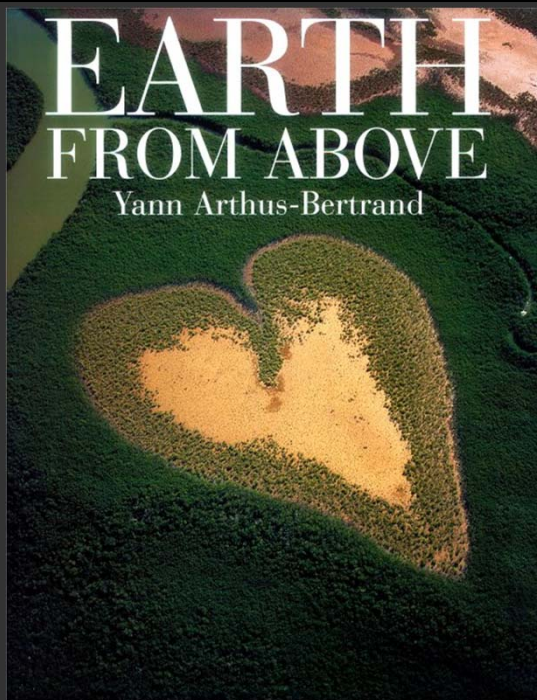




scimaps.org

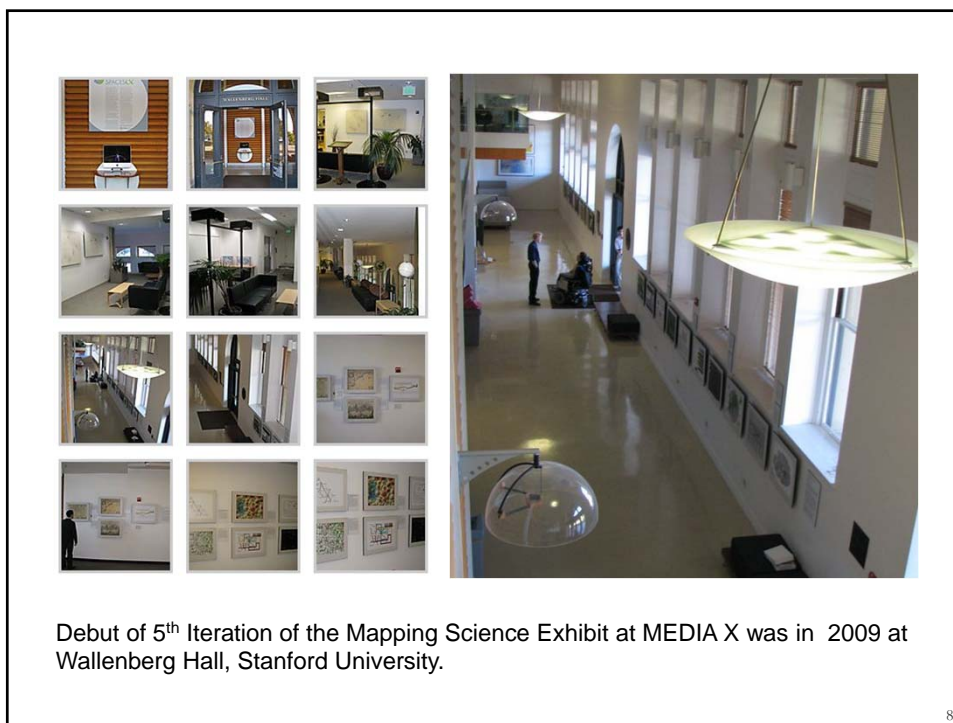
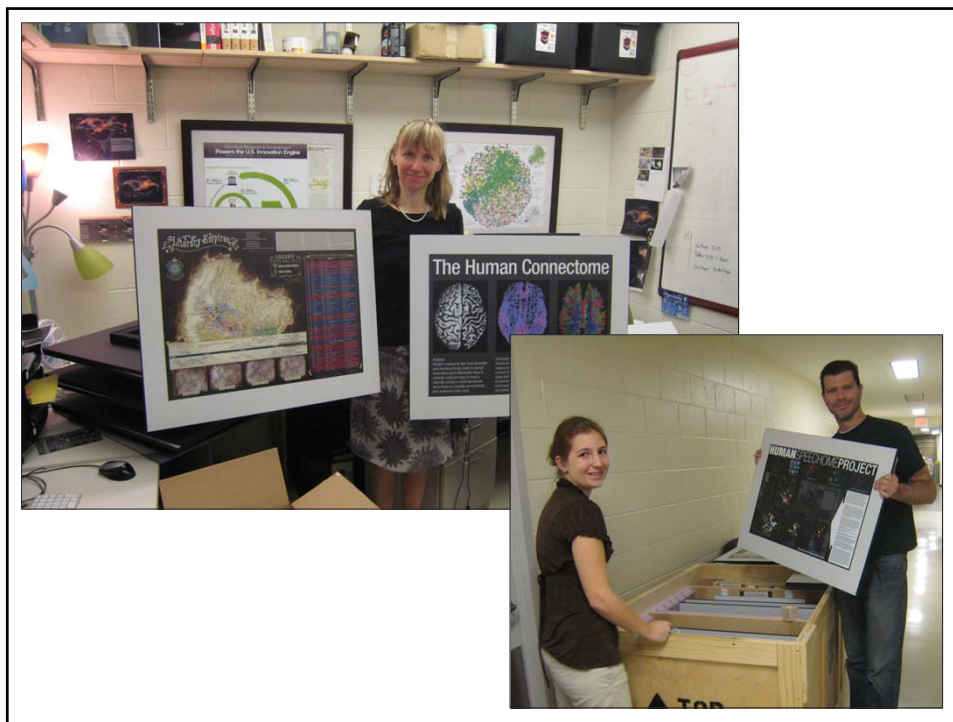


How can we communicate the beauty, structure, and dynamics of science to a general audience?



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



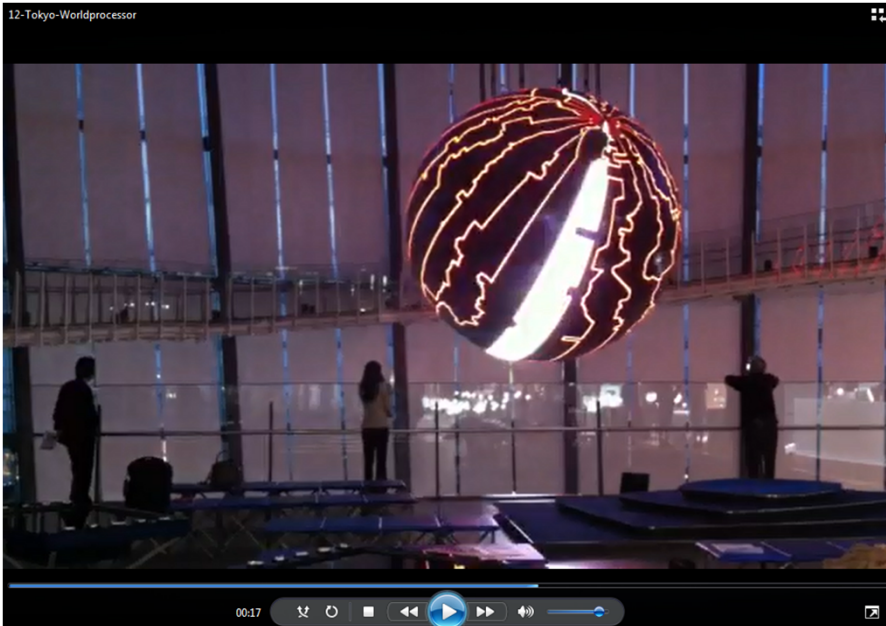


Debut of 5th Iteration of the Mapping Science Exhibit at MEDIA X was in 2009 at Wallenberg Hall, Stanford University.

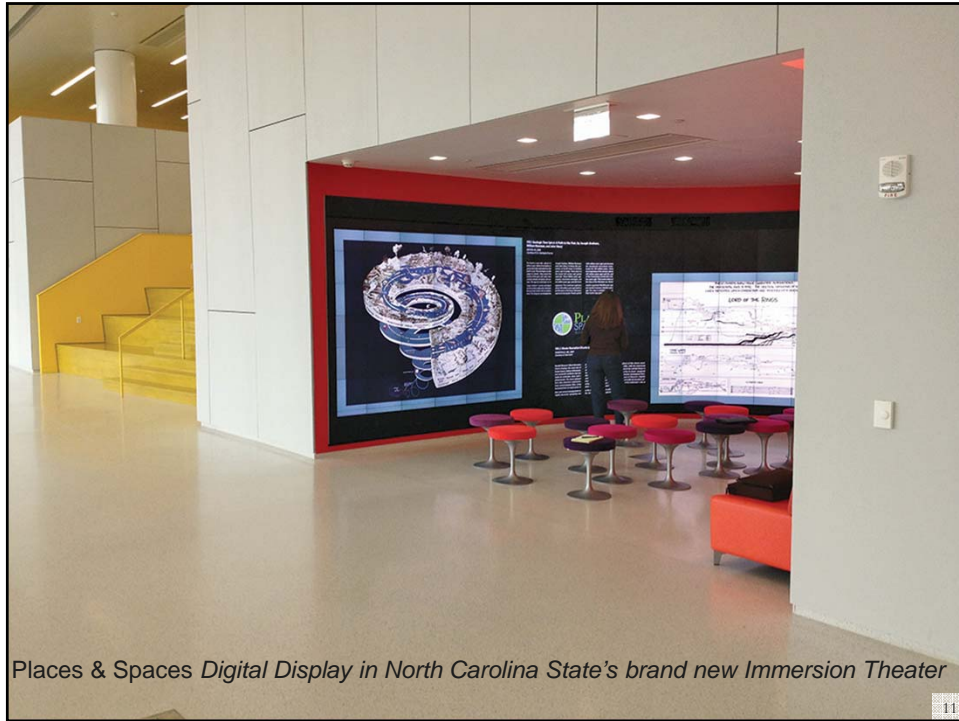


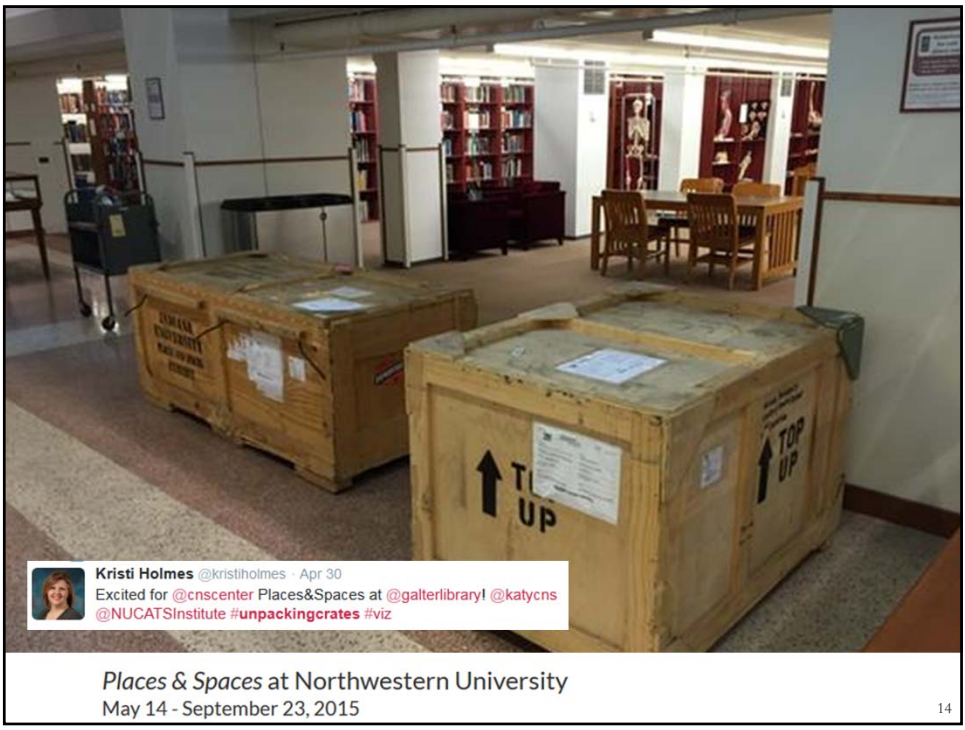
Science Maps in "Expedition Zukunft" science train visited 62 cities in 7 months. Opening was on April 23rd, 2009 by German Chancellor Merkel

9



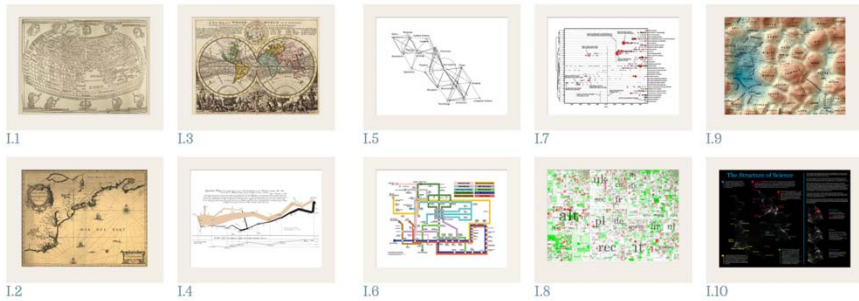
Ingo Gunther's Worldprocessor globe design on display at the Museum of Emerging Science and Innovation in Tokyo, Japan





10 iterations over 10 years
equal
 $10 \times 10 = 100$ maps!

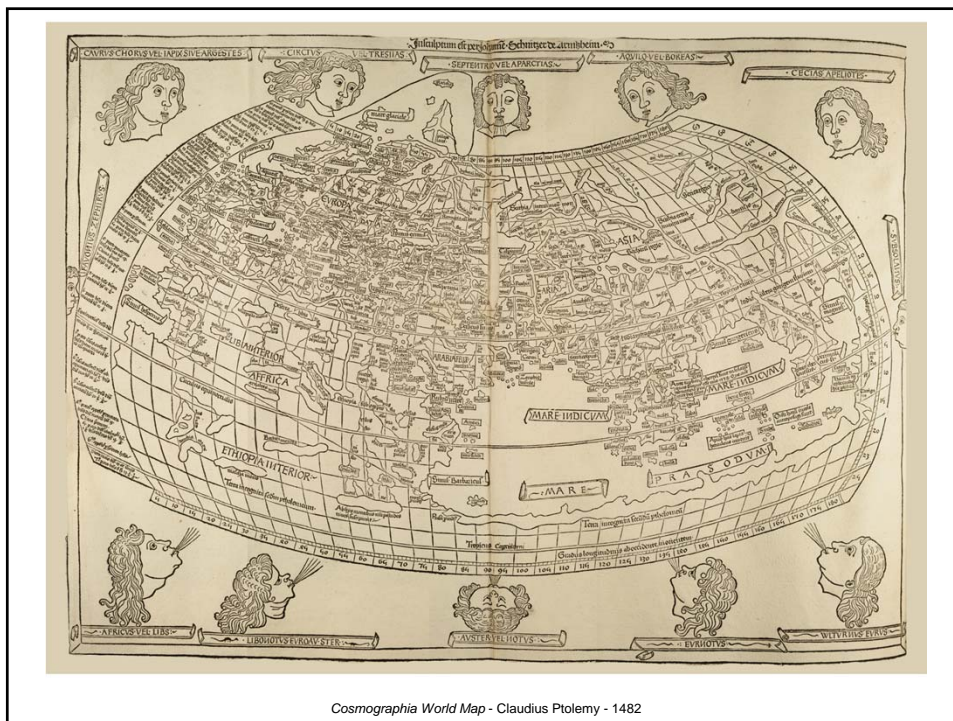
The Power of Maps 2005

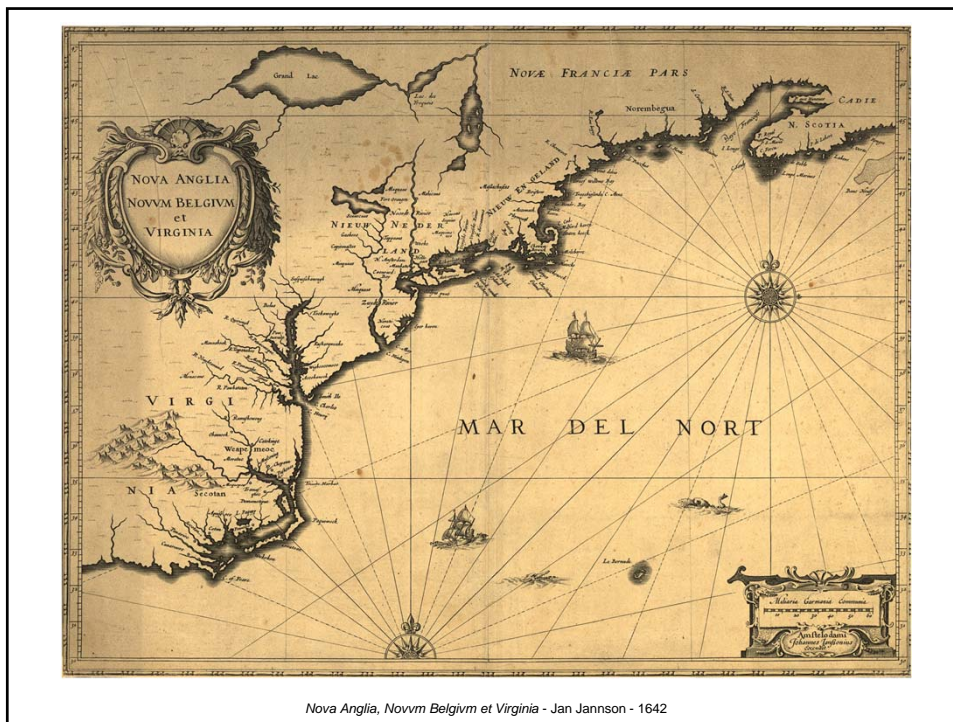


Cartographic maps of physical places have guided mankind's explorations for centuries.

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

Without maps, we would be lost.





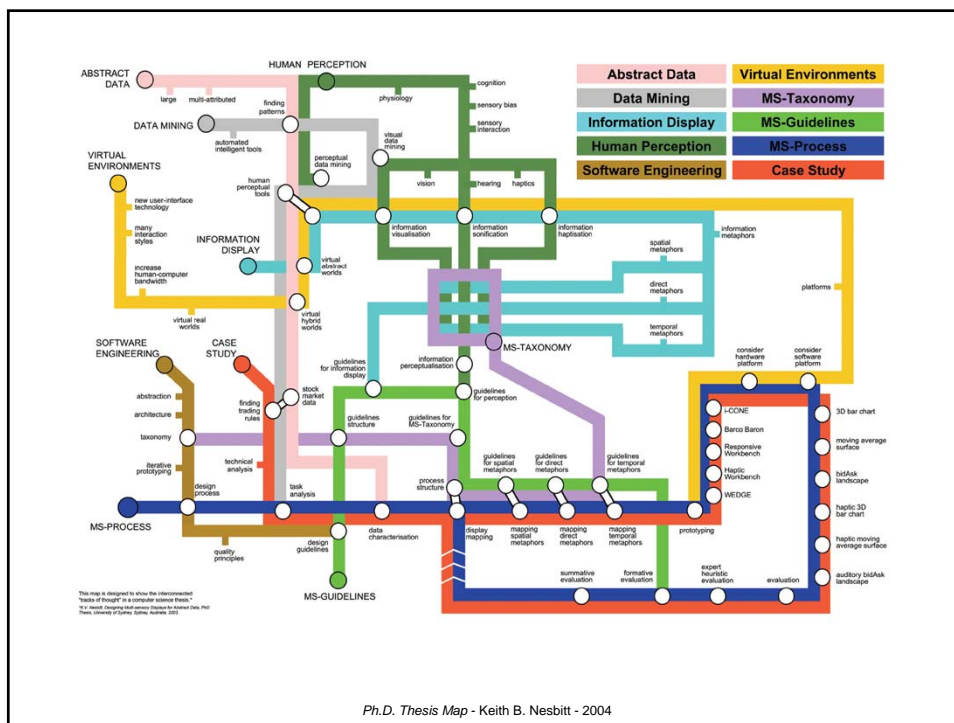
Nova Anglia, Novvm Belgivm et Virginia - Jan Jansson - 1642



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

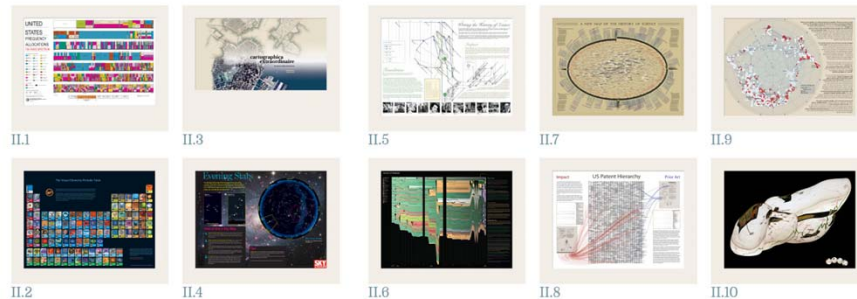
Science maps of abstract semantic spaces aim to serve today's explorers navigating the world of science.

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.

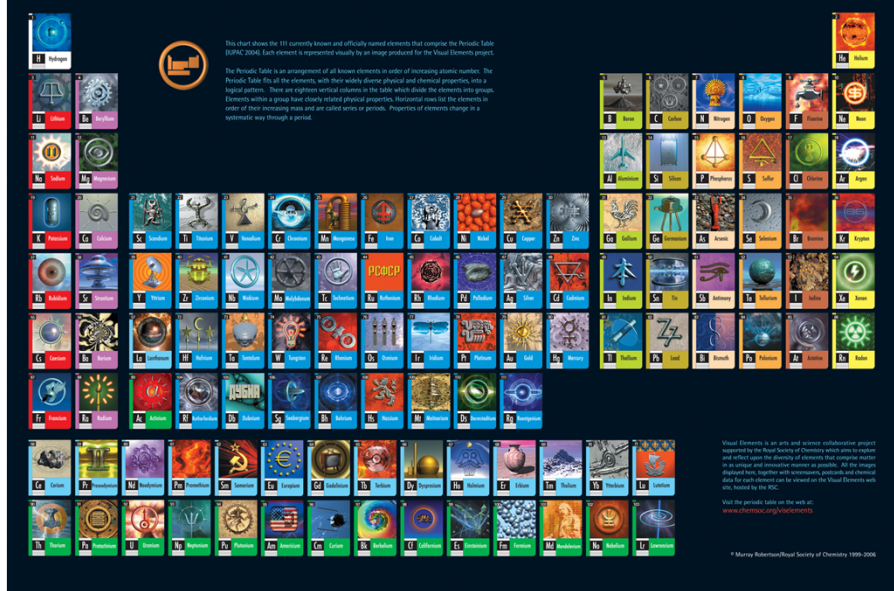


Ph.D. Thesis Map - Keith B. Nesbitt - 2004

The Power of Reference Systems 2006



The Visual Elements Periodic Table



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

Evening Stars

The Big Dipper floats high in the northeast these early spring evenings, while Orion sinks low in the southwest. These are just a few of the celestial sights you can find on any clear evening in April using a sky map like the one shown here.

April 5-6
Moon: after dark

Looking very high toward SW

April 12-14
Moon: up to 3 am

How to Use a Sky Map

- Check the dates and times of night.** Take your map out under the night sky around the right time, and bring along a flashlight to read it by. It helps to attach a piece of red paper over the front or to use a flashlight with red LEDs; the dim red light won't spoil your night vision.
- Details, you need to know which direction you're facing.** If you're unsure, just note where the Sun sets, that's west. (Whichever way you're facing, make sure the corresponding yellow label along the curved edge of the map is at the bottom, "right side up". This curved edge represents the horizon. The stars above it on the map match the stars in front of you. The further up from the map's edge they appear, the higher they'll be in the sky. The center of the map is the zenith (straight overhead). So a star halfway from the edge of the map to the center will appear halfway from straight ahead to straight up. Ignore all the parts of the map above horizons you're not facing.
- Let's give it a try!** Pretend you're facing the southwest horizon (labeled "Facing SW"). Just a little way up (that is, a little way in from the edge of the map) is Sirius, the brightest star in the night sky, in the constellation Canis Major. Further up, nearly halfway overhead, is the star Procyon in Canis Minor. Still further up is the ringed planet Saturn. Go out at the right time, face southwest, and look up into the sky — there they are!

When to Use This Map

Early April: 10 pm (daylight-saving time)
Late April: Dark

Tips

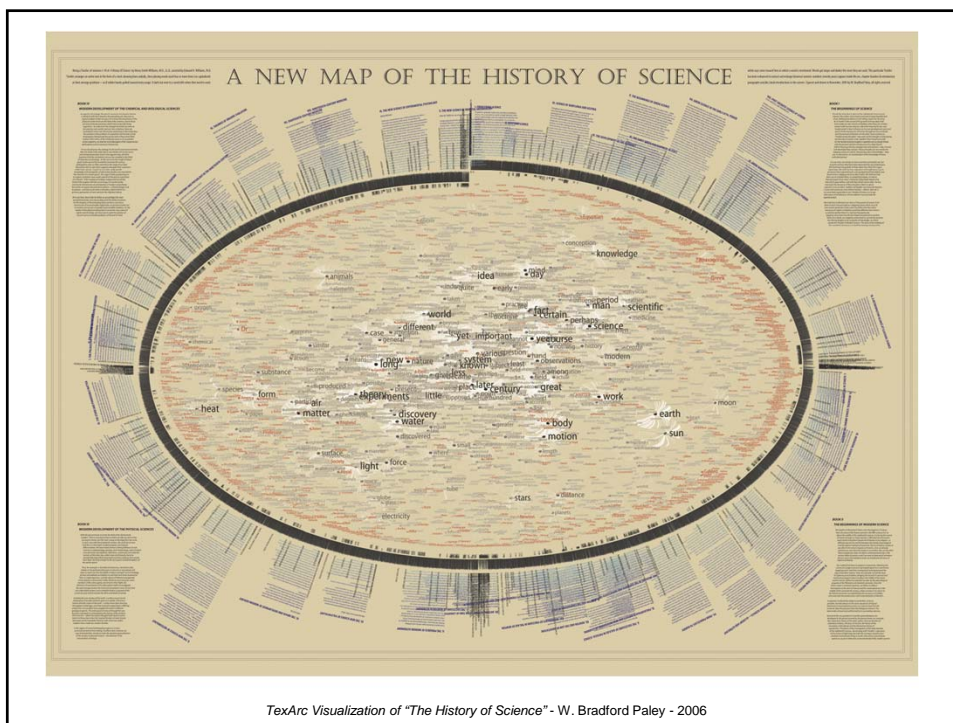
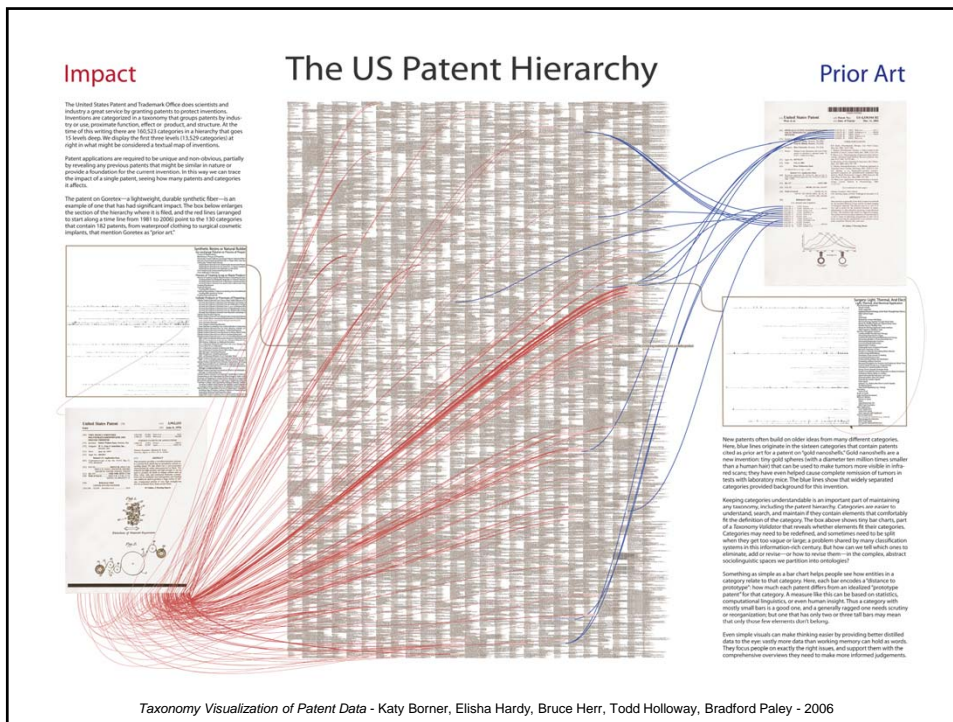
A couple of tips: Look for the brightest stars and constellations first; light pollution or moonlight may wash out the fainter ones. And remember that star patterns in the sky will look a lot bigger than they do here on paper. With a map like this, you can identify celestial sights all over the sky. Go out the next clear night and make some stargazing friends!

You can customize a night sky map for any time and place at SkyandTelescope.com.

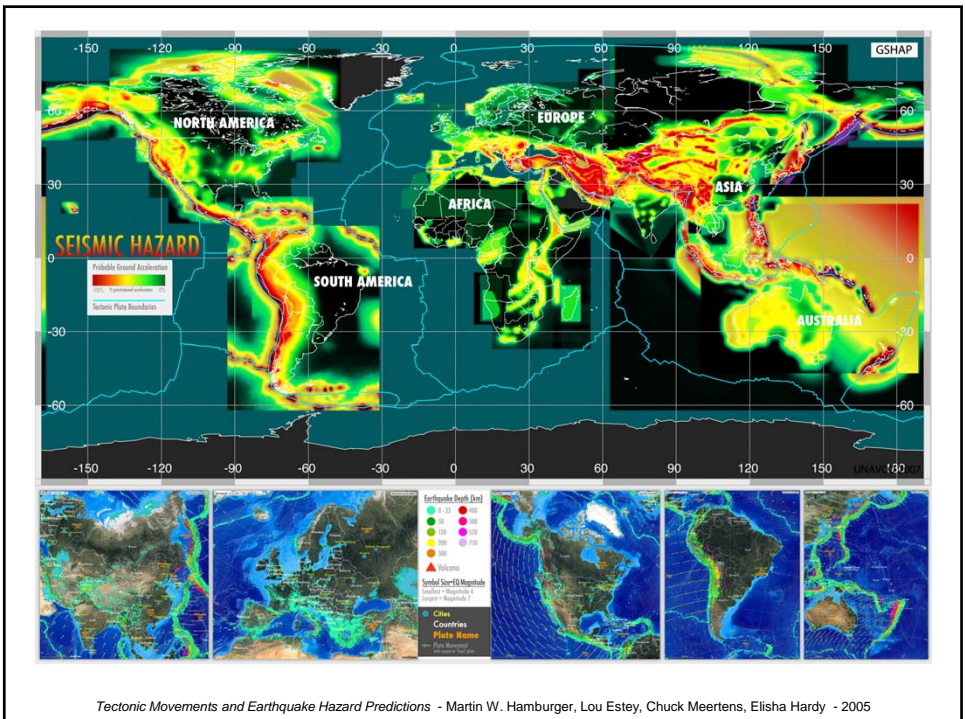
Sky Chart of New York City in April 2006 - Roger W. Sinnott, Interactive Factory - 2006

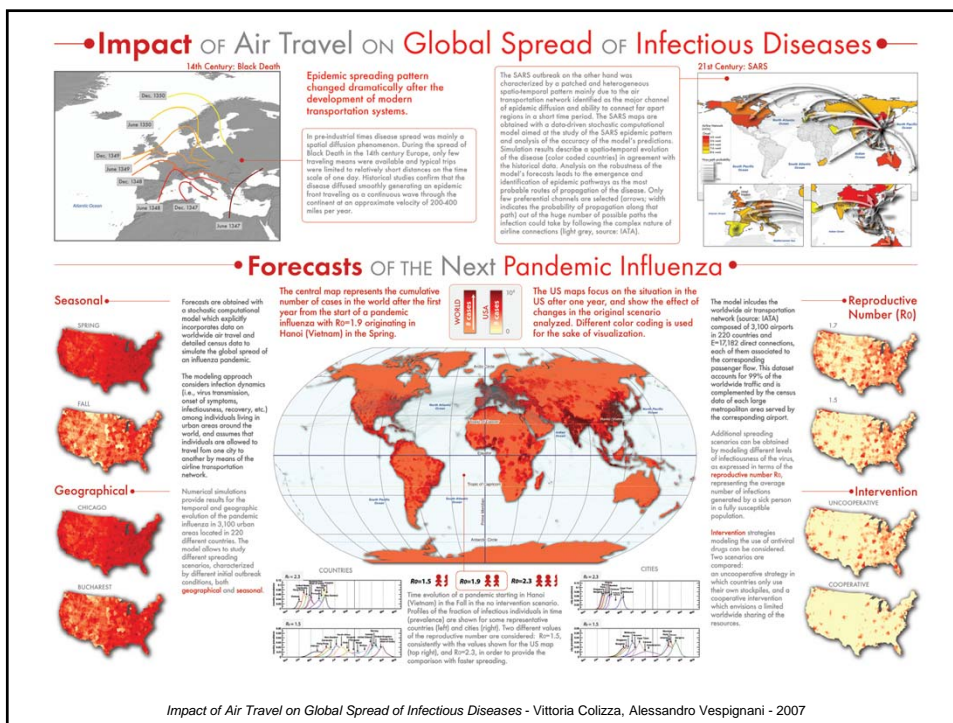
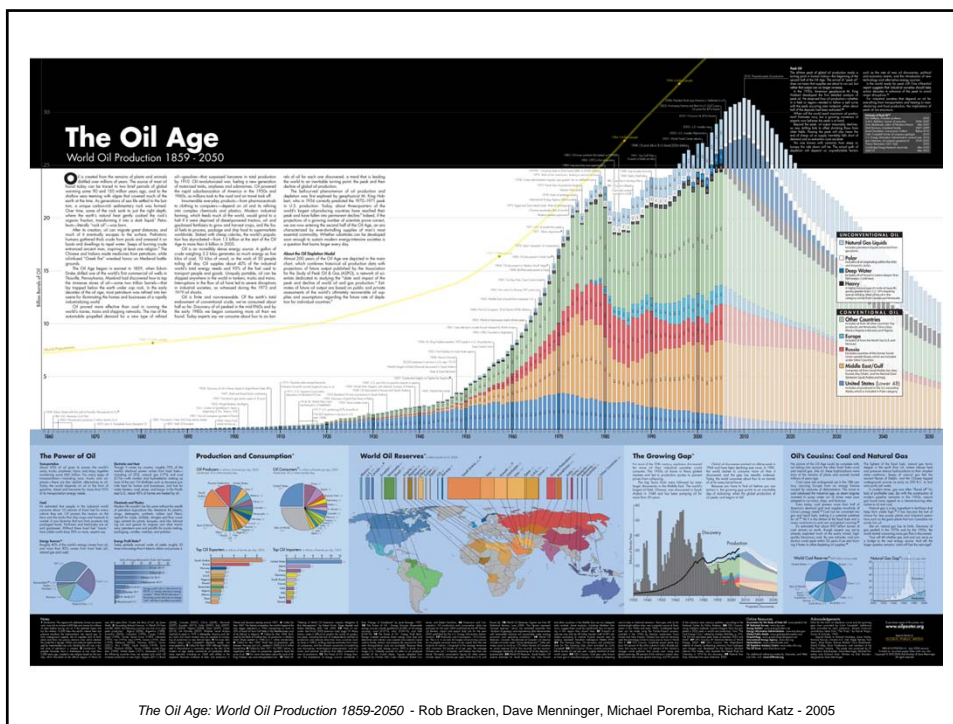
How would a reference system for all of science look?

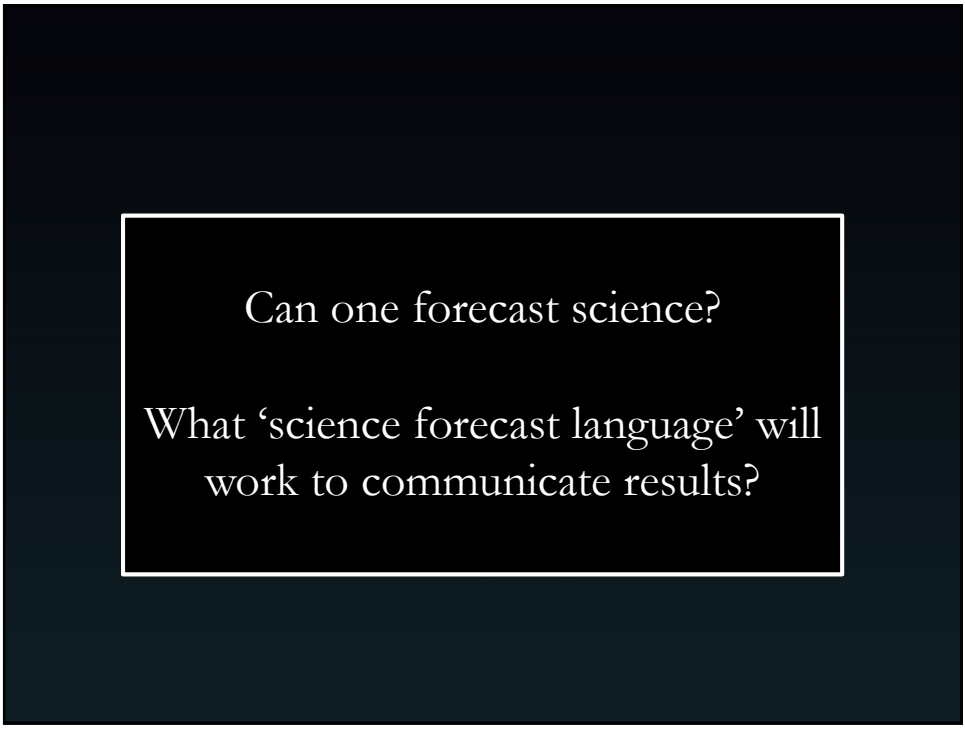
What dimensions would it have?



The Power of Forecasts 2007







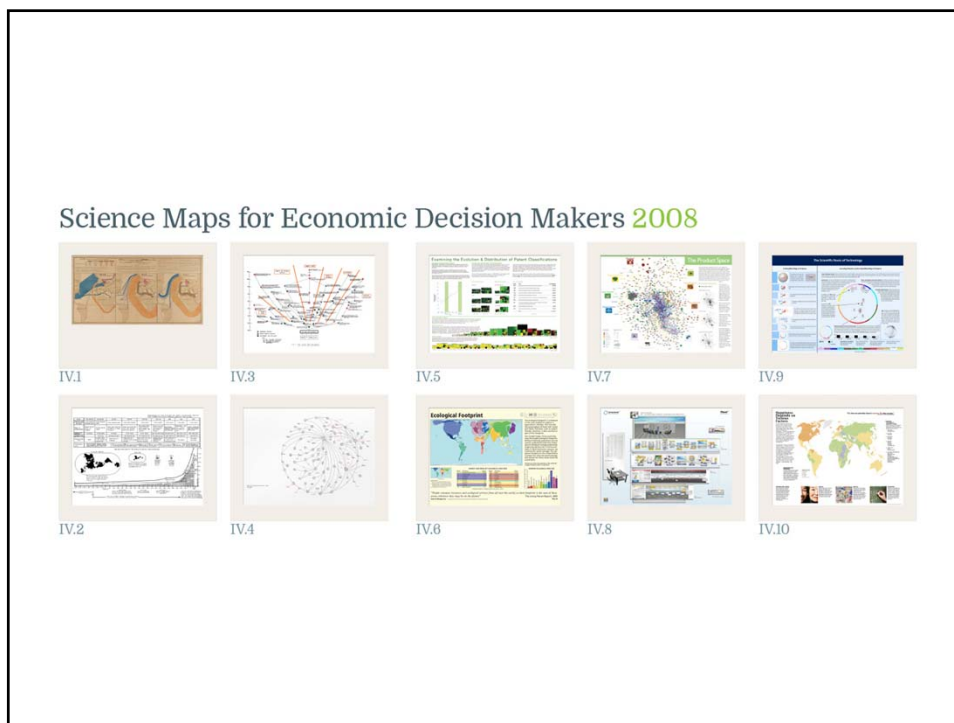
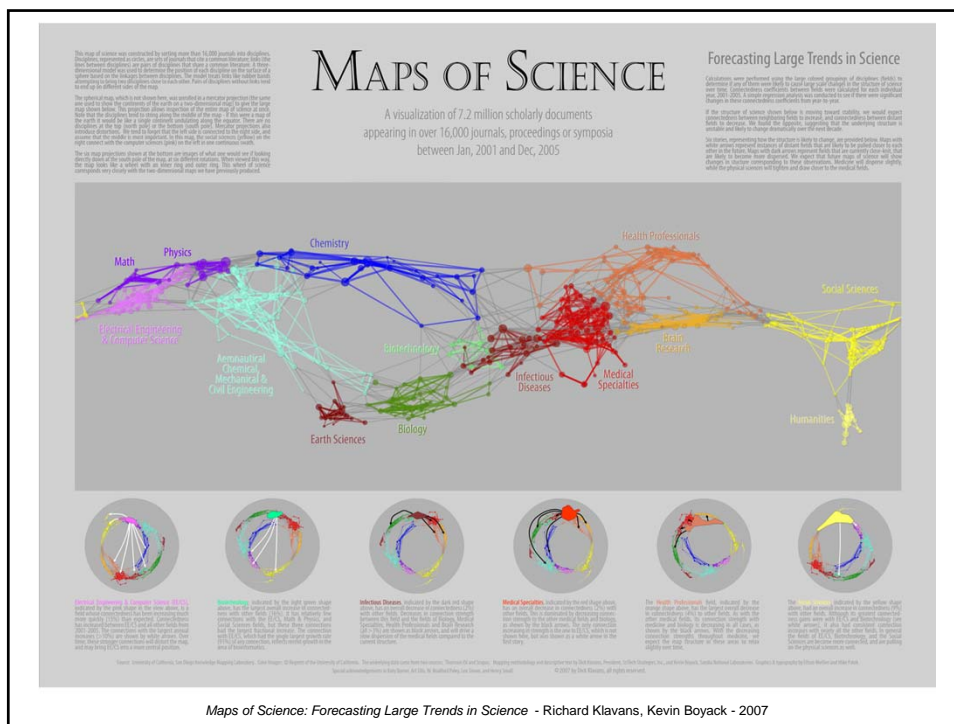
INSTITUTE FOR THE FUTURE
Science & Technology Outlook: 2005-2055

Technology Horizons Program
 Institute for the Future
 12A University Avenue, 2nd Floor, Palo Alto, CA 94301
 415.954.2022 | 415.954.3030 | www.iftf.org

MAP THEMES

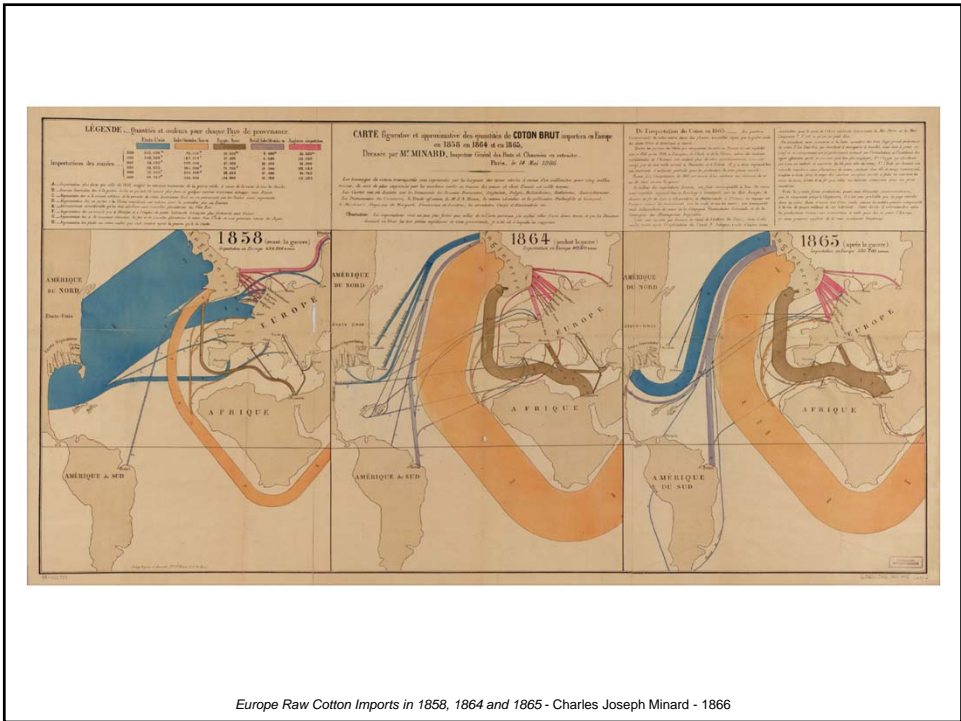
- 1. Globalization**
 After 50 years of basic research and development at the 100-year horizon, the emergence of nanotechnology as a source of innovations and new capabilities in everything from materials science to medicine is already well advanced. This trend, however, will define how nanotechnology will unfold, and what impacts it will have. From nanotechnology to a single field with a coherent intellectual program, it is an open-ended hybrid, shaped by a combination of functional research questions, growing technical applications, and venture and state capital. Systems nanotechnology is viewed as a key driver of small-scale mechanical engineering—which assembles basic mechanical systems from individual devices—toward one which includes biological and biomimetic components. This will lead to a new era of biological and biomimetic systems that will be used in a wide range of applications, from medicine to defense.
- 2. Information Biology**
 For a 30-year horizon, evolution has generated biology as the most complex and diverse of all systems. In the next 30 years, the ability to read and write the genetic code will be largely complete, and the ability to engineer living organisms will be largely complete. This will lead to a new era of biological and biomimetic systems that will be used in a wide range of applications, from medicine to defense.
- 3. Energy Transformation**
 In the next 30 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 data about the physical world, and even emotional data of people and things in their surroundings. As a result, increasing the ability to read and write the genetic code will be a key driver of progress in the next 30 years.
- 4. Mathematical World**
 The ability to process, manipulate, and ultimately understand patterns in enormous amounts of data will allow decoding of previously intractable problems in everything from biological to social systems. Scientists are learning that at the core of many biological phenomena—regulation, growth, repair, and others—are computational processes that can be decoded and simulated. Using mathematical models, scientists are beginning to understand whether these are physical, biological, or social—will likely emerge as an increasing field of computational systems in the next 30 years. Such massive computation will also make simulation independent. 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.
- 5. Technological Infrastructure**
 A confluence of new materials and distributed intelligence is poised to reshape the economics of moving people, goods, energy, and information. From the molecular level to the macro-economic 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 networks than the capital-intensive networks of the 20th century. These intelligent infrastructure networks are the product of a new era of distributed intelligence, which will be used to build a more resilient, more secure, and more efficient infrastructure.
- 6. Transdisciplinary**
 The phenomenon of self-organizing systems 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 it can be designed. Emergent phenomena have been observed across a variety of fields and problems to which it can be applied. It is proving useful for modeling a wide variety of phenomena, from biological systems to social systems. This research will be used to build a more resilient, more secure, and more efficient infrastructure.

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

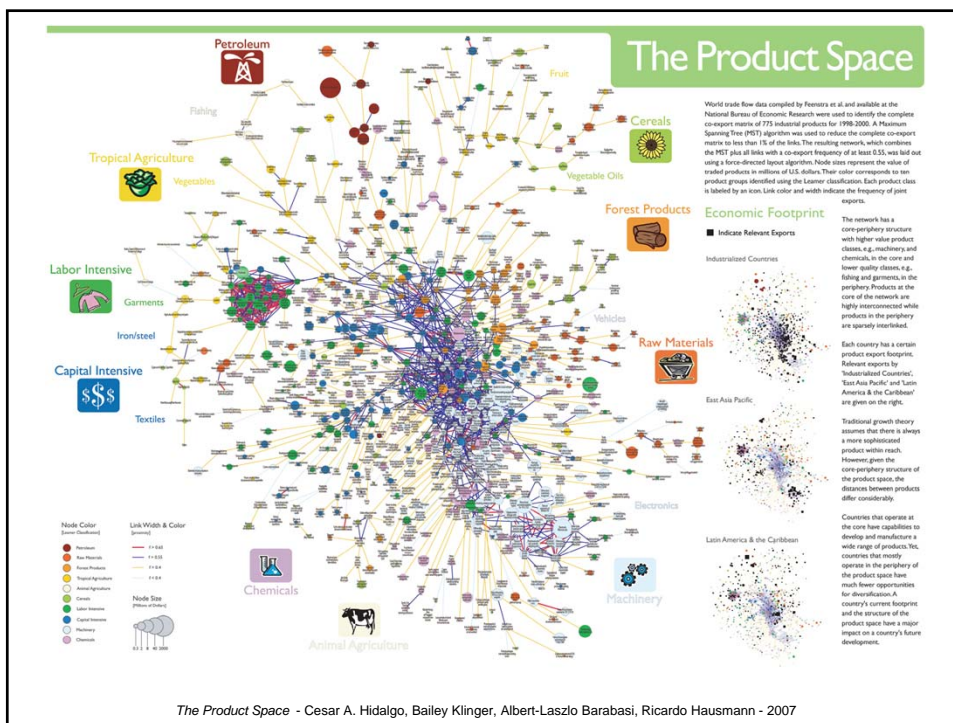
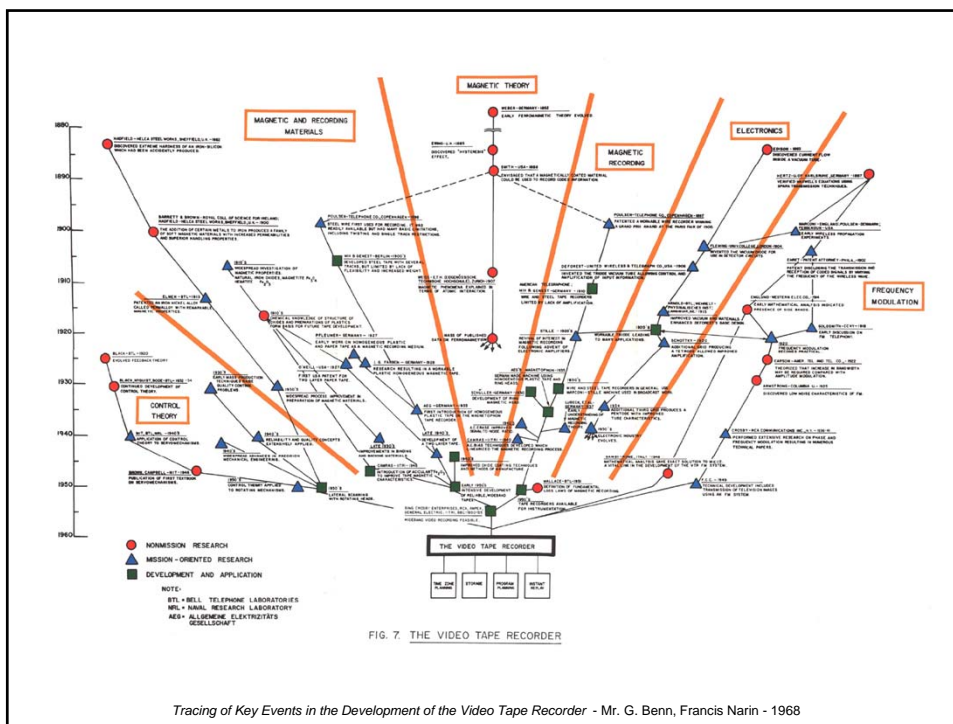


What insight needs to economic
 decision makers have?

 What data views are most useful?



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



Happiness Depends on Various Factors

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 rating 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. Average 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.

MEASURING THE INTANGIBLE
The map is derived from the New Economics Foundation's 2006 "Happy Planet Index," which comes on one 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).

Happiness Index
 ■ Very happy
 ■ Happy
 ■ Content
 ■ Lousy
 ■ No data
Source: NEF, n.d.

DEFINING WELL-BEING
By comparing the happiness index to data from the U.S., the U.K., 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. In Iceland, at the other end of the scale, is plagued by poverty, disease, and violence. Obstacles to access to health care divide many countries into have and have-nots.

WEALTH
Money will not 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. That poverty means real misery, a fate shared by nations.

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.

"It's time we admitted there's more to life than money."
—David Cameron, U.K. prime of the appointment 2010

RANKING THE WORLD'S HAPPIEST PLACES
Residents of Europe, North America, and several wealthy countries made the list, but so do many less prosperous island nations.

- 1 DENMARK
- 2 SWITZERLAND
- 3 AUSTRIA
- 4 ICELAND
- 5 BAHAMAS
- 6 FINLAND
- 7 SWEDEN
- 8 BHUTAN
- 9 BRUNEI
- 10 CANADA
- 11 IRELAND
- 12 LUXEMBOURG
- 13 COSTA RICA
- 14 MALTA
- 15 NETHERLANDS
- 16 ANTIGUA AND BARBUDA
- 17 MALAYSIA
- 18 NEW ZEALAND
- 19 NORWAY
- 20 SEYCHELLES
- 21 ST. KITTS AND NEVIS
- 22 UNITED ARAB EMIRATES
- 23 UNITED STATES
- 24 MALDIVU
- 25 VENEZUELA

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

Science Maps for Science Policy Makers 2009

V.1 Science and Society in Equilibrium

V.2

V.3

V.4

V.5

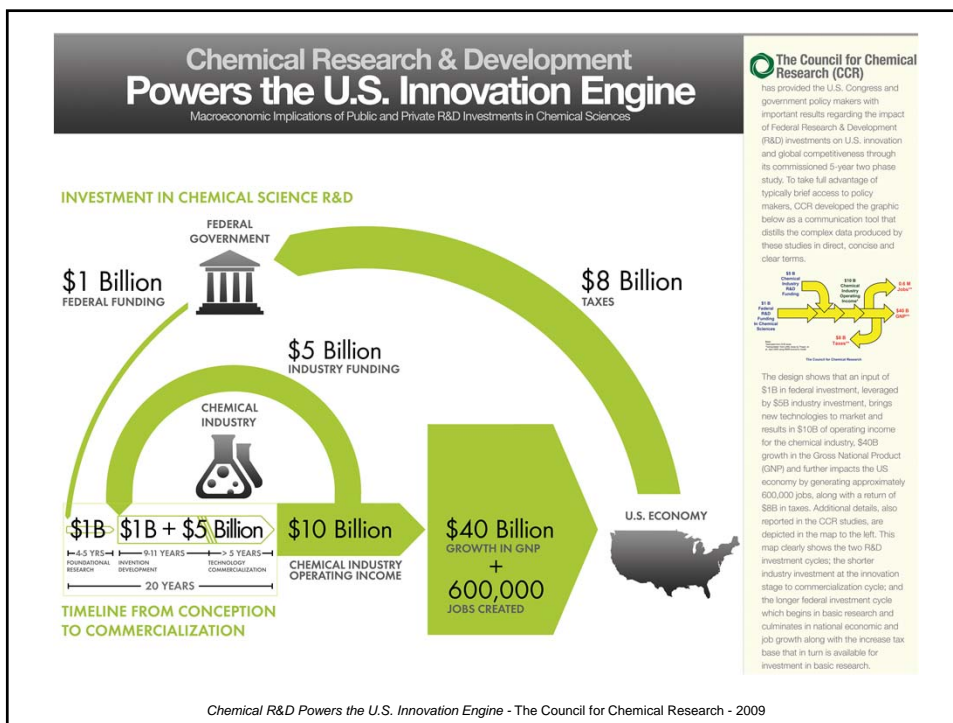
V.6 Powers the U.S. Innovation Engine

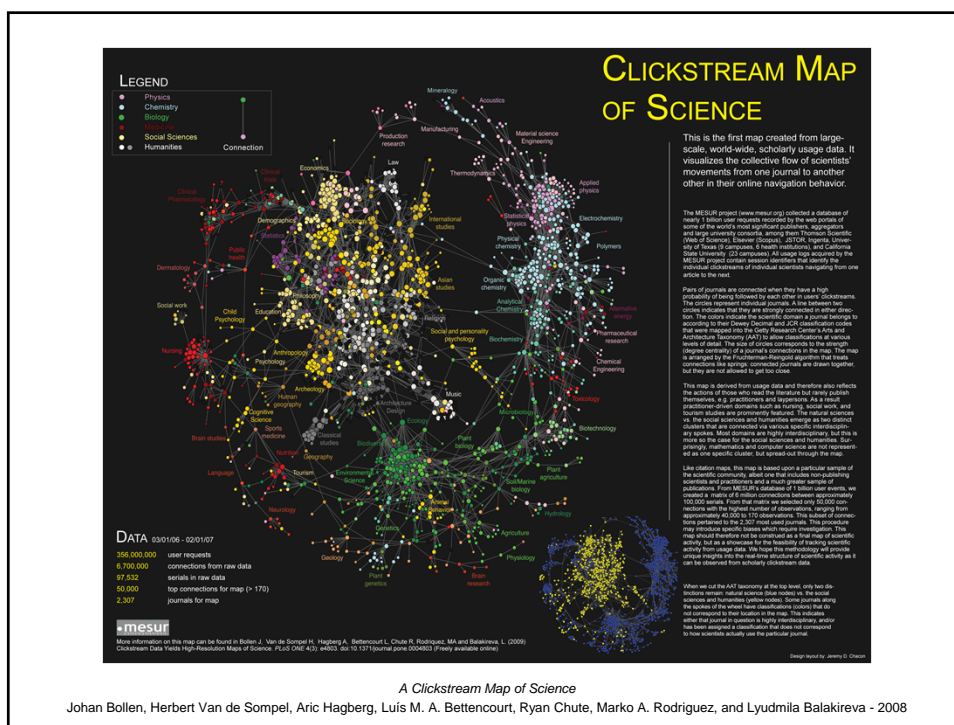
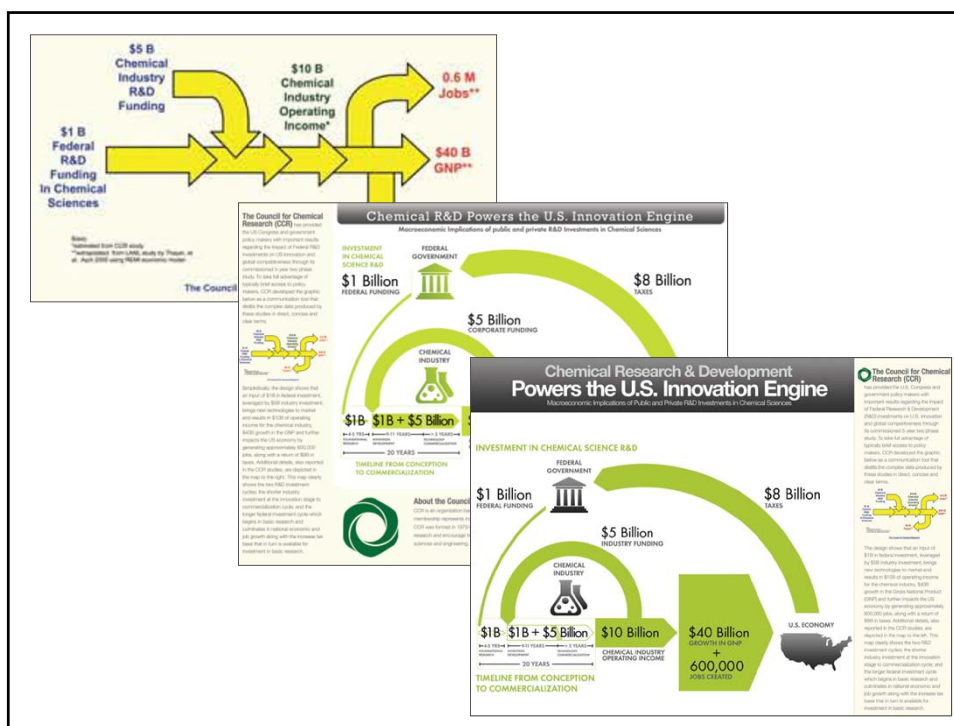
V.7

V.8

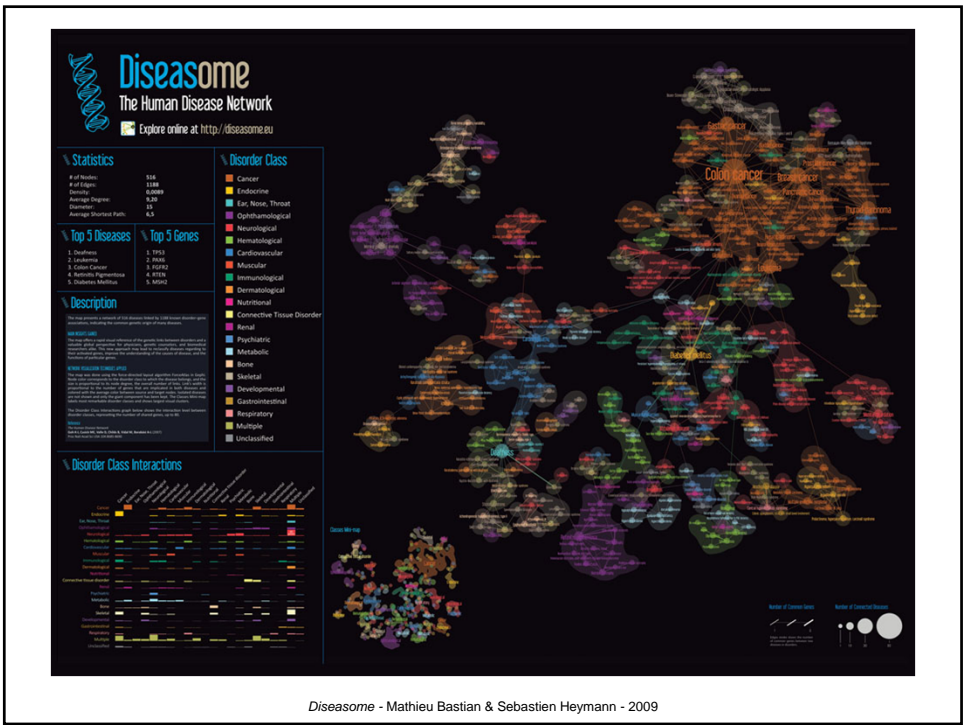
V.9 US Vulnerability in Science

V.10

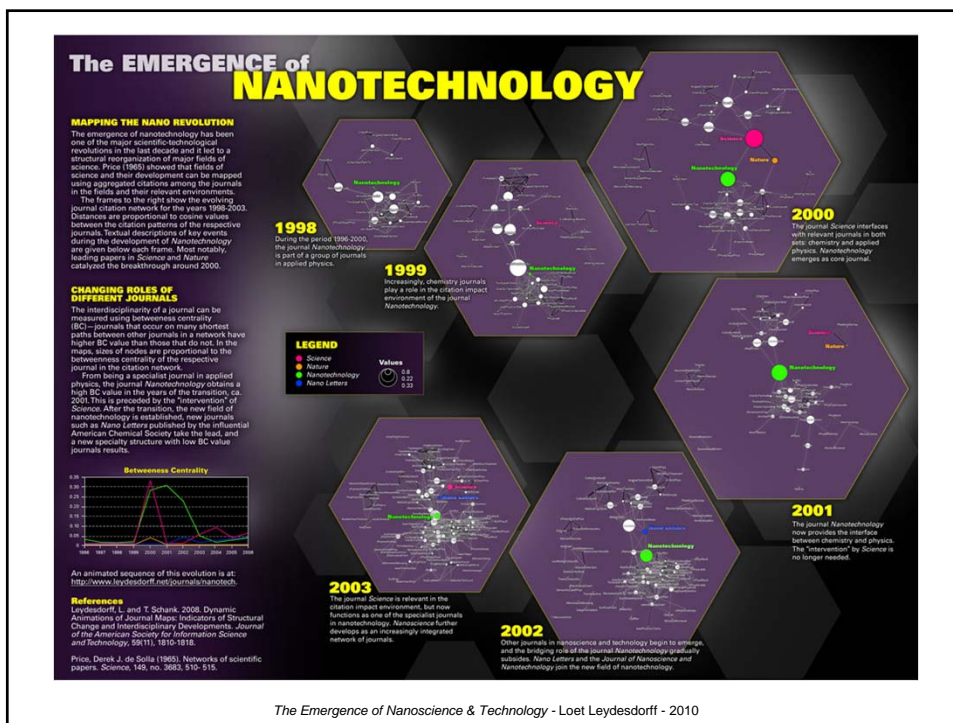
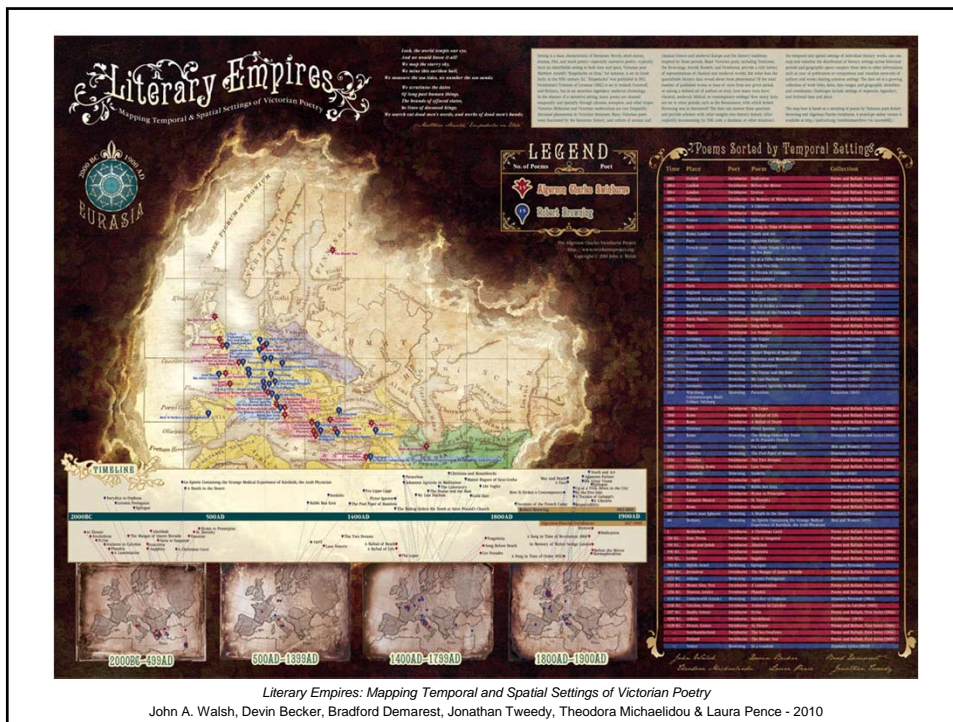


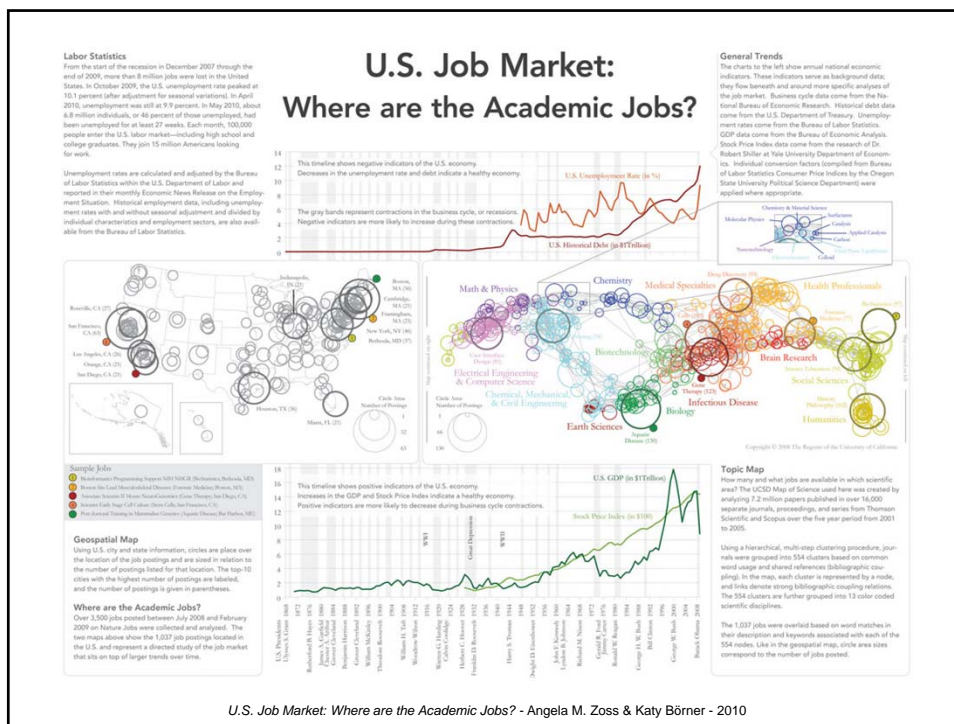


Science Maps for Scholars 2010



Diseaseome - Mathieu Bastian & Sebastien Heymann - 2009





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 "translucent paper"
EUM Archives E141
© Mundaneum - Miroslav Beljanc

The Mondothèque is a multimedia desk with spaces for essential books, with shelves 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 of communication and broadcasting instruments, such as radio, telephone, television and film equipment.

"Our 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 | 27 x 38 cm
pen and ink on translucent paper
EUM E304
© Mundaneum - Miroslav Beljanc

MUNDOTECA [Documentatio-Universalis-Mundaneum]
BRINGING TOGETHER OF ALL KINDS OF DOCUMENTATION: (THE 16 KINDS) IN A SINGLE ORDERED GROUPING
An agency for: construction, preservation, use (specific or general) - systematic developments in furniture, building, gardens.

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A. Catalogue of the Mundaneum for all kinds of documentation
B. Universal Classification 8. Organisation (Radio, Manual)
C. Mundaneum A. Case with (Photograph, Microfilm, Television) B. To use with (Telephone, Photograph, Microphone, Radio)
1. Microfilm and 2.3. To use with (Telephone, Photograph, Microphone, Radio)
4. Microfilm A. Case of films B. Slide (Three movements) C. Case

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

DESIGN VS. EMERGENCE: VISUALIZATION OF KNOWLEDGE ORDERS

WIKIPEDIA'S CATEGORY STRUCTURE

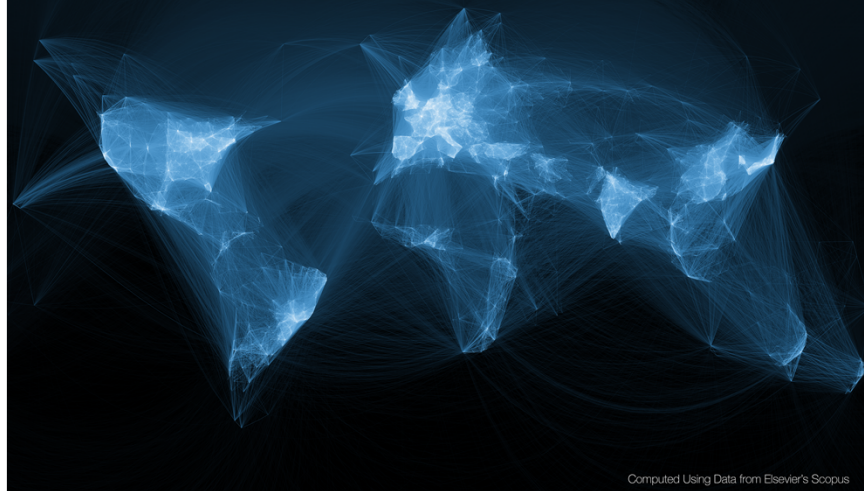
UNIVERSAL DECIMAL CLASSIFICATION

CATEGORY DISTRIBUTION OF WIKIPEDIA & UDC

WIKIPEDIA TO UDC: BAR CHART

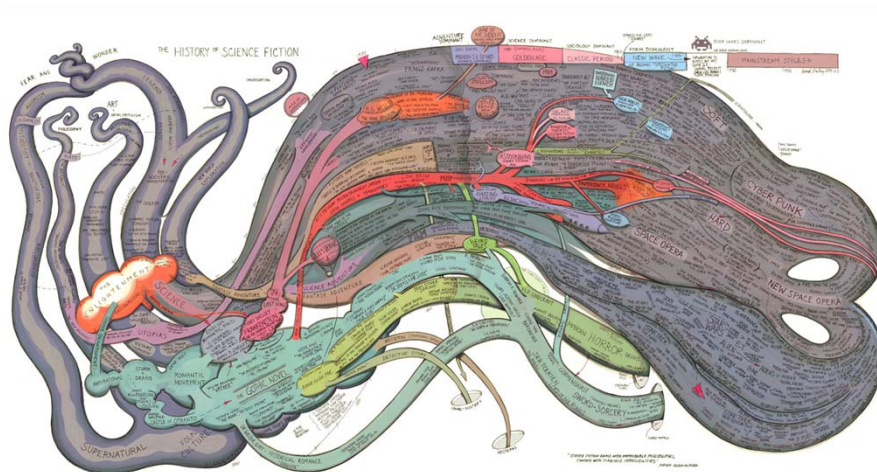
Design vs. Emergence: Visualization of Knowledge Orders
Alkim Almila Akdag Salah, Cheng Gao, Krzysztof Suhecki, and Andrea Scharnhorst - 2011

Map of Scientific Collaborations from 2005-2009



Computed Using Data from Elsevier's Scopus

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



History of Science Fiction - Ward Shelley - 2011

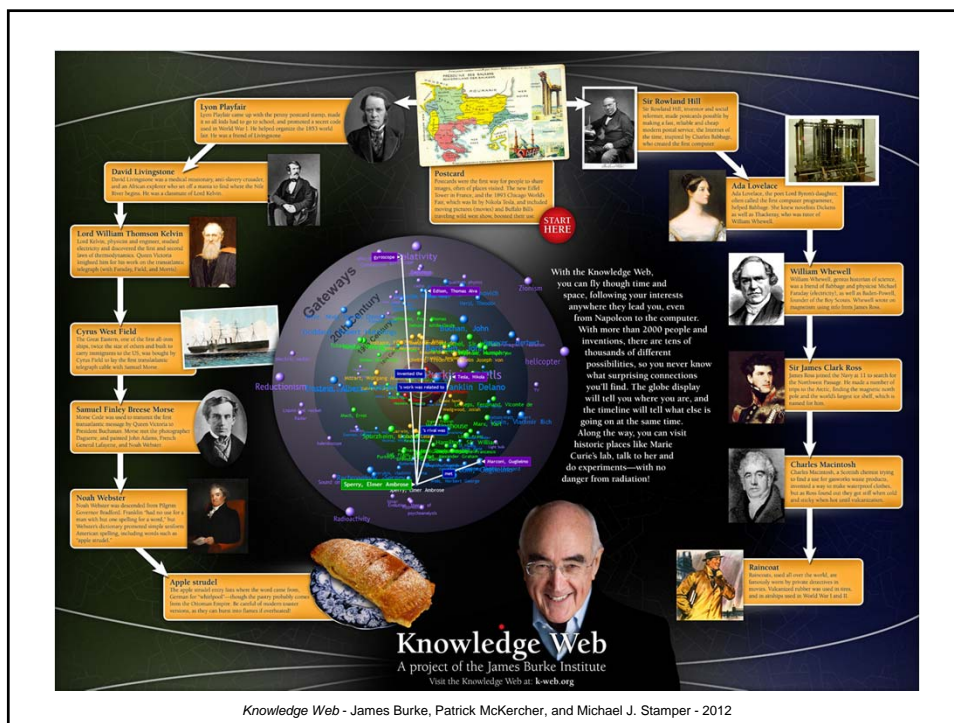
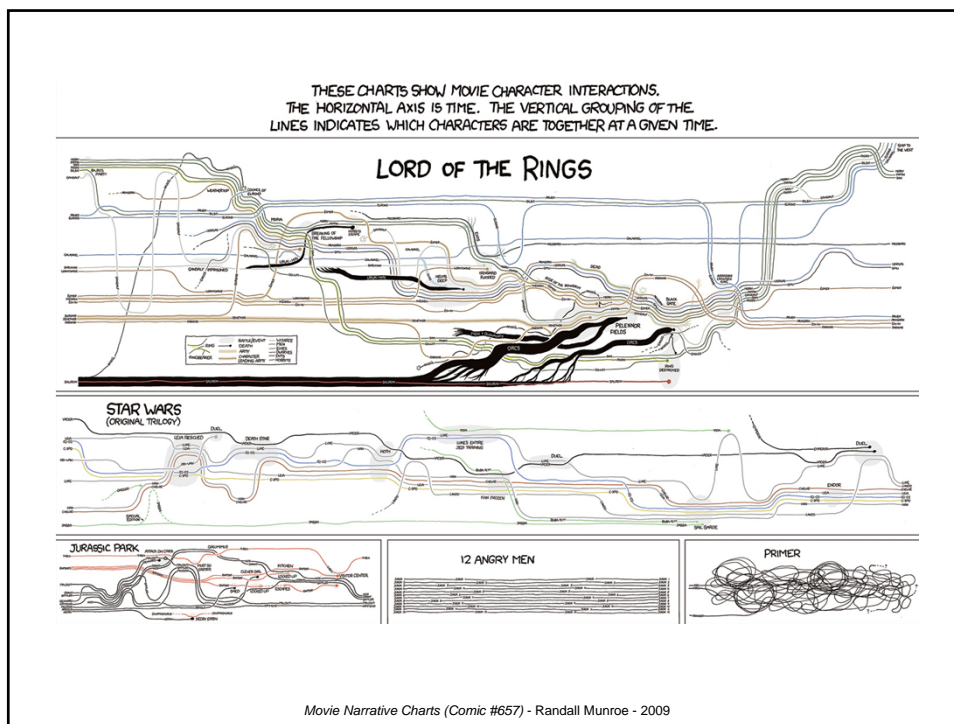
Check out our **Zoom Maps** online!

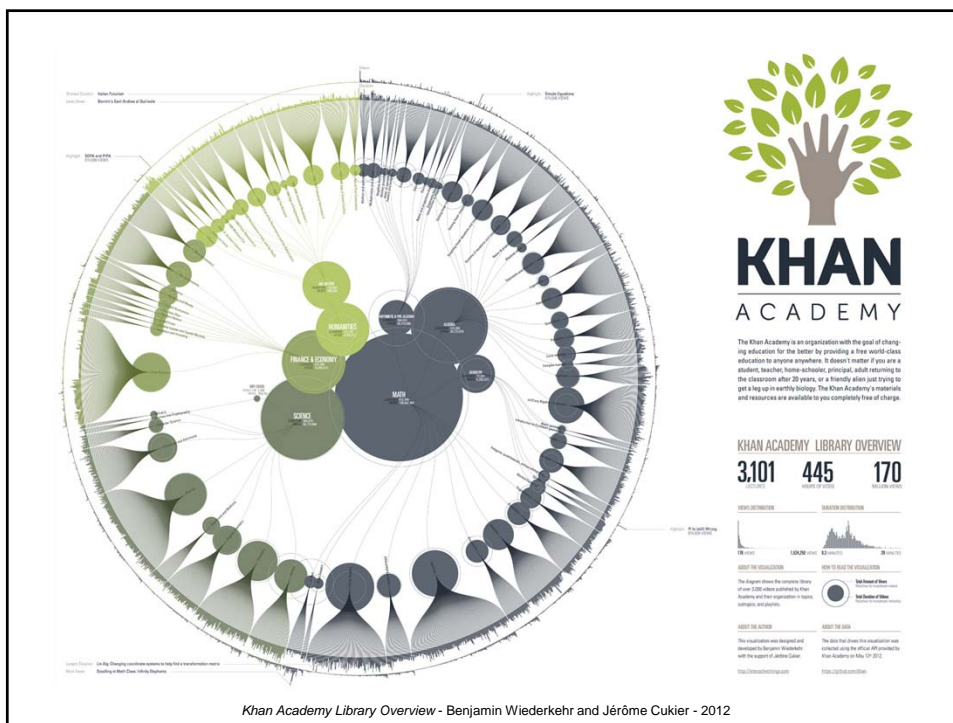
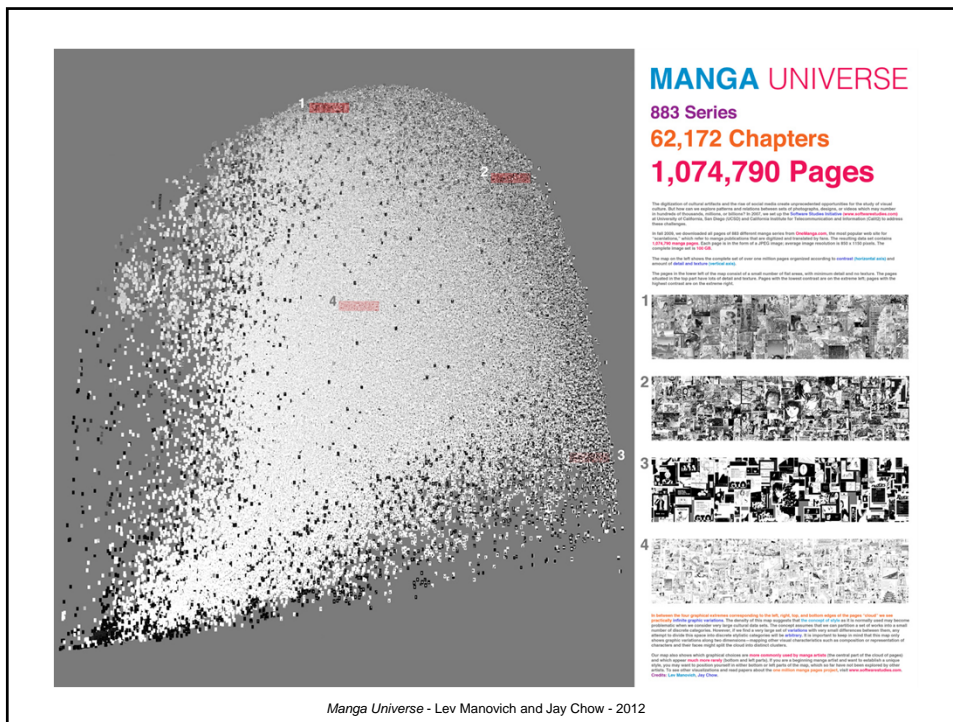


Visit scimaps.org and check out all our maps in stunning detail!

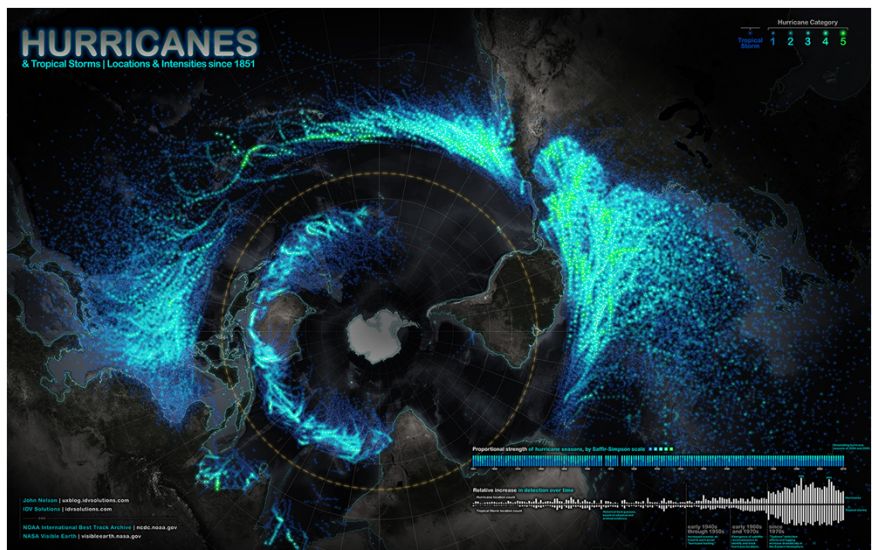
Science Maps for Kids 2012



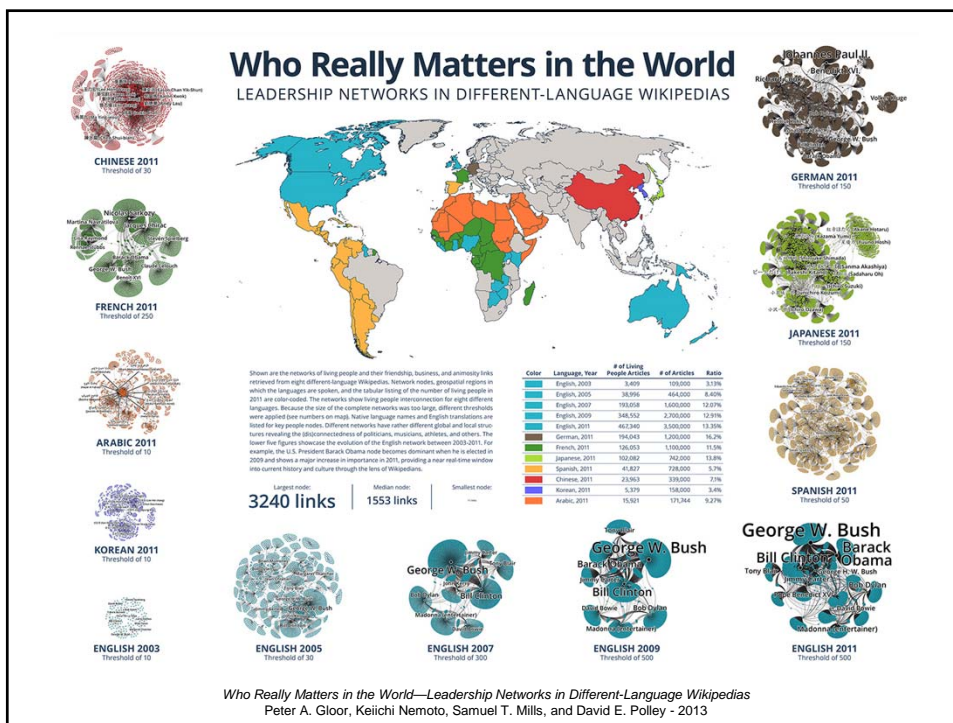
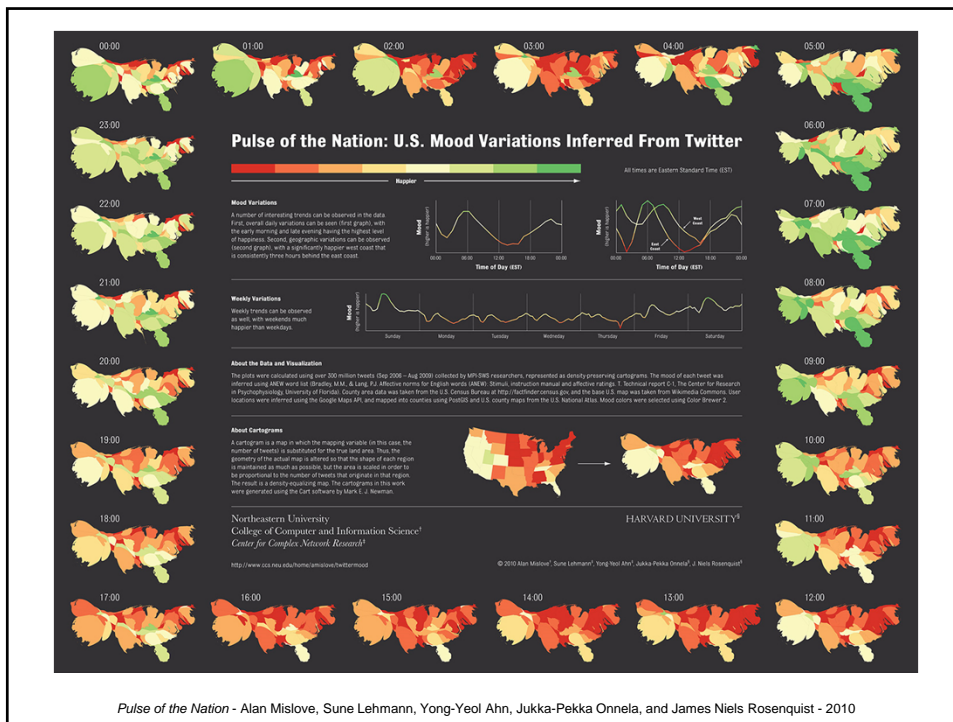




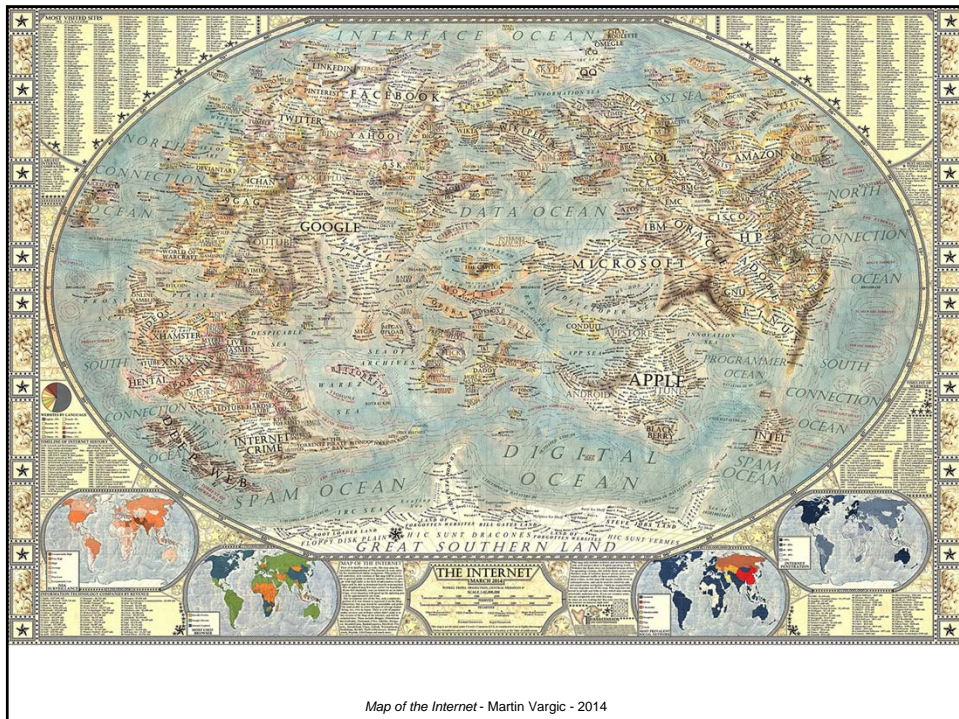
Science Maps Showing Trends and Dynamics 2013



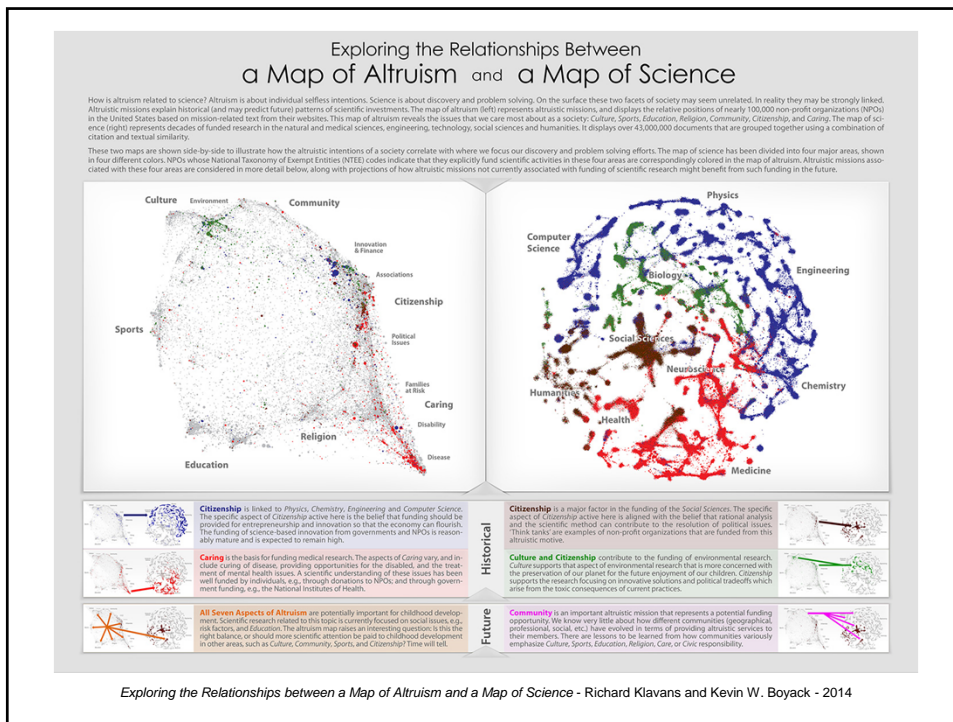
Hurricanes & Tropical Storms—Locations and Intensities Since 1851 - John Nelson - 2012



The Future of Science Mapping 2014



Map of the Internet - Martin Vargic - 2014



Explore the maps and background information at

<http://scimaps.org>

Curated by the CyberInfrastructure for Network Science Center

search scimaps.org

About
Maps & More
Exhibitions
Host the Exhibit
Mapmakers
Store
News
Contact

Full 100-map exhibit on display for the first time ever at the University of Miami

University of Miami Otto G. Richter Library

1 What is a Science Map?

If you're new to science mapping or data visualization, here's an overview

3 Purchase Maps & More

Have a favorite map? Have it printed and framed to hang in your home or office!

2 Meet the Mapmakers

Over the years, the exhibit has employed over 240 mapmakers from around the world

2 See the Maps

Zoom in to all 100 maps that comprise the Places & Spaces exhibit to see them in stunning detail

3 P&S Around the World

Browse photos of Places & Spaces exhibits from around the world and see a full list of venues

2 Host the Exhibit

Put your institution on the map by hosting the exhibit at your university, museum, or library

Tweets

Andy Bomer @ibomer 22 Aug
Big data visualization "Jas and the Big Data Baseball" theater piece now playing at SMM. #scimaps #placesandspaces

Places & Spaces @mappingscience 18 Aug
Enjoy a FREE night out @theaterspace & see #placesandspaces on the big screen till 8pm. FREE tax @ box office night of show. #placesandspaces #scimaps

Places & Spaces @mappingscience 18 Aug
#placesandspaces featured in PBS & soon in ITG! won a Hugo for "best graphic" equipment.com/news/how.php... #placesandspaces

Tweet to @mappingscience



Visit us on Facebook!

The 9th Iteration is Coming Soon!
Curators, mapmakers and designers are hard at work preparing the 9th iteration of for public viewing. Look out for the online debut at scmaps.org

Places & Spaces: Mapping Science
508 likes · 7 talking about this

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

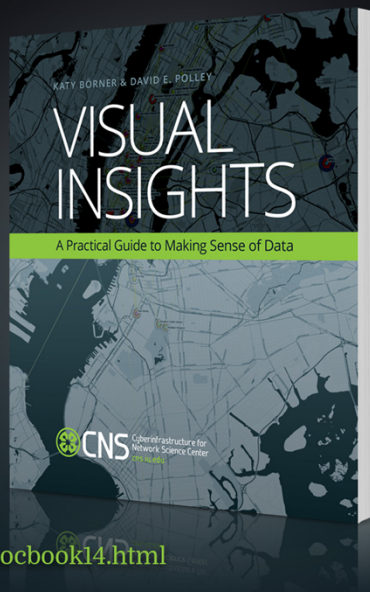
[facebook.com/mappingscience](https://www.facebook.com/mappingscience)

A screenshot of a Facebook page for 'Places & Spaces: Mapping Science'. The page features a post with a dark, glowing map image and text announcing the 9th iteration. The page has 508 likes and 7 people talking about it. The URL in the browser is <https://www.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

Information Visualization MOOC 2015



Overview

This course provides an overview about the state of the art in information visualization. It teaches the process of producing effective visualizations that take the needs of users into account.

The course can be taken for three Indiana University credits as part of the [Online Data Science Program](#), as part of the [Information and Library Science M.S. program](#), and as part of the online Data Science M.S. Program offered by the School of Informatics and Computing. Students seeking enrollment information should contact Rhonda Spencer at 812-855-2018, ilsmain@indiana.edu or datasci@indiana.edu.

Among other topics, the course covers:

- Data analysis algorithms that enable extraction of patterns and trends in data
- Major temporal, geospatial, topical, and network visualization techniques
- Discussions of systems that drive research and development.

Just like in past years, students will have the opportunity to collaborate on real-world projects for a variety of clients. [Click here to see the current list of clients and projects.](#) You can also see the detailed results of the 2013 client projects from the Visual Insights book [here](#).

Everyone who registers gains free access to the Scholarly Database (26 million paper, patent, and grant records), the Sci2 Tool (100+ algorithms and tools), and free PDF access to Part 2 of Katy Börner's *Atlas of Knowledge* (due out March 2015).

Please watch the introduction video to learn more.

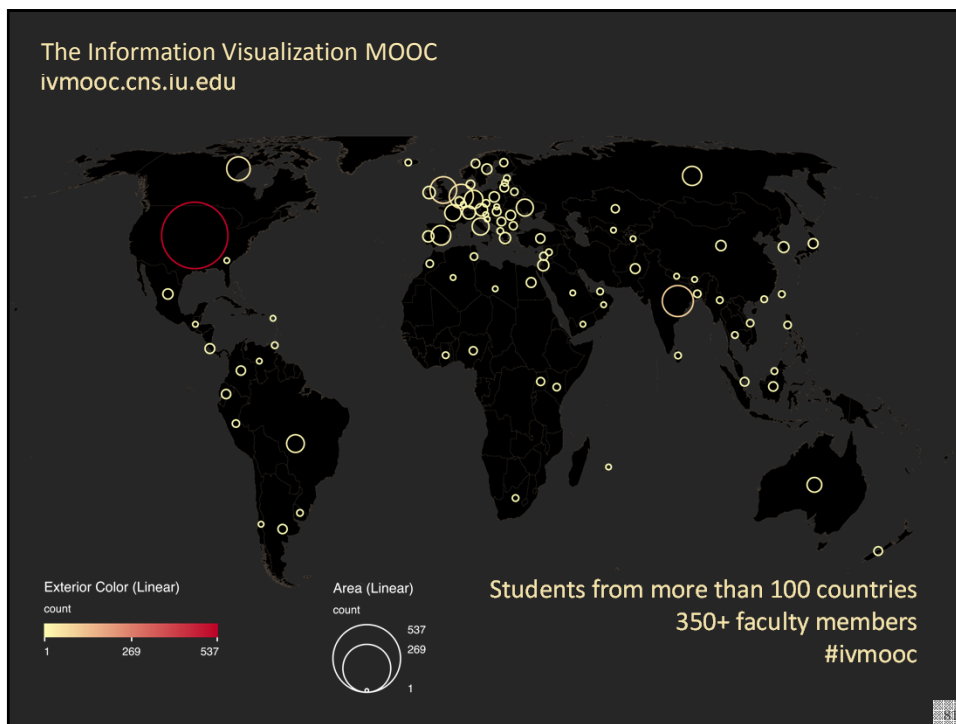


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Register for free at <http://ivmooc.cns.iu.edu>. Class started January 13, 2015.

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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, NJ 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 Medicine	Borner, K Contractor, J Research & Experimental HJ Fiore, SM Hall, KL Keyton, J Spring, B Stokols, D Trochim, W Uzzi, B

Statistical Analysis—p. 44


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

Temporal Burst Analysis—p. 48

Geospatial Analysis—p. 52

Geospatial Analysis—p. 52


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



Co-author and many other bi-modal networks.

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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/

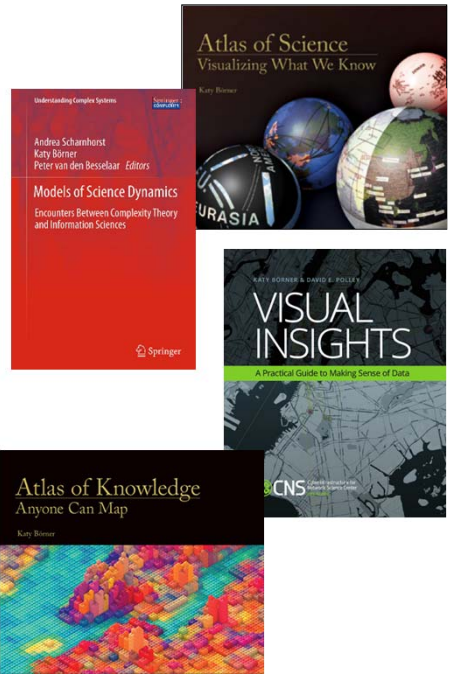
Börner, Katy (2010) **Atlas of Science: Visualizing What We Know**. The MIT Press. <http://scimaps.org/atlas>

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>



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Hidalgo, César A., Bailey Klinger, Albert-László Barabási, and Ricardo Hausmann. 2007. See also The Product Space map from Phase I of Places & Spaces.

Call for Macroscopic Tools for the *Places & Spaces: Mapping Science* Exhibit (2015)

<http://scimaps.org/call>

Themes for the upcoming iterations/years are:

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- 12th Iteration (2016): Macroscopes for Making Sense of Science
- 13th Iteration (2017): Macroscopes for Forecasting Science
- 14th Iteration (2018): Macroscopes for Economic Decision Makers
- 15th Iteration (2019): Macroscopes for Science Policy Makers
- 16th Iteration (2020): Macroscopes for Scholars

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15th INTERNATIONAL CONFERENCE ON SCIENTOMETRICS & INFORMETRICS
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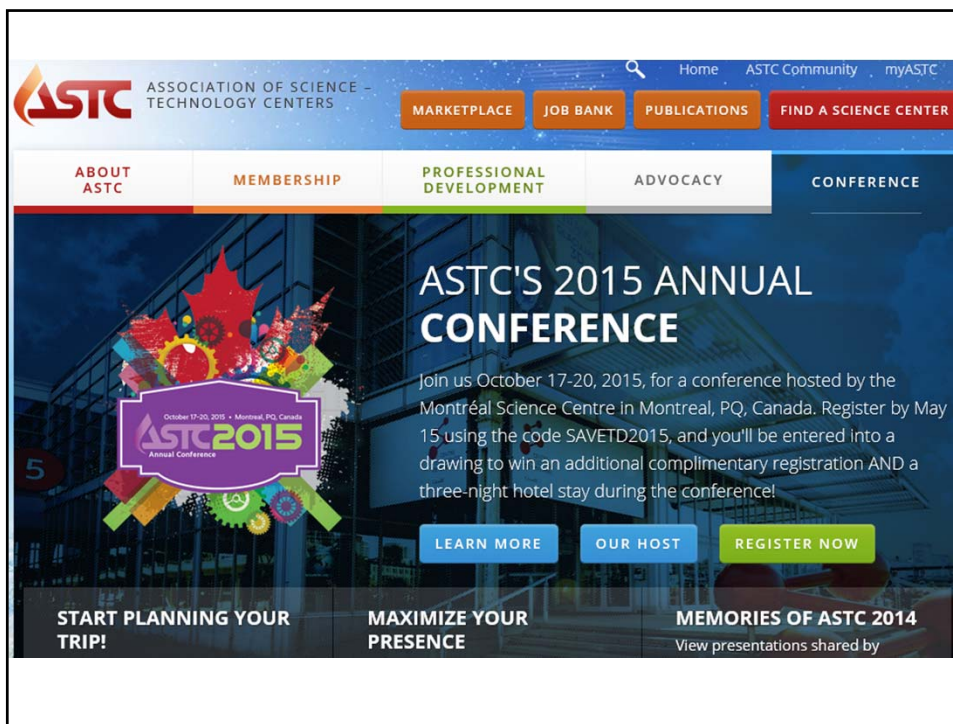


3. Forecasting science: Models of science and technology dynamics for innovation policy

Organized by

- Katy Börner (Indiana University, USA)
- Andrea Scharnhorst (KNAW, The Netherlands)
- Stasa Milojevic (Indiana University, USA)
- Petra Ahrweiler (Director and CEO, EA European Academy of Technology and Innovation Assessment GmbH, Bad Neuenahr-Ahrweiler, Germany)
- David Chavalarias (Centre d'Analyses de Mathématiques Sociales (CAMS), Ecole des Hautes Etudes en Sciences Sociales (EHESS), Director of the Complex Systems Institute of Paris Ile-de-France, Paris, France)

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