The Power of Reference Systems

Four Existing Reference Systems
VERSUS
Six Potential Reference Systems of Science



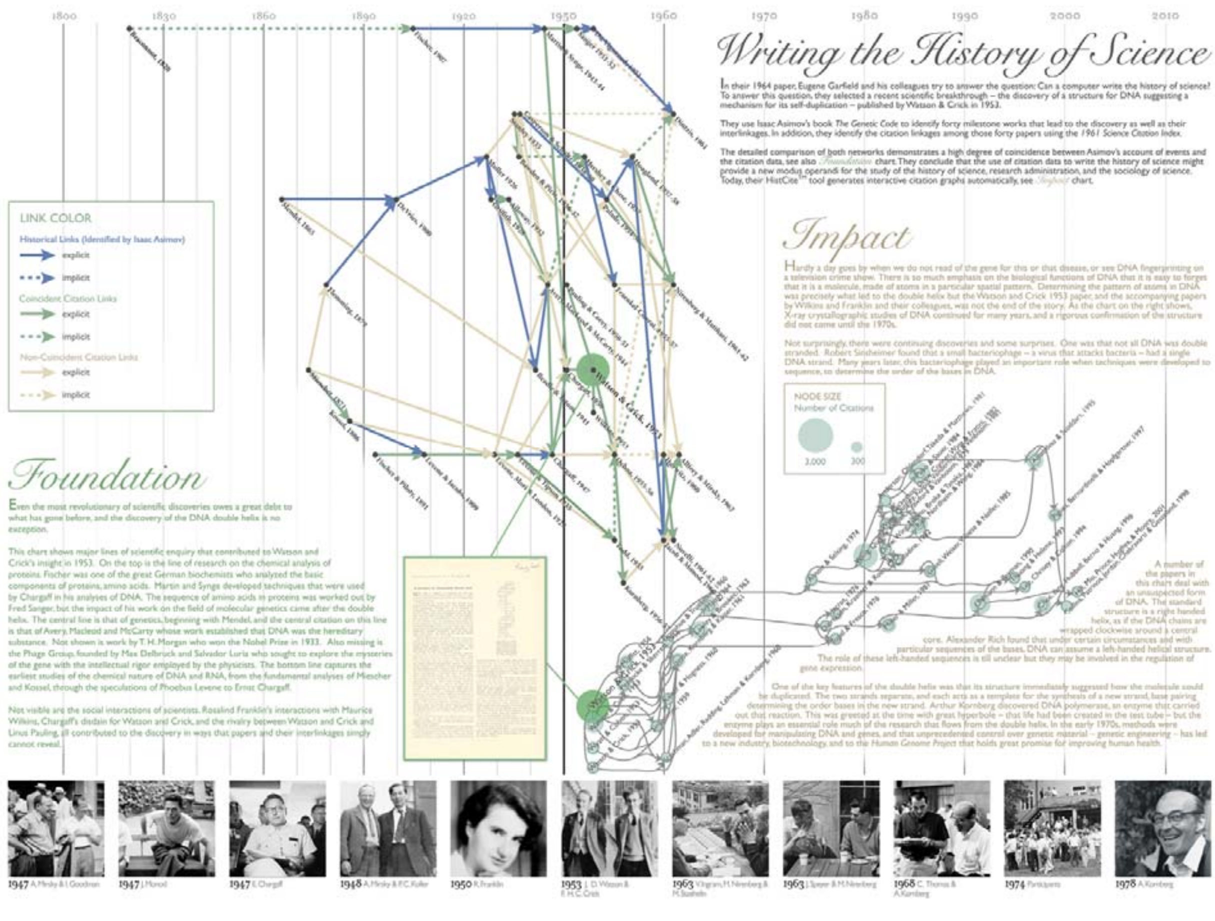
(2nd Iteration of Places & Spaces Exhibit - 2006)



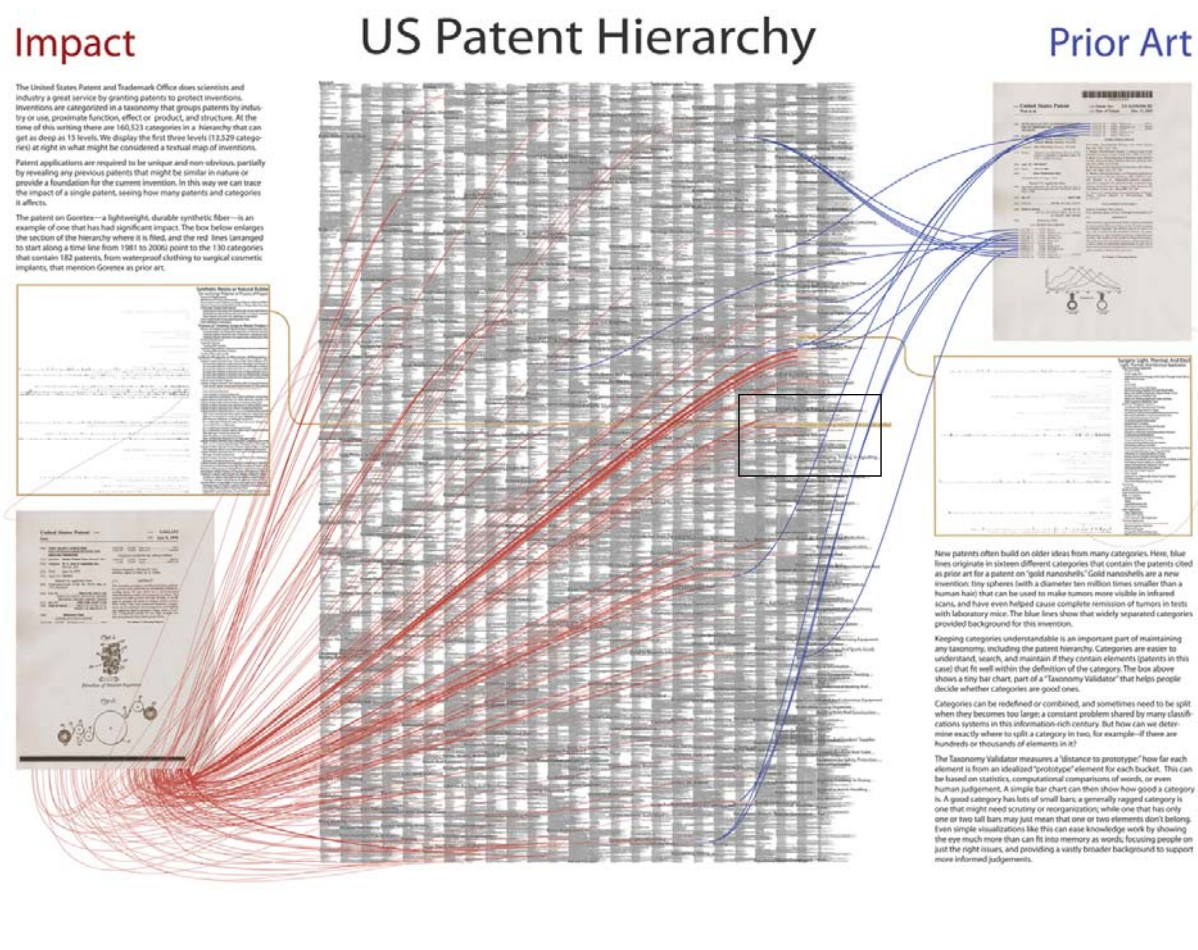


How would a reference system for all of science look?

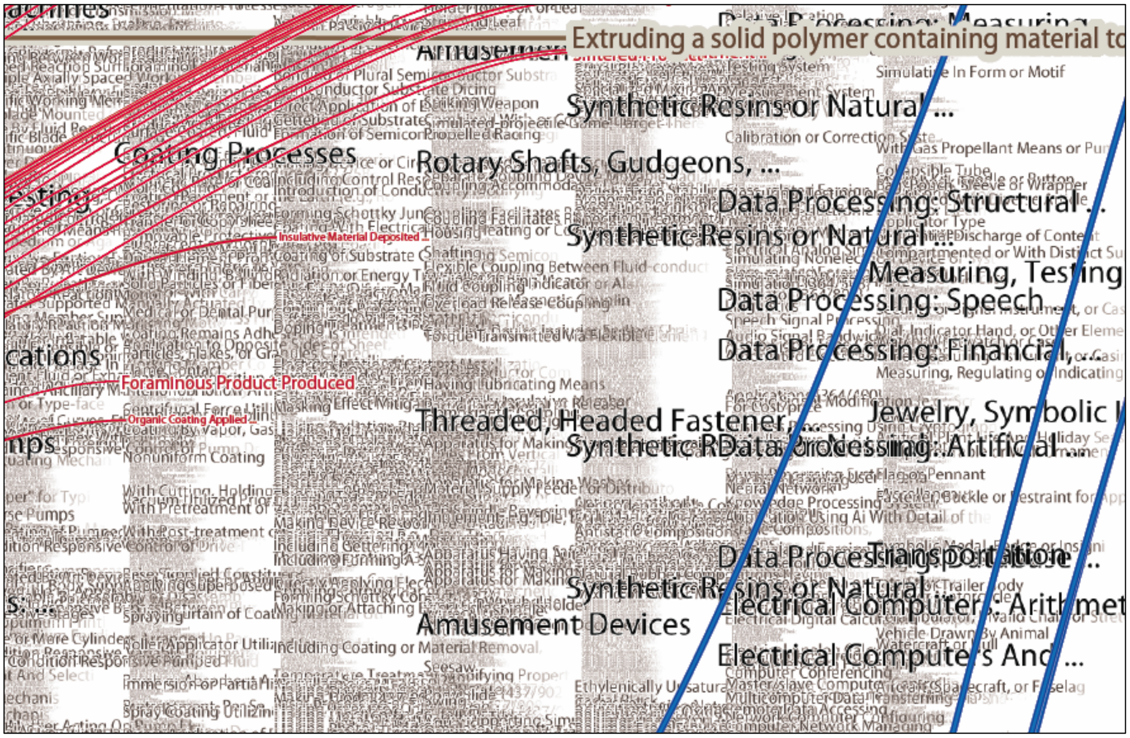
What dimensions would it have?



1800
1830
1860
1890
1920
1950
1960
1970
1980
1990
2000
2010
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.
LINK COLOR
Historical Links (Identified by Isaac Asimov)
explicit
implicit
Coincident Citation Links
explicit
implicit
Non-Coincident Citation Links
explicit
implicit
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.
NODE SIZE
Number of Citations
3,000
300
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.
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.
1947 A. Minsky & I. Goodman
1947 J. Monod
1947 E. Chargaff
1948 A. Minsky & P.C. Koller
1950 R. Franklin
1953 J. D. Watson & F. H. C. Crick
1963 V. Ingram, M. Nirenberg & M. Staehelin
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.
United States Patent
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.



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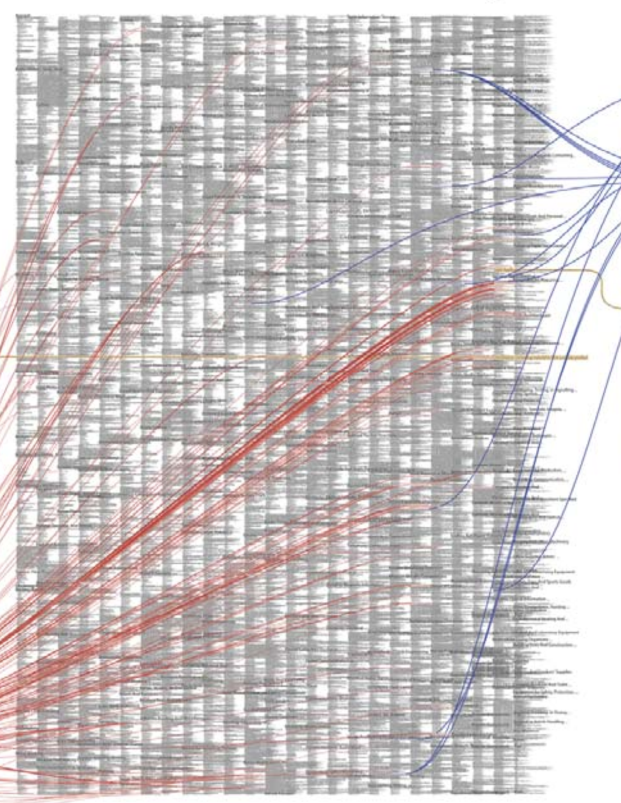
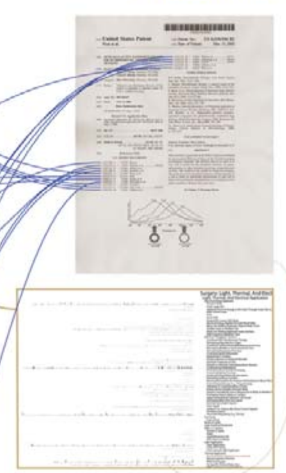


Prior Art



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.

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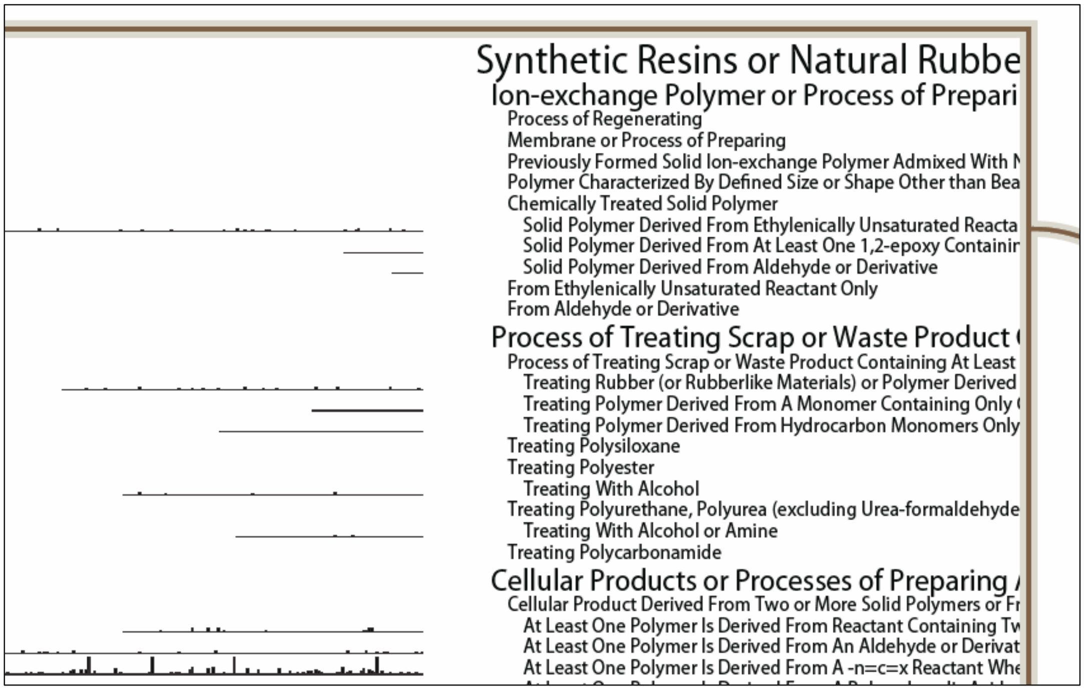
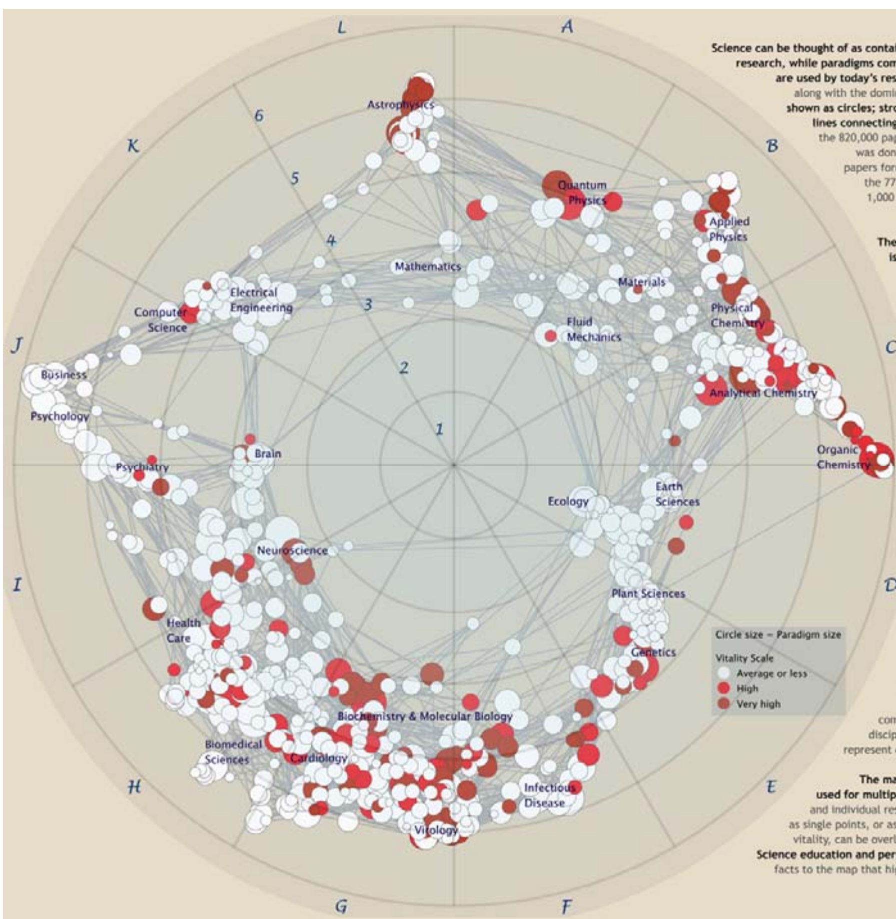




Science can be thought of as containing themes and paradigms. Themes are areas of current research, while paradigms comprise the dominant tool sets and existing knowledge that are used by today's researchers. This map shows **776 major paradigms in science** along with the dominant relationships between 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.

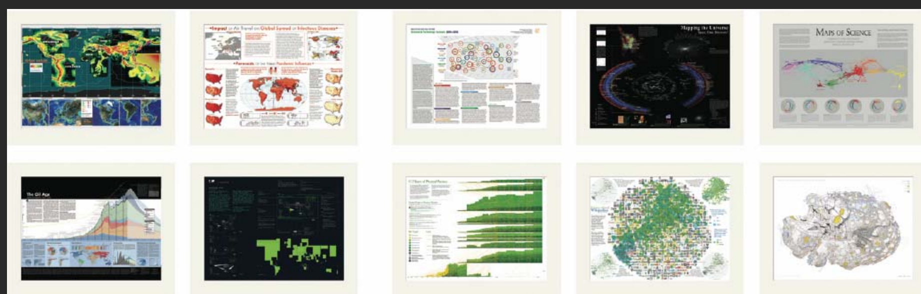
Because of the robust nature of the structure of science and its paradigms, we have placed our 776 scientific paradigms within a **reference system containing 12 radial slices and 6 rings.** This allows the position of each paradigm to be codified and available for lookup; for instance ***Fluid Mechanics*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

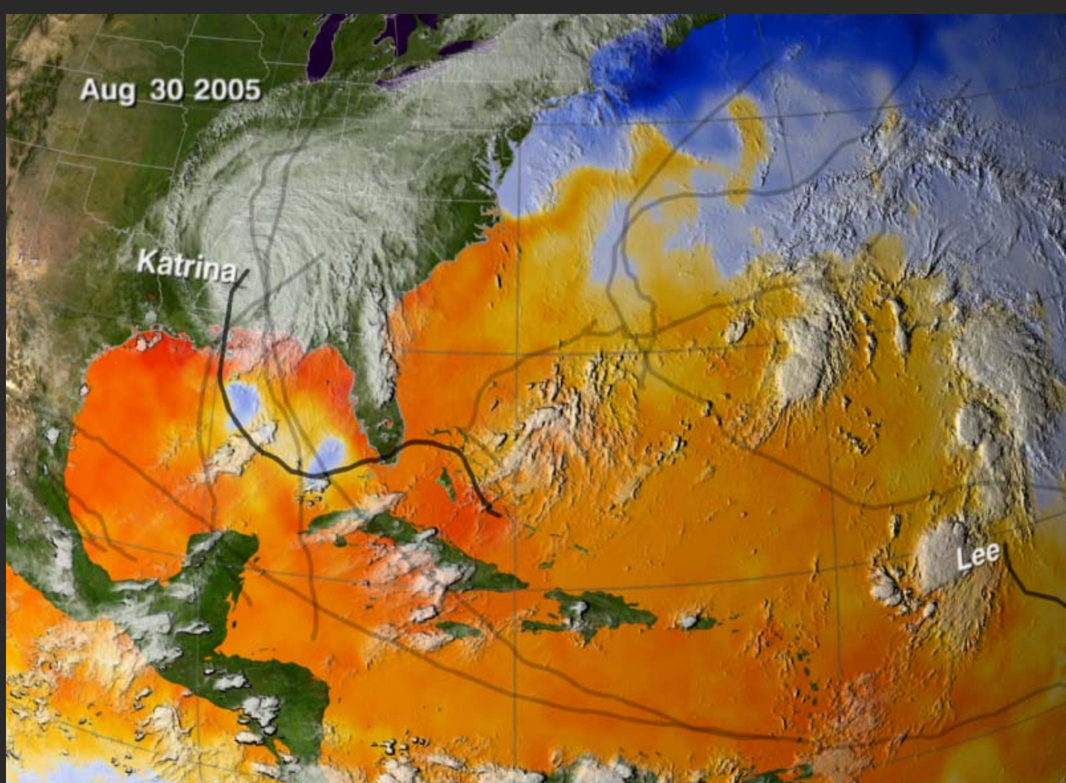
The map of scientific paradigms and its reference system can be used for multiple purposes. Countries, industries, companies, universities, and individual researchers can all **locate themselves within the map**, either as single points, or as a specific collection of paradigms. Various metrics, such 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.

The Power of Forecasts

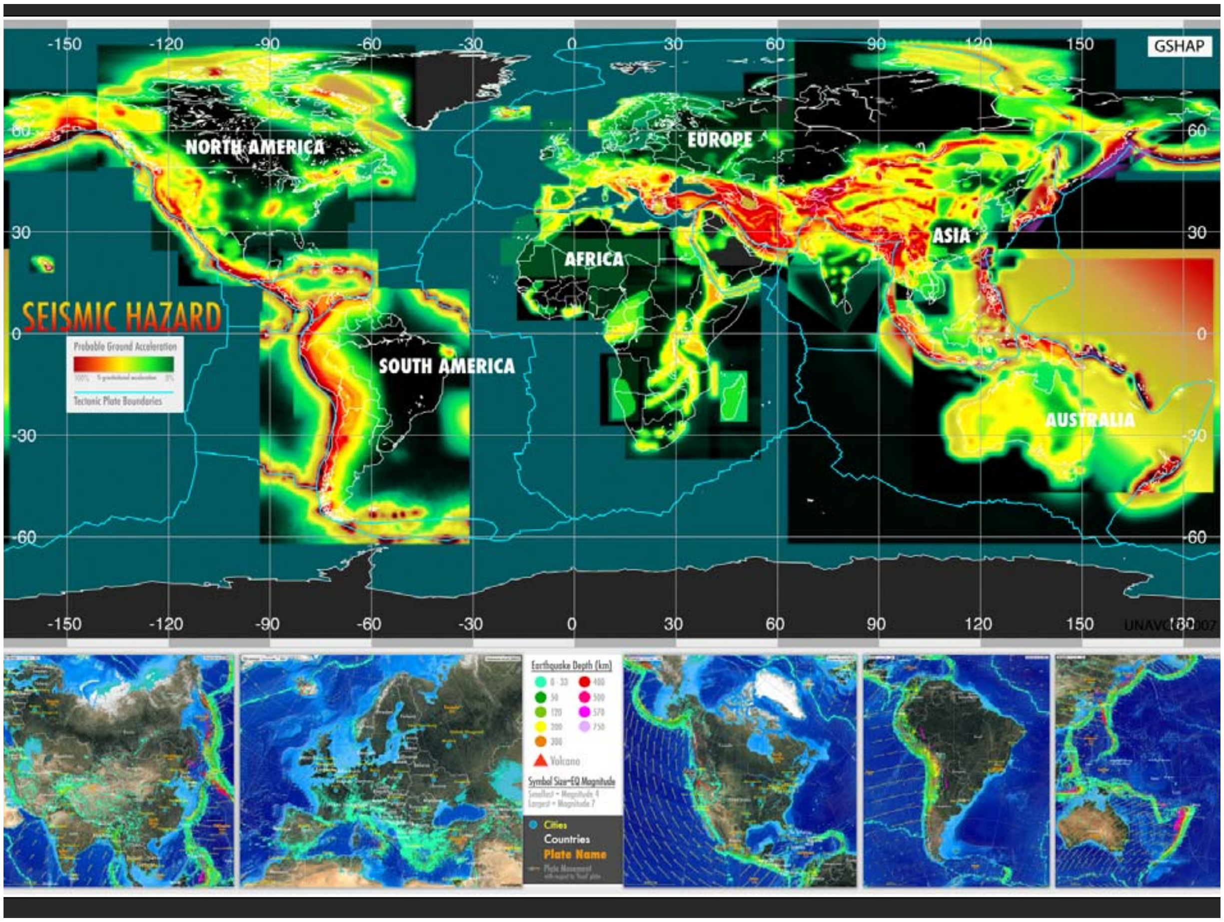
Four Existing Forecasts
VERSUS
Six Potential Science 'Weather' Forecasts

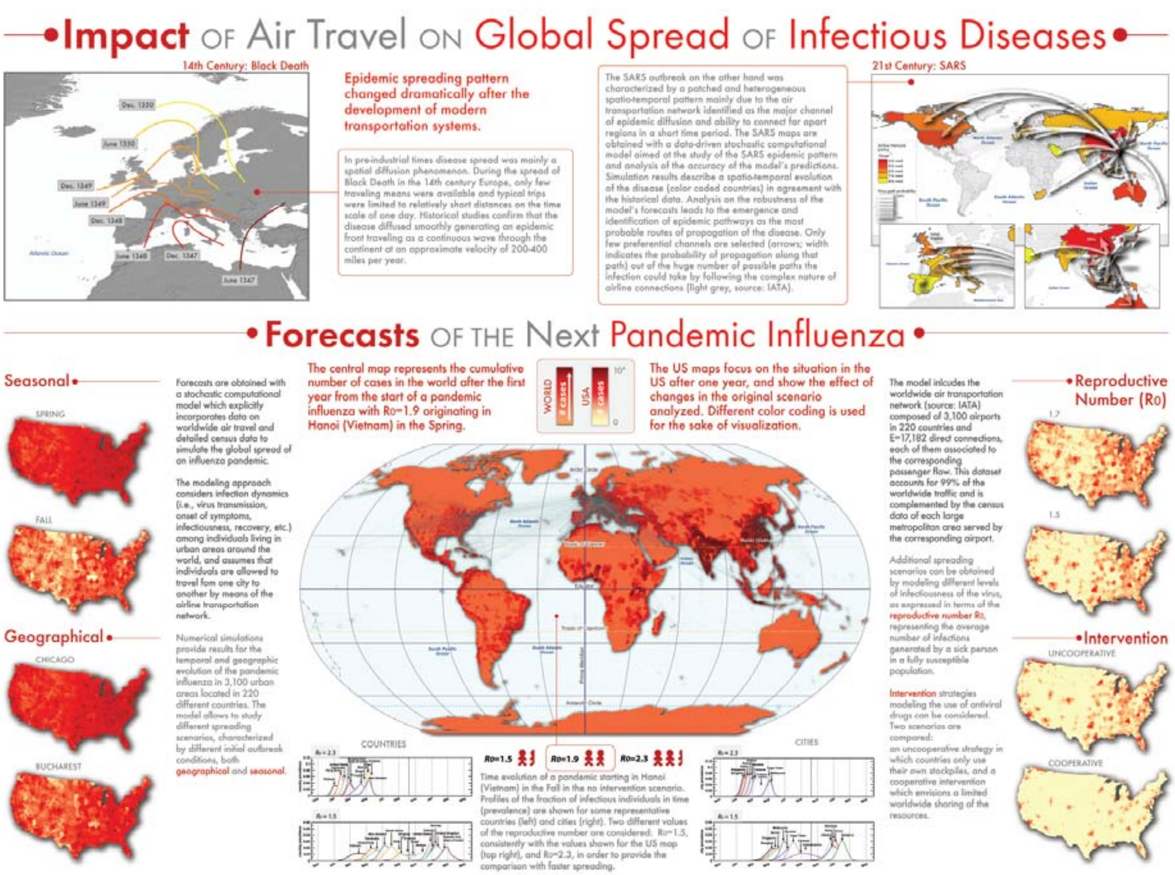


(3rd Iteration of Places & Spaces Exhibit - 2007)



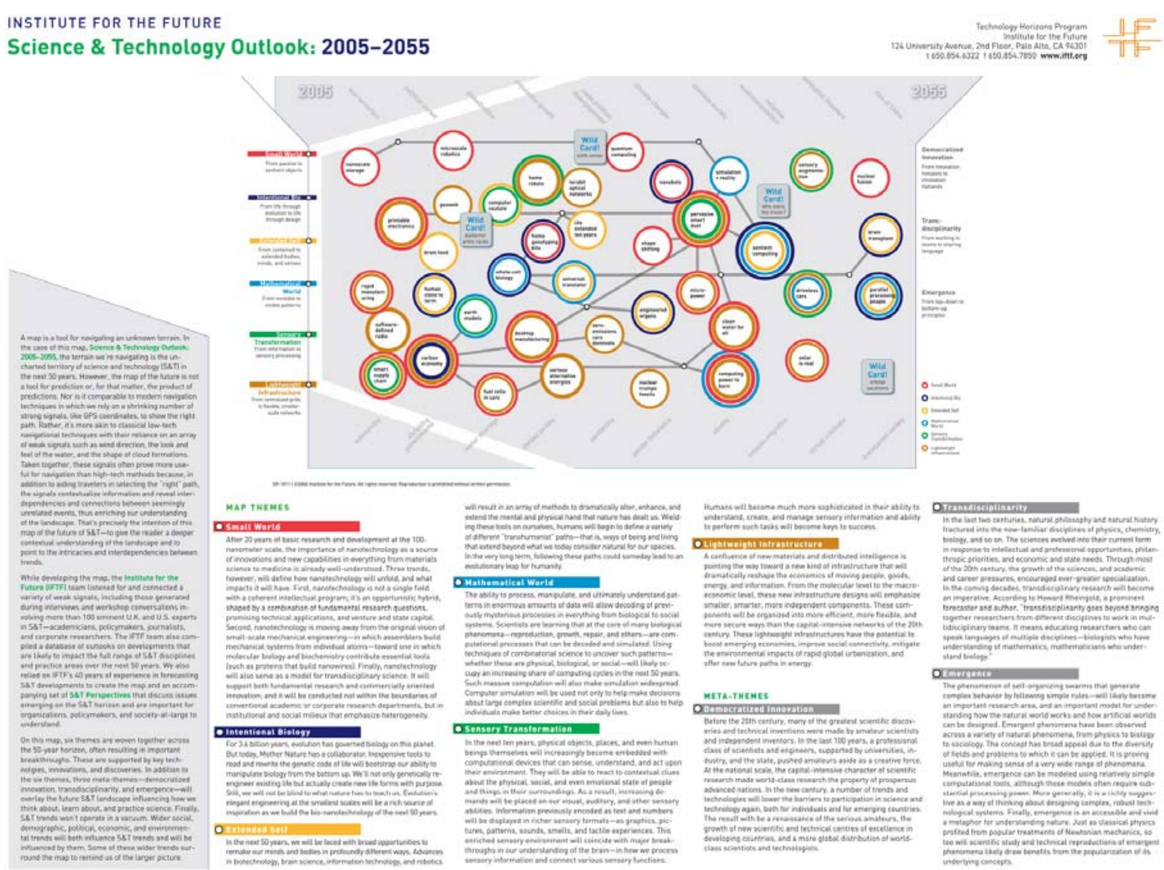
Named Storms, available online at http://svs.gsfc.nasa.gov/vis/a000000/a003200/a003279

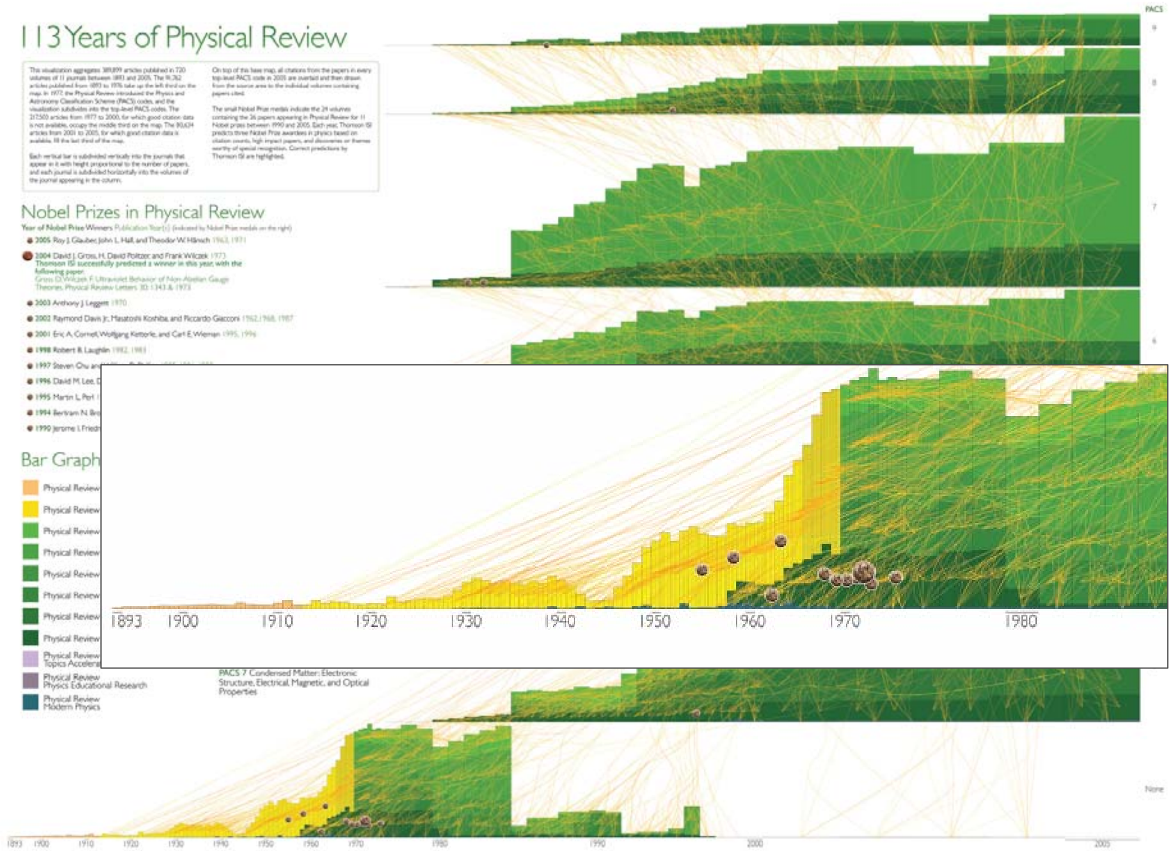

GSHAP
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
AUSTRALIA
SEISMIC HAZARD
Probable Ground Acceleration
Tectonic Plate Boundaries
Earthquake Depth (km)
Volcano
Symbol Size=EQ Magnitude
Cities
Countries
Plate Name
Plate Movement

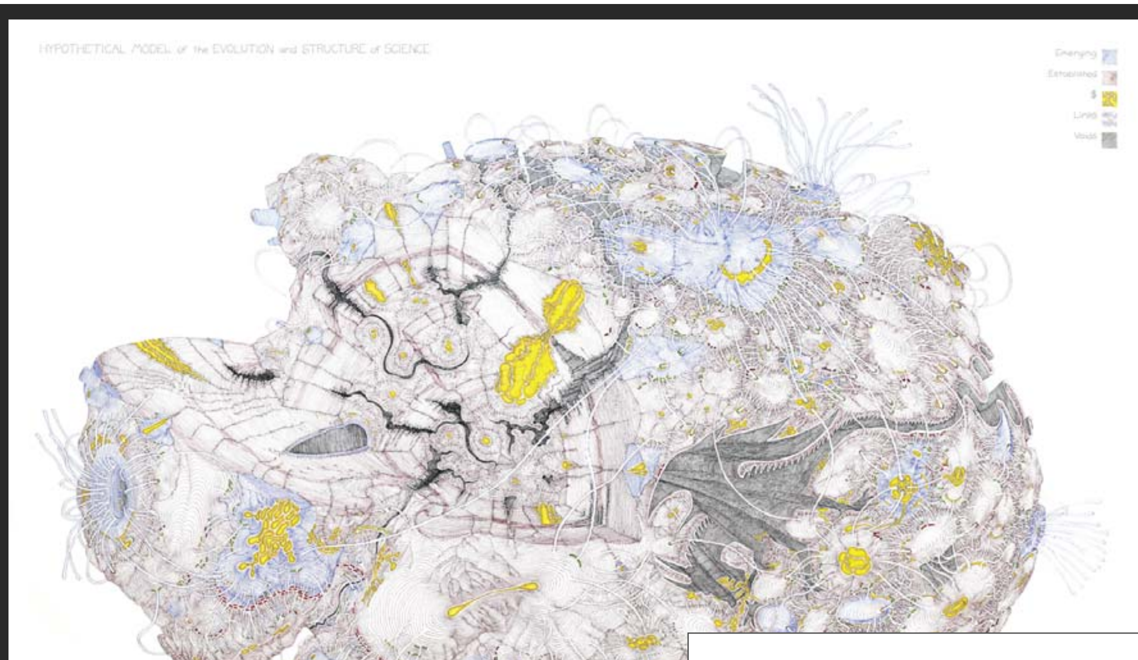

Impact OF Air Travel ON Global Spread OF Infectious Diseases
14th Century: Black Death
Dec. 1350
June 1350
Dec. 1349
June 1349
Dec. 1348
June 1348
Dec. 1347
June 1347
Epidemic spreading pattern changed dramatically after the development of modern transportation systems.
In pre-industrial times disease spread was mainly a spatial diffusion phenomenon. During the spread of Black Death in the 14th century Europe, only few traveling means were available and typical trips were limited to relatively short distances on the time scale of one day. Historical studies confirm that the disease diffused smoothly generating an epidemic front traveling as a continuous wave through the continent at an approximate velocity of 200-400 miles per year.
The SARS outbreak on the other hand was characterized by a patched and heterogeneous spatio-temporal pattern mainly due to the air transportation network identified as the major channel of epidemic diffusion and ability to connect far apart regions in a short time period. The SARS maps are obtained with a data-driven stochastic computational model aimed at the study of the SARS epidemic pattern and analysis of the accuracy of the model's predictions. Simulation results describe a spatio-temporal evolution of the disease (color coded countries) in agreement with the historical data. Analysis on the robustness of the model's forecasts leads to the emergence and identification of epidemic pathways as the most probable routes of propagation of the disease. Only few preferential channels are selected (arrows; width indicates the probability of propagation along that path) out of the huge number of possible paths the infection could take by following the complex nature of airline connections (light grey, source: IATA).
21st Century: SARS
Forecasts OF THE Next Pandemic Influenza
Seasonal
SPRING
FALL
Geographical
CHICAGO
BUCHAREST
Forecasts are obtained with a stochastic computational model which explicitly incorporates data on worldwide air travel and detailed census data to simulate the global spread of an influenza pandemic.
The modeling approach considers infection dynamics (i.e., virus transmission, onset of symptoms, infectiousness, recovery, etc.) among individuals living in urban areas around the world, and assumes that individuals are allowed to travel fom one city to another by means of the airline transportation network.
Numerical simulations provide results for the temporal and geographic evolution of the pandemic influenza in 3,100 urban areas located in 220 different countries. The model allows to study different spreading scenarios, characterized by different initial outbreak conditions, both geographical and seasonal.
The central map represents the cumulative number of cases in the world after the first year from the start of a pandemic influenza with R0=1.9 originating in Hanoi (Vietnam) in the Spring.
WORLD
cases
USA
cases
The US maps focus on the situation in the US after one year, and show the effect of changes in the original scenario analyzed. Different color coding is used for the sake of visualization.
COUNTRIES
CITIES
R0=1.5
R0=1.9
R0=2.3
Time evolution of a pandemic starting in Hanoi (Vietnam) in the Fall in the no intervention scenario. Profiles of the fraction of infectious individuals in time (prevalence) are shown for some representative countries (left) and cities (right). Two different values of the reproductive number are considered: R0=1.5, consistently with the values shown for the US map (top right), and R0=2.3, in order to provide the comparison with faster spreading.
The model inlcudes the worldwide air transportation network (source: IATA) composed of 3,100 airports in 220 countries and E=17,182 direct connections, each of them associated to the corresponding passenger flow. This dataset accounts for 99% of the worldwide traffic and is complemented by the census data of each large metropolitan area served by the corresponding airport.
Additional spreading scenarios can be obtained by modeling different levels of infectiousness of the virus, as expressed in terms of the reproductive number R0, representing the average number of infections generated by a sick person in a fully susceptible population.
Intervention strategies modeling the use of antiviral drugs can be considered. Two scenarios are compared:
an uncooperative strategy in which countries only use their own stockpiles, and a cooperative intervention which envisions a limited worldwide sharing of the resources.
Reproductive Number (R0)
1.7
1.5
Intervention
UNCOOPERATIVE
COOPERATIVE

Can one forecast science?

What 'science forecast language' will work?

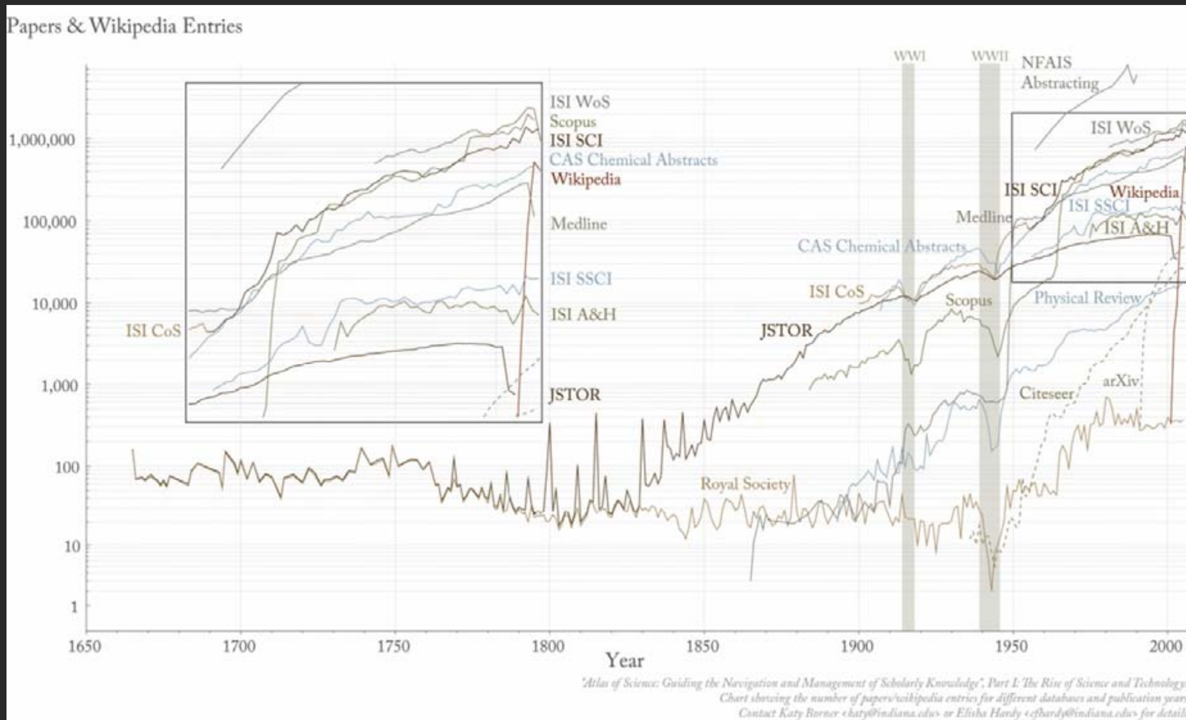




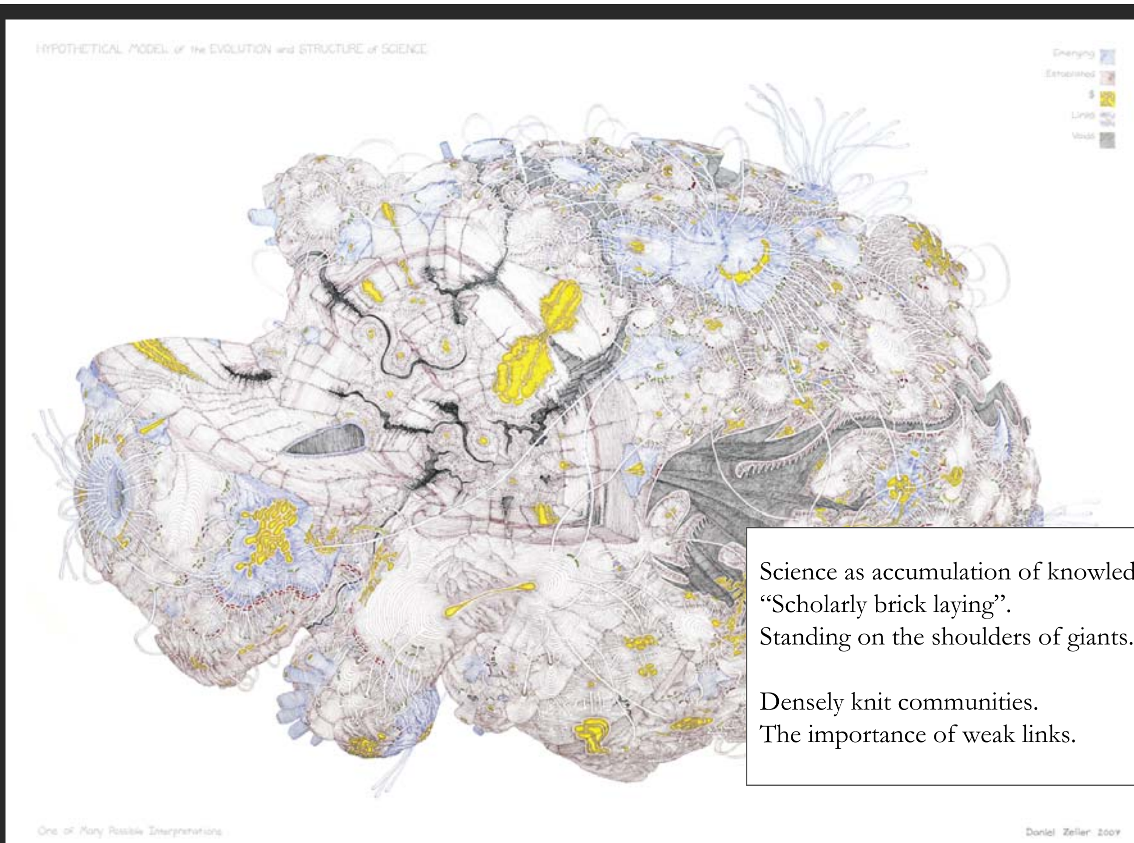


Authors are mortal. Papers are immortal.
Monsters = 'the unknown' or voids.
Impact of funding on science (yellow).
Good and bad years.

Hypothetical Model of the Evolution of Science - Daniel Zeller - 2007



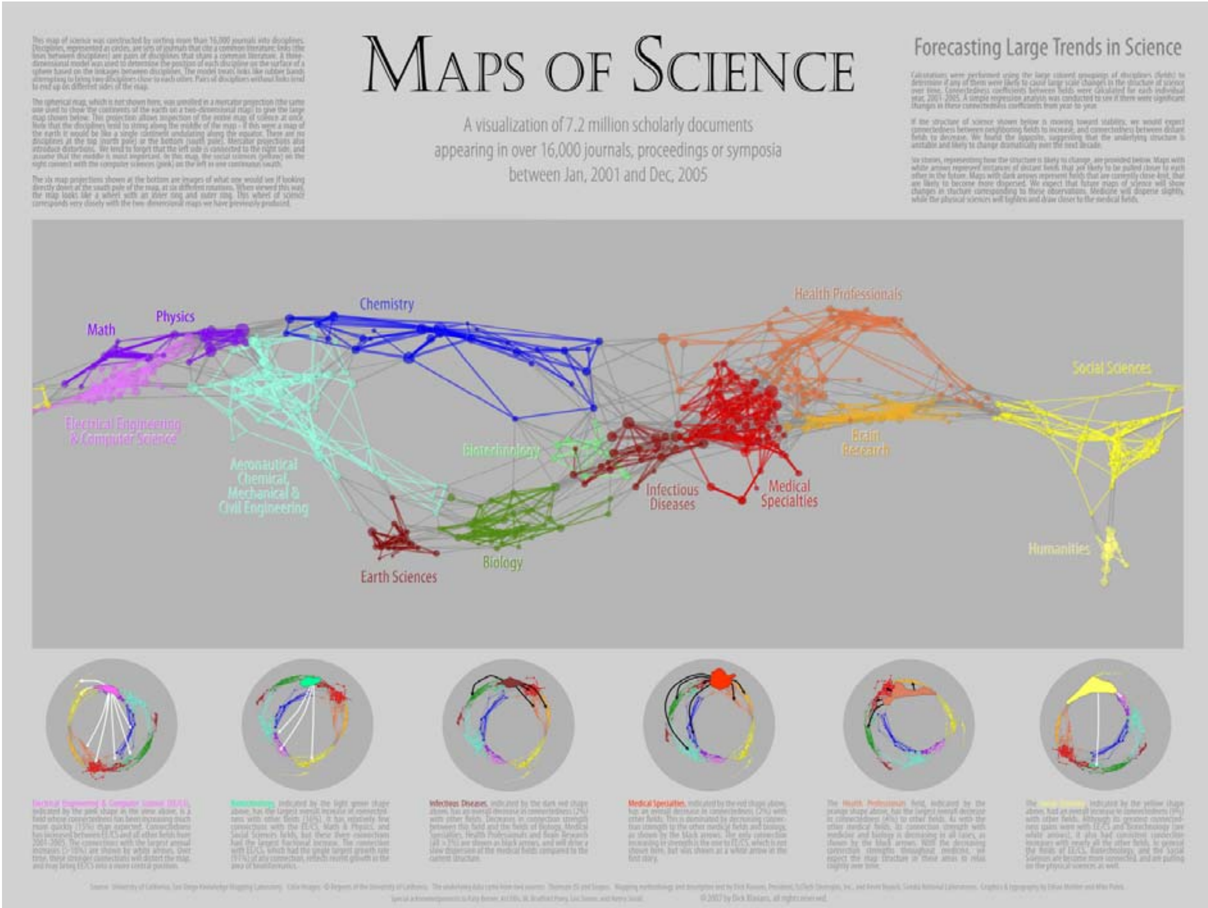
Atlas of Science - Katy Borner - 2010



Science as accumulation of knowledge.
"Scholarly brick laying".
Standing on the shoulders of giants.

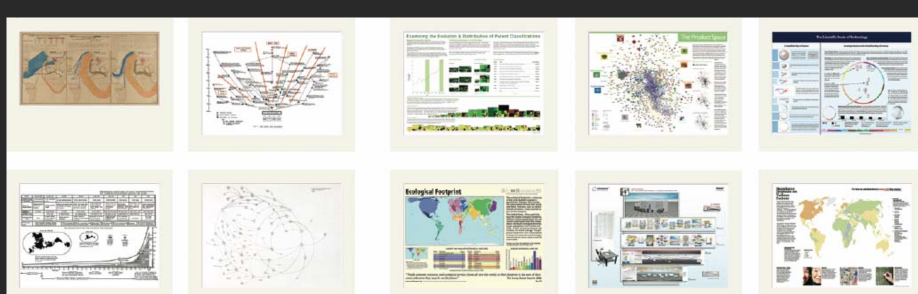
Densely knit communities.
The importance of weak links.

Hypothetical Model of the Evolution of Science - Daniel Zeller - 2007

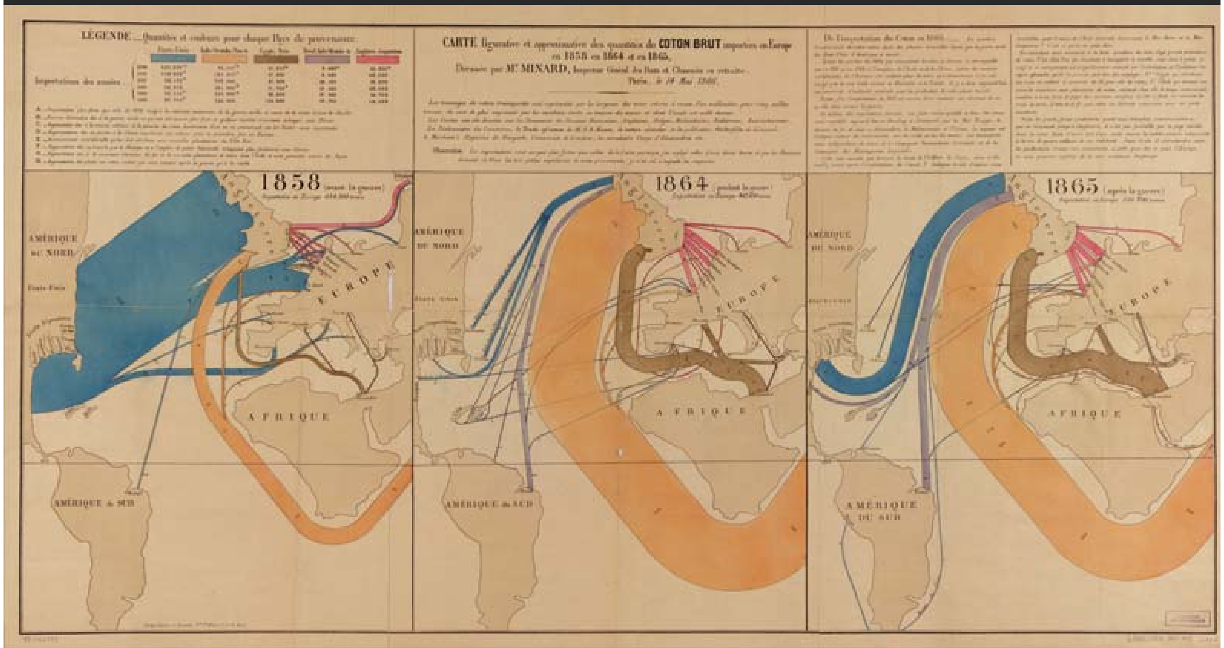


Science Maps for Economic Decision Making

Four Existing Maps
VERSUS
Six Science Maps



(4^{th} Iteration of Places & Spaces Exhibit - 2008)



Joseph Minard, Title: Europe Raw Cotton Imports in 1858, 1864 and 1865 (1866)

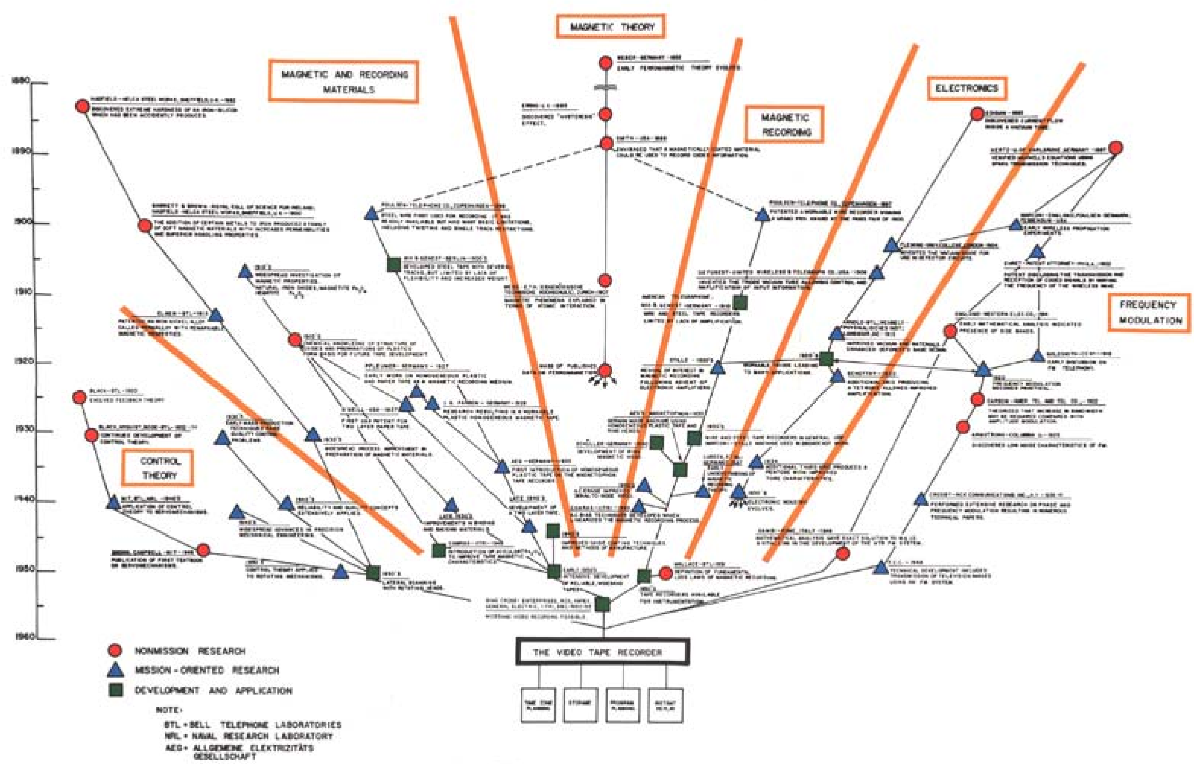
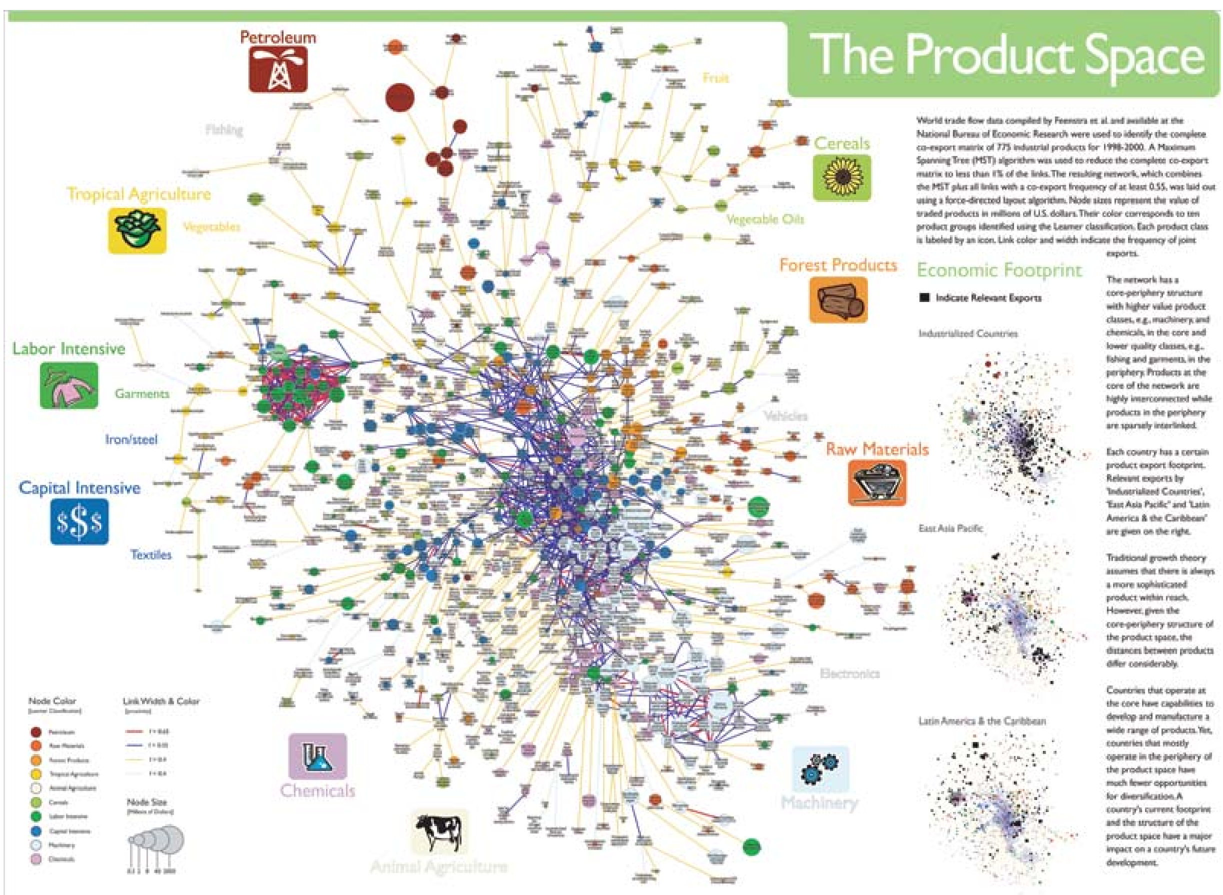


FIG. 7. THE VIDEO TAPE RECORDER

What insight needs to economic decision makers have?

What data views are most useful?

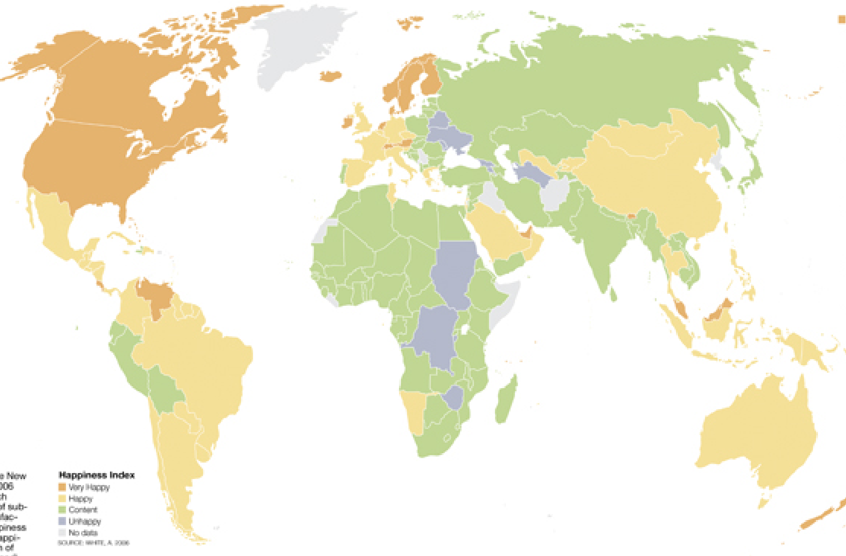


Happiness Depends on Various Factors

"It's time we admitted there's more to life than money."
- David Cameron, U.K. leader of the opposition, 2006

Social scientists are starting to include relative happiness with hard data on economic status, health, and other factors as they assess quality of life. They rely on surveys of "subjective well-being"—how good people feel about their lives. A world map of one "happiness index" shows many, but not all, wealthy northern countries faring well. Residents of sub-Saharan Africa and the former Soviet Union, meanwhile, report particularly low levels of contentment.

Any attempt to measure happiness will fall short—each life is a series of joys, struggles, and sorrows, and satisfaction can depend as much on outlook as on circumstances. Averages obscure the happy moments in struggling nations, as well as people who suffer from poor health, poverty, or discrimination in countries that rank high. Still, happiness indices can help researchers move beyond simple economics as they track progress—or backsliding—over time.



RANKING THE WORLD'S HAPPIEST PLACES

Northern Europe, North America, and several wealthy countries make the list, but so do many less prosperous island nations.

1. DENMARK, SWITZERLAND
2. AUSTRIA, ICELAND
3. BAHAMAS, FINLAND, SWEDEN
4. BHUTAN, BRUNEI, CANADA, IRELAND, LUXEMBOURG
5. COSTA RICA, MALTA, NETHERLANDS
6. ANTIGUA AND BARBUDA, MALAYSIA, NEW ZEALAND, NORWAY, SEYCHELLES, ST. KITTS AND NEVIS, UNITED ARAB EMIRATES, UNITED STATES, VANUATU, VENEZUELA

MEASURING THE INTANGIBLE

The map is derived from the New Economics Foundation's 2006 "Happy Planet Index," which drew on over 100 surveys of subjective well-being. Its "satisfaction with life scale"—a happiness index—ranks the relative happiness of nations, from a high of 273 (Denmark and Switzerland) to a low of 100 (Burundi).

DEFINING WELL-BEING

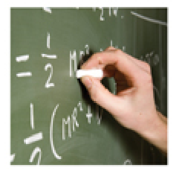
By comparing the happiness index to data from the UN, the CIA, and other sources, a U.K. psychologist determined that good health and health care, enough money for fundamental needs, and access to basic education are the most important factors for subjective well-being. European countries top all three measures.

HEALTH

Japan boasts the world's longest life expectancy—one measure of overall health. Swaziland, at the other end of the scale, is plagued by poverty, disease, and violence. Disparities in access to health care divide many countries into haves and have-nots.

WEALTH

Money still can't buy love, or happiness, and wealthier people aren't always more content. Still, tiny Luxembourg, which takes top rank in per capita Gross Domestic Product (GDP), also rates a 253 on the happiness index. Real poverty means real misery, a fate shared by billions.



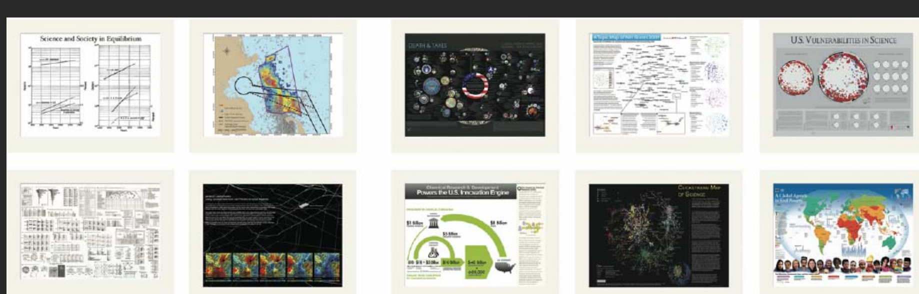
EDUCATION

Residents of Australia can expect to spend more time in school—an average of almost 21 years—than citizens of any other country. But only a basic education is needed to see a significant jump in overall happiness. Around the world, hundreds of millions lack even that.

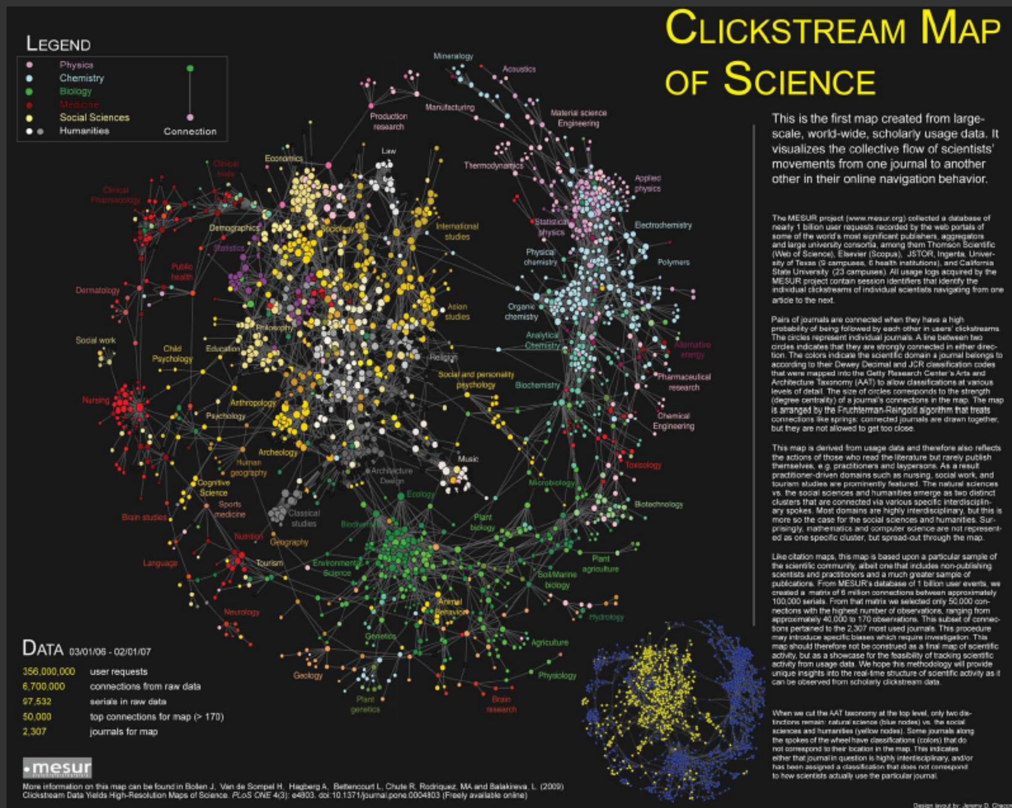
*Photos different than those used in EarthPulse publication

Science Maps for Science Policy Making

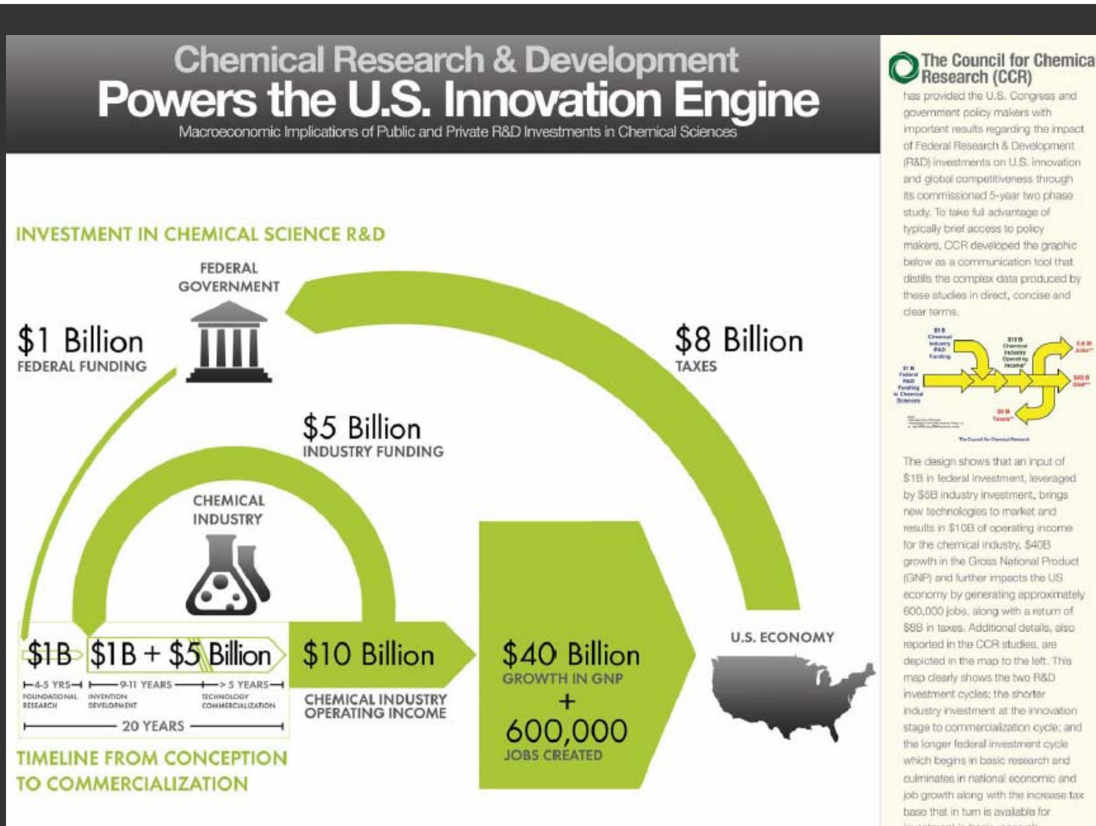
Four Existing Maps VERSUS Six Science Maps



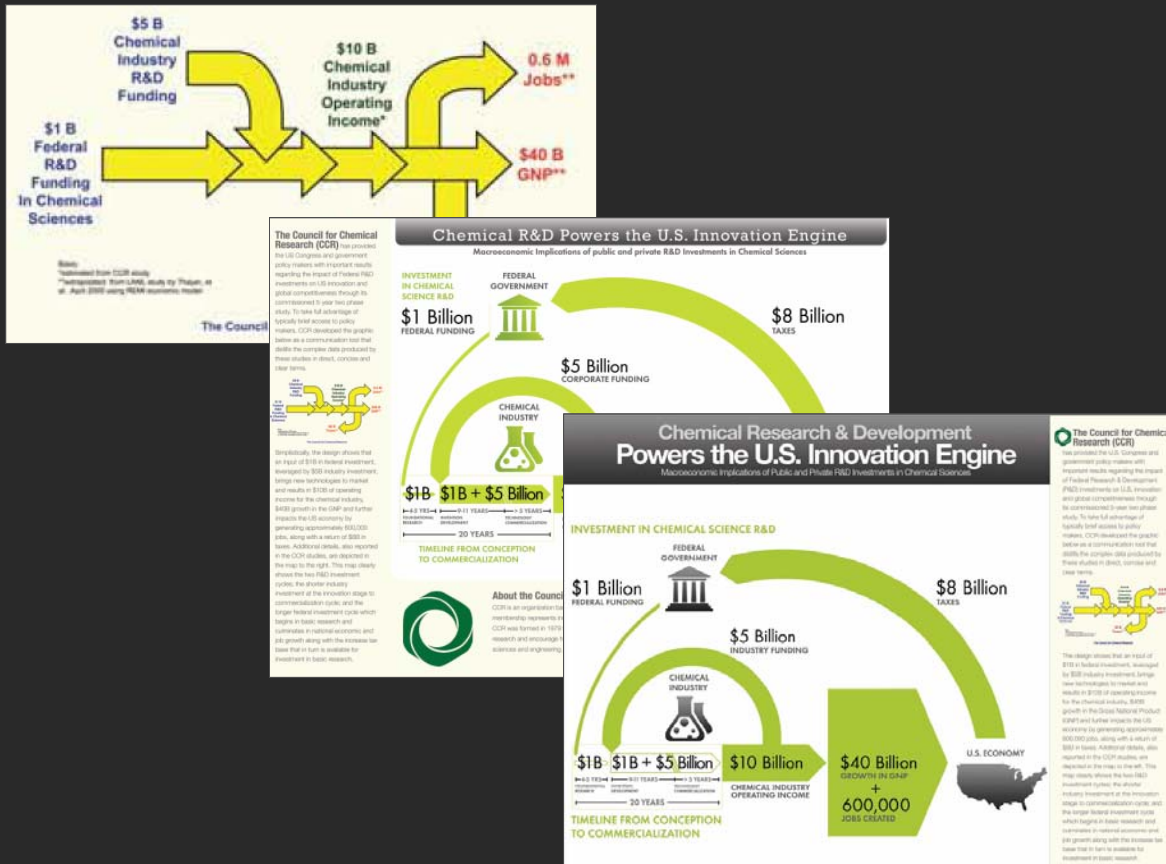
(5th Iteration of Places & Spaces Exhibit - 2009)



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



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



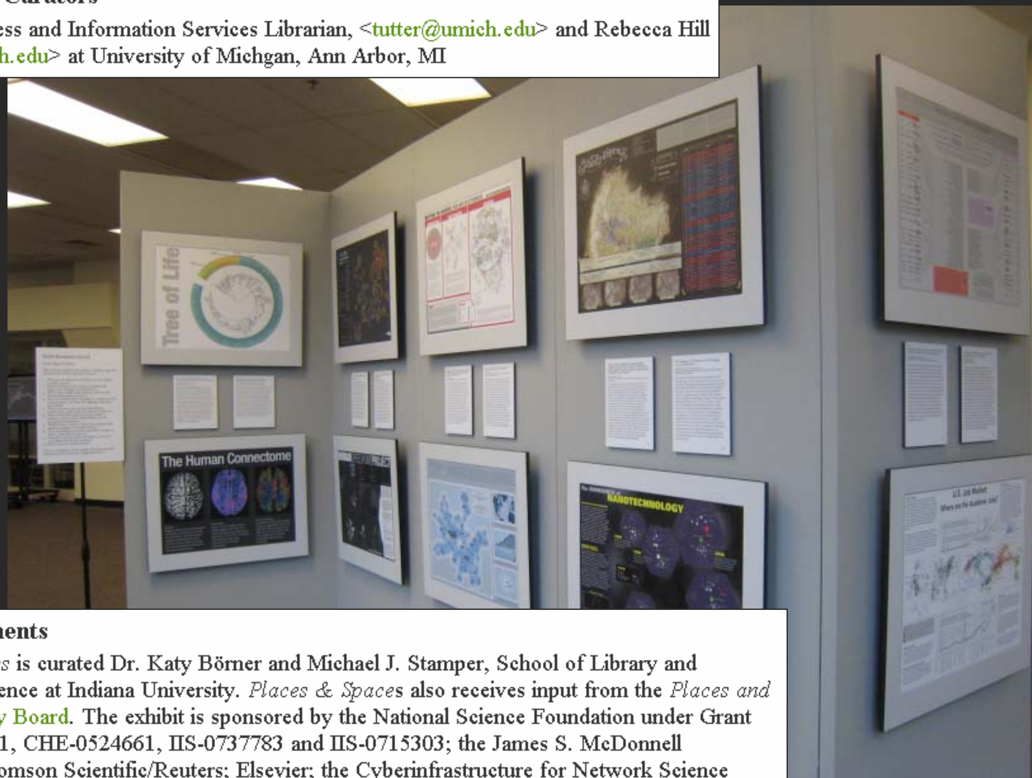
Science Maps for Scholars

Four Existing Maps
VERSUS
Six Science Maps

(6th Iteration of Places & Spaces Exhibit – 2010)

Local Exhibit Curators

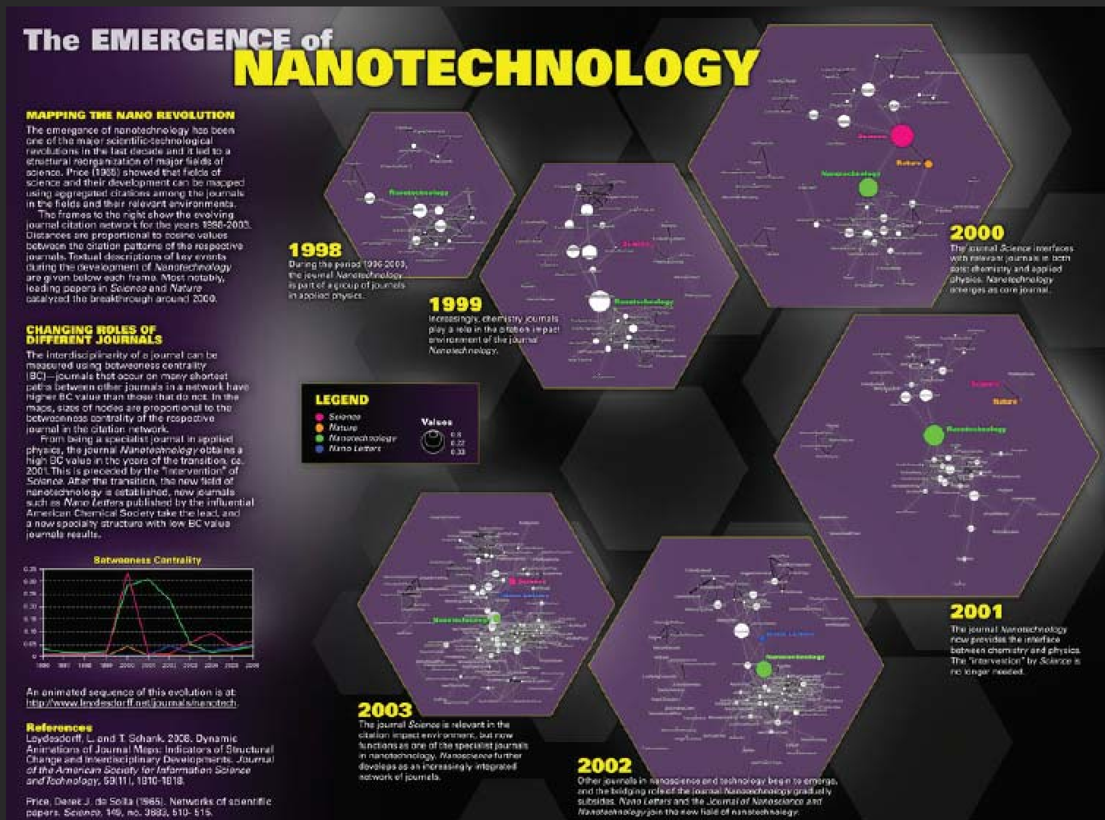
Tim Utter, Access and Information Services Librarian, <tutter@umich.edu> and Rebecca Hill <rebehill@umich.edu> at University of Michigan, Ann Arbor, MI



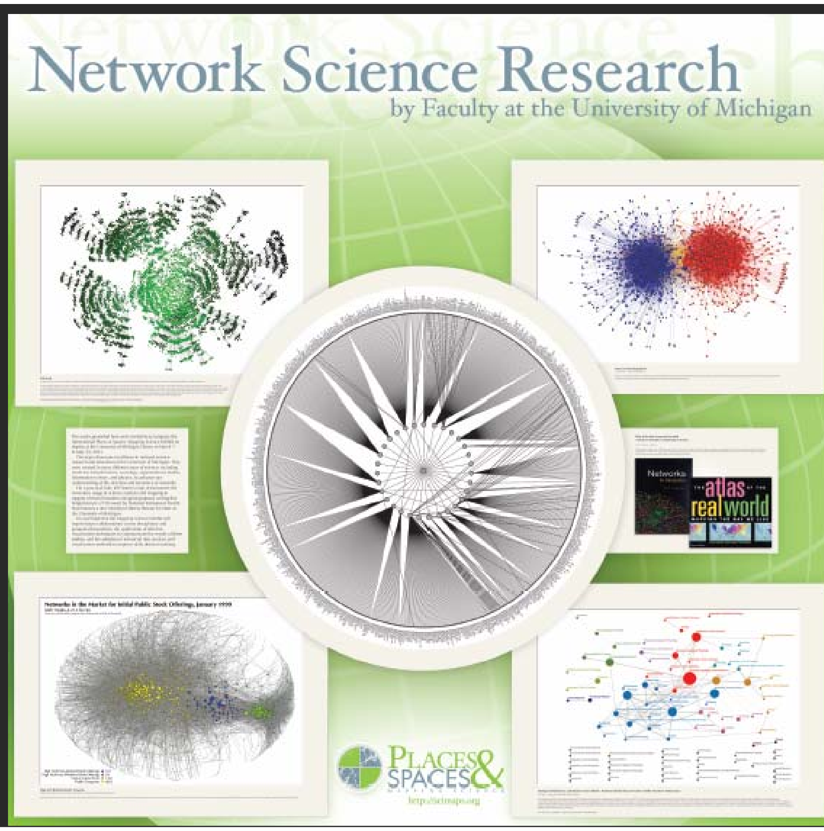
Acknowledgments

Places & Spaces is curated Dr. Katy Börner and Michael J. Stamper, School of Library and Information Science at Indiana University. *Places & Spaces* also receives input from the *Places and Spaces* Advisory Board. The exhibit is sponsored by the National Science Foundation under Grant No. IIS-0238261, CHE-0524661, IIS-0737783 and IIS-0715303; the James S. McDonnell Foundation; Thomson Scientific/Reuters; Elsevier; the Cyberinfrastructure for Network Science Center, University Information Technology Services, and the School of Library and Information Science, all three at Indiana University. Some of the data used to generate the science maps is from Thomson Scientific/Reuters.

John A. Walsh, Devin Becker, Bradford Demarest, Jonathan Tweedy, Theodora Michaelidou, and Laura Pence (2010) Map of Literary Empires: Mapping Temporal and Spatial Settings of Victorian Poetry.



Loet Leydesdorff, Thomas Schank and the Journal of the American Society for Information Science and Technology. 2010. The Emergence of Nanoscience & Technology.



Several University of Michigan faculty created maps included in the exhibit: Santiago Schnell, Molecular and Integrative Physiology; Lada Adamic, School of Information; M. E. J. Newman, Physics; Jeff Horon, Medical School; Helena Buhr, Natalie Cotton, and Jason Owen-Smith, Sociology and Organizational Studies.

Upcoming Iterations

- Science Maps as Visual Interfaces to Digital Libraries (2011)
- Science Maps for Kids (2012)
- Science Forecasts (2013)
- How to Tell Lies with Science Maps (2014)

WIRED SCIENCE

NEWS FOR YOUR NEURONS

PREVIOUS POST NEXT POST

Data as Art: 10 Striking Science Maps

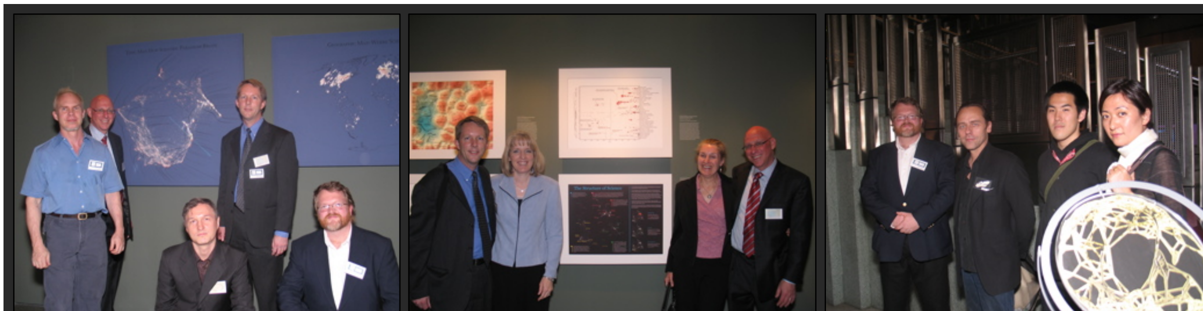
By Dave Mosher March 8, 2011 | 7:00 am | Categories: Art, Tech

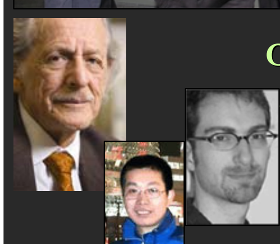
<< Previous | Next >>

The computer age triggered a seemingly endless stream of scientific data, but such incoming mountains of information come at a cost. The more data you amass, the tougher it is to comprehend what you're dealing with.

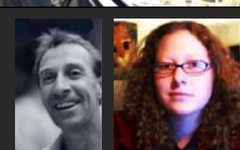
In a push for better perspective, a group of information scientists in 2005 created a decade-long competitive art exhibit called Places & Spaces: Mapping Science. From artistic pop-culture plots to illustrations of the state of scientific collaboration (above), the founders hope winning entries inspire researchers to present their troves of data in clever and digestible ways.

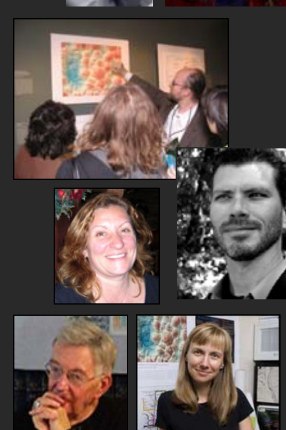
"Good science maps give you a holistic understanding of how the data is structured," said information scientist Katy Börner of Indiana University, a founder and curator of the exhibit. She is also author of the Atlas of Science, a collection of the maps gathered over the years. "You don't just have to use maps to find your way home. They can be ways to get global overviews on topics."





Contact the map makers or the exhibit curators:
Katy Börner (katy@indiana.edu) and Michael J. Stamper (mstamper@indiana.edu)



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Atlas of Science
Wall
Places & Spaces: Mapping...
Top Posts
Places & Spaces: Mapping Science
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