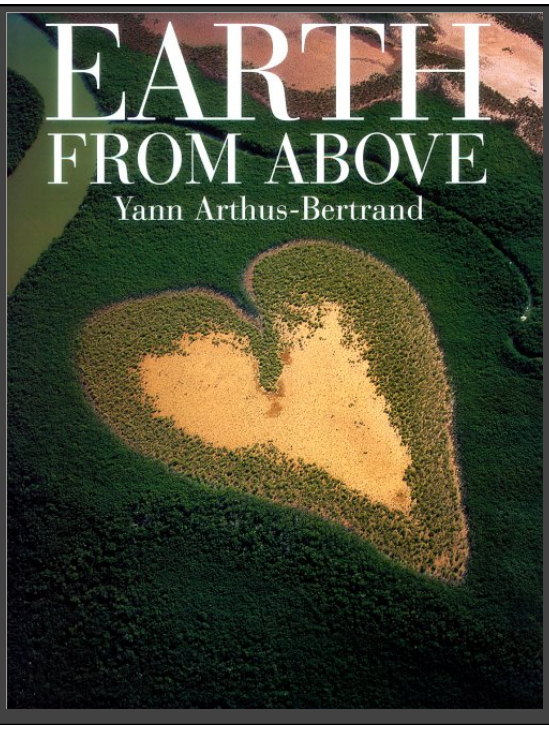
PLACES & SPACES

MAPPING SCIENCE

scimaps.org

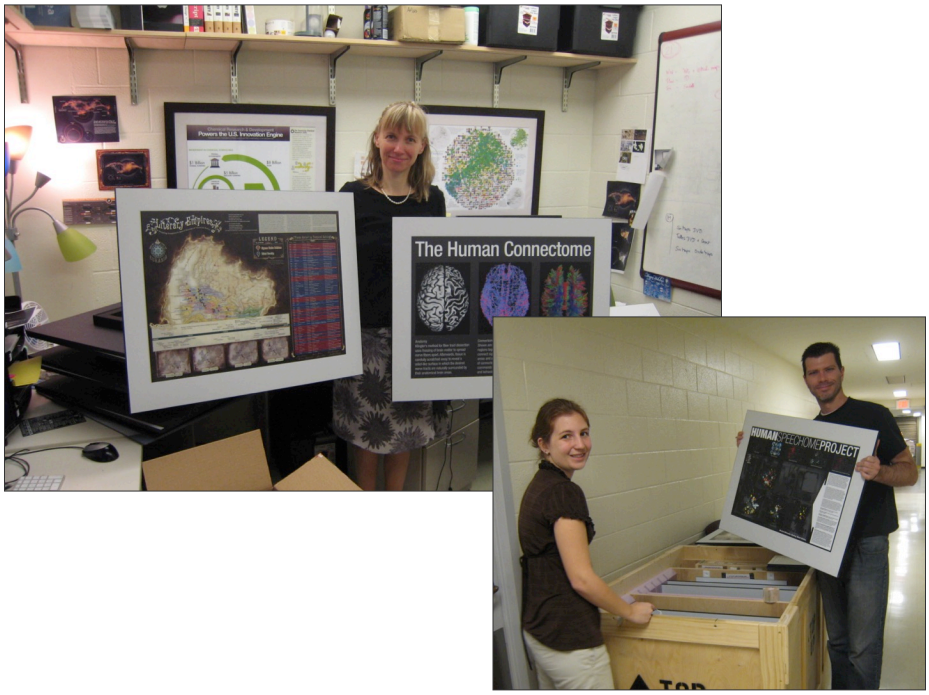


How can we communicate the beauty, structure, and dynamics of science to a general audience?


April, 2005: 101st Annual Meeting of the
Association of American Geographer, Denver, Colorado.


The Structure of Science
9, 2005: 101st Annual Meetin
American Geographer, Denv


INDIANA
UNIVERSITY
PLACES AND SPACES
EXHIBIT

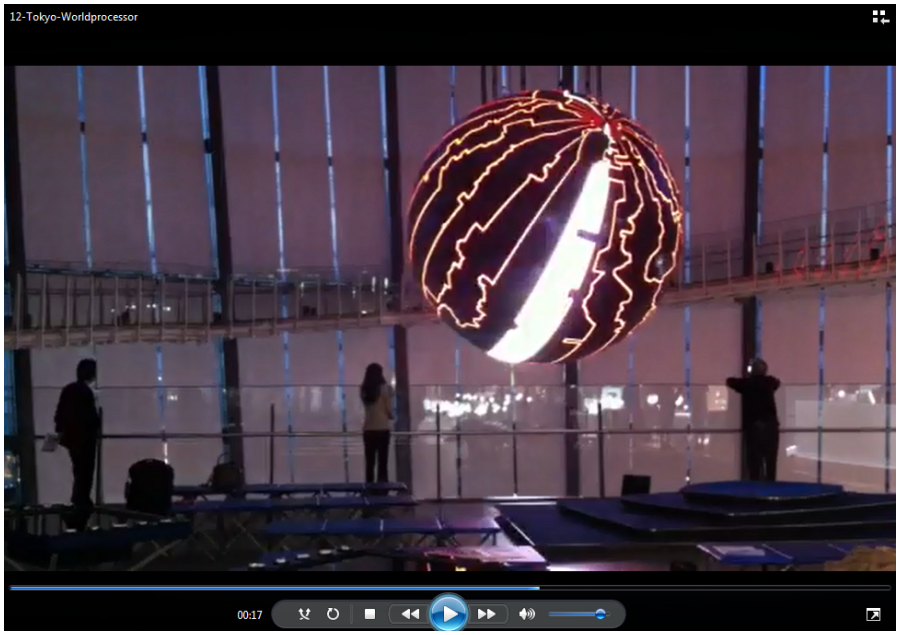



Debut of 5th Iteration of the Mapping Science Exhibit at MEDIA X was in 2009 at Wallenberg Hall, Stanford University.

8


Science Maps in “Expedition Zukunft” science train visited 62 cities in 7 months. Opening was on April 23rd, 2009 by German Chancellor Merkel

9




Ingo Gunther's Worldprocessor globe design on display at the Museum of Emerging Science and Innovation in Tokyo, Japan

Places & Spaces *Digital Display in North Carolina State's brand new Immersion Theater*

11

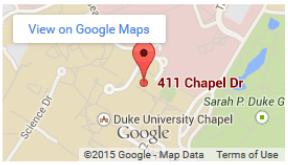


## Places & Spaces at Duke University

January 12 - April 10, 2015

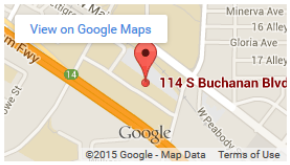
### Venues:

The Edge
411 Chapel Dr.
Durham, NC 27708




Gross Hall
Near Towerview Rd. & Science Dr.
Durham, NC 27710


Smith Warehouse
114 S. Buchanan Blvd.
Durham, NC 27701




### Special Events

**Wednesday, January 21**, 4:00 - 6:00 PM, Jones Open Lab – Opening Keynote and Reception
**Wednesday, January 21**, 3:00 - 4:00 PM, The Edge – Digital Scholarship Series – Manifest Data
**Thursday, January 22**, 12:00 - 1:00 PM, Smith Warehouse – Screening of *Humanexus*
**Friday, January 23**, 9:45 AM - 3:00 PM, Perkins Library – Uncharted: Mapping the Spaces Between Disciplines
**Friday, January 23**, 12:00 - 1:00 PM, The Edge – Exhibit Tour in the Edge

### Acknowledgments:

*Places & Spaces: Mapping Science* is curated by Dr. Katy Börner and Lisel Record at the Cyberinfrastructure for Network Science Center, School of Informatics at Indiana University. Places & Spaces also receives input from its Advisory Board. Support from Duke University for this exhibit comes from: Information Science + Information Studies; Duke Institute for Brain Sciences; Bass Connections, Brain & Society Theme; Office of the Vice Provost for Research; Information Initiative at Duke; Duke University Libraries; Data and Visualization Services; and Scholars@Duke.

10 iterations over 10 years

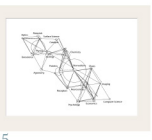
equal

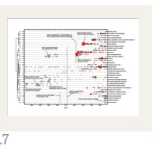
10 x 10 = 100 maps!

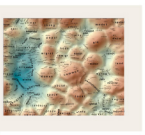
The Power of Maps 2005


I.1

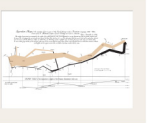

I.3


I.5

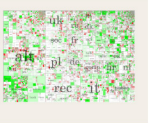

I.7


I.9


I.2


I.4


I.6


I.8

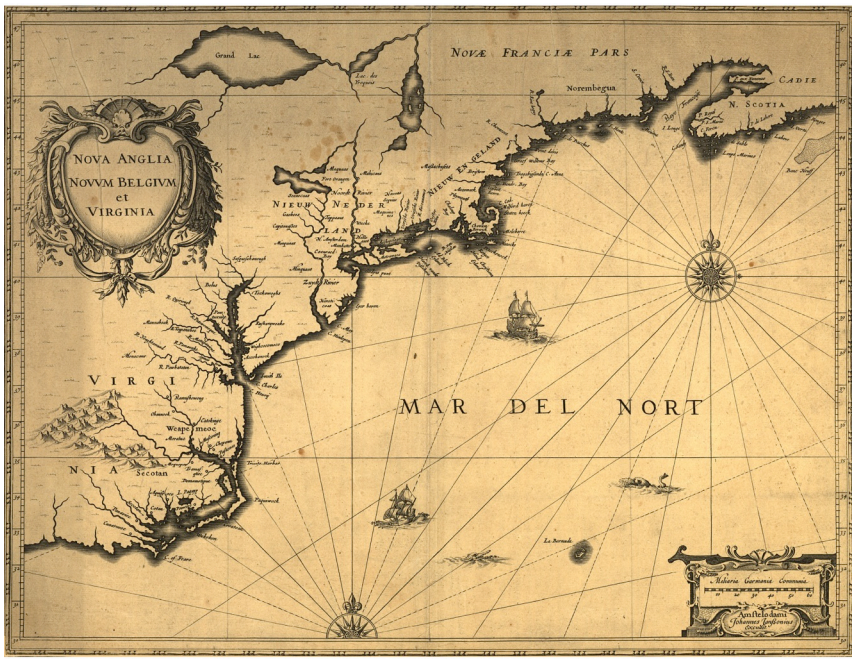

I.10

**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.


*Cosmographia World Map* - Claudius Ptolemy - 1482

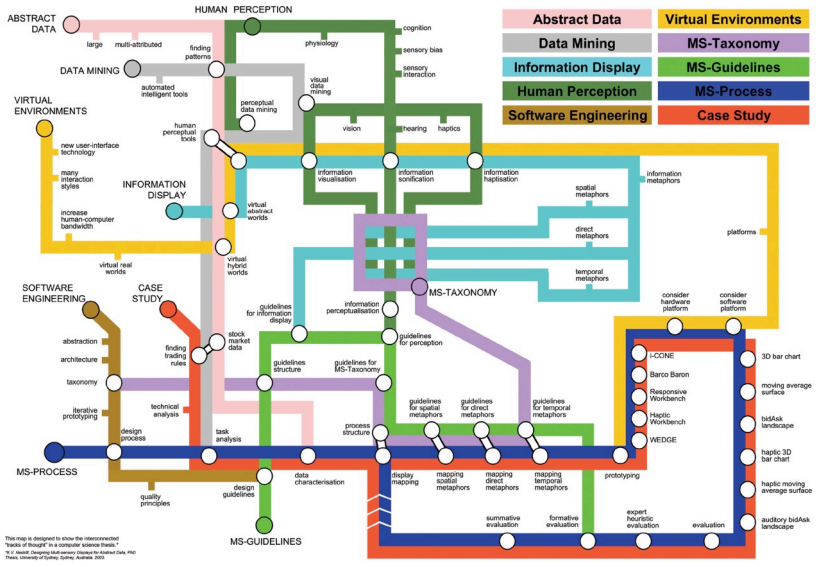



*Nova Anglia, Novvm Belgivm et Virginia* - Jan Jannson - 1642

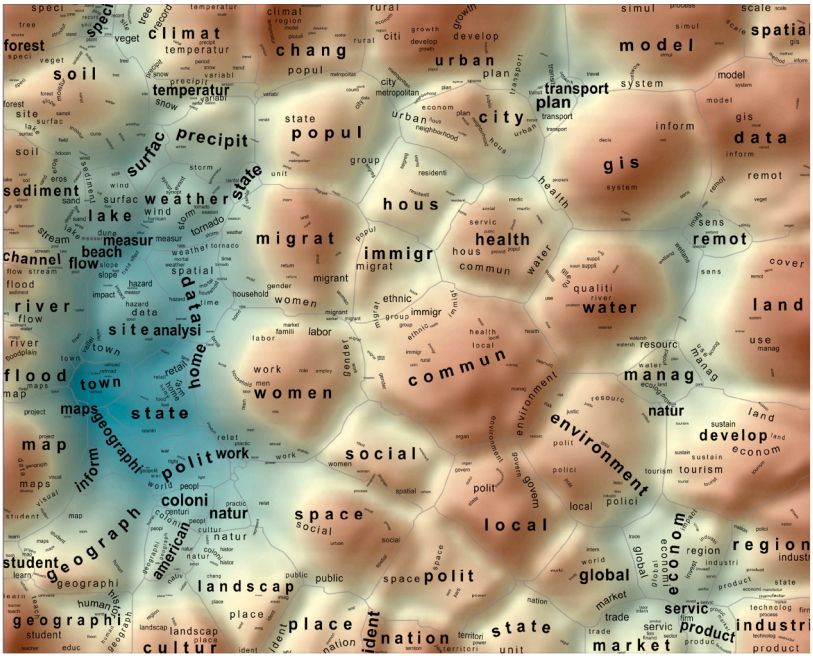

*A New Map of the Whole World with Trade Winds According to the Latest and Most Exact Observations* - Herman Moll - 1736

**Science maps** of abstract semantic spaces aim to serve today's explorers navigating the world of science.

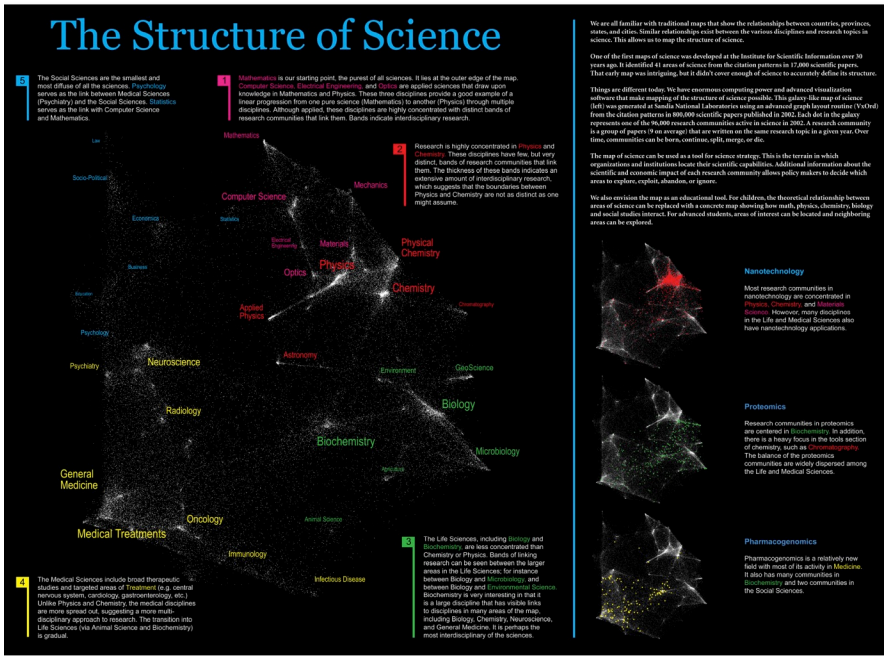
They can be used to identify objectively major experts, institutions, collections. They allow us to track the emergence, evolution, and disappearance of topics and help to identify the most promising areas of research.




*Ph.D. Thesis Map* - Keith B. Nesbitt - 2004




*In Terms of Geography* - Andre Skupin - 2005



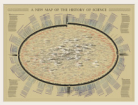

*The Structure of Science* - Kevin Boyack, Richard Klavans - 2005

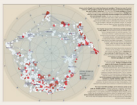
## The Power of Reference Systems 2006


II.1


II.3

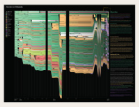

II.5


II.7


II.9

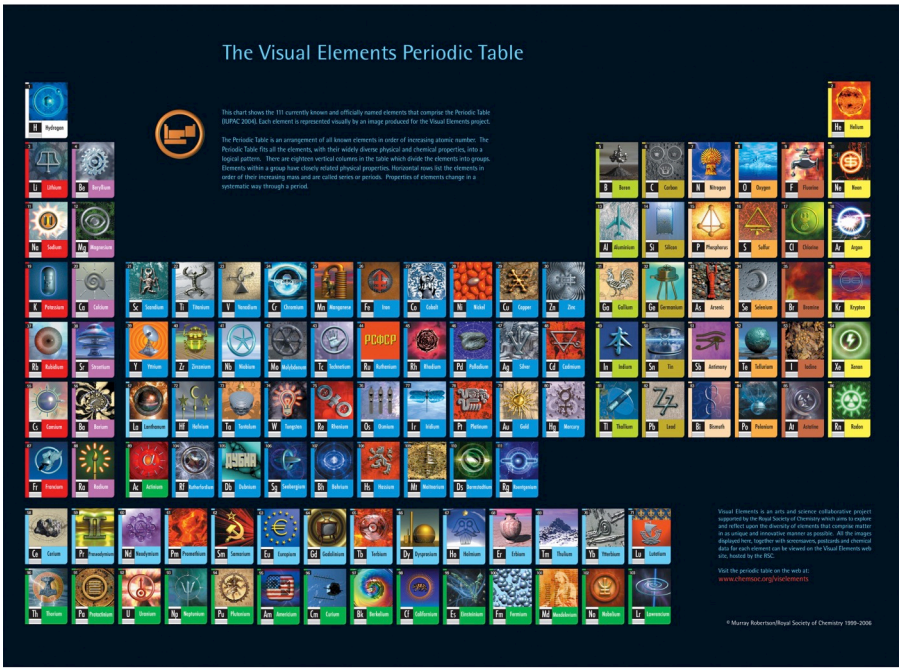

II.2

II.4

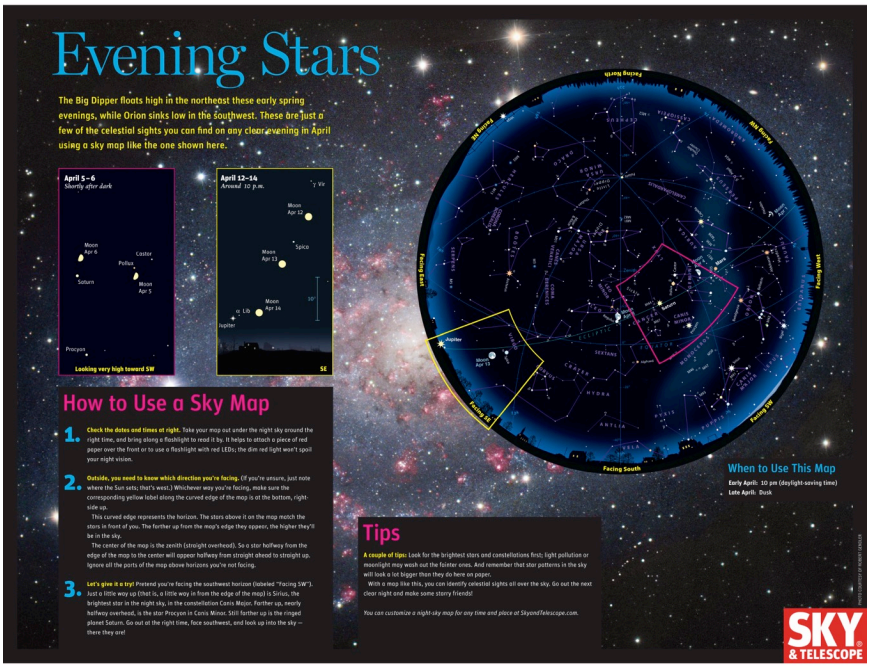

II.6

II.8


II.10



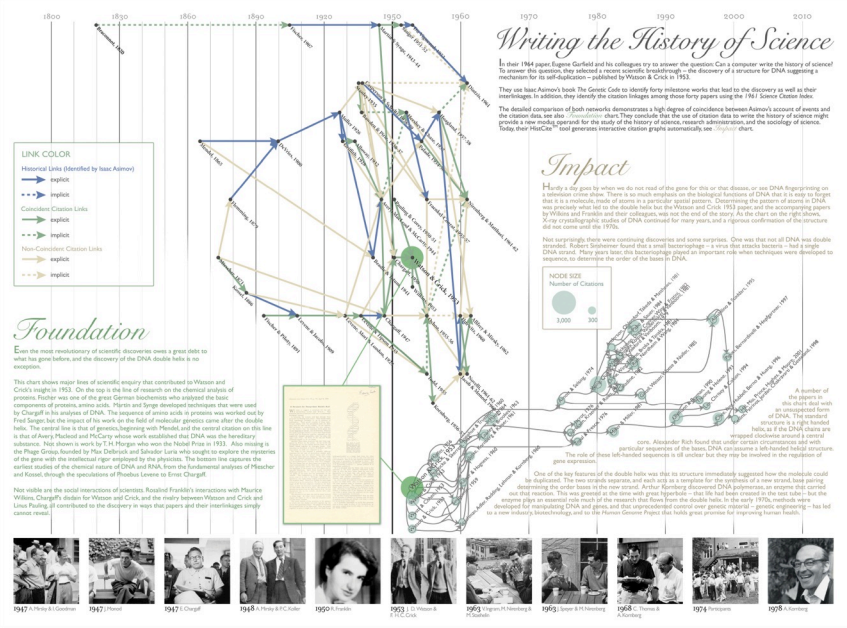

*Visual Elements Periodic Table* - Murray Robertson, John Emsley - 2005



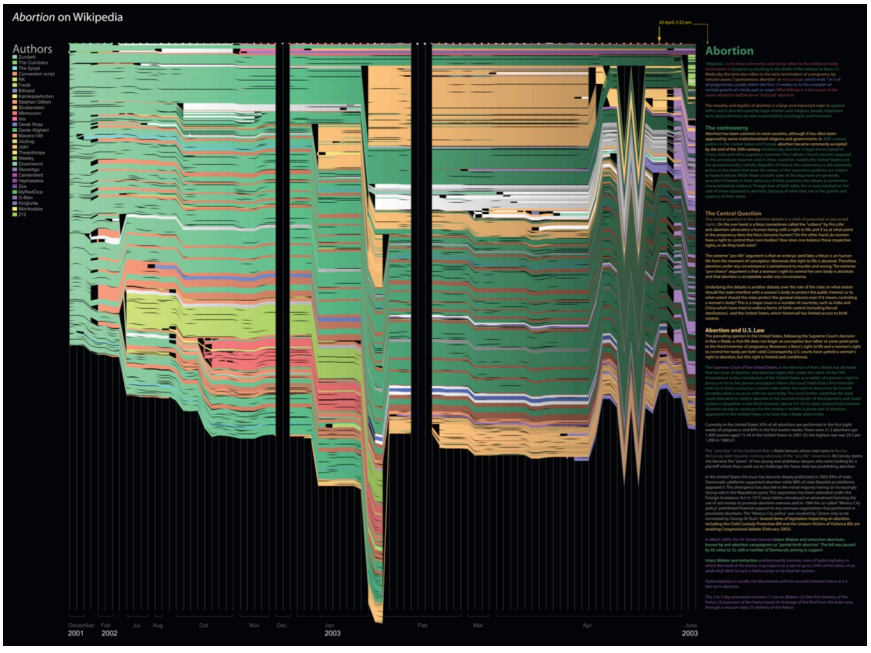

*Sky Chart of New York City in April 2006* - Roger W. Sinnott, Interactive Factory - 2006

How would a reference system for all of science look?

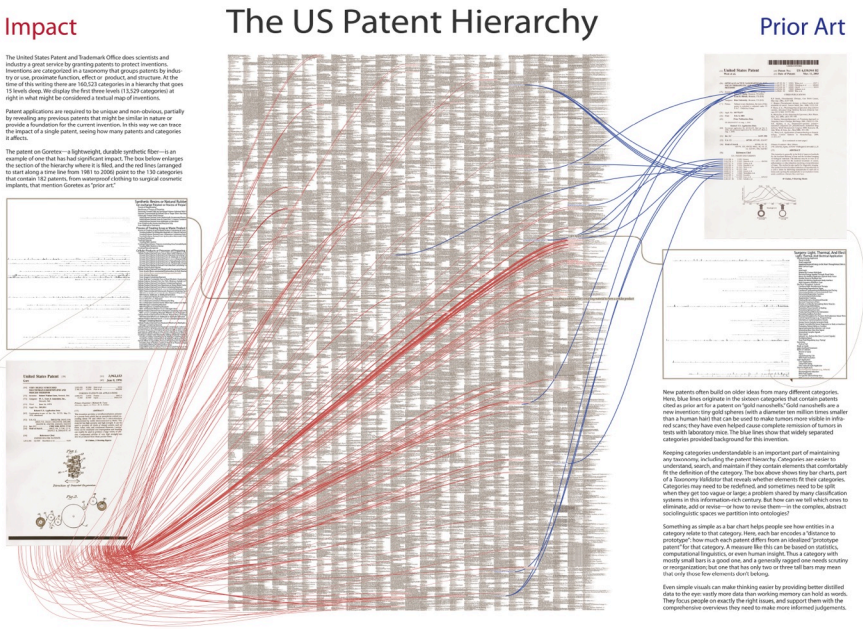
What dimensions would it have?



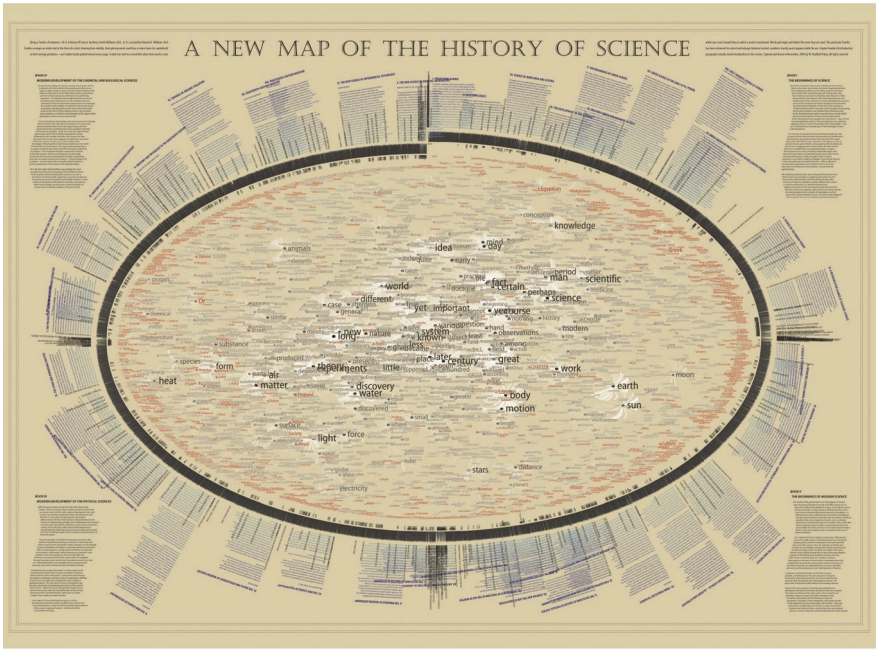

*HistCiteTM Visualization of DNA Development* - Eugene Garfield, Elisha Hardy, Katy Börner, Ludmila Pollock, Jan Witkowski - 2006




*History Flow Visualization of the Wikipedia Entry on "Abortion"* - Martin Wattenberg and Fernanda B. Viégas - 2006

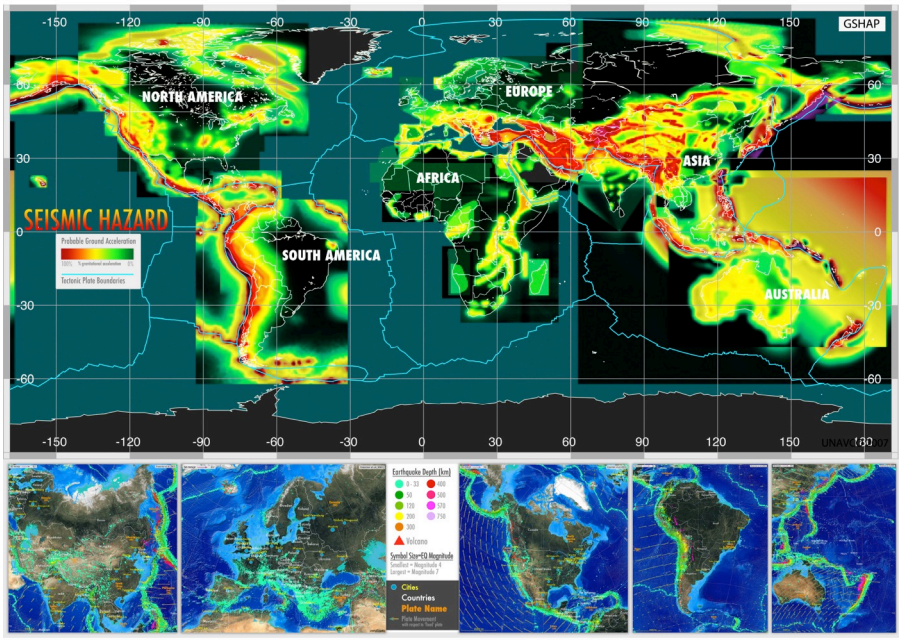



*Taxonomy Visualization of Patent Data* - Katy Borner, Elisha Hardy, Bruce Herr, Todd Holloway, Bradford Paley - 2006

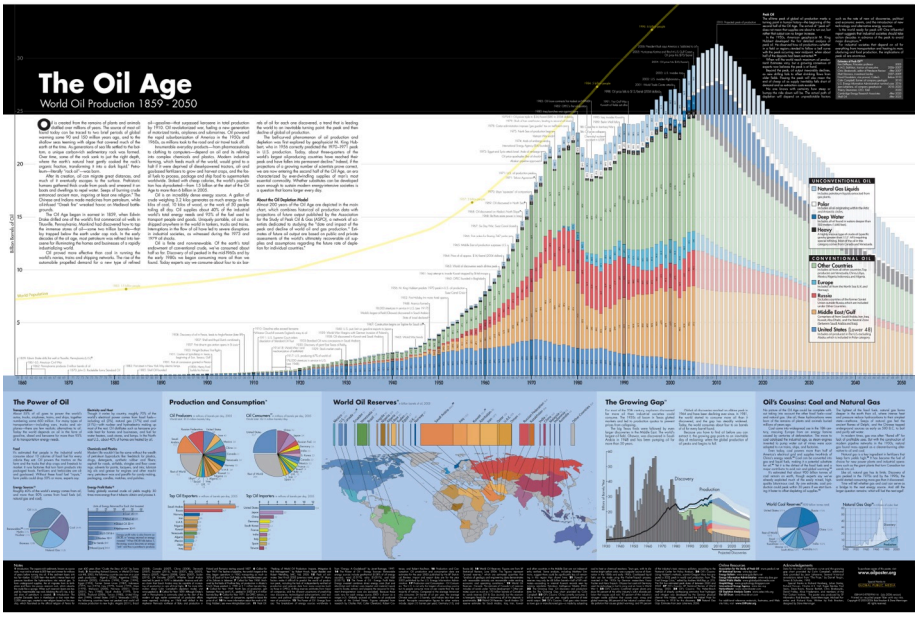



*TexArc Visualization of "The History of Science"* - W. Bradford Paley - 2006

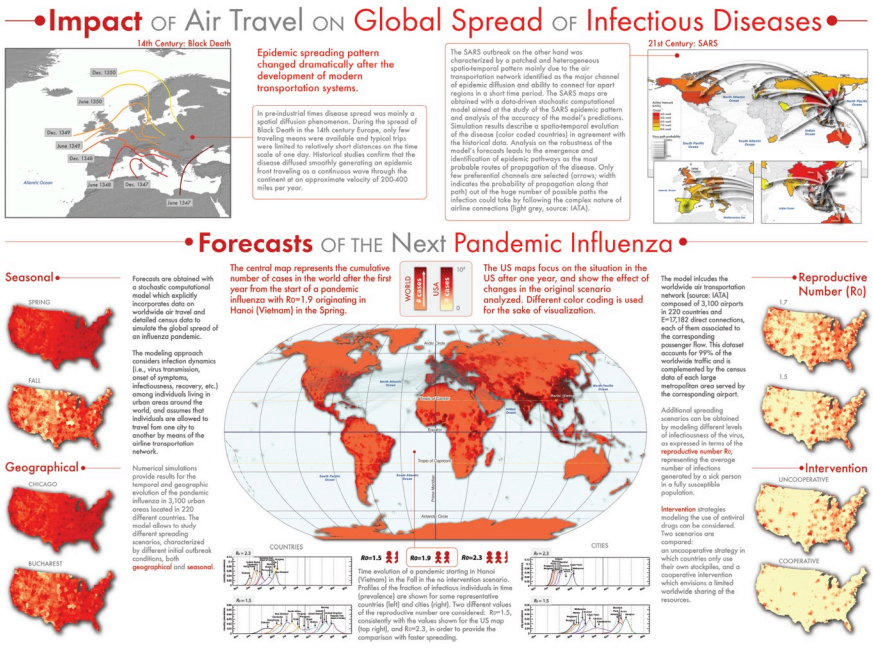
## The Power of Forecasts 2007


*Tectonic Movements and Earthquake Hazard Predictions* - Martin W. Hamburger, Lou Estey, Chuck Meertens, Elisha Hardy - 2005



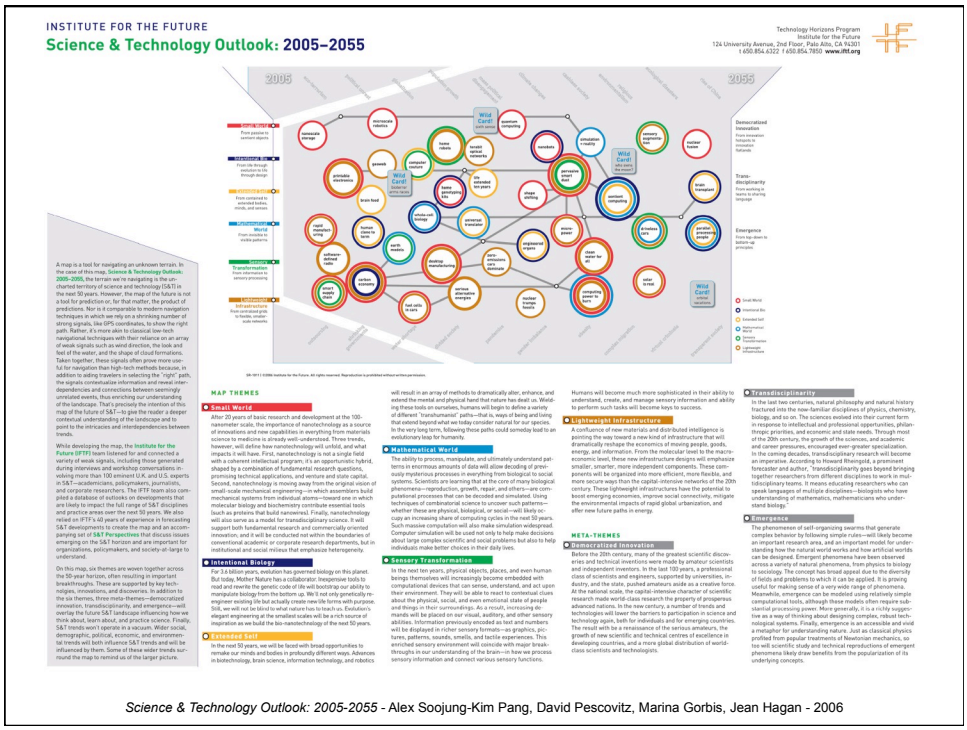

*The Oil Age: World Oil Production 1859-2050* - Rob Bracken, Dave Menninger, Michael Poremba, Richard Katz - 2005




*Impact of Air Travel on Global Spread of Infectious Diseases* - Vittoria Colizza, Alessandro Vespignani - 2007

Can one forecast science?

What 'science forecast language' will work to communicate results?



INSTITUTE FOR THE FUTURE

Science & Technology Outlook: 2005–2055

Technology Horizons Program
Institute for the Future
124 University Avenue, 2nd Floor, Palo Alto, CA 94301
t 650.854.6322 f 650.854.7850 www.iftf.org

2005 2055

A map is a tool for navigating an unknown terrain. In the case of this map, Science & Technology Outlook: 2005–2055, the terrain we're navigating is the uncharted territory of science and technology (S&T) in the next 50 years. However, the map of the future is not a tool for prediction or, for that matter, the product of predictions. Nor is it comparable to modern navigation techniques in which we rely on a shrinking number of strong signals, like GPS coordinates, to show the right path. Rather, it's more akin to classical low-tech navigational techniques with their reliance on an array of weak signals such as wind direction, the look and feel of the water, and the shape of cloud formations. Taken together, these signals often prove more useful for navigation than high-tech methods because, in addition to aiding travelers in selecting the "right" path, the signals contextualize information and reveal interdependencies and connections between seemingly unrelated events, thus enriching our understanding of the landscape. That's precisely the intention of this map of the future of S&T—to give the reader a deeper contextual understanding of the landscape and to point to the intricacies and interdependencies between trends.

While developing the map, the Institute for the Future (IFTF) team listened for and connected a variety of weak signals, including those generated during interviews and workshop conversations involving more than 100 eminent U.K. and U.S. experts in S&T—academicians, policymakers, journalists, and corporate researchers. The IFTF team also compiled a database of outlooks on developments that are likely to impact the full range of S&T disciplines and practice areas over the next 50 years. We also relied on IFTF's 40 years of experience in forecasting S&T developments to create the map and an accompanying set of S&T Perspectives that discuss issues emerging on the S&T horizon and are important for organizations, policymakers, and society-at-large to understand.

On this map, six themes are woven together across the 50-year horizon, often resulting in important breakthroughs. These are supported by key technologies, innovations, and discoveries. In addition to the six themes, three meta-themes—democratized innovation, transdisciplinarity, and emergence—will overlap the future S&T landscape influencing how we think about, learn about, and practice science. Finally, S&T trends won't operate in a vacuum. Wider social, demographic, political, economic, and environmental trends will both influence S&T trends and will be influenced by them. Some of these wider trends surround the map to remind us of the larger picture.

MAP THEMES

**Small World**

After 20 years of basic research and development at the 100-nanometer scale, the importance of nanotechnology as a source of innovations and new capabilities in everything from materials science to medicine is already well-understood. Three trends, however, will define how nanotechnology will unfold, and what impacts it will have. First, nanotechnology is not a single field with a coherent intellectual program; it's an opportunistic hybrid, shaped by a combination of fundamental research questions, promising technical applications, and venture and state capital. Second, nanotechnology is moving away from the original vision of small-scale mechanical engineering—in which assemblers build mechanical systems from individual atoms—toward one in which molecular biology and biochemistry contribute essential tools (such as proteins that build nanowires). Finally, nanotechnology will also serve as a model for transdisciplinary science. It will support both fundamental research and commercially oriented innovation, and it will be conducted not within the boundaries of conventional academic or corporate research departments, but in institutional and social milieus that emphasize heterogeneity.

**Intentional Biology**

For 3.6 billion years, evolution has governed biology on this planet. But today, Mother Nature has a collaborator. Inexpensive tools to read and rewrite the genetic code of life will bootstrap our ability to manipulate biology from the bottom up. We'll not only genetically reengineer existing life but actually create new life forms with purpose. Still, we will not be blind to what nature has to teach us. Evolution's elegant engineering at the smallest scales will be a rich source of inspiration as we build the bio-nanotechnology of the next 50 years.

**Extended Self**

In the next 50 years, we will be faced with broad opportunities to remake our minds and bodies in profoundly different ways. Advances in biotechnology, brain science, information technology, and robotics will result in an array of methods to dramatically alter, enhance, and extend the mental and physical hand that nature has dealt us. Wielding these tools on ourselves, humans will begin to define a variety of different "transhumanist" paths—that is, ways of being and living that extend beyond what we today consider natural for our species. In the very long term, following those paths could someday lead to an evolutionary leap for humanity.

**Mathematical World**

The ability to process, manipulate, and ultimately understand patterns in enormous amounts of data will allow decoding of previously mysterious processes in everything from biological to social systems. Scientists are learning that at the core of many biological phenomena—reproduction, growth, repair, and others—are computational processes that can be decoded and simulated. Using techniques of combinatorial science to uncover such patterns—whether these are physical, biological, or social—will likely occupy an increasing share of computing cycles in the next 50 years. Such massive computation will also make simulation widespread. Computer simulation will be used not only to help make decisions about large complex scientific and social problems but also to help individuals make better choices in their daily lives.

**Sensory Transformation**

In the next ten years, physical objects, places, and even human beings themselves will increasingly become embedded with computational devices that can sense, understand, and act upon their environment. They will be able to react to contextual clues about the physical, social, and even emotional state of people and things in their surroundings. As a result, increasing demands will be placed on our visual, auditory, and other sensory abilities. Information previously encoded as text and numbers will be displayed in richer sensory formats—as graphics, pictures, patterns, sounds, smells, and tactile experiences. This enriched sensory environment will coincide with major breakthroughs in our understanding of the brain—in how we process sensory information and connect various sensory functions.

Humans will become much more sophisticated in their ability to understand, create, and manage sensory information and ability to perform such tasks will become keys to success.

**Lightweight Infrastructure**

A confluence of new materials and distributed intelligence is pointing the way toward a new kind of infrastructure that will dramatically reshape the economics of moving people, goods, energy, and information. From the molecular level to the macroeconomic level, these new infrastructure designs will emphasize smaller, smarter, more independent components. These components will be organized into more efficient, more flexible, and more secure ways than the capital-intensive networks of the 20th century. These lightweight infrastructures have the potential to boost emerging economies, improve social connectivity, mitigate the environmental impacts of rapid global urbanization, and offer new future paths in energy.

META-THEMES

**Democratized Innovation**

Before the 20th century, many of the greatest scientific discoveries and technical inventions were made by *amateur* scientists and independent inventors. In the last 100 years, a professional class of scientists and engineers, supported by universities, industry, and the state, pushed amateurs aside as a creative force. At the national scale, the capital-intensive character of scientific research made world-class research the property of prosperous advanced nations. In the new century, a number of trends and technologies will lower the barriers to participation in science and technology again, both for individuals and for emerging countries. The result will be a renaissance of the serious amateurs, the growth of new scientific and technical centres of excellence in developing countries, and a more global distribution of world-class scientists and technologists.

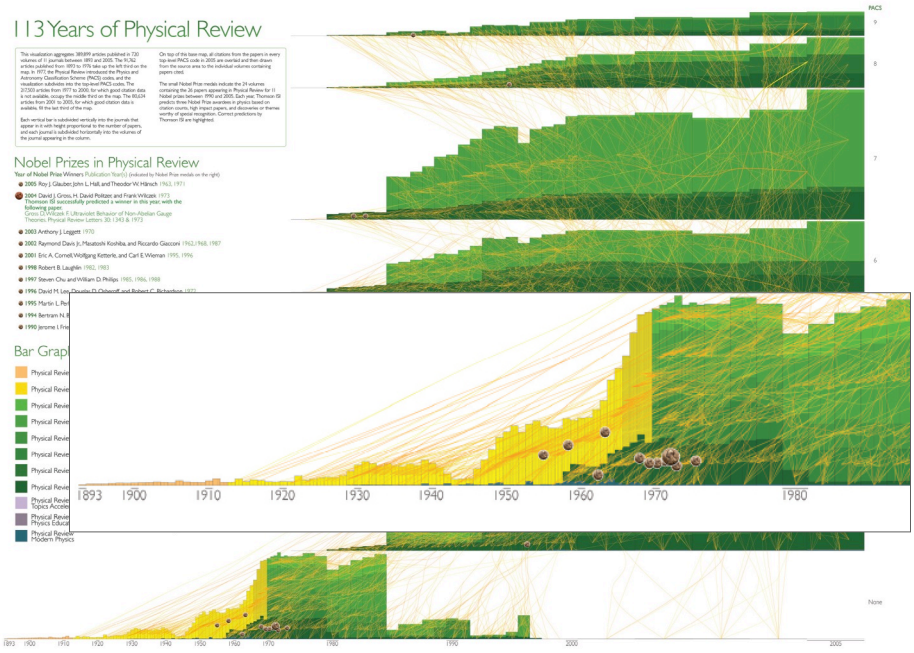
**Transdisciplinarity**

In the last two centuries, natural philosophy and natural history fractured into the now-familiar disciplines of physics, chemistry, biology, and so on. The sciences evolved into their current form in response to intellectual and professional opportunities, philanthropic priorities, and economic and state needs. Through most of the 20th century, the growth of the sciences, and academic and career pressures, encouraged ever-greater specialization. In the coming decades, transdisciplinary research will become an imperative. According to Howard Rheingold, a prominent forecaster and author, "transdisciplinarity goes beyond bringing together researchers from different disciplines to work in multidisciplinary teams. It means educating researchers who can speak languages of multiple disciplines—biologists who have understanding of mathematics, mathematicians who understand biology."

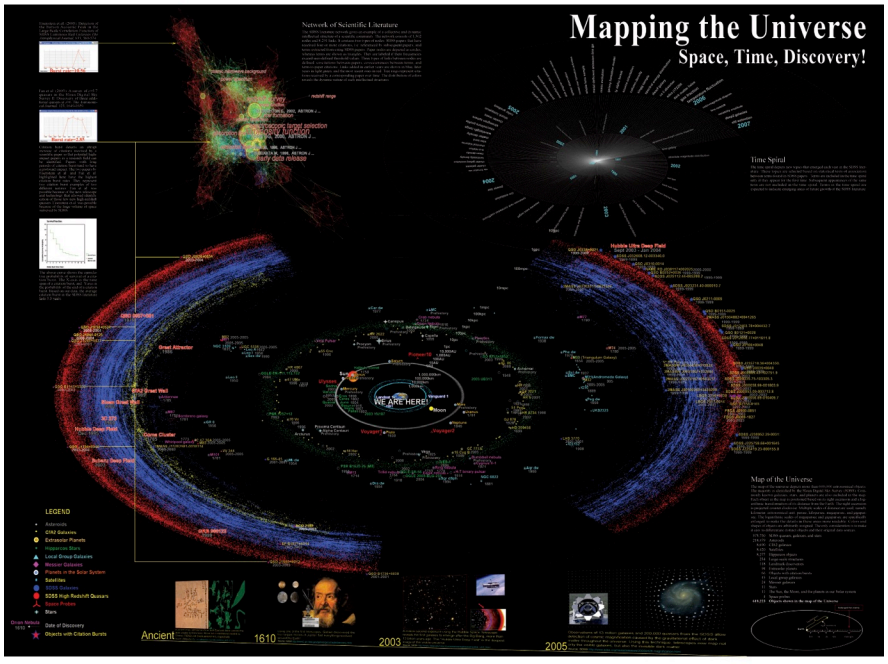
**Emergence**

The phenomenon of self-organizing swarms that generate complex behavior by following simple rules—will likely become an important research area, and an important model for understanding how the natural world works and how artificial worlds can be designed. Emergent phenomena have been observed across a variety of natural phenomena, from physics to biology to sociology. The concept has broad appeal due to the diversity of fields and problems to which it can be applied. It is proving useful for making sense of a very wide range of phenomena. Meanwhile, emergence can be modeled using relatively simple computational tools, although these models often require substantial processing power. More generally, it is a richly suggestive as a way of thinking about designing complex, robust technological systems. Finally, emergence is an accessible and vivid a metaphor for understanding nature. Just as classical physics profited from popular treatments of Newtonian mechanics, so too will scientific study and technical reproductions of emergent phenomena likely draw benefits from the popularization of its underlying concepts.

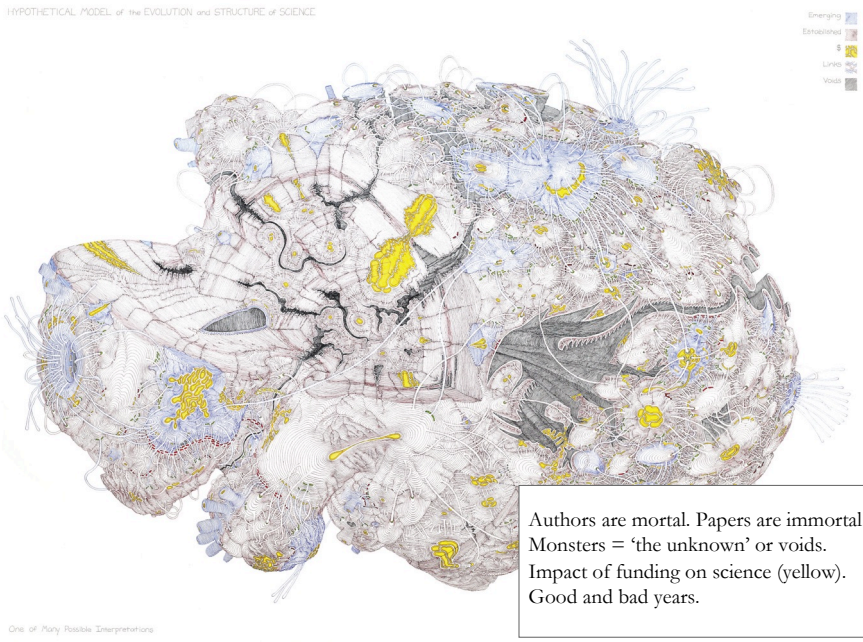
*Science & Technology Outlook: 2005-2055* - Alex Soojung-Kim Pang, David Pescovitz, Marina Gorbis, Jean Hagan - 2006




*114 Years of Physical Review* - Bruce W. Herr II, Russell Duhon, Katy Borner, Elisha Hardy, Shashikant Penumarthy - 2007

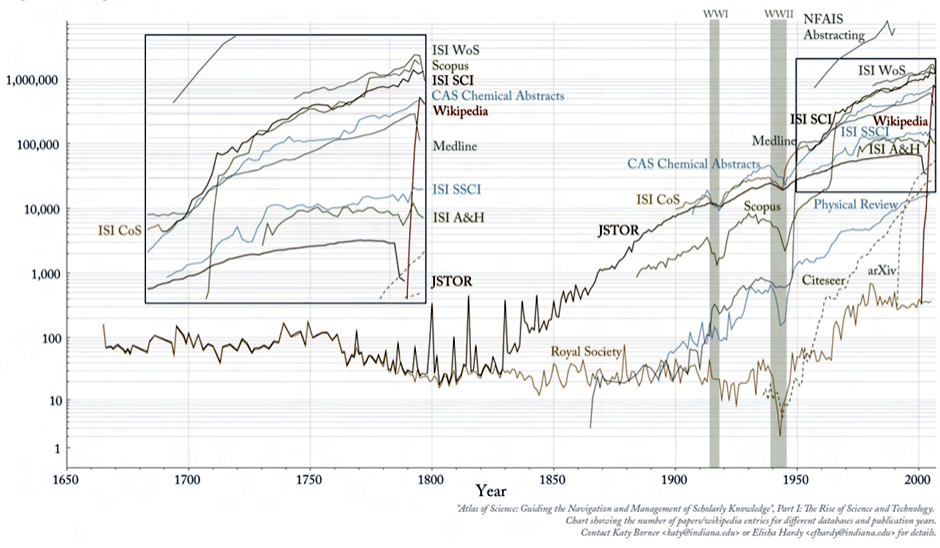



*Mapping the Universe: Space, Time, Discovery!*
Choumei Chen, Jian Zhang, Michael S. Vogeley, J. Richard Gott III, Mario Juric, Lisa Kershner - 2007

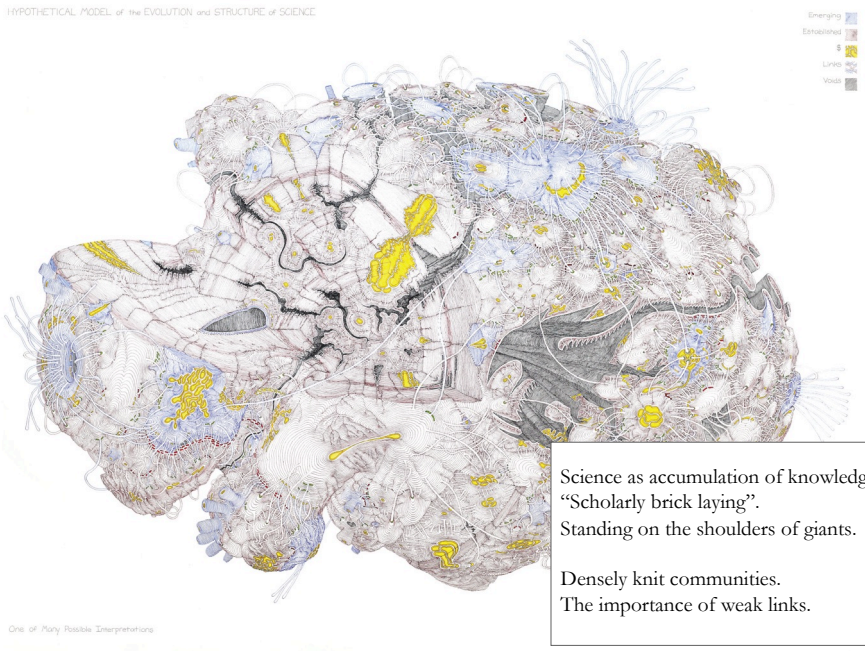



Authors are mortal. Papers are immortal.
Monsters = 'the unknown' or voids.
Impact of funding on science (yellow).
Good and bad years.

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



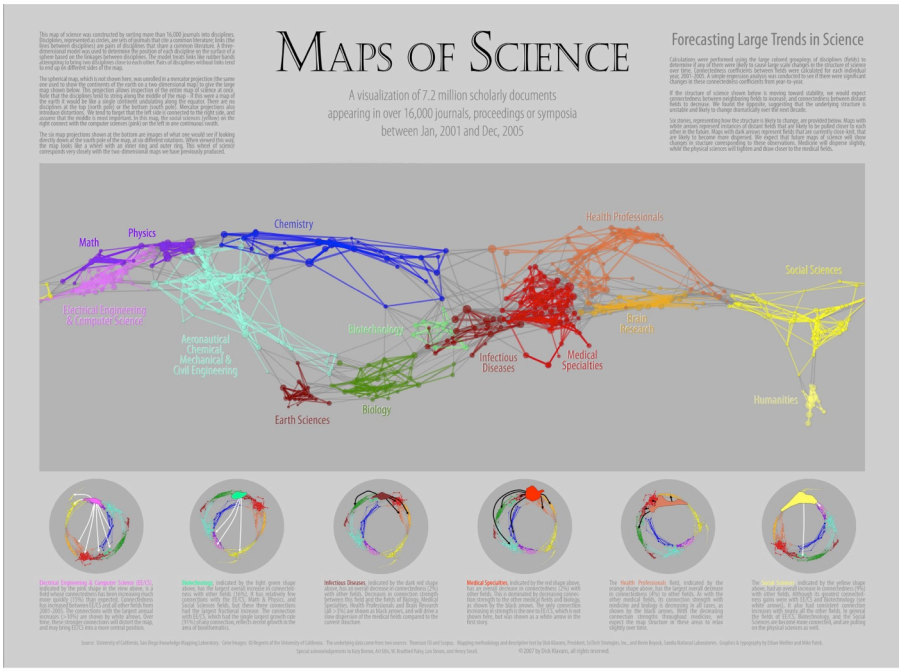

*Atlas of Science - Katy Borner - 2010*




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

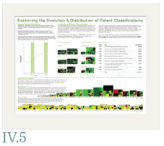


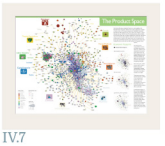

*Maps of Science: Forecasting Large Trends in Science* - Richard Klavans, Kevin Boyack - 2007

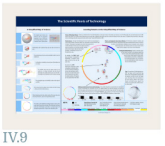
## Science Maps for Economic Decision Makers 2008

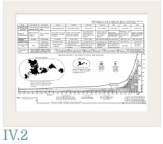

IV.1


IV.3


IV.5


IV.7


IV.9


IV.2


IV.4

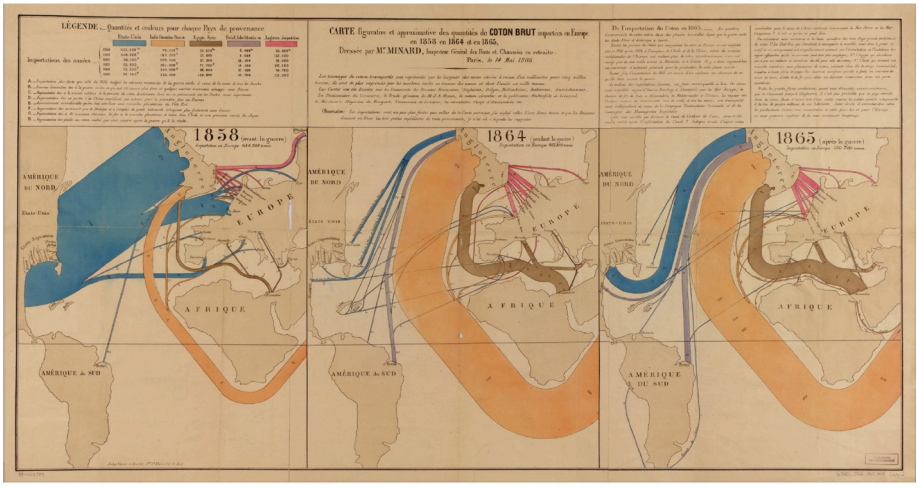

IV.6


IV.8


IV.10

What insight needs to economic decision makers have?

What data views are most useful?




*Europe Raw Cotton Imports in 1858, 1864 and 1865* - Charles Joseph Minard - 1866

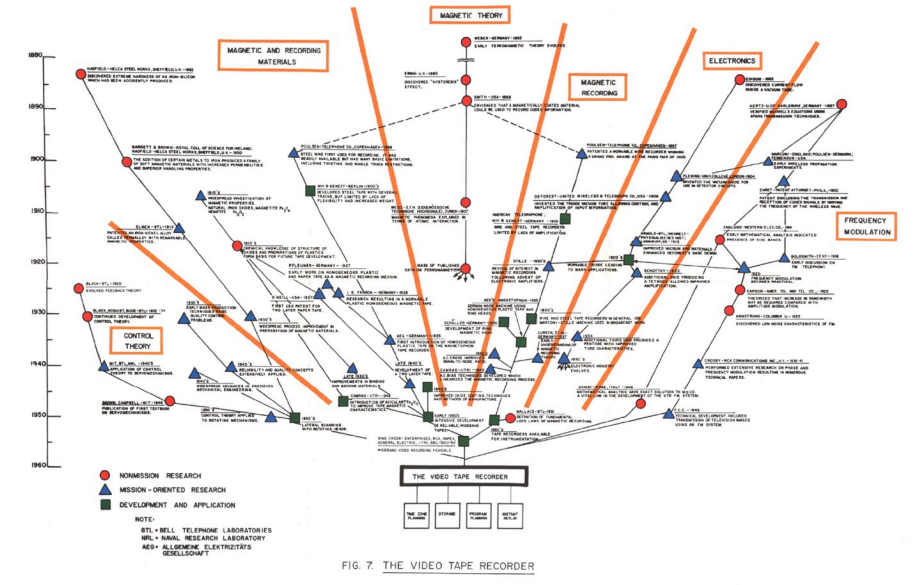
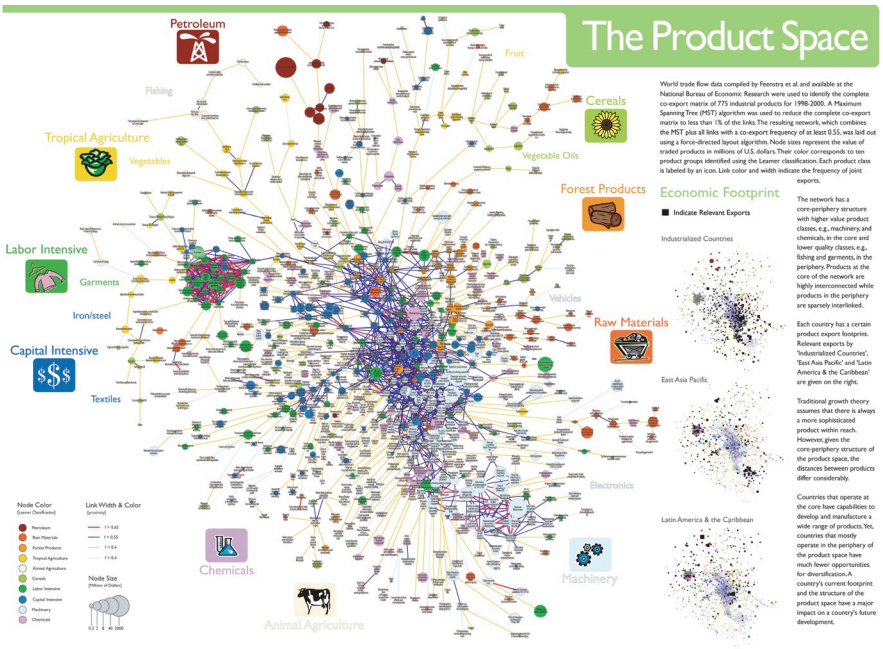
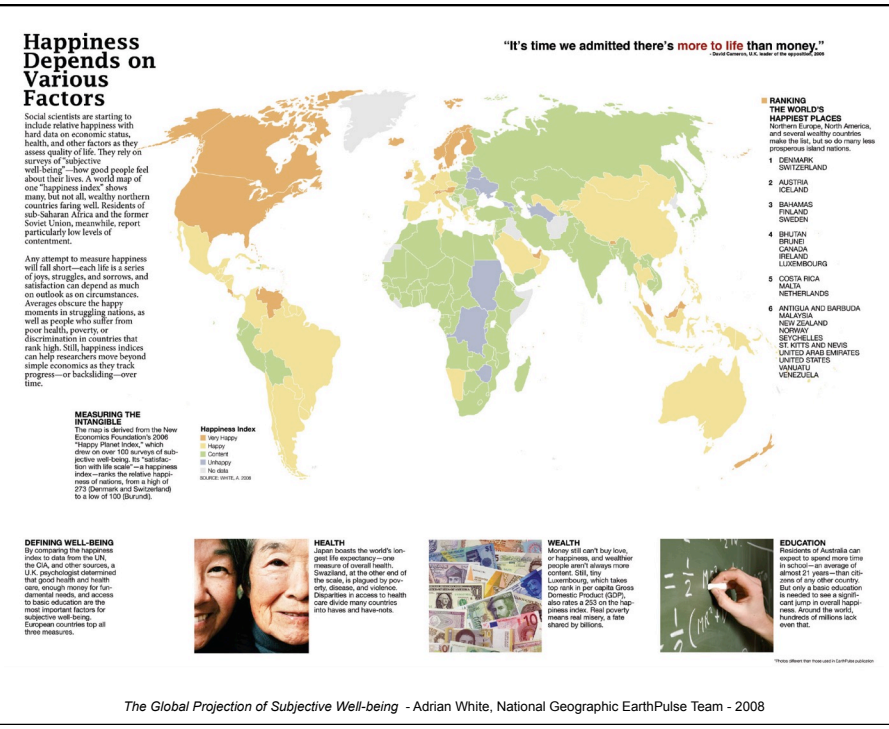



FIG. 7. THE VIDEO TAPE RECORDER

*Tracing of Key Events in the Development of the Video Tape Recorder* - Mr. G. Benn, Francis Narin - 1968



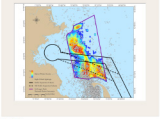

*The Product Space* - Cesar A. Hidalgo, Bailey Klinger, Albert-Laszlo Barabasi, Ricardo Hausmann - 2007



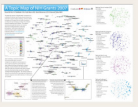

*The Global Projection of Subjective Well-being* - Adrian White, National Geographic EarthPulse Team - 2008

## Science Maps for Science Policy Makers 2009


V.1

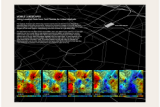

V.3


V.5

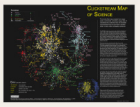

V.7


V.9

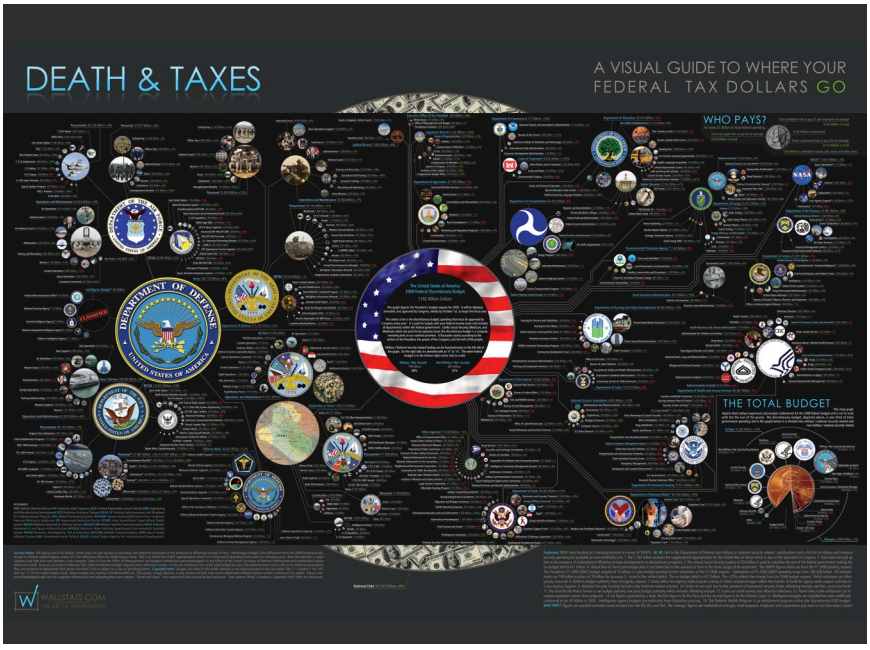

V.2


V.4

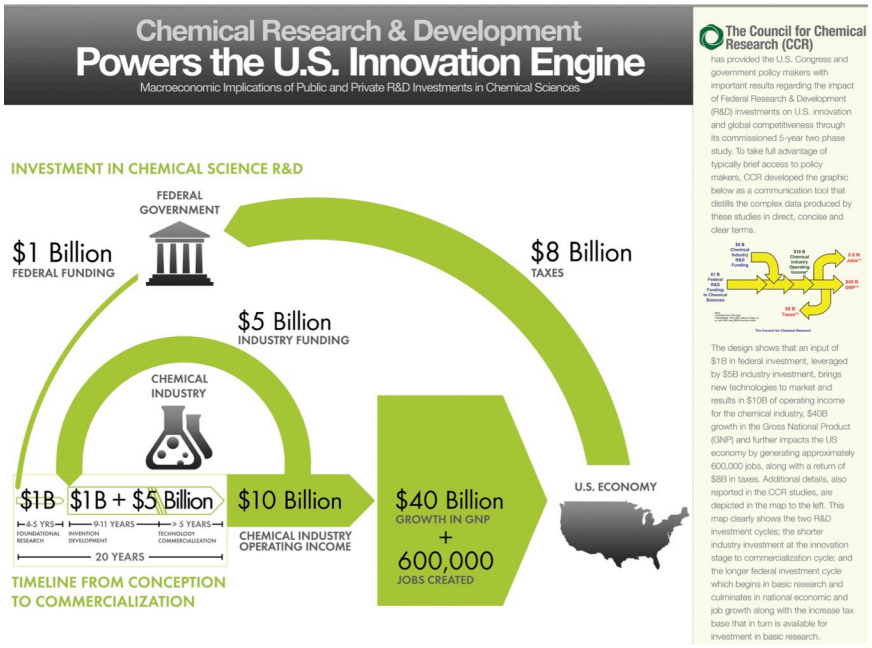

V.6


V.8

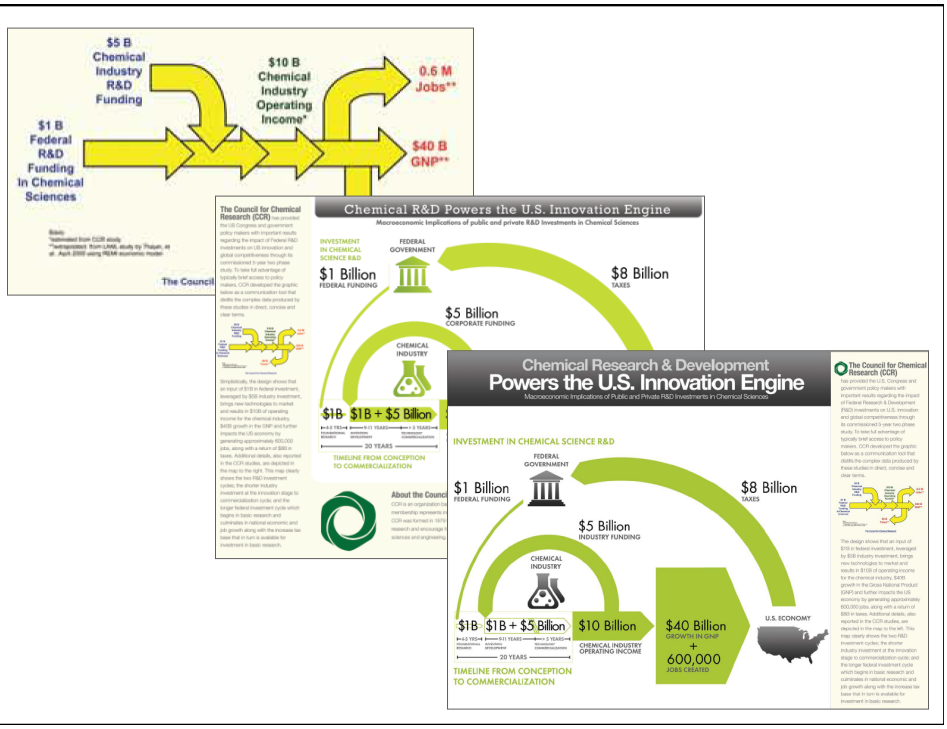

V.10

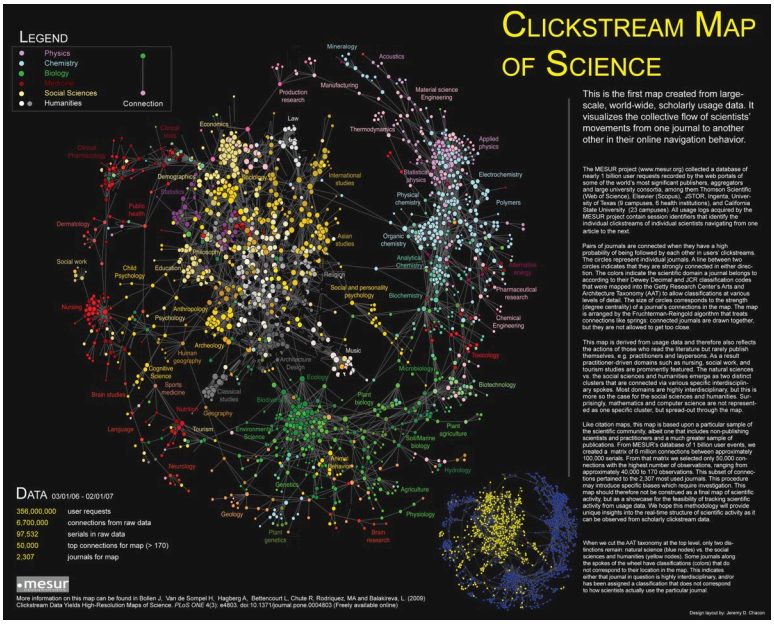



*Death and Taxes 2009* - Jess Bachman - 2009



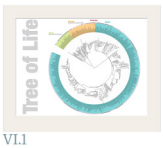

*Chemical R&D Powers the U.S. Innovation Engine* - The Council for Chemical Research - 2009






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

## Science Maps for Scholars 2010



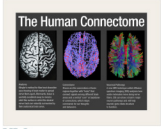
VI.1


VI.3


VI.5


VI.7


VI.9



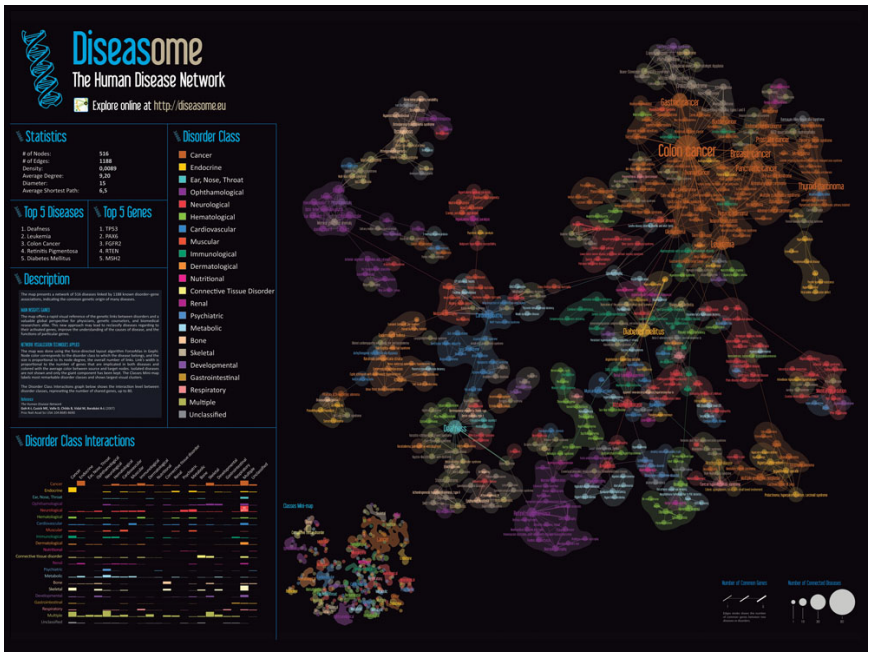
VI.2

VI.4

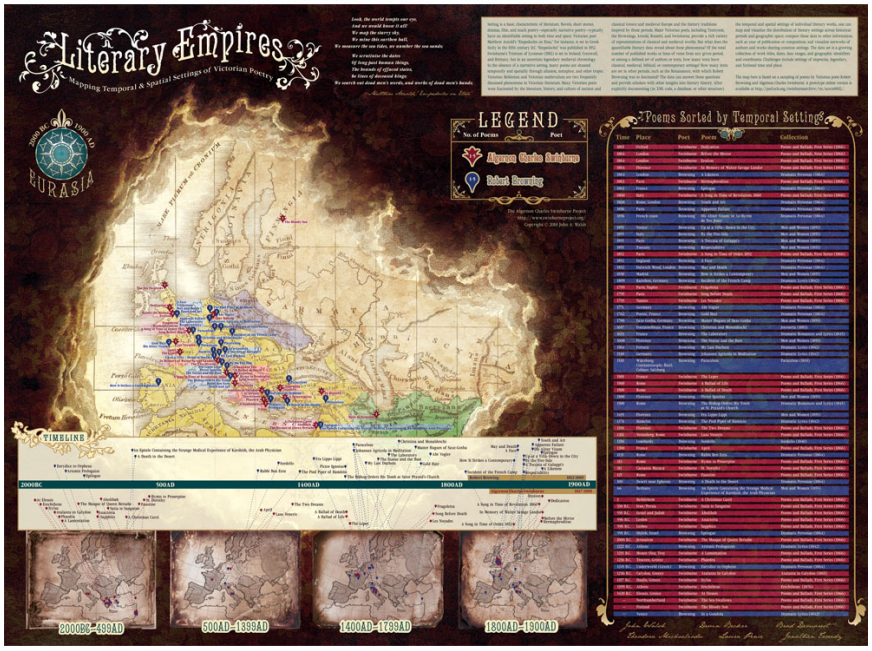

VI.6

VI.8

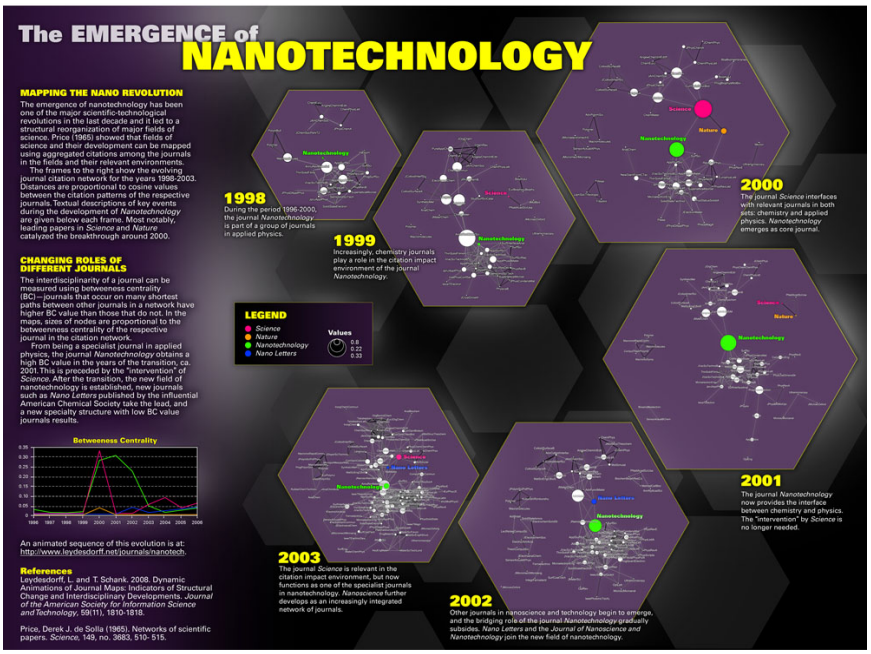
VI.10



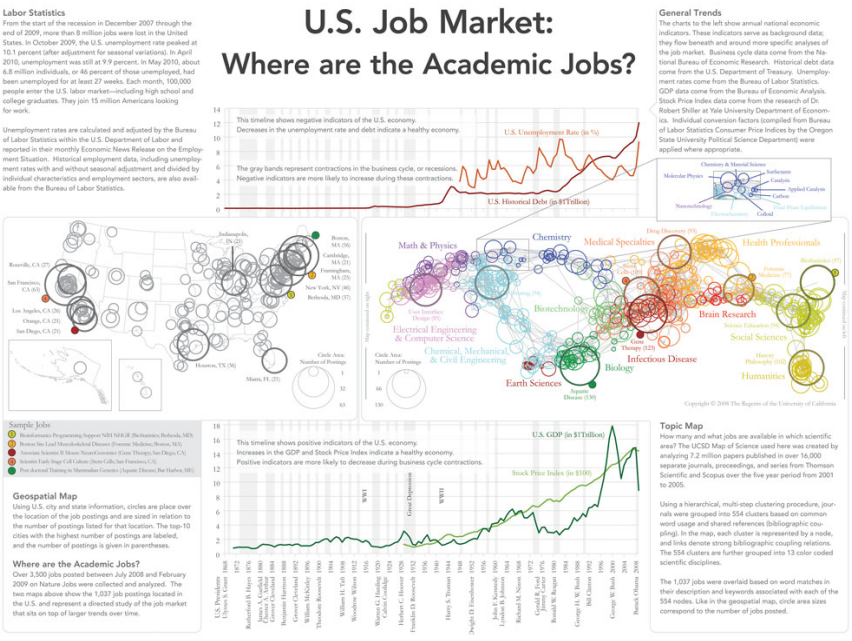

*Diseasome* - Mathieu Bastian & Sebastien Heymann - 2009




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




*The Emergence of Nanoscience & Technology* - Loet Leydesdorff - 2010




*U.S. Job Market: Where are the Academic Jobs?* - Angela M. Zoss & Katy Börner - 2010

## Science Maps as Visual Interfaces to Digital Libraries 2011

VII.1 VII.3 VII.5 VII.7 VII.9

VII.2 VII.4 VII.6 VII.8 VII.10

# MONDOTHÈQUE

## A MULTIMEDIA DESK IN A GLOBAL INTERNET

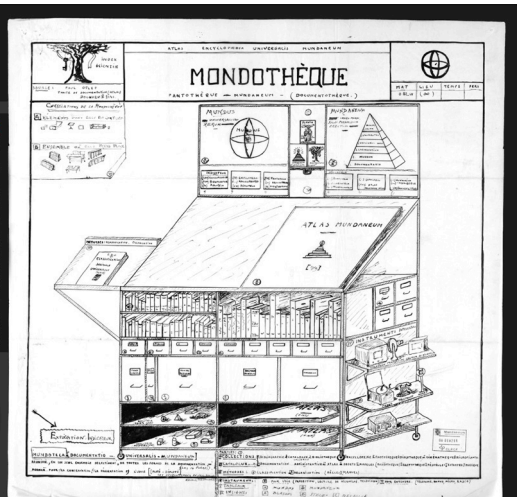
Paul Otlet (1868-1944), visionary Belgian lawyer fascinated by the problems of access to global knowledge, is often acknowledged as a pioneer of the Internet. His design of 1936 for a multimedia desk for home use, the Mondothèque, integrated access to new documentary formats including multimedia substitutes for traditional books involving all available communications technologies such as microfilm, gramophone, radio and TV. A major resource was a new form of visual encyclopedia, the Encyclopedia Universalis Mundaneum. Connected by the Mondothèque to a network of global collections (Species Mundaneum), the user could access and engage in the international production and dissemination of knowledge.

**Paul Otlet**
**Mondothèque**
June 8, 1936 | 64 x 67 cm
Pen and ink on transparent paper
EUM Affiches 8141
© Mundaneum Mons Belgium

The Mondothèque is a multimedia desk with spaces for essential books, with atlases in the form of visual encyclopedia, for small (museum) objects and with drawers for bibliographical cards and microfilms ordered according to the rules of his Universal Decimal Classification system. On its shelves all communication and broadcasting instruments, such as radio, telephone, television and film equipment.

*Otlet's original drawing is on light grey tracing paper. It has been lightened here for legibility and printing purposes.

**Paul Otlet**
**Species Mundaneum**
January 16, 1937 | 21 x 28 cm
pen and ink on transparent paper
EUM 8504
© Mundaneum Mons Belgium




## MUNDOTECA-[Documentatio-Universalis-Mundaneum]

BRINGING TOGETHER OF ALL KINDS OF DOCUMENTATION - (THE 16 KINDS) IN A SINGLE ORDERED GROUPING

An agency for (C) conservation, (P) presentation, (U) use (specific or general) – systematic developments in furniture, buildings, galleries.

COMPONENTS

I. COLLECTIONS: 1 Bibliography · 2 Union Catalogue · 3 Library · 4 Encyclopedia · 5 Photographic library · 6 Music library · 7 Film library · 8 Microfilm library · 9 Administrative Documentation · 10 Atlas (collection of maps, engravings, charts, graphic representations) · 11 Objects · 12 Models (library of museum objects) · 13 Sculpture collection · 14 Medals · 15 Prints · 16 Music

II. CATALOGUE of the Mundaneum for all 16 kinds of documentation

III. METHOD: A Classification · B Organisation (Rules, Manual)

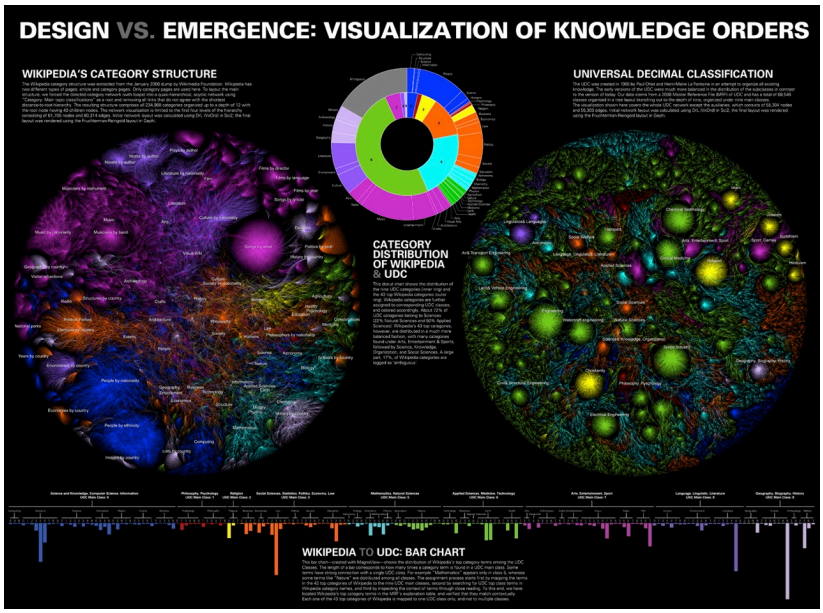
IV. INSTRUMENTS: A To see with (Projection, Microfilm reader, Television) · B To hear with (Telephone, Phonograph, Microphone, Radio)

V. CHARTS and TABLES: A Mundus · B Mundaneum

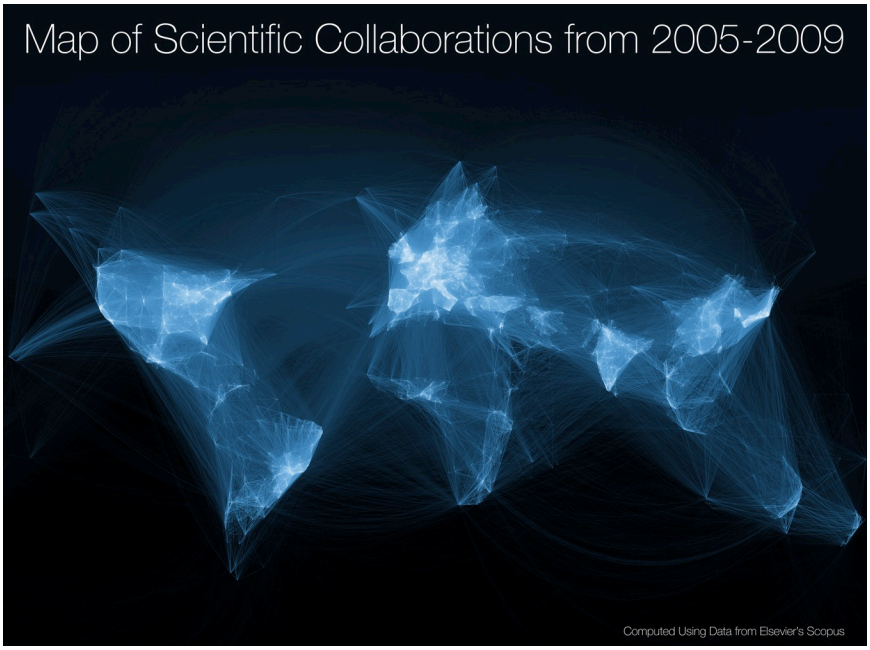
VI. MEDIUM: A Coats of Arms · B Stele (Stone monuments) · C Coins

Text: Mondothèque. A multimedia desk in a global internet
Charles van den Heuvel, Huygens INS (KNAW), The Hague & W. Boyd Rayward, University of Illinois, Urbana-Champaign
Acknowledgment: Stéphanie Manford, Mundaneum, Mons
Graphic Design: Janet Armstrong BNO, Armstrong Design, Maastricht, NL with the collaboration of Michael J. Stamper

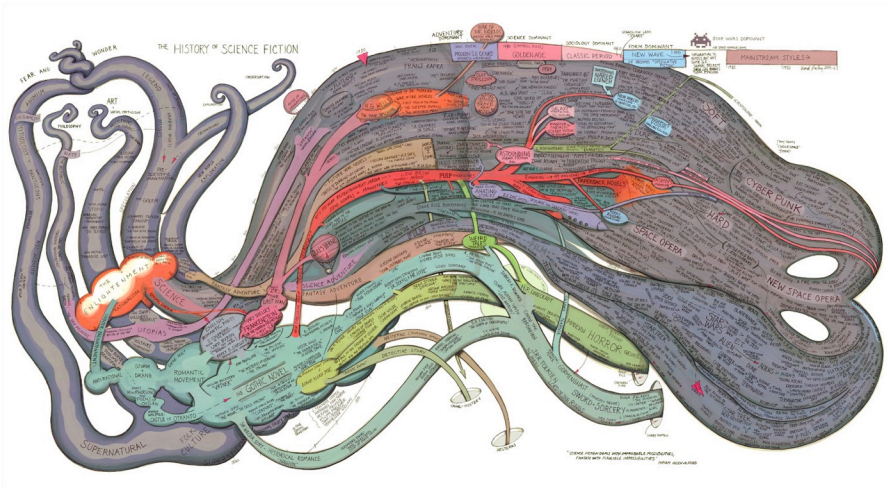
*Mondothèque. Multimedia Desk in a Global Internet* - Paul Otlet - 1936/37




*Design vs. Emergence: Visualization of Knowledge Orders*
Alkim Almila Akdag Salah, Cheng Gao, Krzysztof Suchecki, and Andrea Scharnhorst - 2011




*Stream of Scientific Collaborations between World Cities* - Olivier H. Beauchesne - 2012

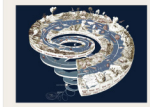



*History of Science Fiction* - Ward Shelley - 2011

## Check out our Zoom Maps online!

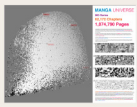

Visit scimaps.org and check out all our maps in stunning detail!

## Science Maps for Kids 2012


VIII.1


VIII.3


VIII.5


VIII.7


VIII.9

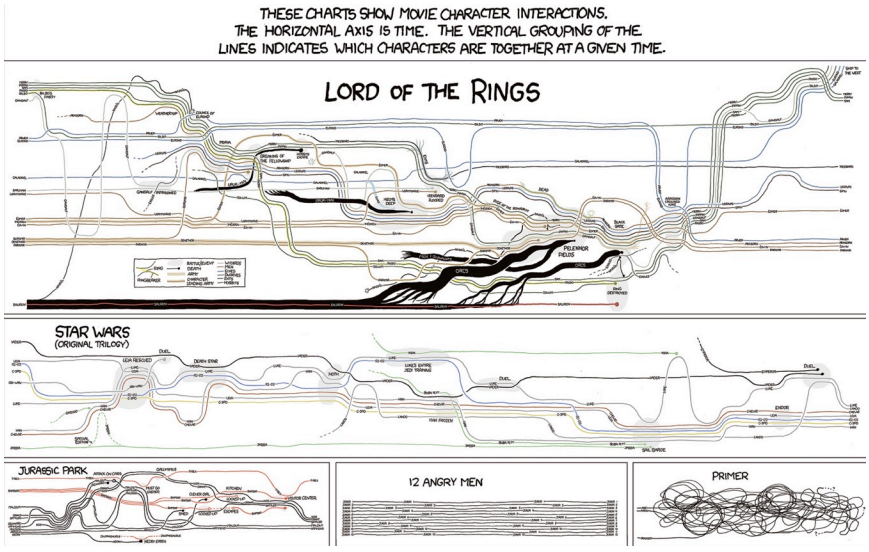

VIII.2


VIII.4

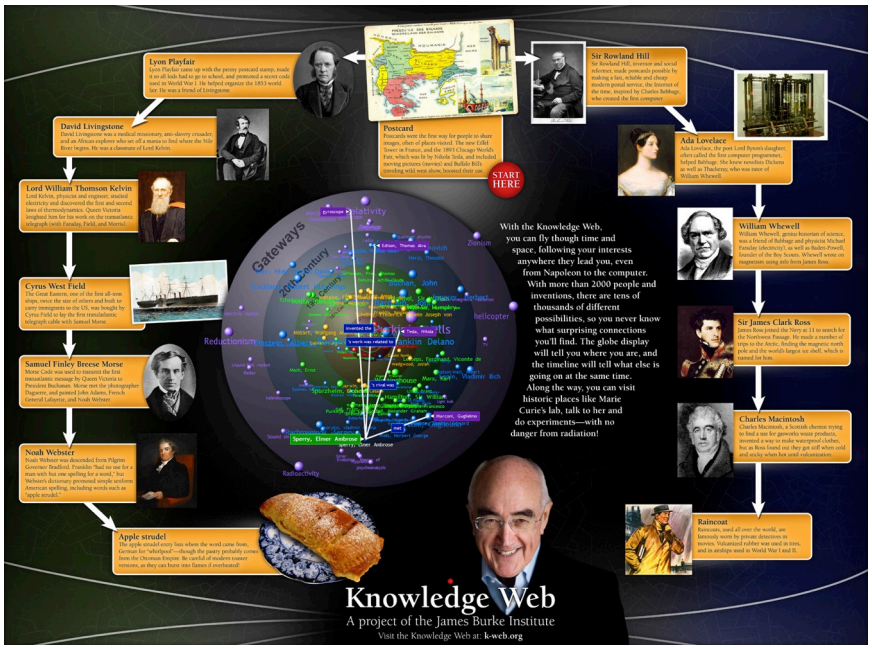

VIII.6


VIII.8

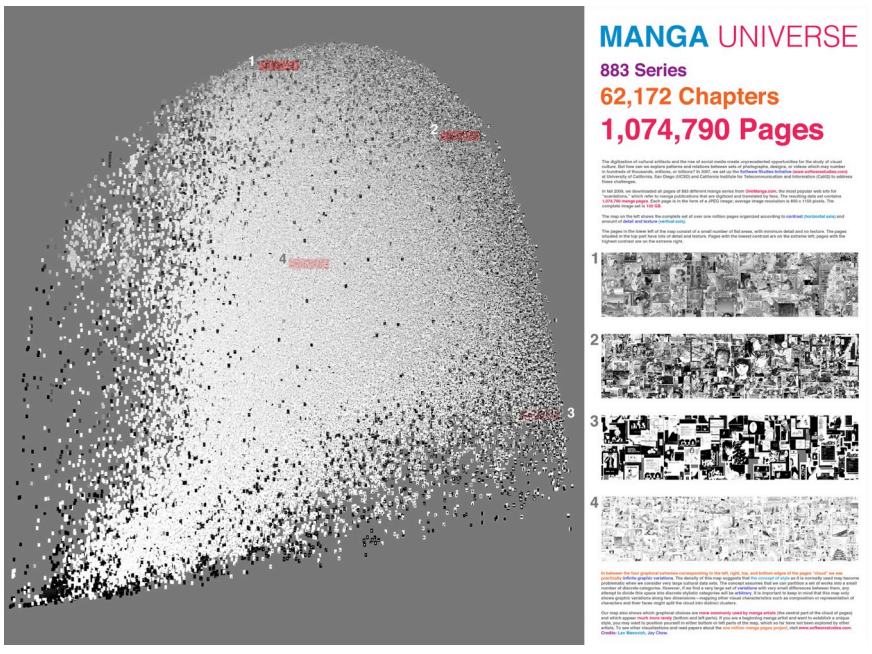
VIII.10



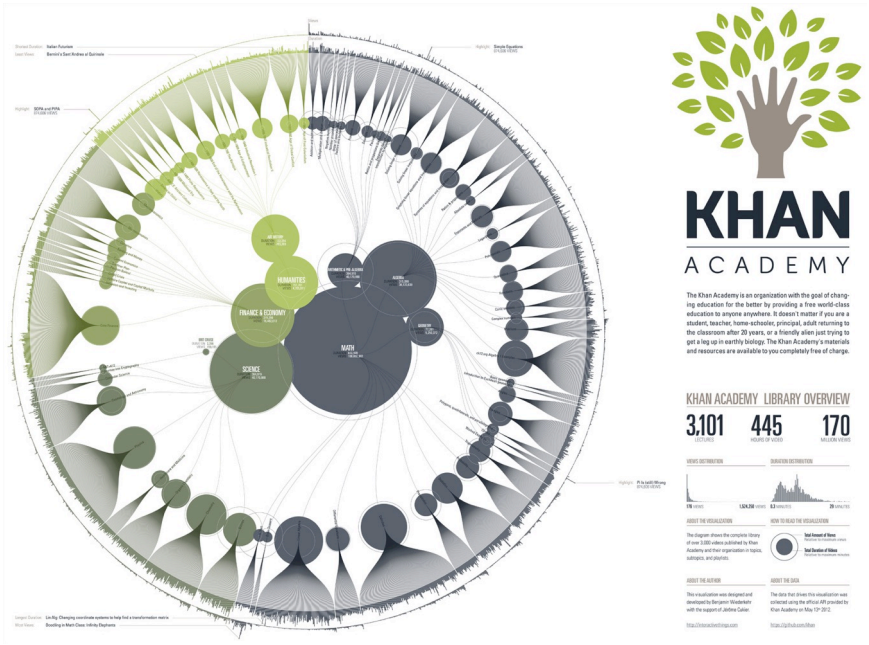

*Movie Narrative Charts (Comic #657)* - Randall Munroe - 2009




*Knowledge Web* - James Burke, Patrick McKercher, and Michael J. Stamper - 2012

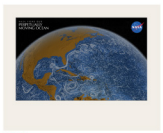



*Manga Universe* - Lev Manovich and Jay Chow - 2012




*Khan Academy Library Overview* - Benjamin Wiederkehr and Jérôme Cukier - 2012

## Science Maps Showing Trends and Dynamics 2013


IX.1


IX.3


IX.5


IX.7


IX.9

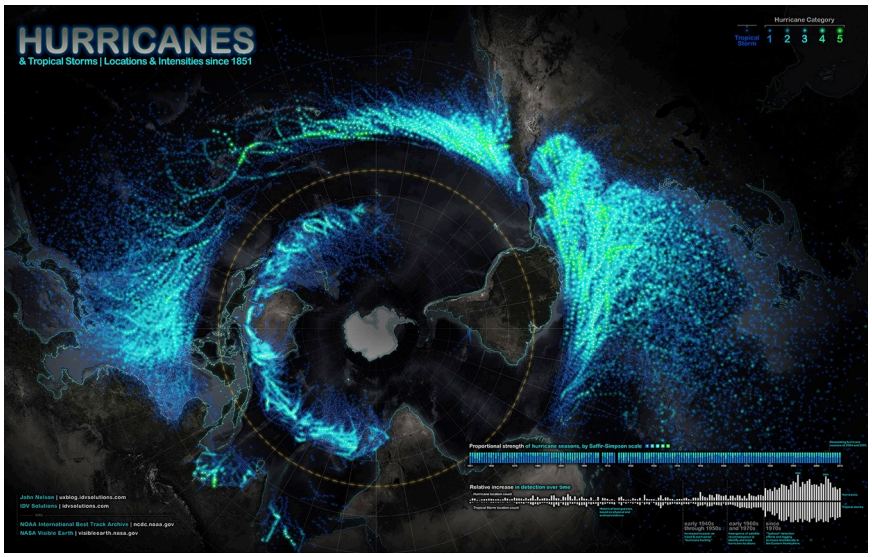

IX.2


IX.4

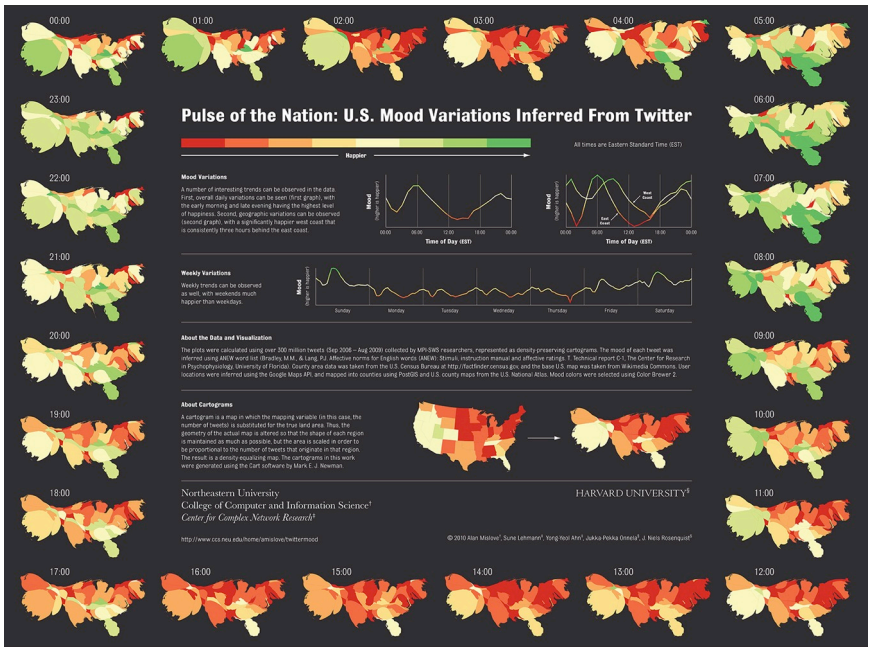

IX.6


IX.8

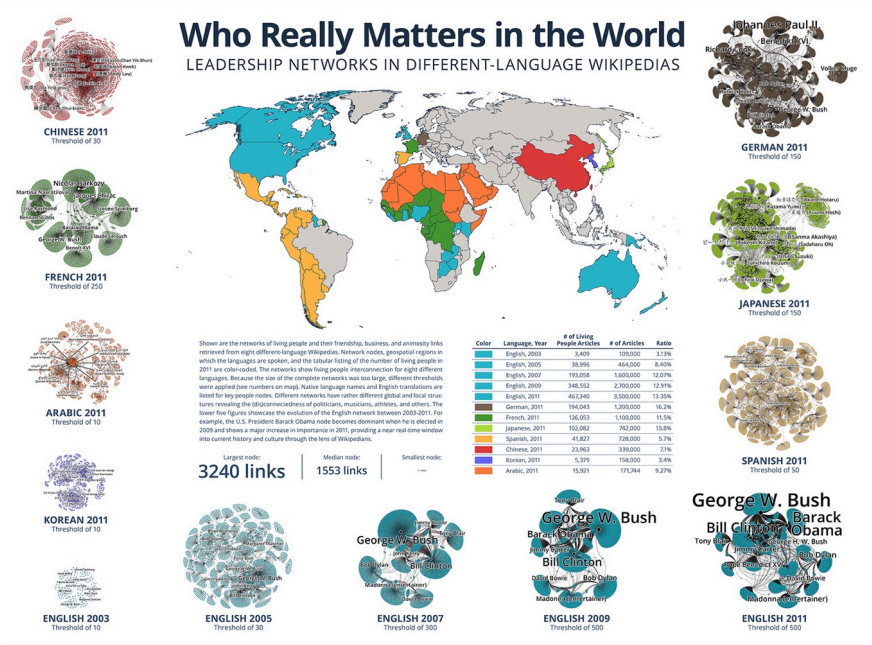

IX.10




*Hurricanes & Tropical Storms—Locations and Intensities Since 1851* - John Nelson - 2012




*Pulse of the Nation* - Alan Mislove, Sune Lehmann, Yong-Yeol Ahn, Jukka-Pekka Onnela, and James Niels Rosenquist - 2010



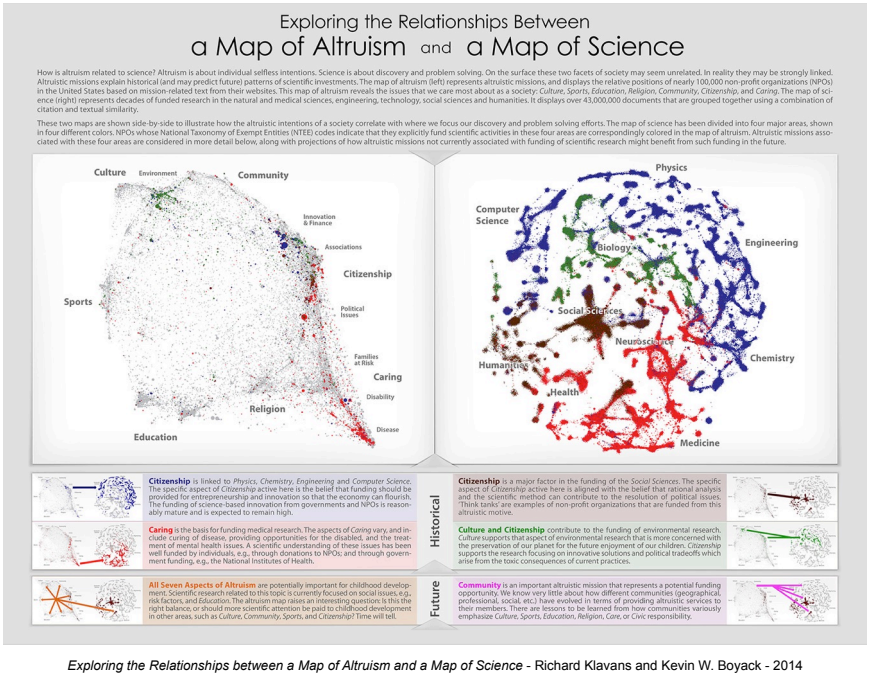

*Who Really Matters in the World—Leadership Networks in Different-Language Wikipedias*
Peter A. Gloor, Keiichi Nemoto, Samuel T. Mills, and David E. Polley - 2013

## The Future of Science Mapping 2014

X.1 X.3 X.5 X.7 X.9

X.2 X.4 X.6 X.8 X.10

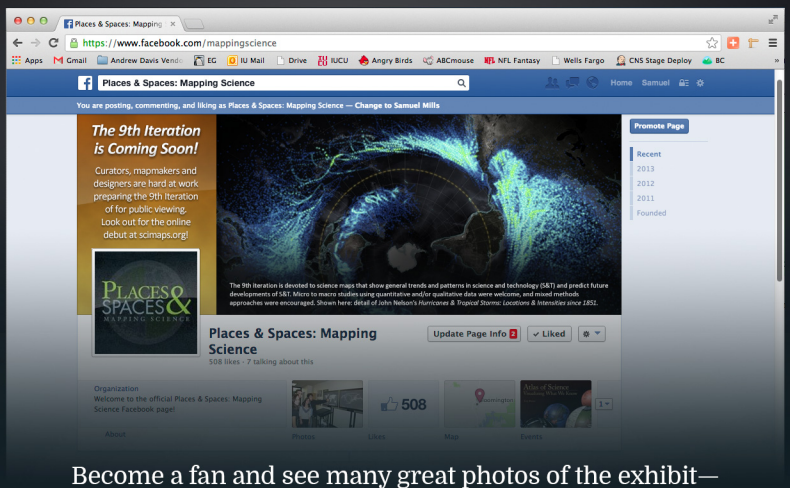

*Map of the Internet* - Martin Vargic - 2014




*Exploring the Relationships between a Map of Altruism and a Map of Science* - Richard Klavans and Kevin W. Boyack - 2014

Explore the maps and background information at http://scimaps.org


# Visit us on Facebook!



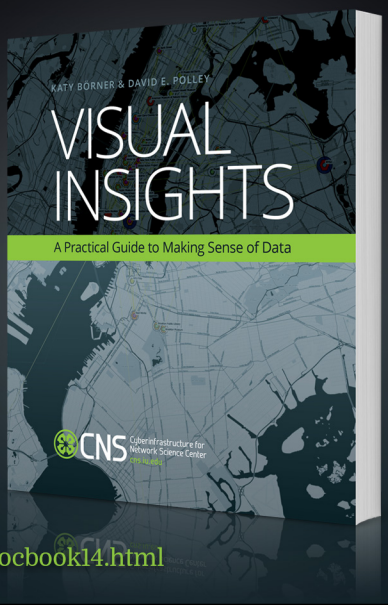

Become a fan and see many great photos of the exhibit—
plus find out when it's coming to a venue near you!

facebook.com/mappingscience

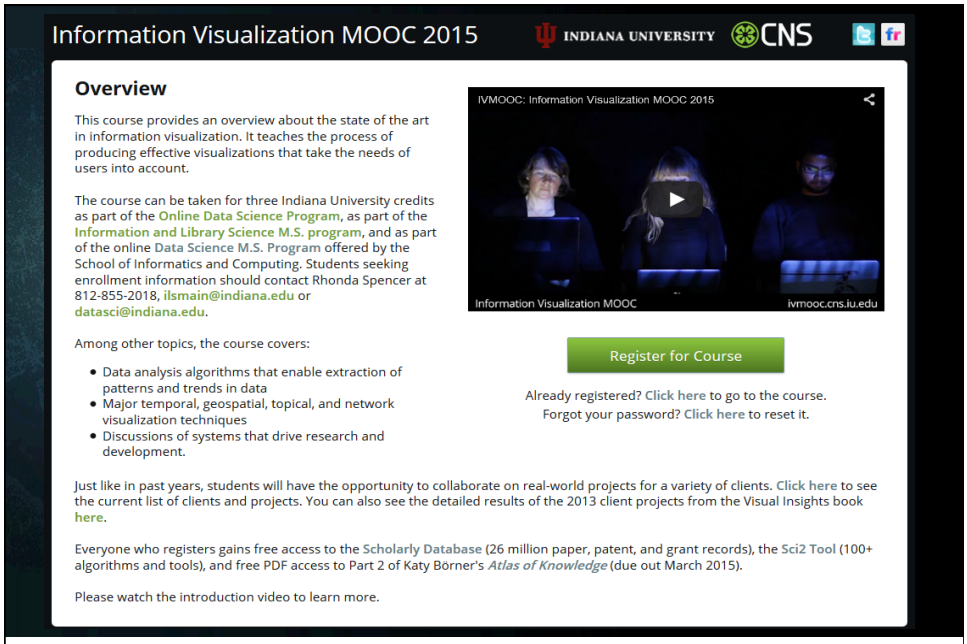
# The IVMOOC Companion Textbook

This textbook offers a gentle introduction to the design of insightful visualizations. It seamlessly blends theory and practice, giving readers both the theoretical foundation and the practical skills necessary to render data into insights.

The book accompanies the Information Visualization MOOC that attracted students, scholars, and practitioners from many fields of science and more than 100 different countries.

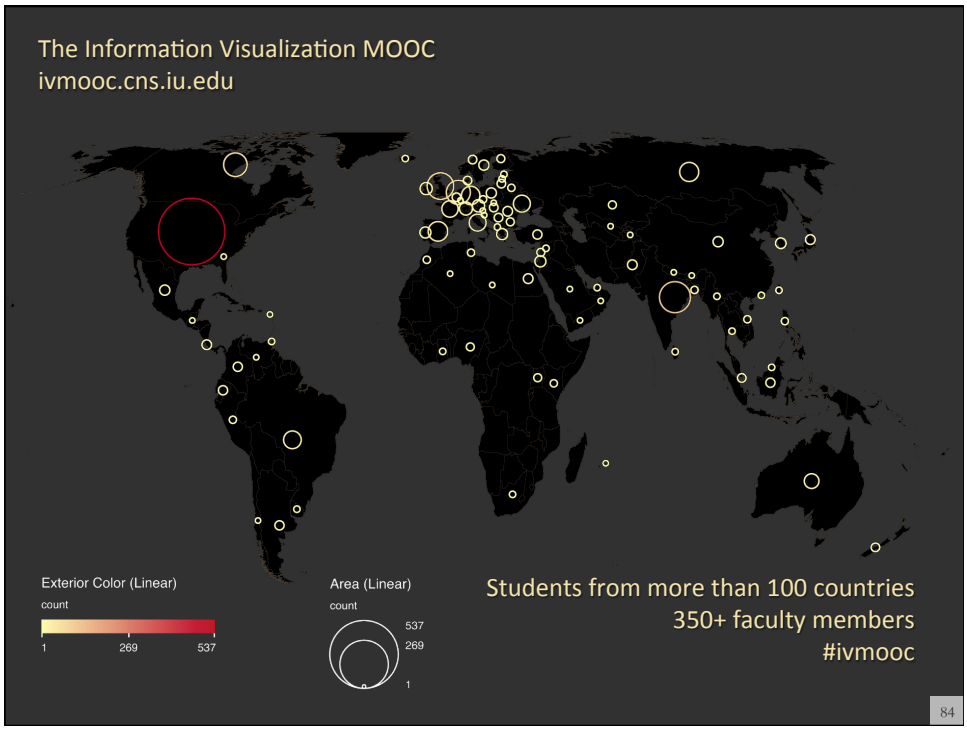



cns.iu.edu/ivmoocbook14.html




Register for free at http://ivmooc.cns.iu.edu. Class started January 13, 2015.

83




84

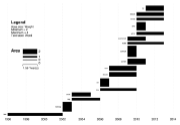
CNS Cyberinfrastructure for Network Science Center

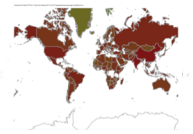
## Load **One** File and Run **Many** Analyses and Visualizations

| Times Cited | Publication Year | City of Publisher | Country | Journal Title (Full) | Title | Subject Category | Authors |
|---|---|---|---|---|---|---|---|
| 12 | 2011 | NEW YORK | USA | COMMUNICATIONS OF THE ACM | Plug-and-Play Macroscopes | Computer Science | Borner, K |
| 18 | 2010 | MALDEN | USA | CTS-CLINICAL AND TRANSLATIONAL SCIENCE | Advancing the Science of Team Science | Research & Experimental Medicine | Falk-Krzesinski, HJ\|Borner, K\|Contractor, N\|Fiore, SM\|Hall, KL\|Keyton, J\|Spring, B\|Stokols, D\|Trochim, W\|Uzzi, B |
| 13 | 2010 | WASHINGTON | USA | SCIENCE TRANSLATIONAL MEDICINE | A Multi-Level Systems Perspective for the Science of Team Science | Cell Biology \| Research & Experimental Medicine | Borner, K\|Contractor, N\|Falk-Krzesinski, HJ\|Fiore, SM\|Hall, KL\|Keyton, J\|Spring, B\|Stokols, D\|Trochim, W\|Uzzi, B |

Statistical Analysis–p. 44 | Temporal Burst Analysis–p. 48 | Geospatial Analysis–p. 52 | Geospatial Analysis–p. 52

| Location | Count | # Citations |
|---|---|---|
| Netherlands | 13 | 292 |
| United States | 9 | 318 |
| Germany | 11 | 36 |
| United Kingdom | 1 | 2 |





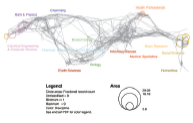
85

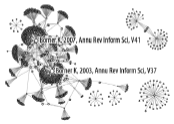
CNS Cyberinfrastructure for Network Science Center

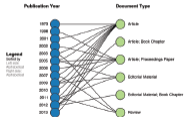
## Load **One** File and Run **Many** Analyses and Visualizations

| Times Cited | Publication Year | City of Publisher | Country | Journal Title (Full) | Title | Subject Category | Authors |
|---|---|---|---|---|---|---|---|
| 12 | 2011 | NEW YORK | USA | COMMUNICATIONS OF THE ACM | Plug-and-Play Macroscopes | Computer Science | Borner, K |
| 18 | 2010 | MALDEN | USA | CTS-CLINICAL AND TRANSLATIONAL SCIENCE | Advancing the Science of Team Science | Research & Experimental Medicine | Falk-Krzesinski, HJ\|Borner, K\|Contractor, N\|Fiore, SM\|Hall, KL\|Keyton, J\|Spring, B\|Stokols, D\|Trochim, W\|Uzzi, B |
| 13 | 2010 | WASHINGTON | USA | SCIENCE TRANSLATIONAL MEDICINE | A Multi-Level Systems Perspective for the Science of Team Science | Cell Biology \| Research & Experimental Medicine | Borner, K\|Contractor, N\|Falk-Krzesinski, HJ\|Fiore, SM\|Hall, KL\|Keyton, J\|Spring, B\|Stokols, D\|Trochim, W\|Uzzi, B |

Topical Analysis–p. 56 | Paper Citation Network–p. 60 | Bi-Modal Network–p. 60







Co-author and many other bi-modal networks.

86

# References


Börner, Katy, Chen, Chaomei, and Boyack, Kevin. (2003). **Visualizing Knowledge Domains.** In Blaise Cronin (Ed.), *ARIST*, Medford, NJ: Information Today, 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/

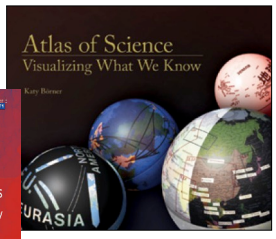
Börner, Katy (2010) **Atlas of Science: Visualizing What We Know**. The MIT Press. http://scimaps.org/atlas

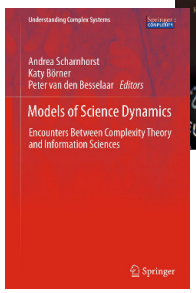
Scharnhorst, Andrea, Börner, Katy, van den Besselaar, Peter (2012) **Models of Science Dynamics**. Springer Verlag.

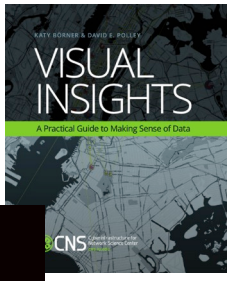
Katy Börner, Michael Conlon, Jon Corson-Rikert, Cornell, Ying Ding (2012) **VIVO: A Semantic Approach to Scholarly Networking and Discovery**. Morgan & Claypool.

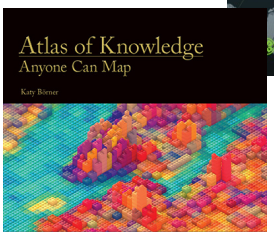
Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. The MIT Press.

Börner, Katy (2015) **Atlas of Knowledge: Anyone Can Map**. The MIT Press. http://scimaps.org/atlas2

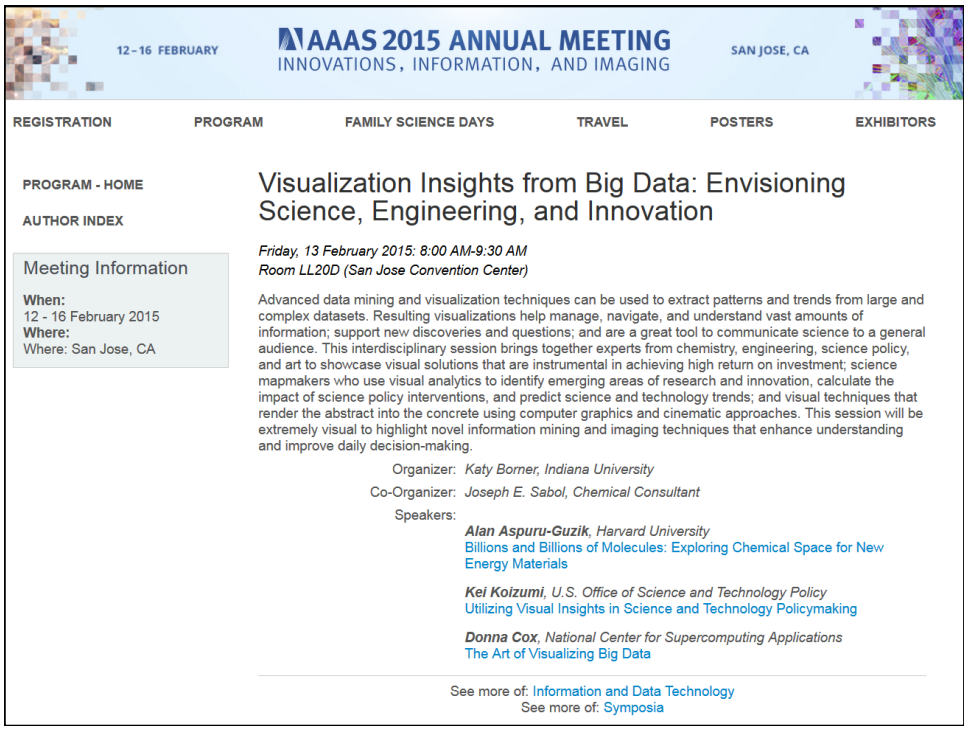




87




All papers, maps, tools, talks, press are linked from http://cns.iu.edu
These slides will soon be at http://cns.iu.edu/docs/presentations

CNS Facebook: http://www.facebook.com/cnscenter
Mapping Science Exhibit Facebook: http://www.facebook.com/mappingscience

89