

Data Visualizations: Drawing Actionable Insights From Data

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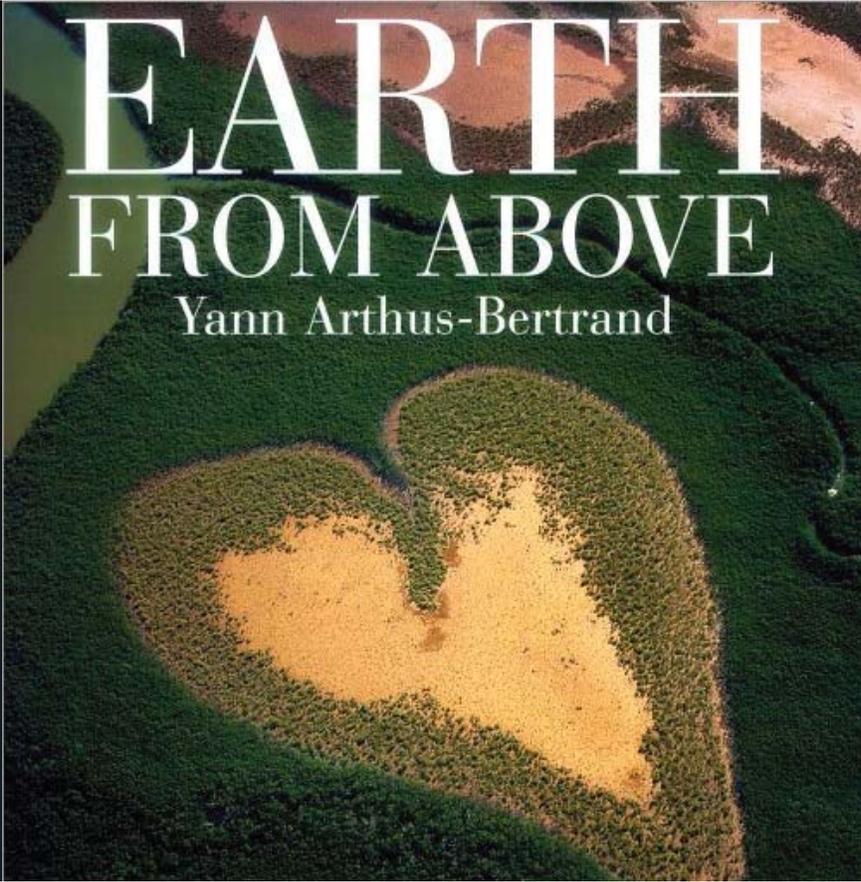
*Inaugural Lecture
Auditorium A, CDC Tom Harkin Global Comm. Center, Atlanta, GA*

February 4, 2016



**PLACES
&
SPACES**
MAPPING SCIENCE

scimaps.org



EARTH FROM ABOVE

Yann Arthus-Bertrand

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.



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.

9



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

10



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 Immersion Theater



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Places & Spaces at Duke University
January 12 - April 10, 2015



Places & Spaces at Northwestern University
May 14 - September 23, 2015

15



Places & Spaces Exhibit at the David J. Sencer CDC Museum, Atlanta, GA
January 25-June 17, 2016

16

10 iterations over 10 years

equal

$10 \times 10 = 100$ maps!

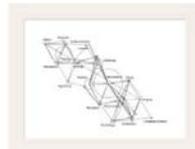
The Power of Maps 2005



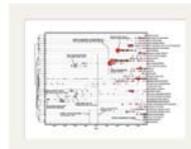
1.1



1.3



1.5



1.7



1.9



1.2



1.4



1.6



1.8

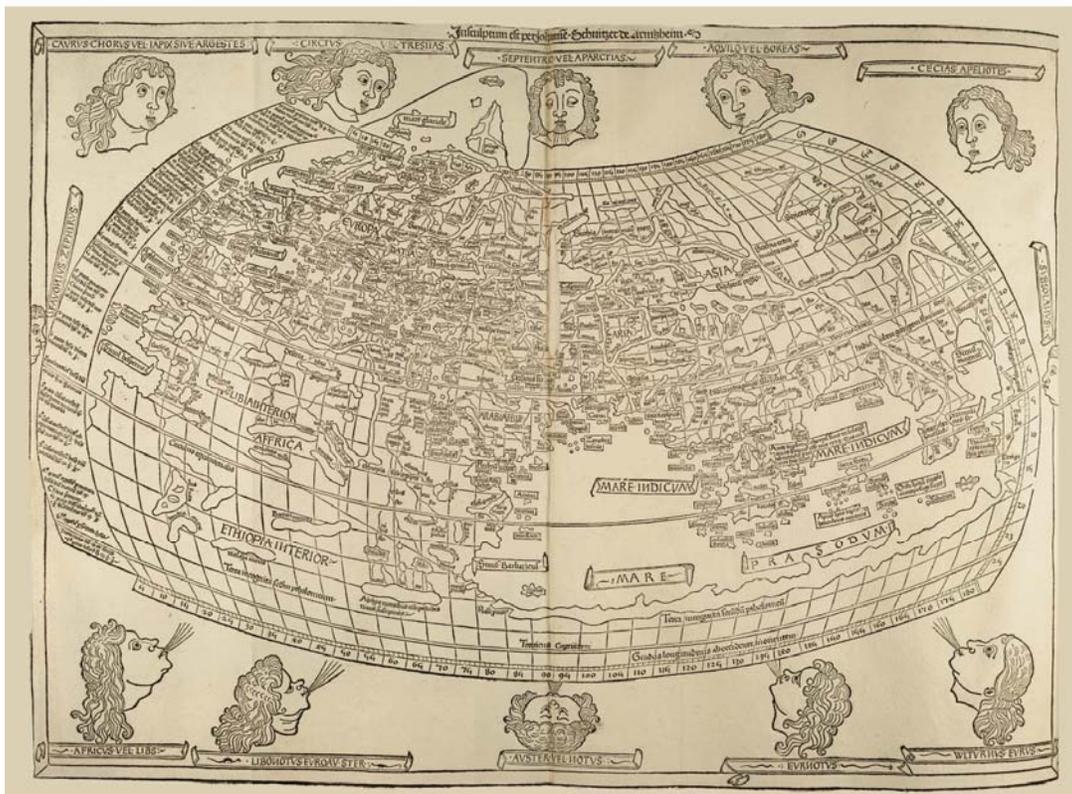


1.10

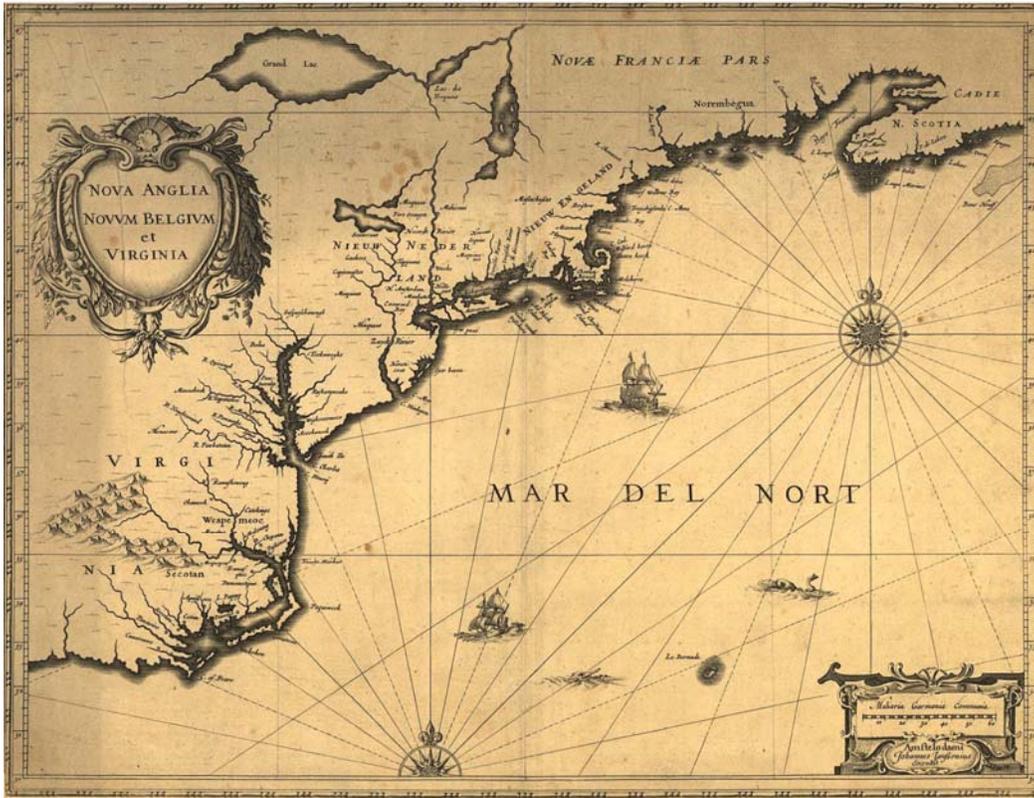
Cartographic maps of physical places have guided mankind's explorations for centuries.

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

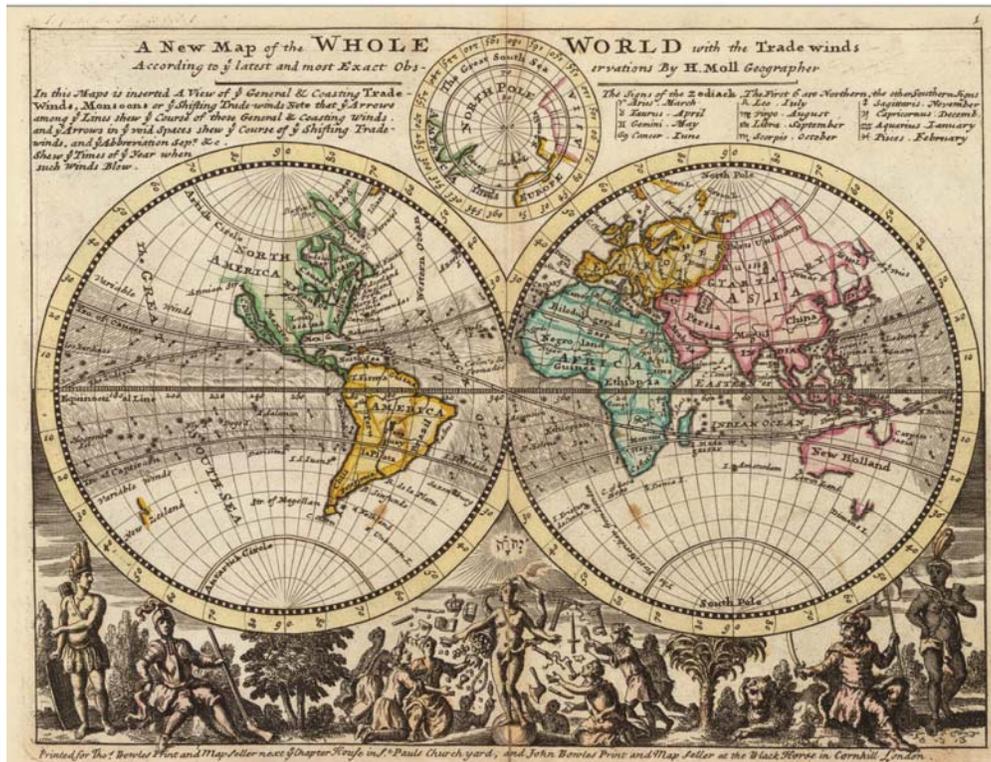
Without maps, we would be lost.



Cosmographia World Map - Claudius Ptolemy - 1482



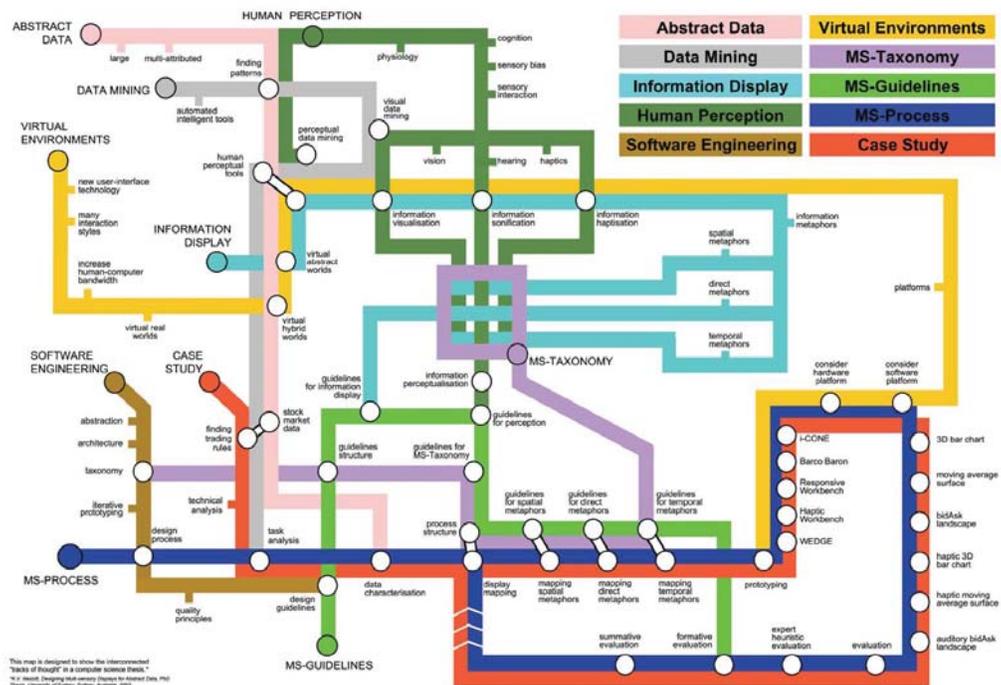
Nova Anglia, Novvm Belgivm et Virginia - Jan Jansson - 1642



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

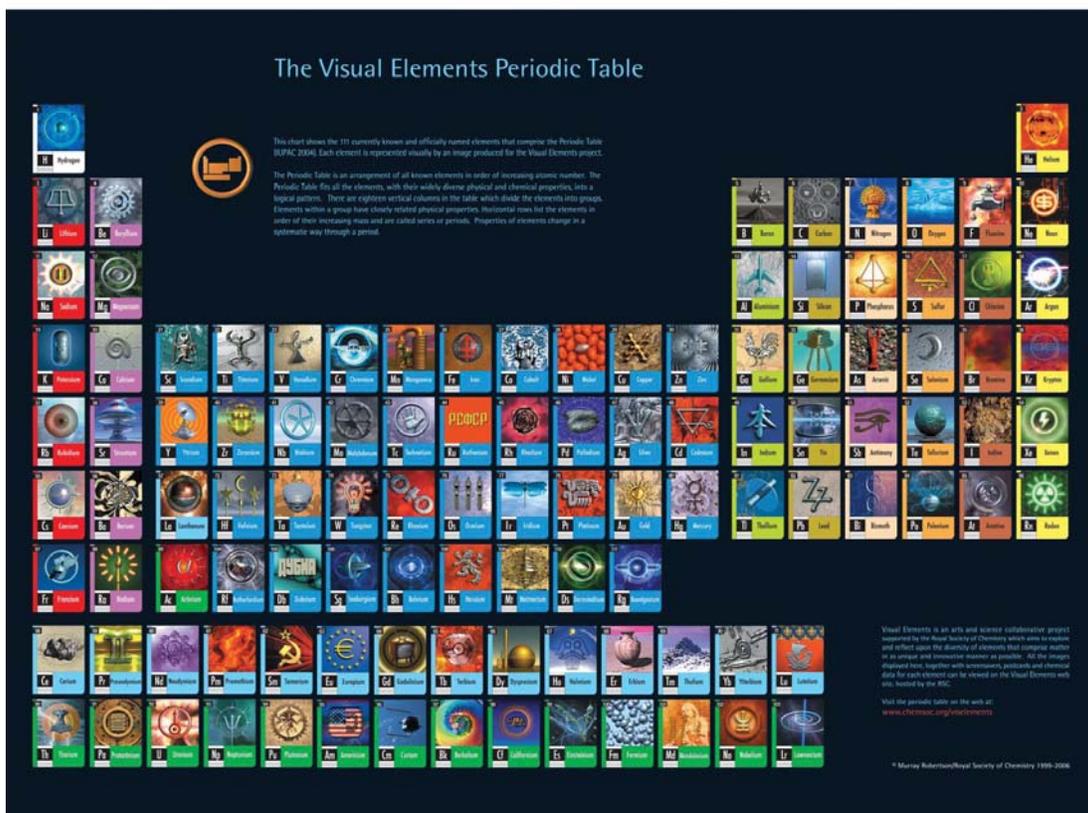
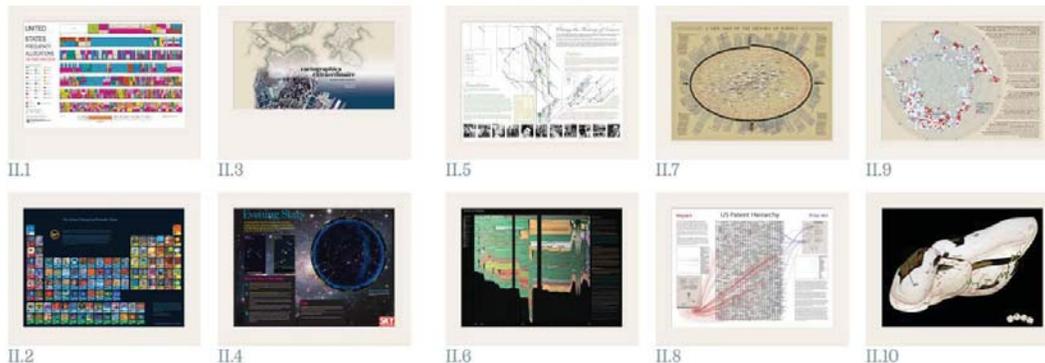
Science maps of abstract semantic spaces aim to serve today's explorers navigating the world of science.

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



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
Starting after dark

Looking very high toward SW

April 12-16
Around 10 p.m.

SE

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.
- Outside, 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, nearby 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!

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!

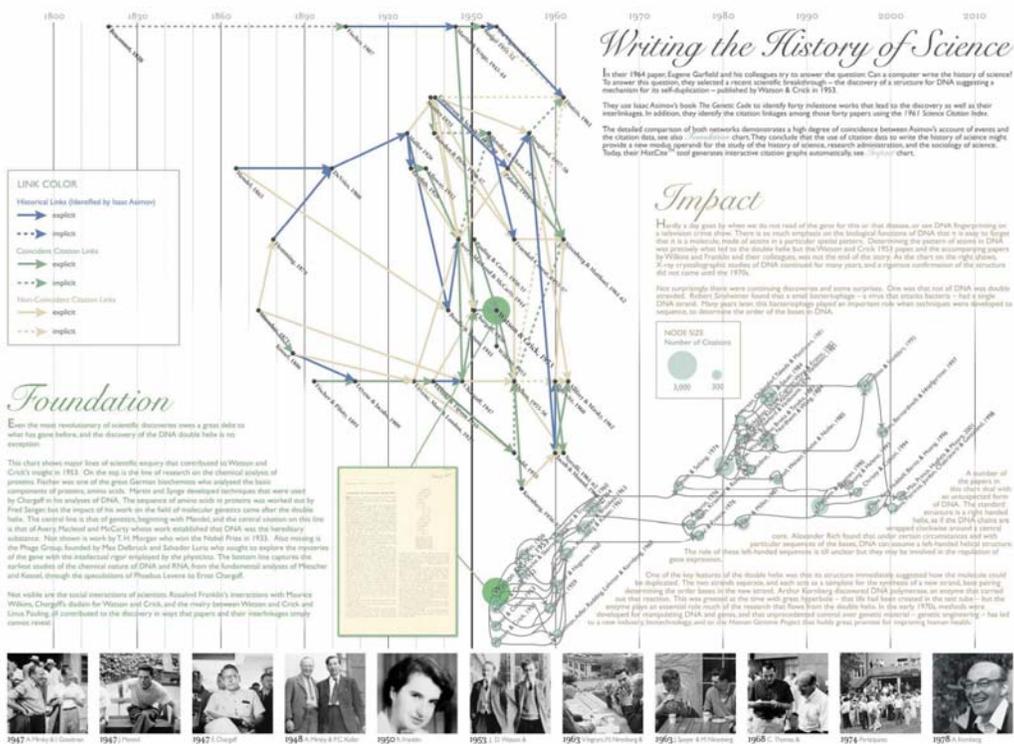
You can customize a night sky map for any time and place at SkyandTelescope.com.

When to Use This Map
 Early April: 10 pm (daylight-saving time)
 Late April: Dusk

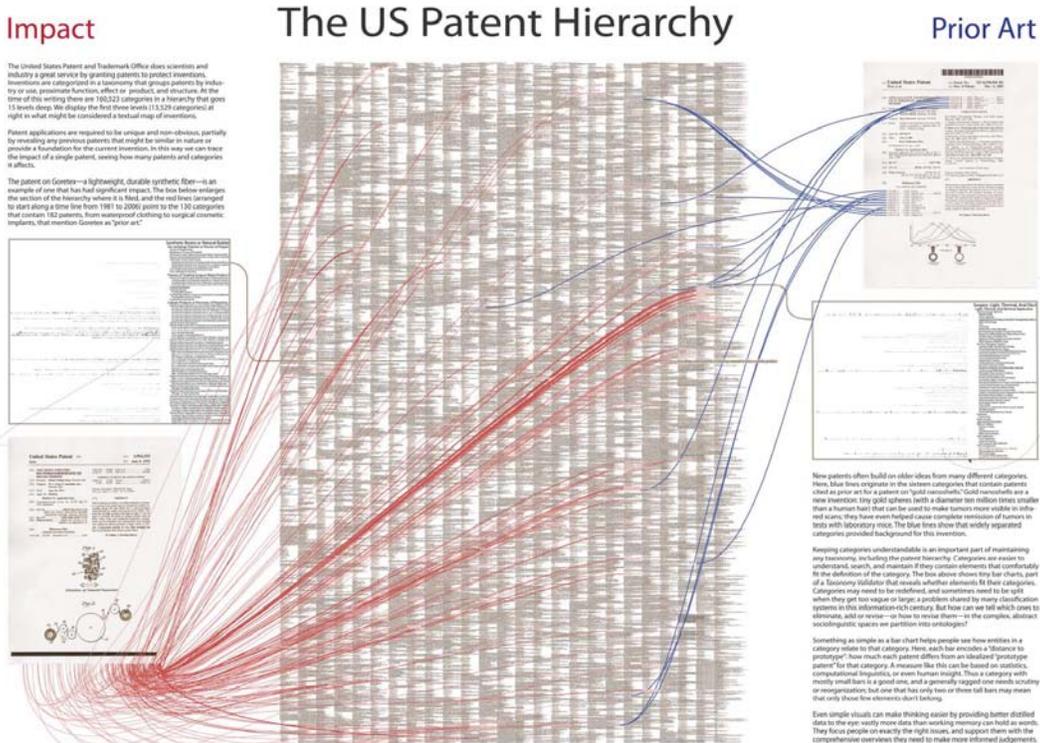
Sky Chart of New York City in April 2006 - Roger W. Sinnott, Interactive Factory - 2006

How would a reference system for all of science look?

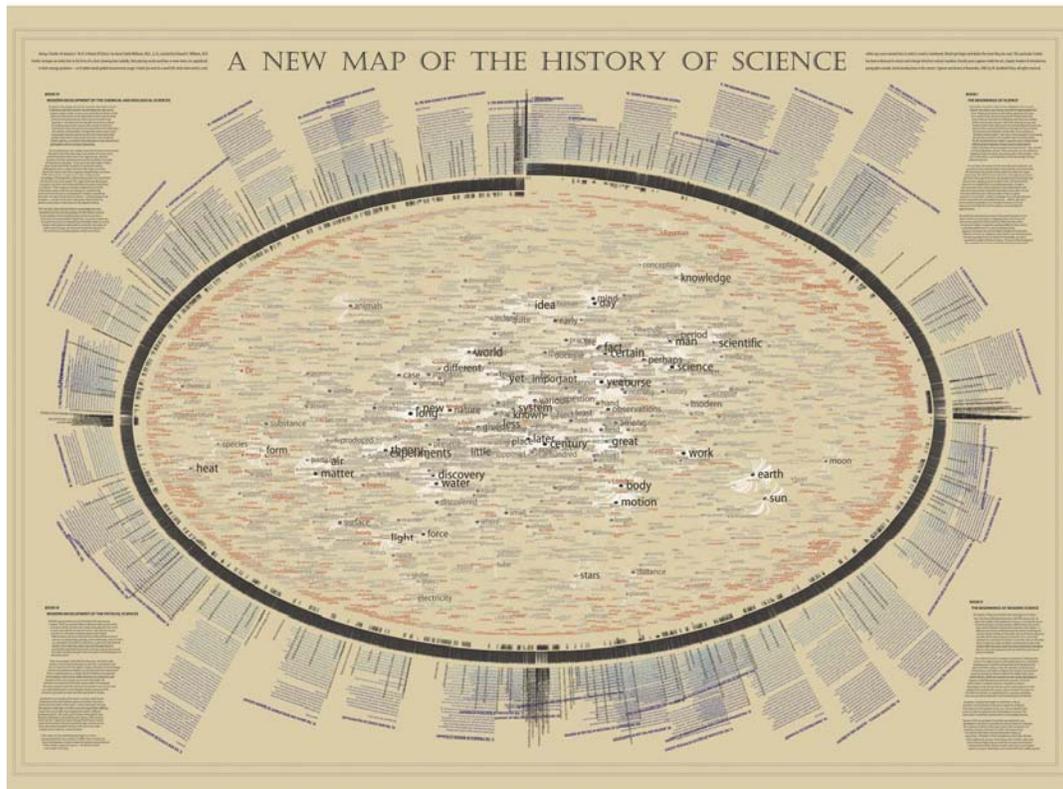
What dimensions would it have?



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



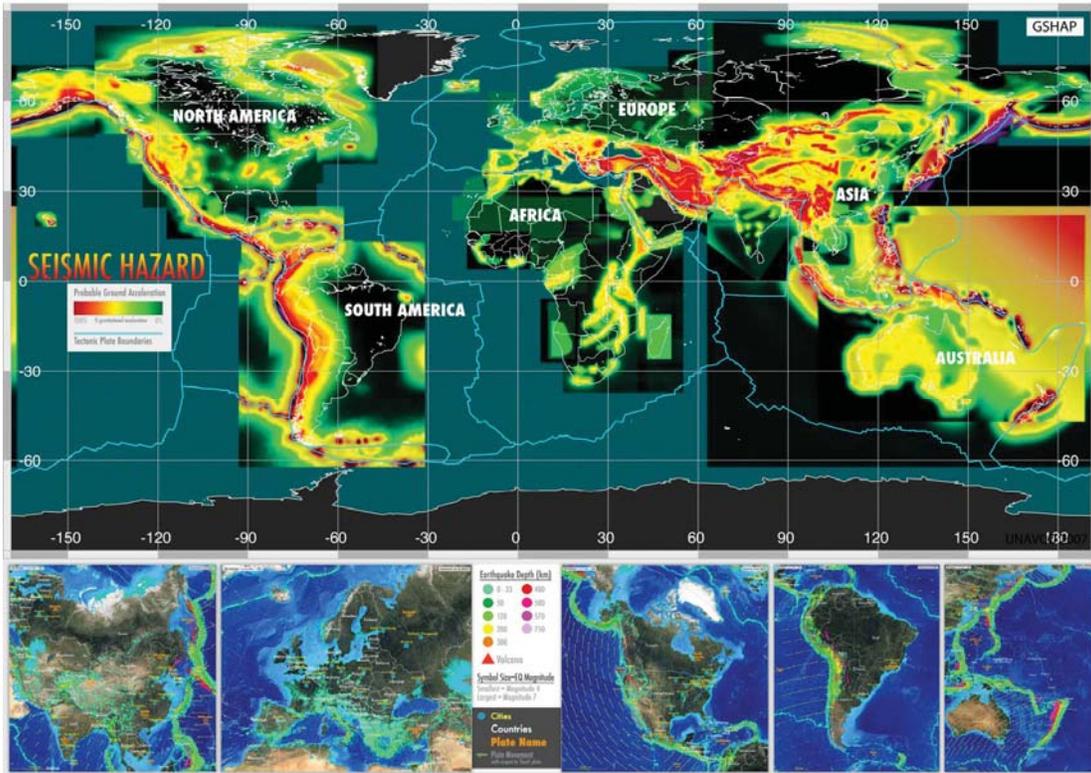
Taxonomy Visualization of Patent Data - Katy Borner, Elisha Hardy, Bruce Herr, Todd Holloway, Bradford Paley - 2006



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

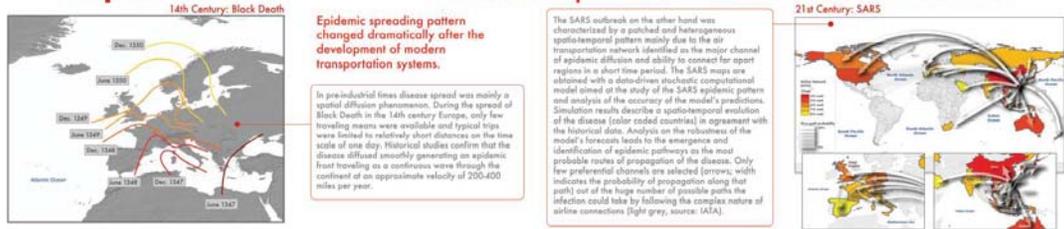
The Power of Forecasts 2007



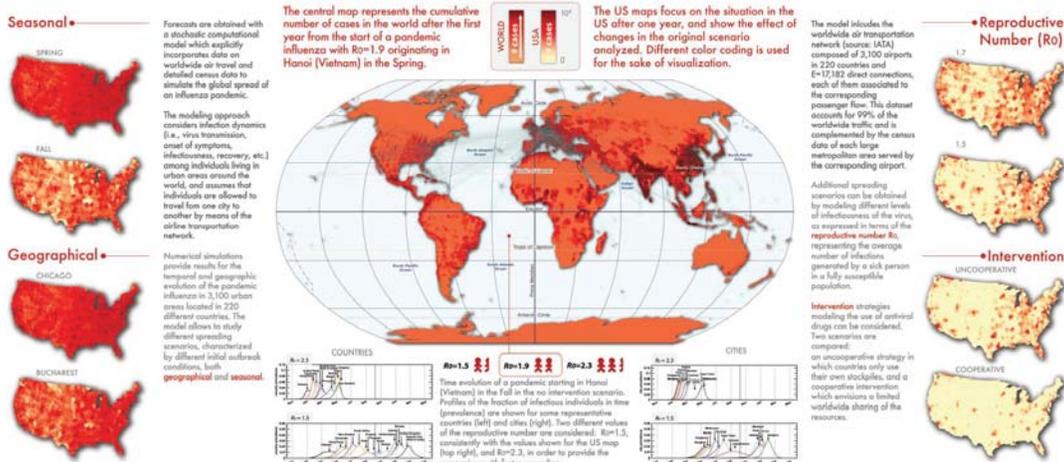


Tectonic Movements and Earthquake Hazard Predictions - Martin W. Hamburger, Lou Estey, Chuck Meertens, Elisha Hardy - 2005

• Impact of Air Travel on Global Spread of Infectious Diseases •



• Forecasts OF THE Next Pandemic Influenza •



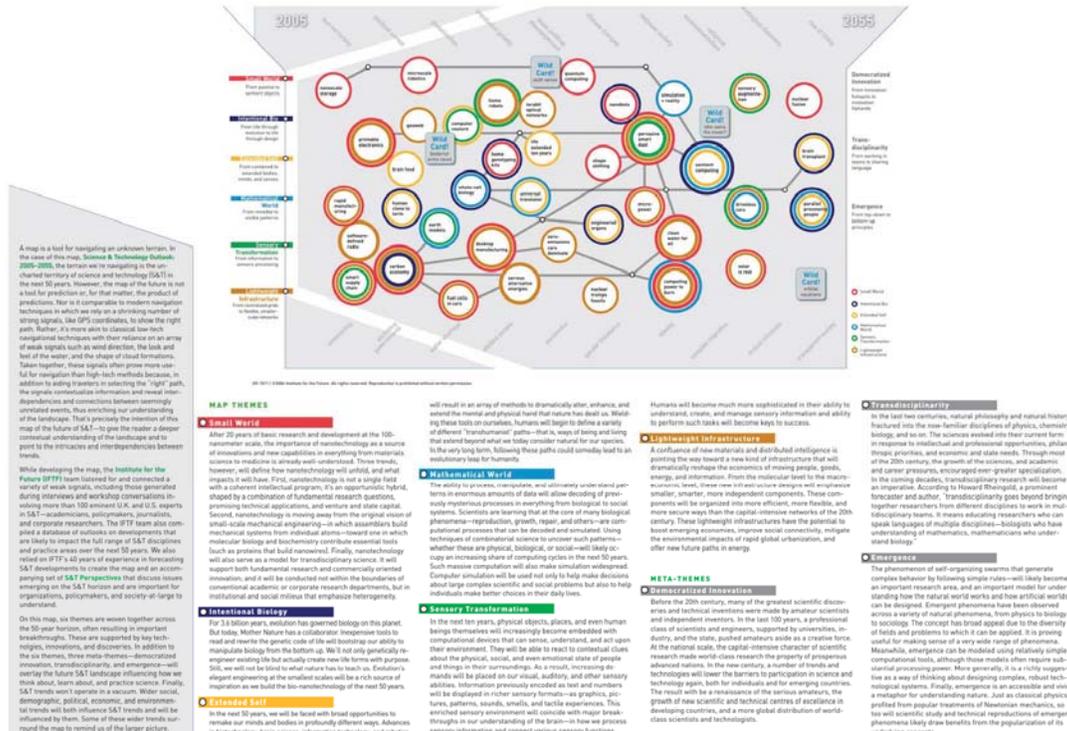
Impact of Air Travel on Global Spread of Infectious Diseases - Vittoria Colizza, Alessandro Vespignani - 2007

Can one forecast science?

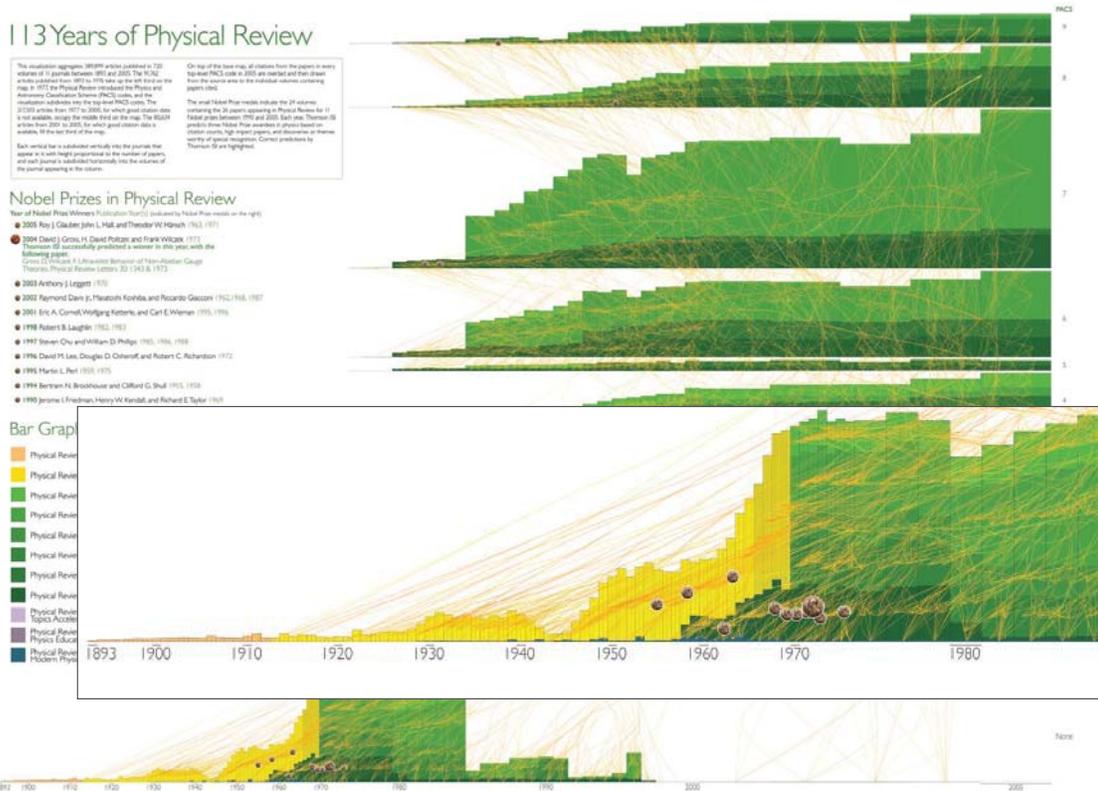
What 'science forecast language' will work to communicate results?

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

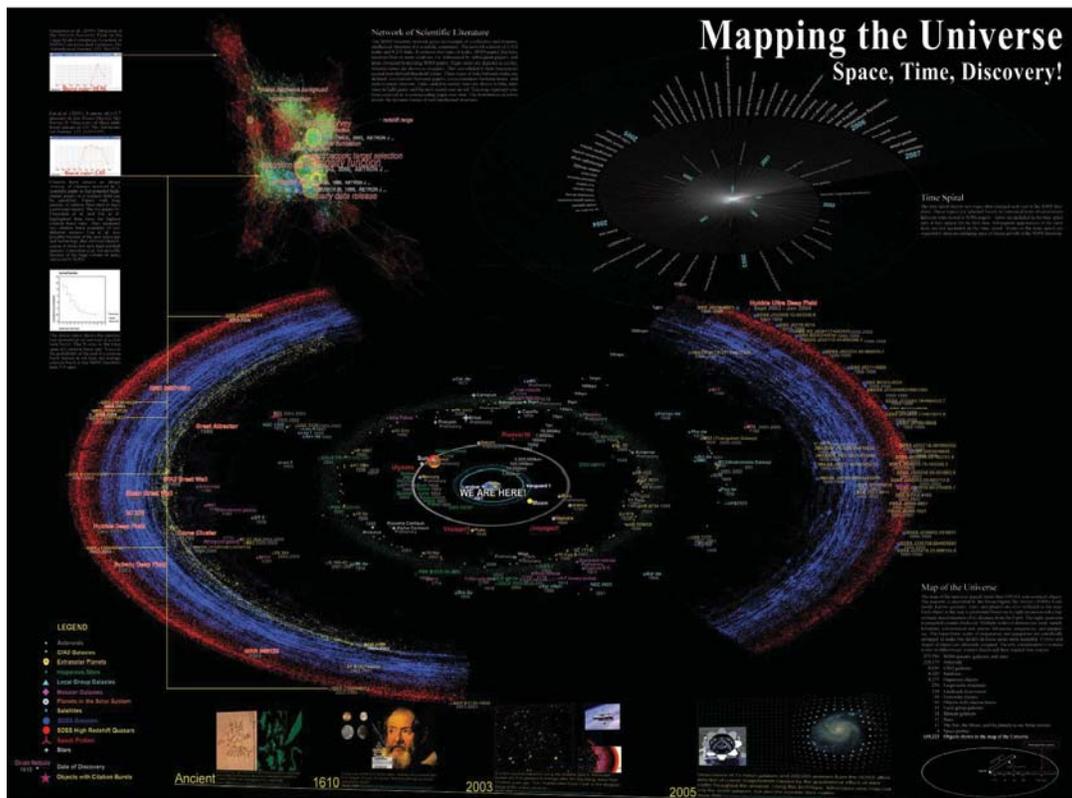
Technology Horizons Program
 Institute for the Future
 124 University Avenue, 2nd Floor, Palo Alto, CA 94301
 1.650.954.6322 1.650.954.7600 www.iftf.org



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 Penumarthu - 2007



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

Science Maps for Economic Decision Makers 2008



IV.1



IV.3



IV.5



IV.7



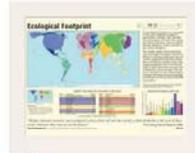
IV.9



IV.2



IV.4



IV.8



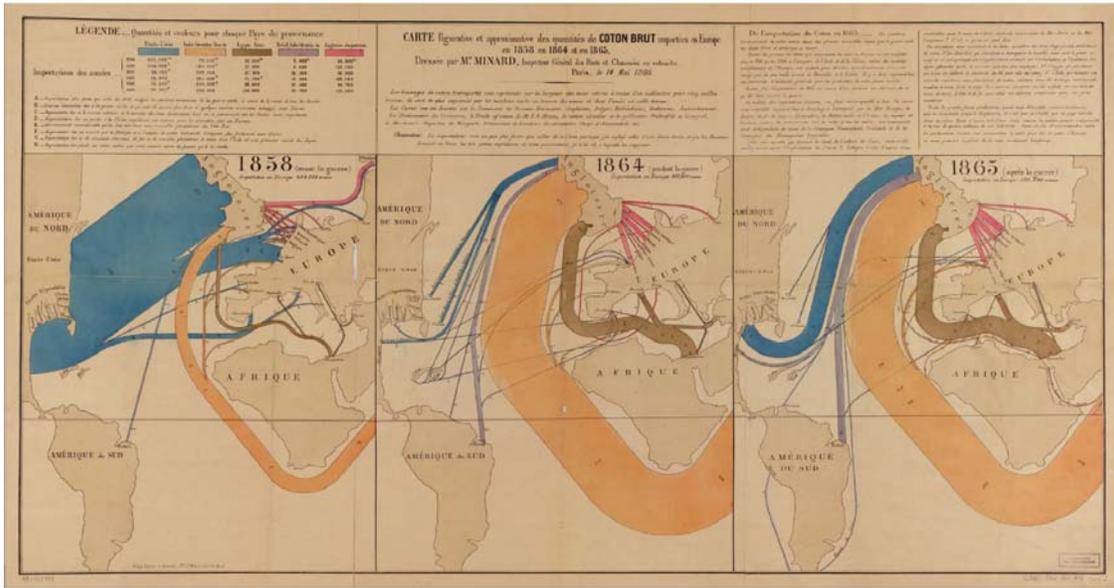
IV.8



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

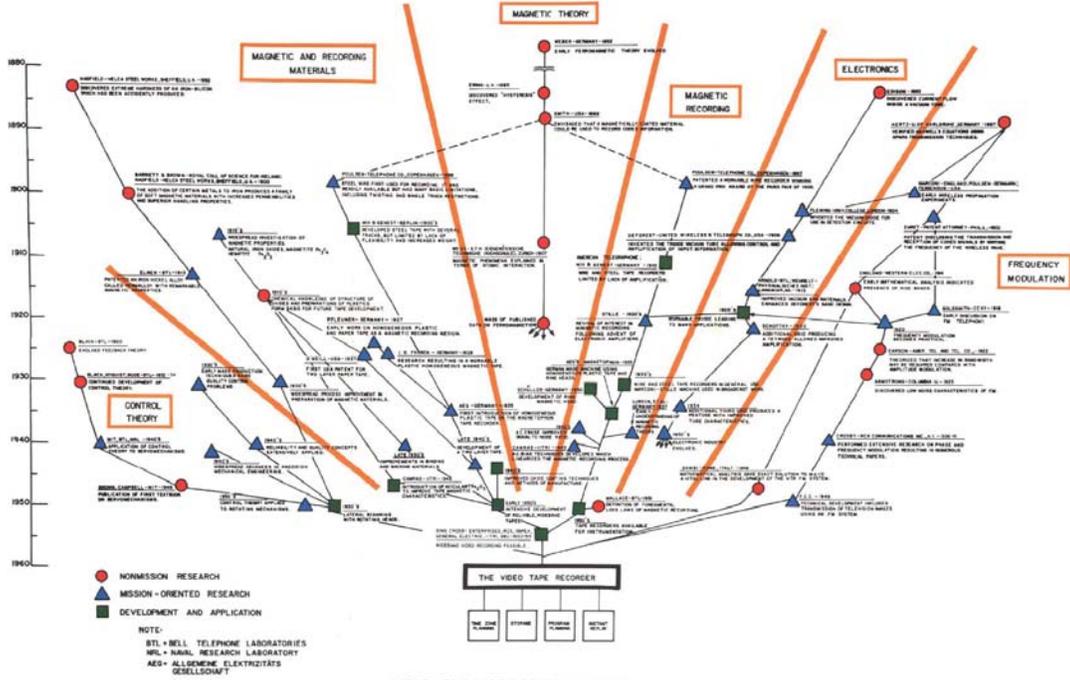
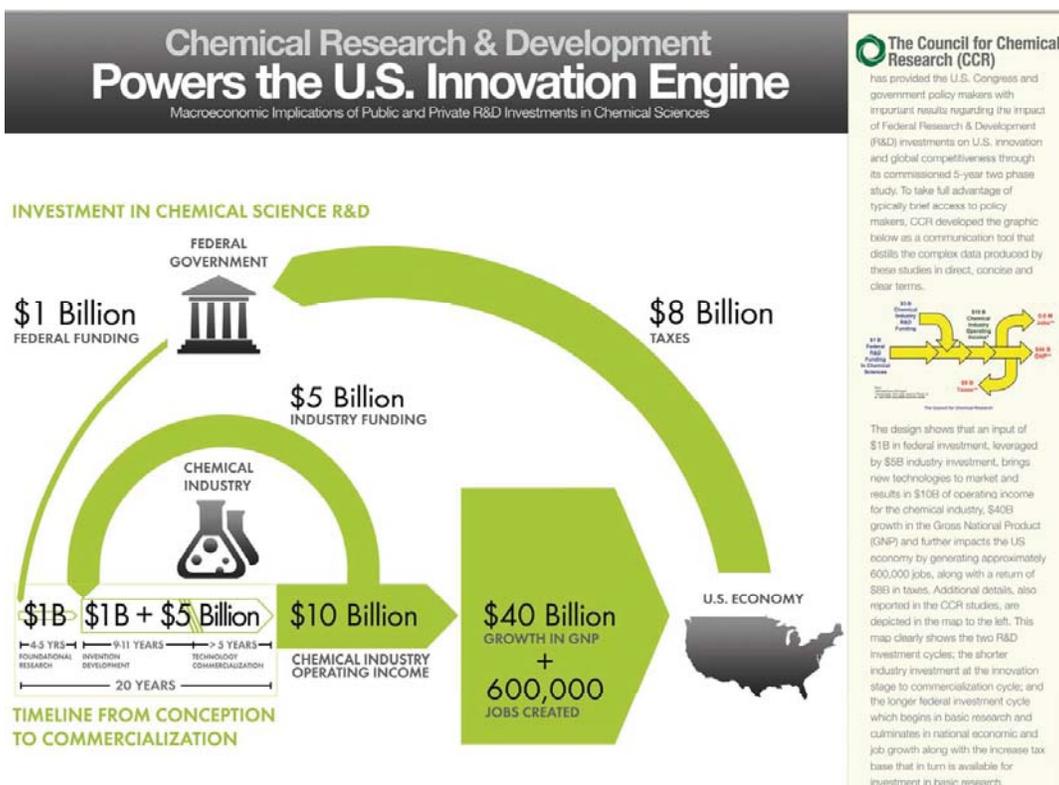
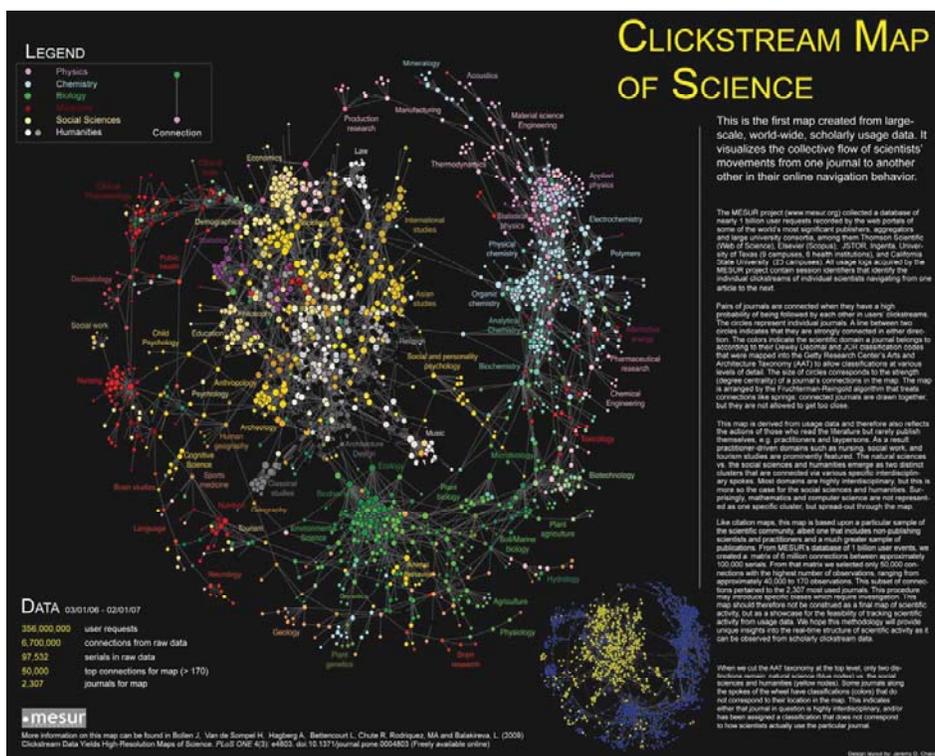
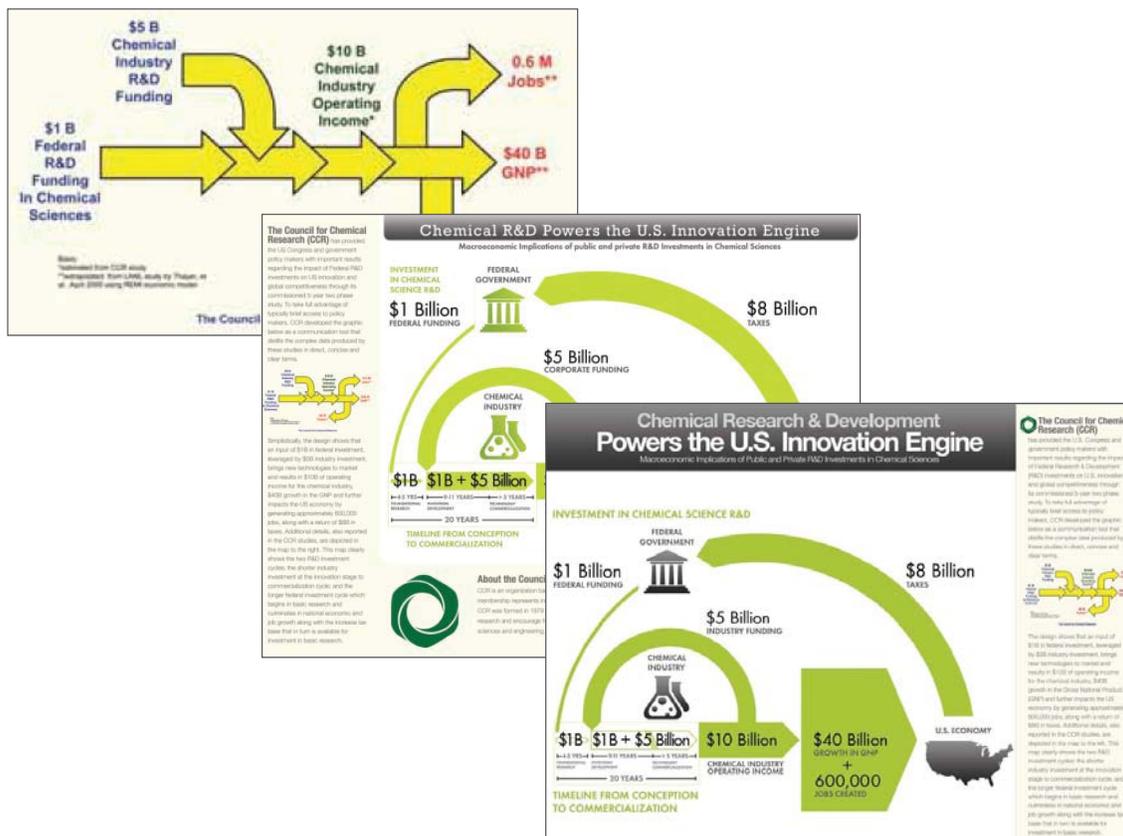


FIG. 7. THE VIDEO TAPE RECORDER

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

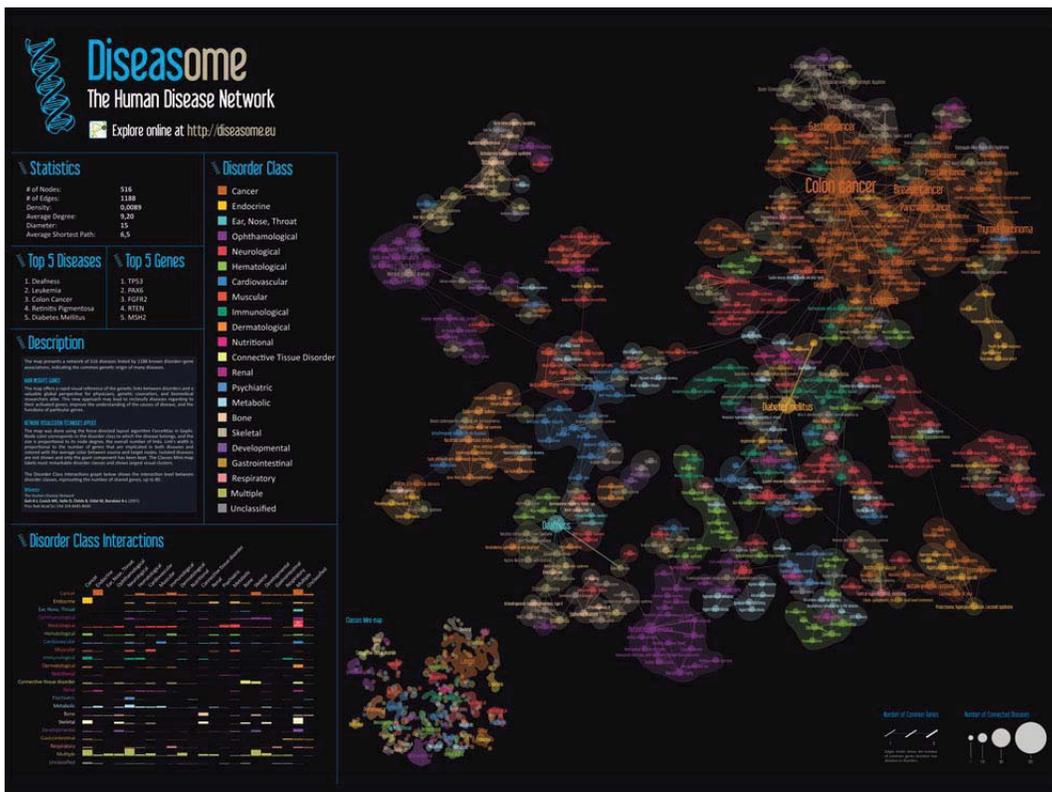
Science Maps for Science Policy Makers 2009



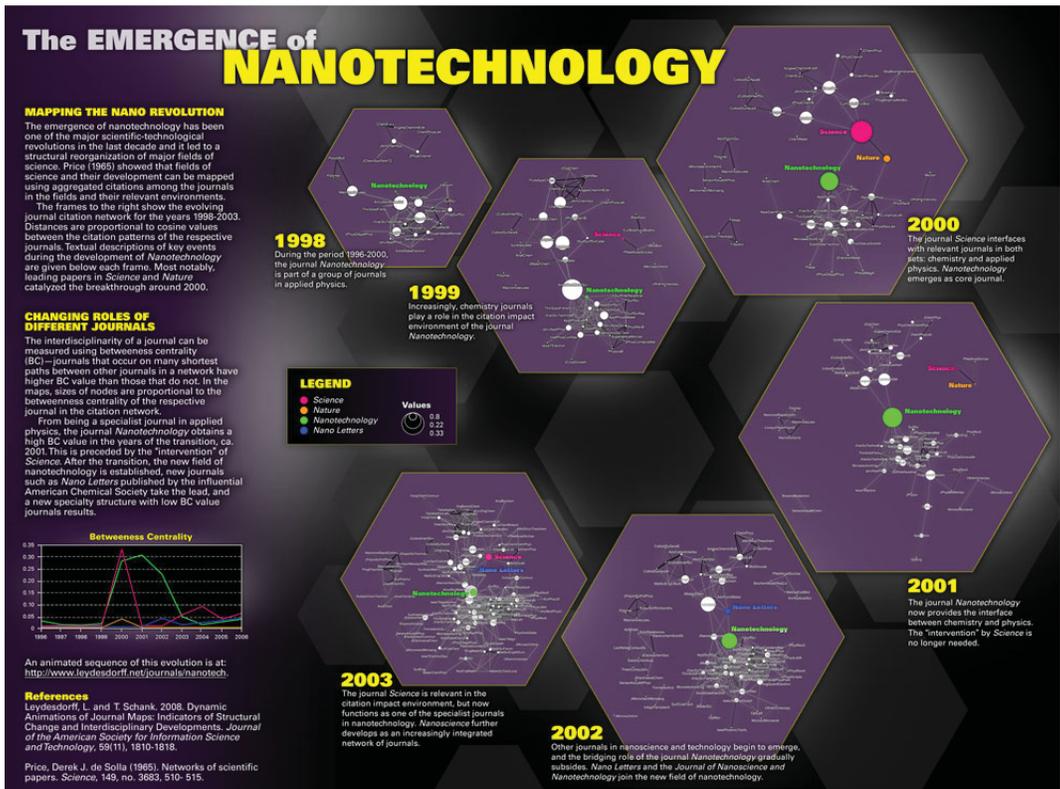


A Clickstream Map of Science. Johan Bollen, Herbert Van de Sompel, Aric Hagberg, Luís M. A. Bettencourt, Ryan Chute, Marko A. Rodriguez, and Lyudmila Balakireva - 2008

Science Maps for Scholars 2010



Diseasome - Mathieu Bastian & Sebastien Heymann - 2009

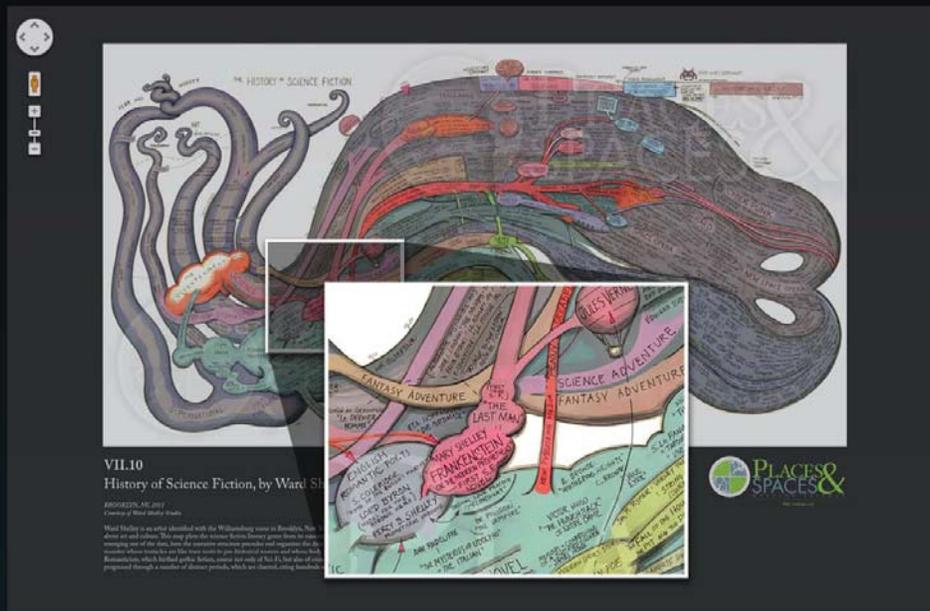


The Emergence of Nanoscience & Technology - Loet Leydesdorff - 2010

Science Maps as Visual Interfaces to Digital Libraries 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



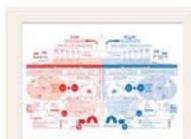
VIII.7



VIII.9



VIII.2



VIII.4



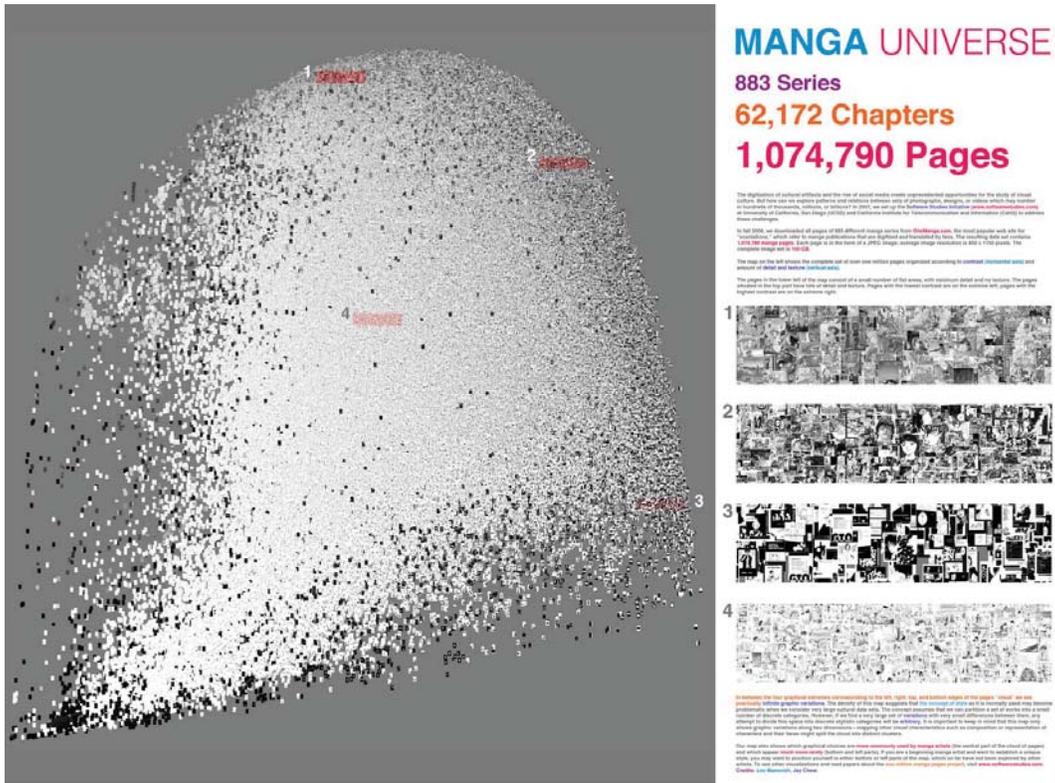
VIII.6



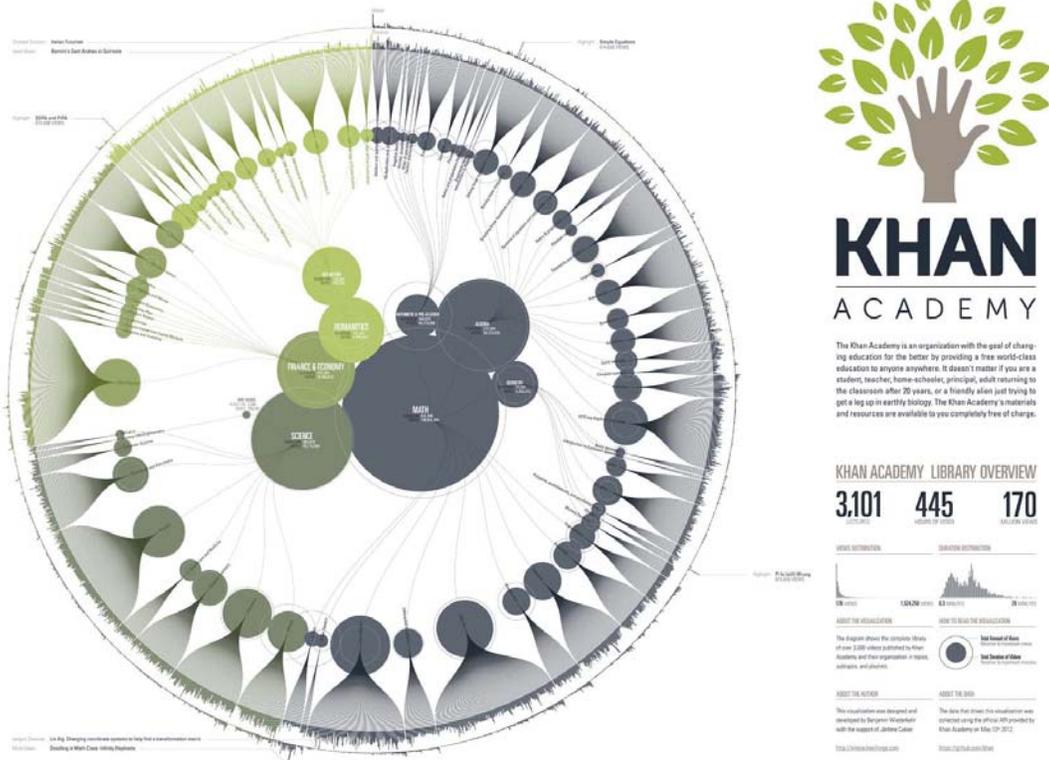
VIII.8



VIII.10

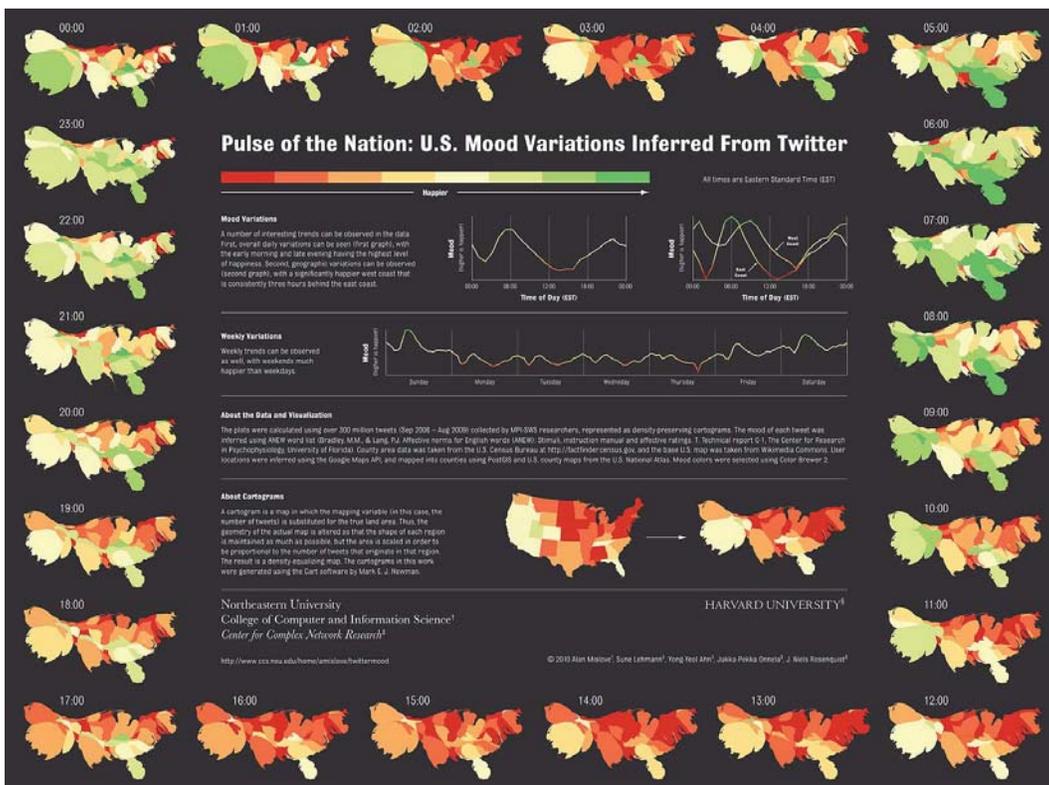


Manga Universe - Lev Manovich and Jay Chow - 2012



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

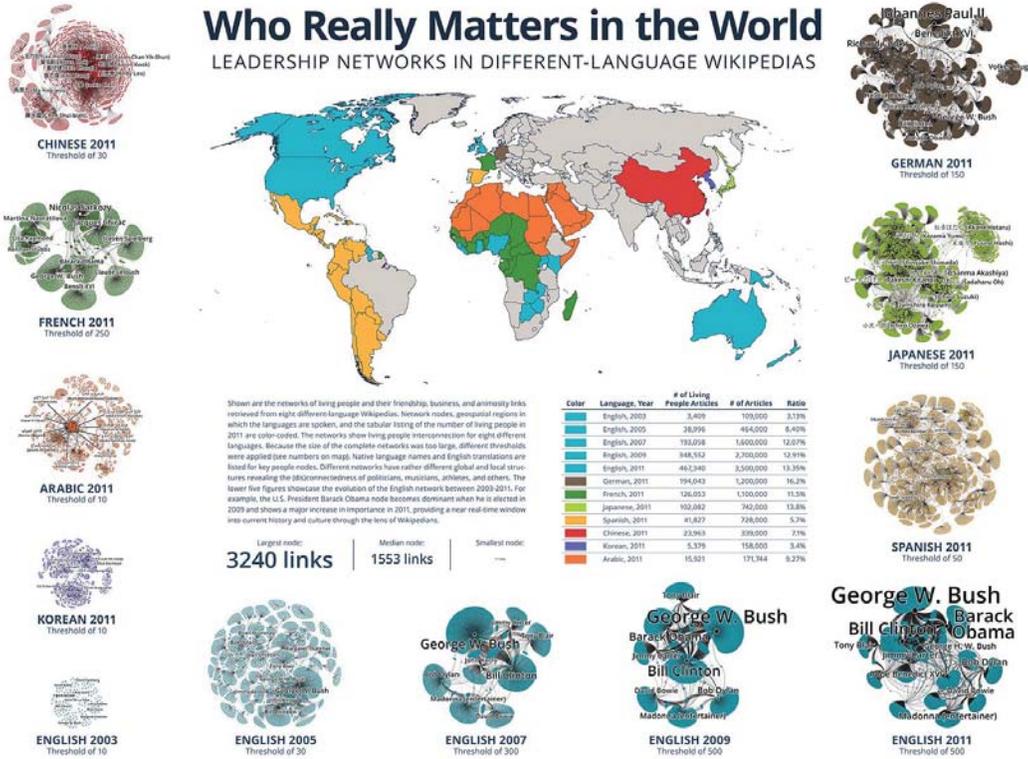
Science Maps Showing Trends and Dynamics 2013



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

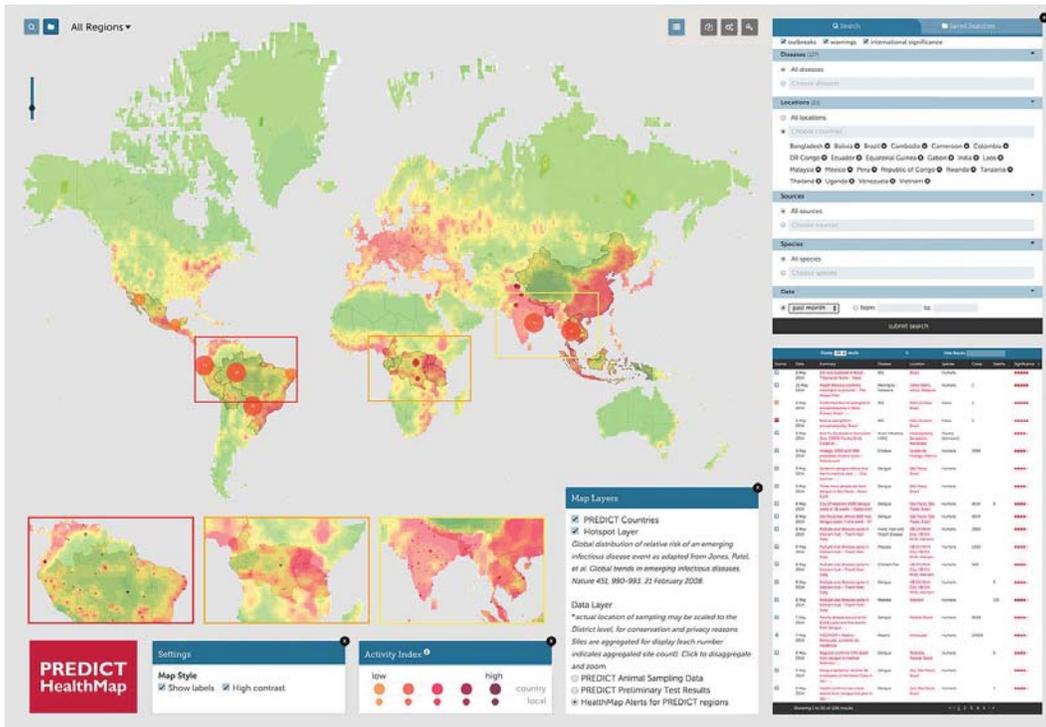
LEADERSHIP NETWORKS IN DIFFERENT-LANGUAGE WIKIPEDIAS



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

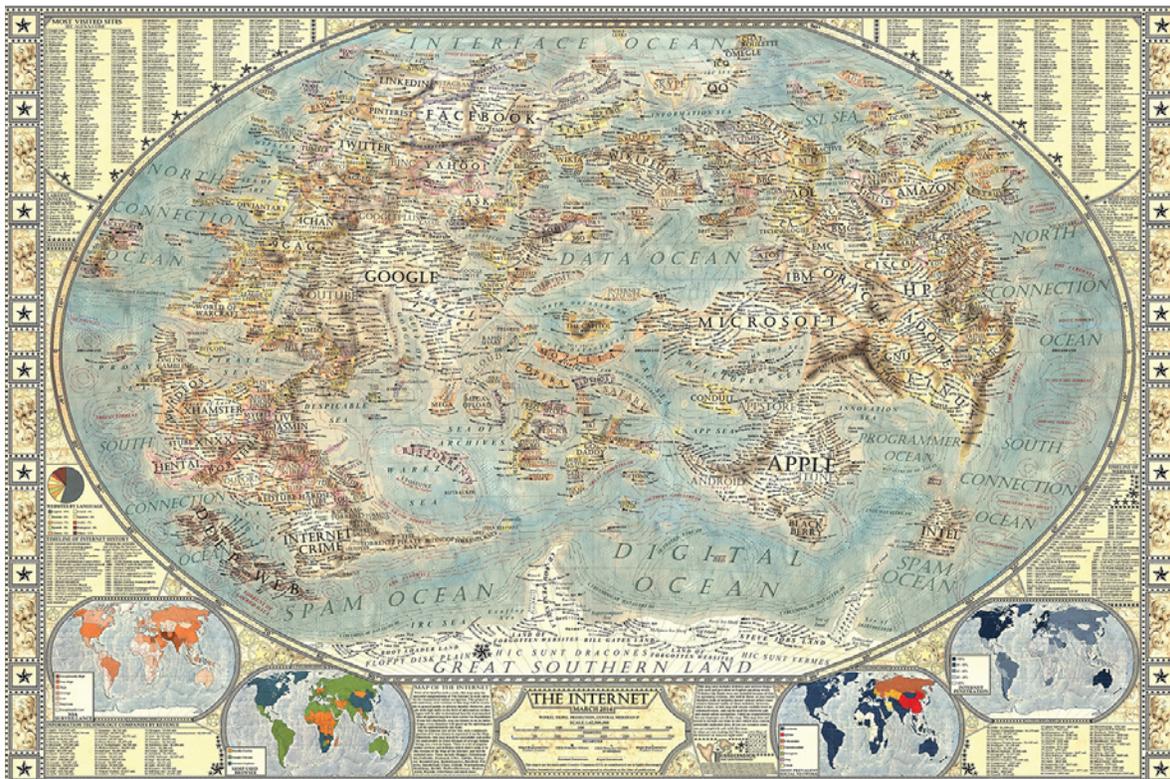




Use the original online tool at healthmap.org/predict



PREDICT: HealthMap - John Brownstein, Damien Joly, William Karesh, Peter Daszak, Nathan Wolfe, Tracey Goldstein, Susan Aman, Clark Freifeld, Sumiko Mekaru, Tammie O'Rourke, Stephen Morse, Christine Kreuder Johnson, Jonna Mazet, and the PREDICT Consortium - 2014

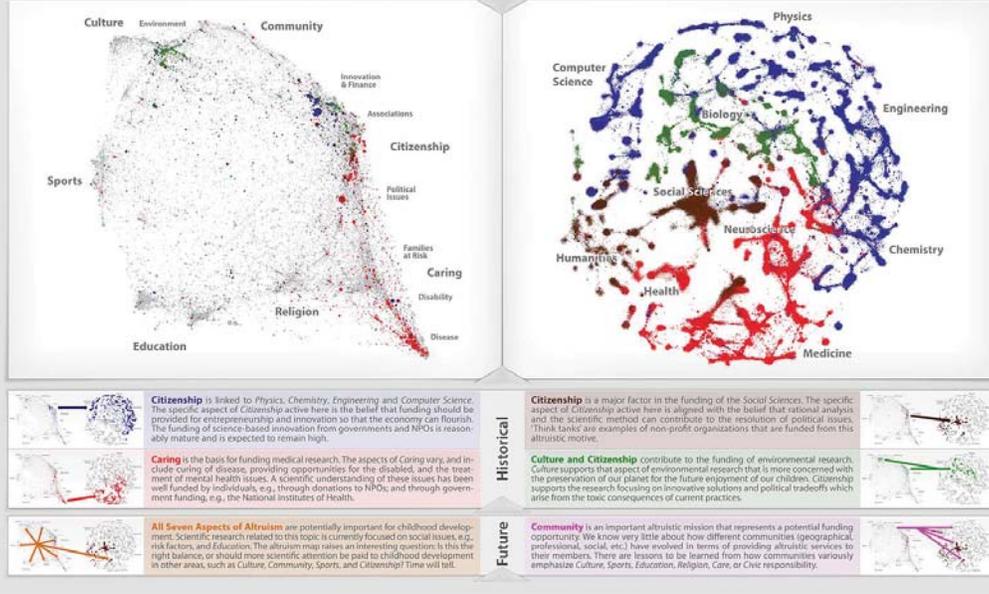


Map of the Internet - Martin Vargic - 2014

Exploring the Relationships Between a Map of Altruism and a Map of Science

How is altruism related to science? Altruism is about individual selfless intentions. Science is about discovery and problem solving. On the surface these two facets of society may seem unrelated. In reality they may be strongly linked. Altruistic missions explain historical (and may predict future) patterns of scientific investments. The map of altruism (left) represents altruistic missions, and displays the relative positions of nearly 100,000 non-profit organizations (NPOs) in the United States based on mission-related text from their websites. This map of altruism reveals the issues that we care most about as a society: Culture, Sports, Education, Religion, Community, Citizenship, and Caring. The map of science (right) represents decades of funded research in the natural and medical sciences, engineering, technology, social sciences and humanities. It displays over 43,000,000 documents that are grouped together using a combination of citation and textual similarity.

These two maps are shown side-by-side to illustrate how the altruistic intentions of a society correlate with where we focus our discovery and problem solving efforts. The map of science has been divided into four major areas, shown in four different colors. NPOs whose National Taxonomy of Exempt Entities (NTEE) codes indicate that they explicitly fund scientific activities in these four areas are correspondingly colored in the map of altruism. Altruistic missions associated with these four areas are considered in more detail below, along with projections of how altruistic missions not currently associated with funding of scientific research might benefit from such funding in the future.



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>

Curated by the Cyberinfrastructure for Network Science Center

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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

2 Purchase Maps & More

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

3 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

2 P&S Around the World

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

3 Host the Exhibit

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

Tweets

Katy Borner @katybors 22 Aug
Big data visualization 'Jax and the Big Data Beast' theater piece now playing at SMM. [bt.ly/1v5dWb](#) #immoc

Places & Spaces @mappingcience 18 Aug
Enjoy a FREE night out @Lionema & see Humanexus on the big screen! 9/8 at 7pm. FREE tix @ box office night of show. [cinema.indiana.edu/?post_type=...](#)

Places & Spaces @mappingcience 18 Aug
Randal Munroe @xkcd featured in ITS & soon in IT10 won a Hugo for "best graphic" [explainscod.com/wiki/index.php...](#)

Tweet to @mappingcience



Hidalgo, César A., Bailey Klöngler, 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 (2016) <http://scimaps.org/call>

Background and Goals

The *Places & Spaces: Mapping Science* exhibit was created to in communicate human activity and scientific progress on a glol that enable the close inspection of large-scale maps in public conferences; (2) novel, interactive macroscopic tools that l

Themes for the upcoming iterations/years are:

- 11th Iteration (2015): Macroscopes for Interacting With Science
- 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

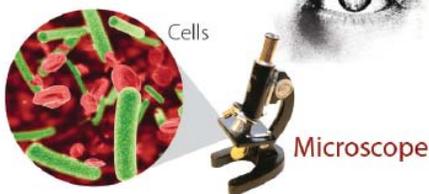
69

Microscopes, Telescopes, Macroscopes Plug-and-Play Macroscopes

The Infinitely Great

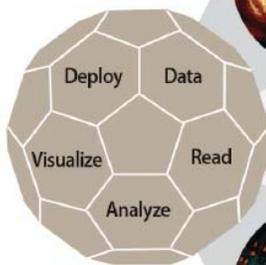


Telescope



Microscope

The Infinitely Small



Macroscopic



Galaxies

Society

The Infinitely Complex

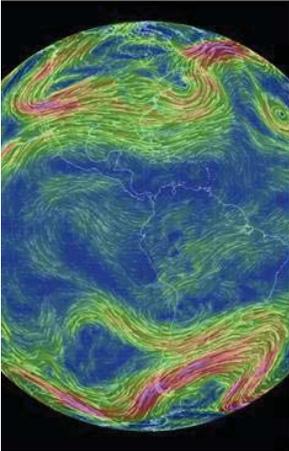


Technology

Nature



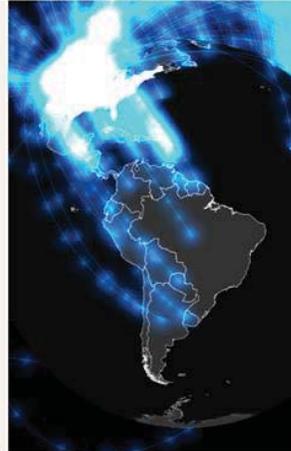
MACROSCOPES FOR INTERACTING WITH SCIENCE



Earth



AcademyScope



Mapping Global Society



Charting Culture

<http://scimaps.org/iteration/11>

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 scimaps.org!

The 9th iteration is devoted to science maps that show general trends and patterns in science and technology (SAT) and predict future developments of SAT. Maps to measure statistics using quantitative and/or qualitative data were welcome, and mixed methods approaches were encouraged. Check here: scimaps.org (John Hesketh's Humanities & Tropical Journals, Lecturers & Instructors since 1952).

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



Contact the map makers or the
exhibit curators

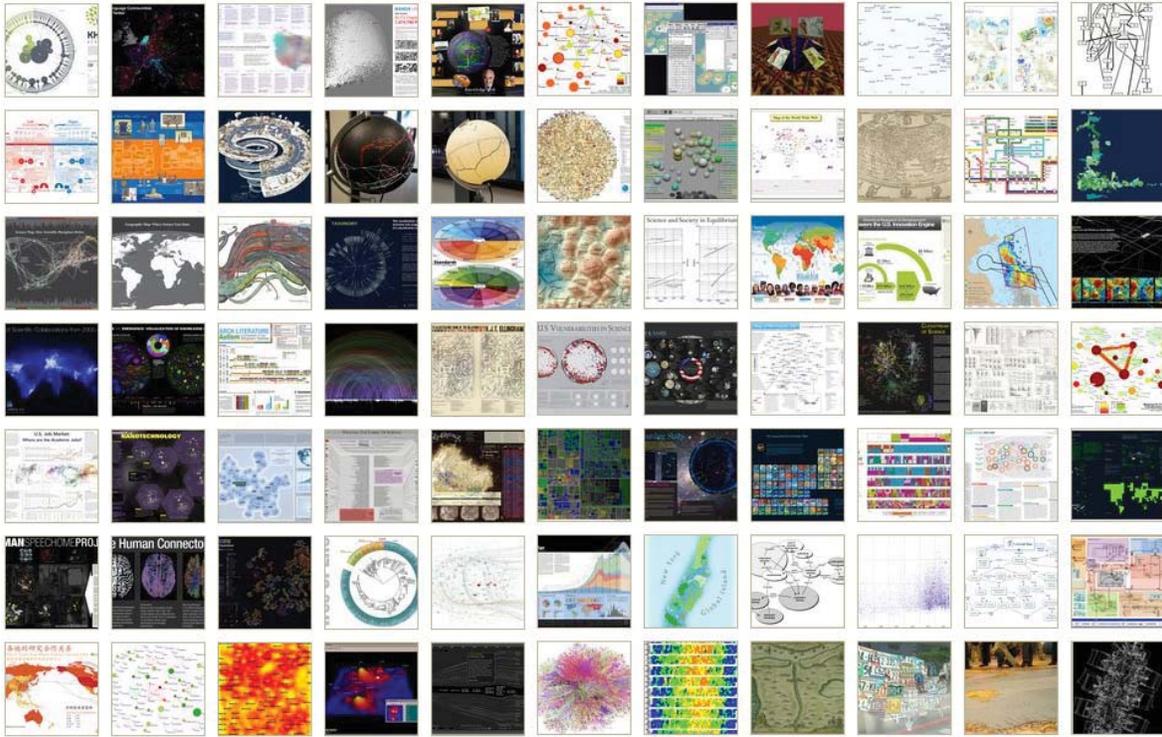
Data Visualizations: Drawing Actionable Insights From Data

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Indiana University, USA

*Inaugural Lecture
Auditorium A, CDC Tom Harkin Global Comm. Center, Atlanta, GA*

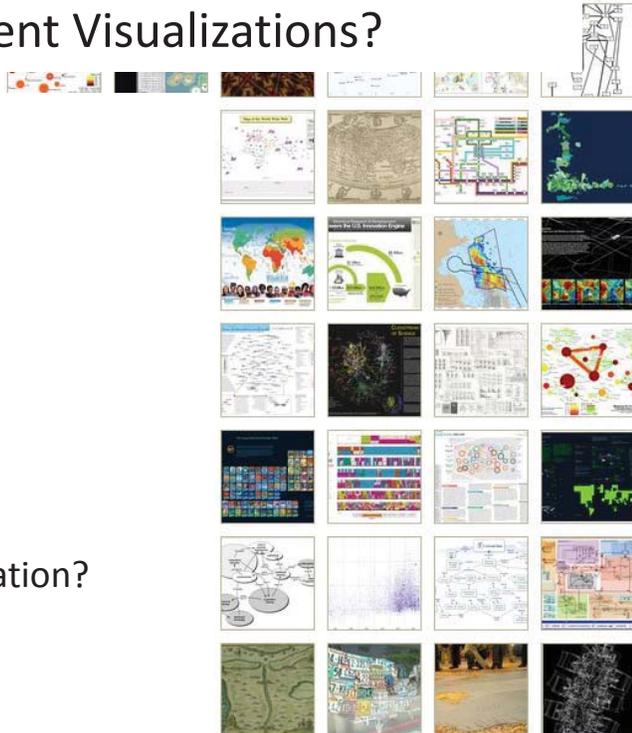
February 4, 2016



How to Classify Different Visualizations?

By

- User insight needs?
- User task types?
- Data to be visualized?
- Data transformation?
- Visualization technique?
- Visual mapping transformation?
- Interaction techniques?
- Or ?

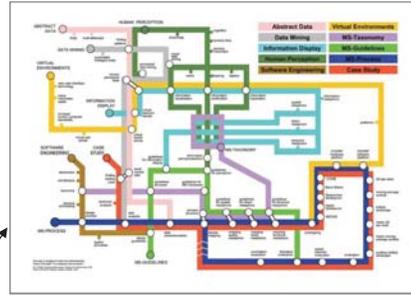


Different Question Types



Terabytes of data

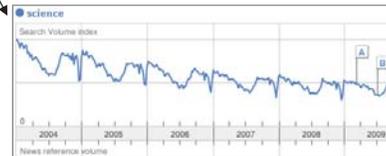
Descriptive & Predictive Models



Find your way



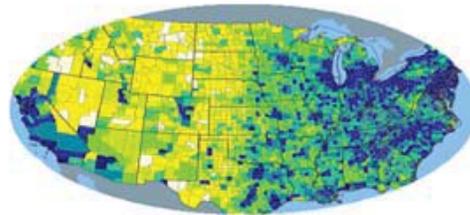
Find collaborators, friends



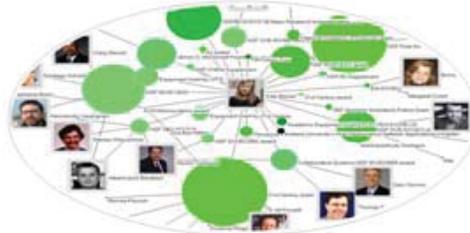
Identify trends

Different Levels of Abstraction/Analysis

Macro/Global
Population Level



Meso/Local
Group Level



Micro
Individual Level



Tasks

LEVELS

MICRO: Individual Level
about 1–1,000 records
page 6



MESO: Local Level
about 1,001–100,000 records
page 8

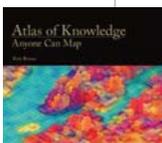


MACRO: Global Level
more than 100,000 records
page 10



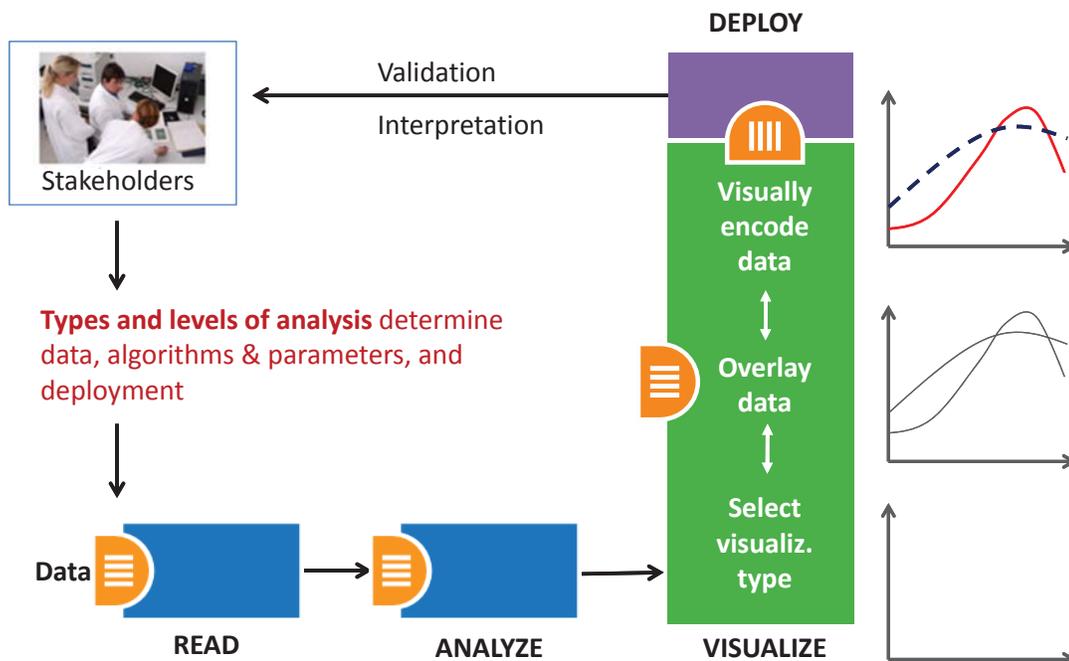
TYPES

<p>Statistical Analysis page 44</p>	<p>Knowledge Cartography page 135</p>	<p>Productivity of Russian life sciences research teams page 105</p>	<p>Scientists and Society in Equilibrium Number of scientists versus population and R&D costs versus GNI page 103</p>
<p>WHEN: Temporal Analysis page 48</p>	<p>Visualizing decision-making processes page 95</p>	<p>Key events in the development of the video tape recorder page 85</p>	<p>Increased travel and communication speeds page 83</p>
<p>WHERE: Geospatial Analysis page 52</p>	<p>Cell phone usage in Milan, Italy page 109</p>	<p>Victorian poetry in Europe page 137</p>	<p>Ecological footprint of countries page 99</p>
<p>WHAT: Topical Analysis page 56</p>	<p>Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89</p>	<p>Evolving journal networks in nanotechnology page 139</p>	<p>Product space showing co-export patterns of countries page 93</p>
<p>WITH WHOM: Network Analysis page 60</p>	<p>World Finance Corporation network page 87</p>	<p>Electronic and new media art networks page 133</p>	<p>World-wide scholarly collaboration networks page 137</p>

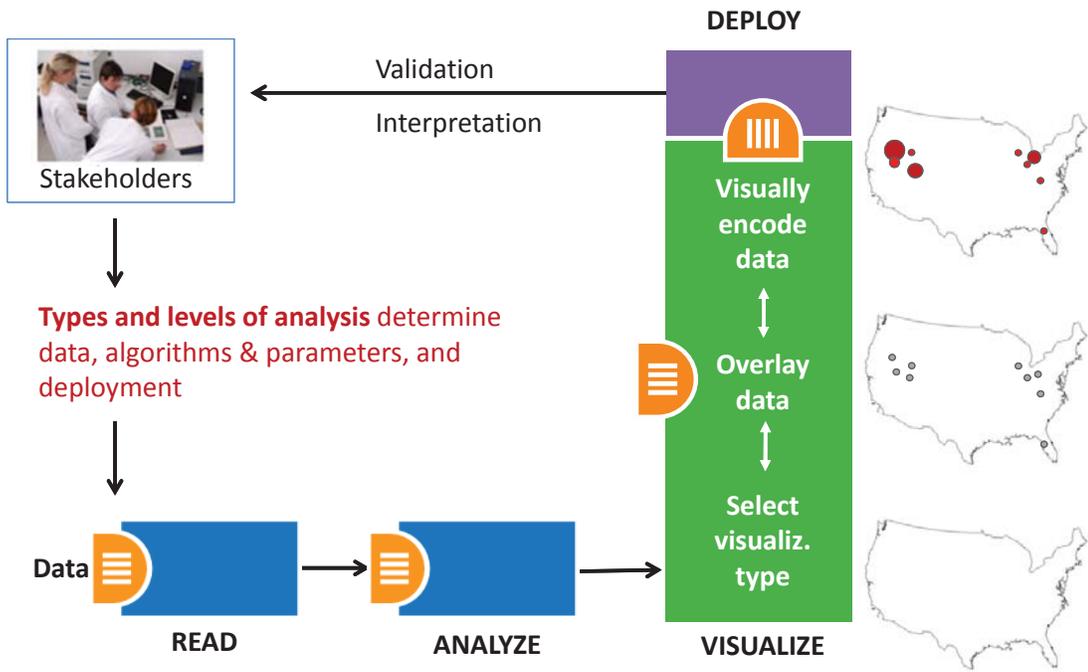


See page 5

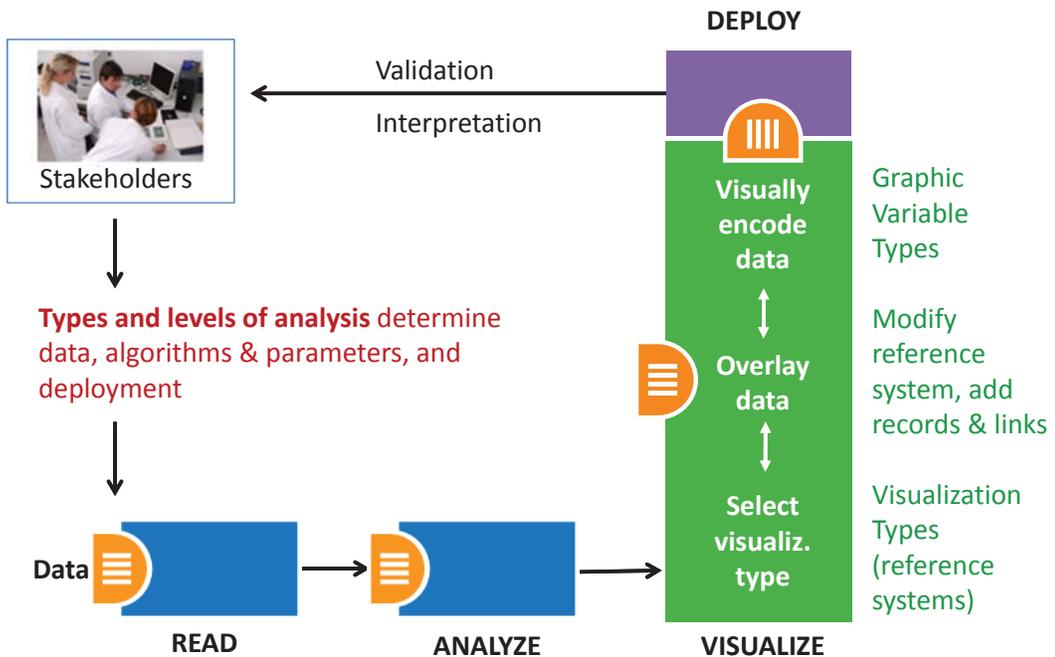
Needs-Driven Workflow Design



Needs-Driven Workflow Design



Needs-Driven Workflow Design



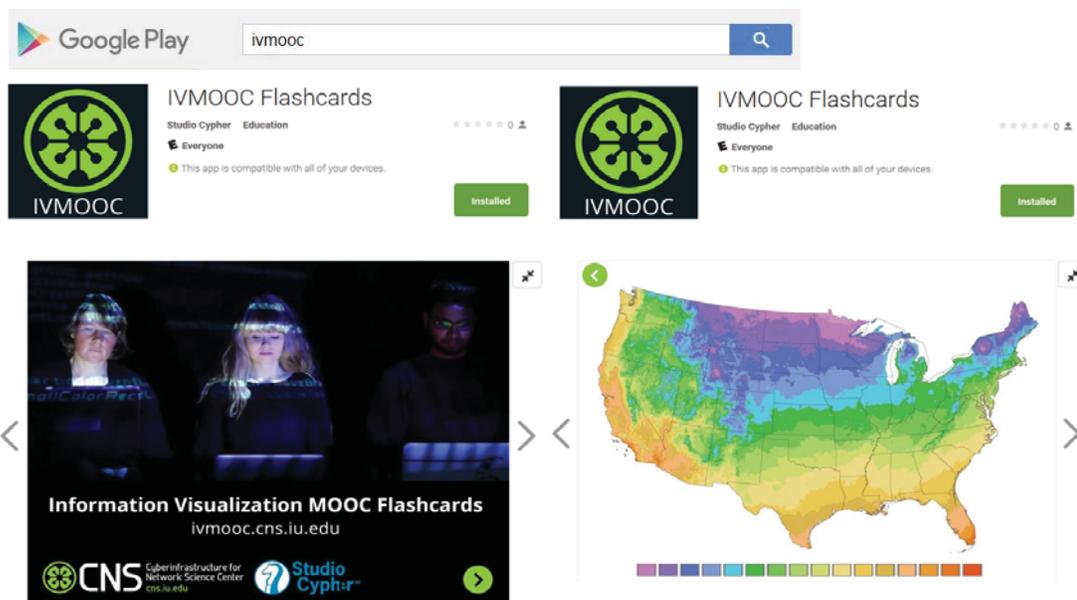
Visualization Types (Reference Systems)

1. **Charts:** No reference system—e.g., Wordle.com, pie charts
2. **Tables:** Categorical axes that can be selected, reordered; cells can be color coded and might contain proportional symbols. Special kind of graph.
3. **Graphs:** Quantitative or qualitative (categorical) axes. Timelines, bar graphs, scatter plots.
4. **Geospatial maps:** Use latitude and longitude reference system. World or city maps.
5. **Network graphs:** Node position might depends on node attributes or node similarity. **Tree graphs:** hierarchies, taxonomies, genealogies. **Networks:** social networks, migration flows.

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IVMOOC App – More than 60 visualizations

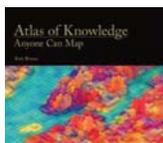
The “IVMOOC Flashcards” app can be downloaded from Google Play and Apple iOS stores.



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Visualization Framework

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
<ul style="list-style-type: none"> • categorize/cluster • order/rank/sort • distributions (also outliers, gaps) • comparisons • trends (process and time) • geospatial • compositions (also of text) • correlations/relationships 	<ul style="list-style-type: none"> • nominal • ordinal • interval • ratio 	<ul style="list-style-type: none"> • table • chart • graph • map • network layout 	<ul style="list-style-type: none"> • geometric symbols <ul style="list-style-type: none"> point line area surface volume • linguistic symbols <ul style="list-style-type: none"> text numerals punctuation marks • pictorial symbols <ul style="list-style-type: none"> images icons statistical glyphs 	<ul style="list-style-type: none"> • spatial <ul style="list-style-type: none"> position • retinal <ul style="list-style-type: none"> form color optics motion 	<ul style="list-style-type: none"> • overview • zoom • search and locate • filter • details-on-demand • history • extract • link and brush • projection • distortion



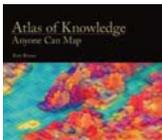
See page 24

Visualization Framework

Basic Task Types								
Bertin, 1967	Wehrend & Lewis, 1996	Few, 2004	Yau, 2011	Rendgen & Wiedemann, 2012	Frankel, 2012	Tool: Many Eyes	Tool: Chart Chooser	Börner, 2014
selection	categorize			category				categorize/cluster
order	rank	ranking					table	order/rank/sort
	distribution	distribution					distribution	distributions (also outliers, gaps)
	compare	nominal comparison & deviation	differences		compare and contrast	compare data values	comparison	comparisons
		time series	patterns over time	time	process and time	track rises and falls over time	trend	trends (process and time)
		geospatial	spatial relations	location		generate maps		geospatial
quantity		part-to-whole	proportions		form and structure	see parts of whole, analyze text	composition	compositions (also of text)
association	correlate	correlation	relationships	hierarchy		relations between data points	relationship	correlations/relationships

Visualization Framework

Insight Need Types page 26	Data Scale Types page 28	Visualization Types page 30	Graphic Symbol Types page 32	Graphic Variable Types page 34	Interaction Types page 26
<ul style="list-style-type: none"> • categorize/cluster • order/rank/sort • distributions (also outliers, gaps) • comparisons • trends (process and time) • geospatial • compositions (also of text) • correlations/relationships 	<ul style="list-style-type: none"> • nominal • ordinal • interval • ratio 	<ul style="list-style-type: none"> • table • chart • graph • map • network layout 	<ul style="list-style-type: none"> • geometric symbols <ul style="list-style-type: none"> • point • line • area • surface • volume • linguistic symbols <ul style="list-style-type: none"> • text • numerals • punctuation marks • pictorial symbols <ul style="list-style-type: none"> • images • icons • statistical glyphs 	<ul style="list-style-type: none"> • spatial <ul style="list-style-type: none"> • position • retinal <ul style="list-style-type: none"> • form • color • optics • motion 	<ul style="list-style-type: none"> • overview • zoom • search and locate • filter • details-on-demand • history • extract • link and brush • projection • distortion



See page 24

Graphic Variable Types Versus Graphic Symbol Types

			Geometric Symbols			
			Point	Line	Area	
Spatial	x	quantitative				
	y	quantitative				
	z	quantitative				
Retinal	Form	Size	quantitative	NA (Not Applicable)		
		Shape	qualitative	NA		
		Rotation	quantitative	NA		
		Curvature	quantitative	NA		
		Angle	quantitative	NA		
		Closure	quantitative	NA		
		Color	Value	quantitative		
qualitative						
quantitative						

Graphic Variable Types Versus Graphic Symbol Types

		Point	Line	Geometric Symbols	Surface	Volume	Linguistic Symbols Text, Numbers, Punctuation Marks	Pictorial Symbols Images, Icons, Symbolical Graphs
Type	Location							
	Size							
	Color							
Shape	Location							
	Size							
	Color							
	Orientation							
	Rotation							
	Curvature							
Value	Location							
	Size							
	Color							
	Orientation							
	Rotation							
	Curvature							
Material	Location							
	Size							
	Color							
	Orientation							
	Rotation							
	Curvature							
	Texture							
	Transparency							
	Shading							
	Shading depth							
	Shading							
	Shading							
Motion	Location							
	Size							

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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 Microscopes	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

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

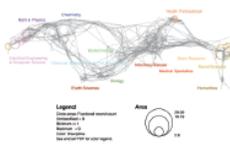


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Load **One** File and Run **Many** Analyses and Visualizations

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 Microscopes	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

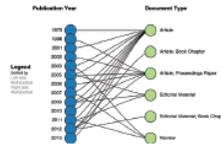
Topical Analysis—p. 56



Paper Citation Network—p. 60



Bi-Modal Network—p. 60



Co-author and many other bi-modal networks.


IVMOOC 2016

MENU



Information Visualization MOOC
ivmooc.cns.iu.edu 

Register for free: <http://ivmooc.cns.iu.edu>. Class started Jan 12, 2016.

Course Schedule

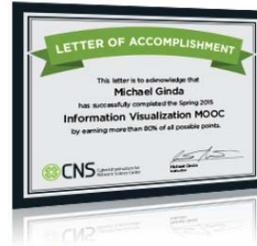
Part 1: Theory and Hands-On

- **Session 1** – Workflow Design and Visualization Framework
- **Session 2** – “When:” Temporal Data
- **Session 3** – “Where:” Geospatial Data
- **Session 4** – “What:” Topical Data

Mid-Term

- **Session 5** – “With Whom:” Trees
- **Session 6** – “With Whom:” Networks
- **Session 7** – Dynamic Visualizations and Deployment

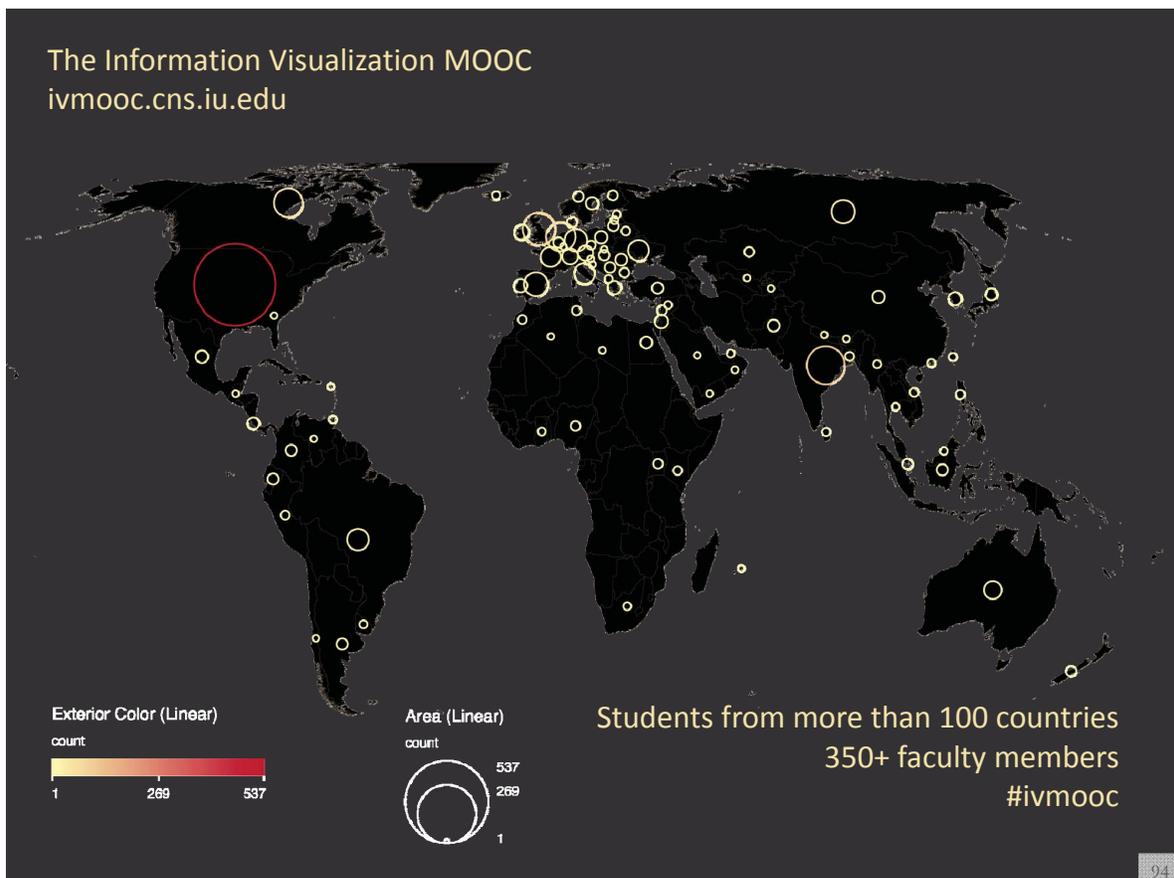
Final Exam



Part 2: Students work in teams on client projects.

Final grade is based on Class Participation (10%), Midterm (30%), Final Exam (30%), and Client Project(30%).

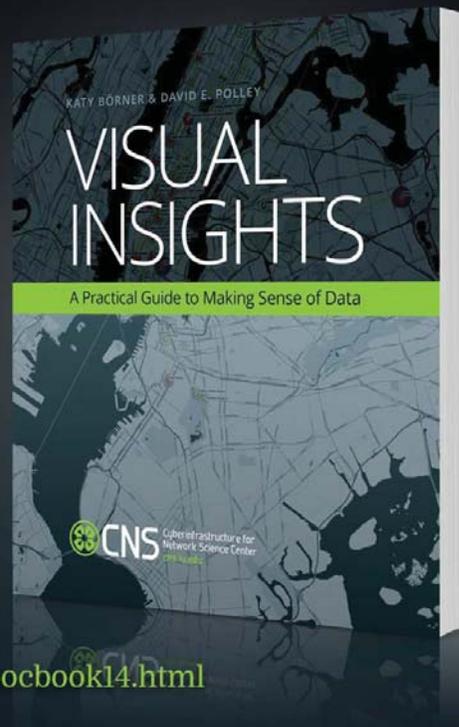
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The IVMOOC Companion Textbook

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



CDC Tutorial on Friday Feb 5, 2016, 8:30-11:30am

Title: Open Source Tools for Data Analysis and Visualization

Speaker: Prof. Katy Börner, Indiana University

Abstract: This tutorial is designed for researchers and practitioners interested to use advanced data mining algorithms and visualizations in their research and daily decision making. It introduces the open source Science of Science (Sci2) Tool that supports temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels. Open data from different government agencies will be used to demonstrate different analysis and visualization workflows.

The tutorial provides “hands-on” training. Please bring your laptop and pre-install the Sci2 (v 1.1 beta) tool prior to the workshop.

Additional theory and hands-on lectures are available in the Information Visualization MOOC (IVMOOC) (<http://ivmooc.cns.iu.edu>) that is taught each Spring for students from 100+ countries.



Modeling Science, Technology & Innovation Conference

WASHINGTON D.C. | MAY 17-18, 2016

[View Agenda](#)

This conference is funded by the NSF Science of Science and Innovation Policy (SciSIP) program and aims at facilitating the generation and execution of a new Roadmap for the Science of Science Policy community and a strategic plan for SciSIP program, see details at <http://modsti.cns.iu.edu>.

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OECD Blue Sky Forum on Science and Innovation Indicators



OECD
BLUE SKY III

INFORMING SCIENCE AND INNOVATION POLICIES:
TOWARDS THE NEXT GENERATION OF DATA AND INDICATORS
Ghent, 19-21 September 2016

[Call for papers](#) | [Venue and dates](#) | [Registration](#)

Every 10 years the OECD Blue Sky Forum engages the policy community, data users and providers into an open dialogue to review and develop its long-term agenda on science, technology and innovation (STI) data and indicators. This event is known as the "OECD Blue Sky Forum", an open and unconstrained discussion on evidence gaps in science and innovation and on initiatives the international community can take to address data needs in this area.



Blue Sky has been held in [Paris \(1996\)](#) and [Ottawa \(2006\)](#). On its last edition, Blue Sky was marked by the announcement of Science for Science and Innovation Policy initiatives. It also launched [OECD work on innovation in firms](#) which exploited the potential of micro-data and informed the OECD Innovation Strategy of 2010 with the publication of [Measuring Innovation: A New Perspective](#).

Every 10 years the OECD Blue Sky Forum engages the policy community, data users and providers into an open dialogue to review and develop its long-term agenda on science, technology and innovation (STI) data and indicators, see details at <http://www.oecd.org/science/blue-sky.htm>

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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

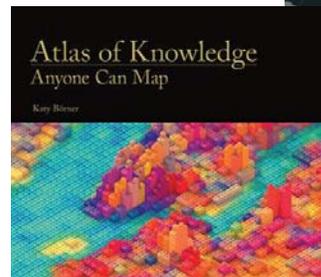
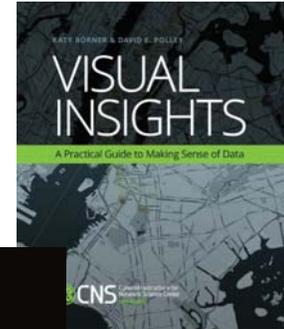
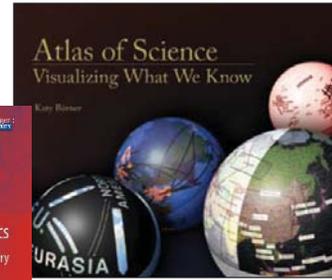
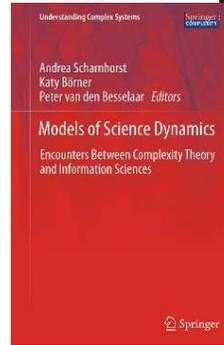
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Katy Börner and David E Polley (2014) **Visual Insights: A Practical Guide to Making Sense of Data**. The MIT Press.

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



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These slides are at <http://cns.iu.edu/docs/presentations>

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