

# Visual Analytics in Support of Education

Katy Börner

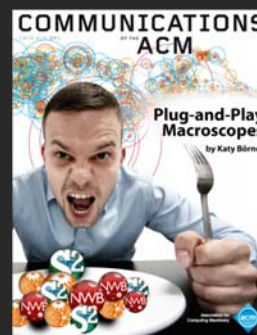
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With special thanks to the members at the Cyberinfrastructure for Network Science Center and the Sci2, NWB, and EpiC teams

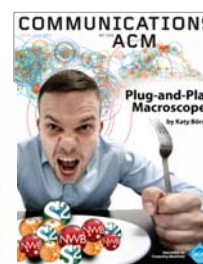
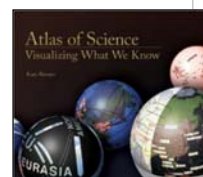
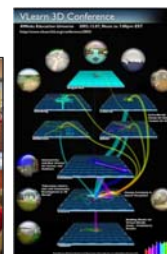
Learning Analytics and Knowledge  
Vancouver, Canada  
<http://projects.arts.nbc.ca/lak12/>

May 1, 2012



## Overview

- Motivation:** Design informative and visually pleasing visualizations that make a difference. Three exemplary problems and solutions.
- Theory:** Learn from and combine approaches from psychology, cartography, computer science, information visualization, statistics, graphic design.
- Practice:** Plug-and-play macroscope tools that commoditize data mining and visualization.



## 1<sup>st</sup> Example

Monitoring and evaluating 3D virtual environments in support of spatial, topical and social navigation and experience/teaching optimization.

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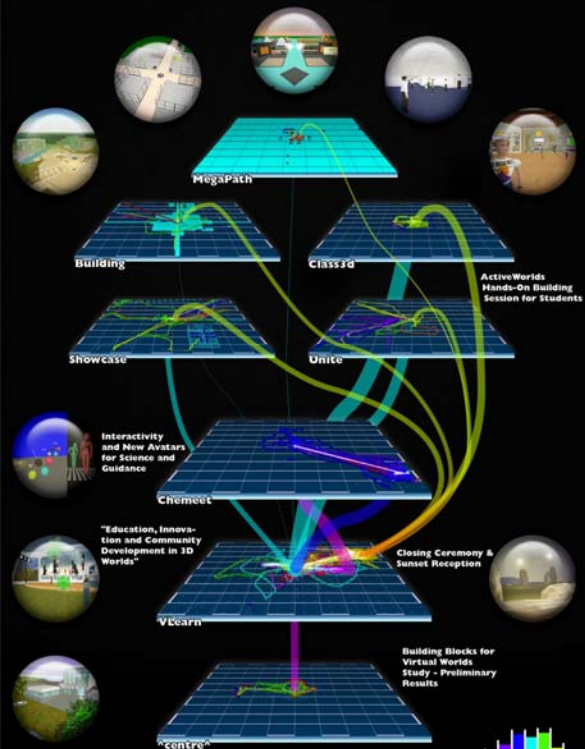
Monitoring and evaluating 3D virtual environments in support of topical and social navigation and optimization.



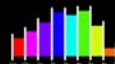
<http://www.vlearn3d.org>

## VLearn 3D Conference

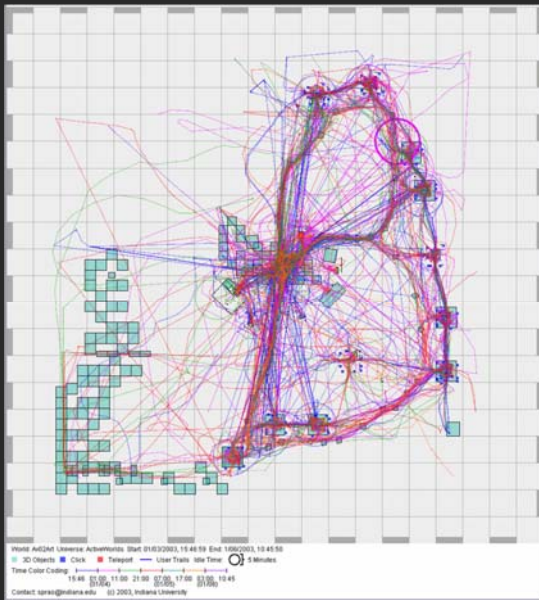
AWedu Education Universe 2002.12.07, Noon to 7:00pm EST  
<http://www.vlearn3d.org/conference2002/>



Katy Birnes, Richard Hadfield, Ryan Jones, Cynthia Jun Lee, Shashant Pansurthy  
Copyright © 2002, Indiana University  
<http://www.indiana.edu/~vlearn/>

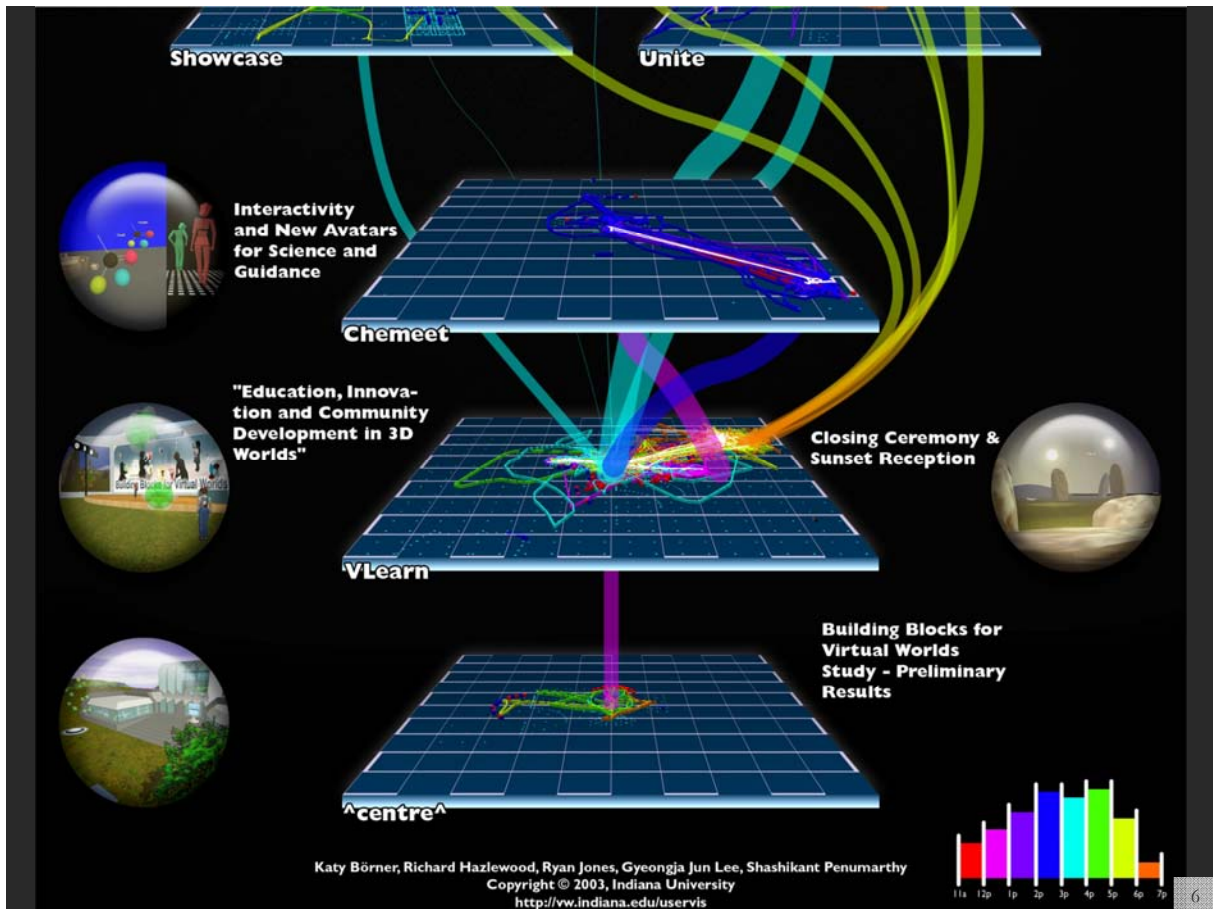
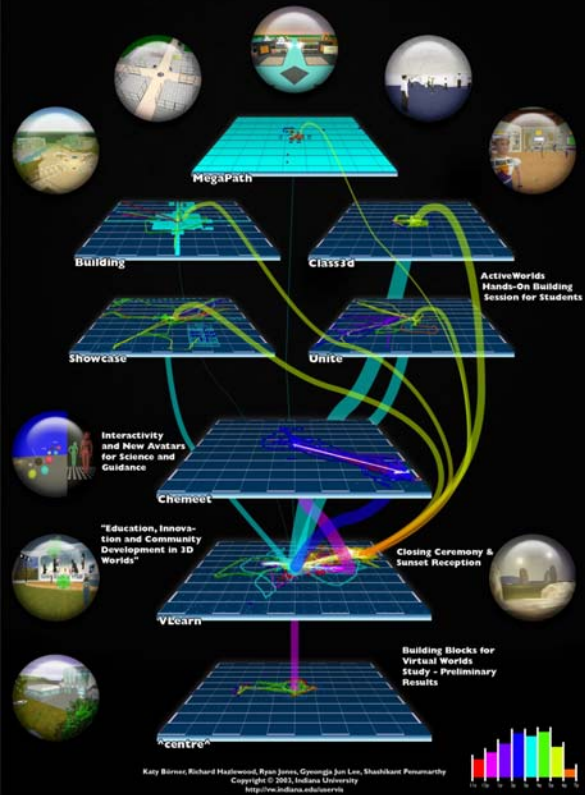


Monitoring and evaluating 3D virtual environments in support of topical and social navigation and optimization.



## VLearn 3D Conference

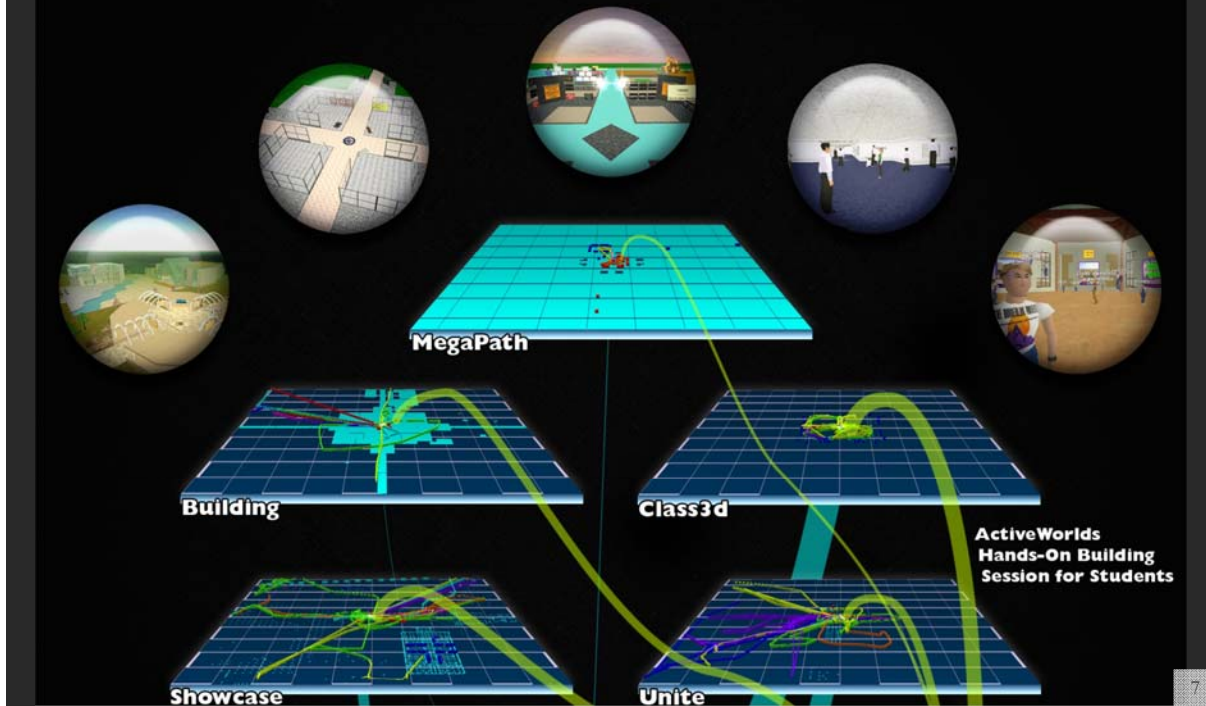
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<http://www.vlearn3d.org/conference2002/>





# VLearn 3D Conference

AWedu Education Universe 2002.12.07, Noon to 7:00pm EST  
<http://www.vlearn3d.org/conference2002/>



## Mapping Virtual Worlds and Their Inhabitants

### Addressed User Tasks

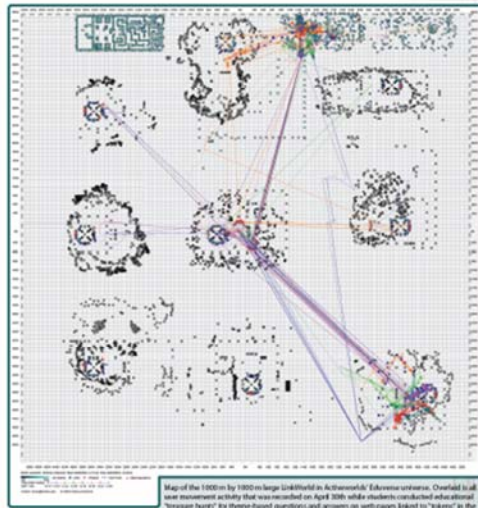
The developed visualization tools are intended to support social navigation in three-dimensional virtual worlds, to help evaluate and optimize the design of virtual worlds, and to provide a means to study the communities evolving in virtual worlds.

### Design Concept

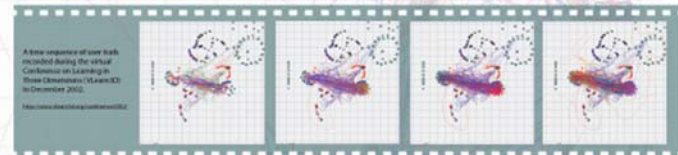
The figures show the layout and utilization of diverse virtual worlds. Information on the position, size and rotation of all three-dimensional objects as well as on interaction possibilities are used to generate a map of a world. Overlaid are user interaction data such as movement, web click, or chat activity recorded during virtual events in a particular world.

### Design Implementation

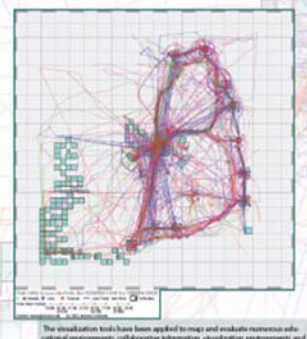
All virtual objects are rendered in transparent green to preserve the visibility of layered objects. A reference grid indicates the size of the virtual world. To show the evolution of a world, darker colors are used for older objects and lighter colors for younger ones. Web links and teleports are indicated by green squares and purple plus signs respectively. Color-coding is used to denote the chronological sequence of user interactions.



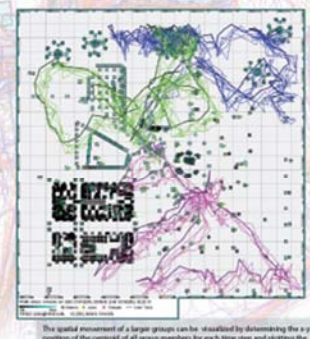
Map of the 1000m by 1000m large 3DWorld in ActiveWorlds Education universe. Overlaid is all user movement activity that was recorded on April 30th while students conducted educational "Virtual Hunt" for theme-based questions and answers on web pages linked to "Hunt" in the virtual world. The path and chat activity of particular users as well as the three separate activity areas can be quickly identified.



A time sequence of user trails recorded during the virtual Conference on Learning in Three Dimensions (Learn3D) in December 2002.



The visualization tools have been applied to map and evaluate numerous educational environments, collaborative information visualization environments and conferences. This map depicts user trails recorded in the Act world during the Act Conference in 2002.



The spatial movement of a large group can be visualized by determining the x-y position of the centroid of all group members for each time step and plotting the movement trail of the group centroid. The spatial homogeneity - measured by the average distance among participants - can be represented by the width of the trail.



Katy Börner and Shashikant Penumarthi (2003). Social Diffusion Patterns in Three-Dimensional Virtual Worlds. *Information Visualization Journal*, 2(3):182-198.

This material is based upon work supported by the National Science Foundation under Grant No. Role # 0411846.

For more information, contact Katy Börner at [katy@indiana.edu](mailto:katy@indiana.edu).



# From Spatial Proximity to Semantic Coherence: A Quantitative Approach to the Study of Group Dynamics in Collaborative Virtual Environments

Chen, Chaomei, and Börner, Katy. 2005. *PRESENCE: Teleoperators and Virtual Environments, Special Issue on Collaborative Information Visualization Environments* 14 (1): 81-103.



## Questions

When, where, and why do users interact when exploring information spaces?

How does the spatial configuration of an information space correlate with spatial, semantic, and social navigation?

## Major Contributions

Conceptualization and quantification of group coherence.

Novel visualizations to communicate results.

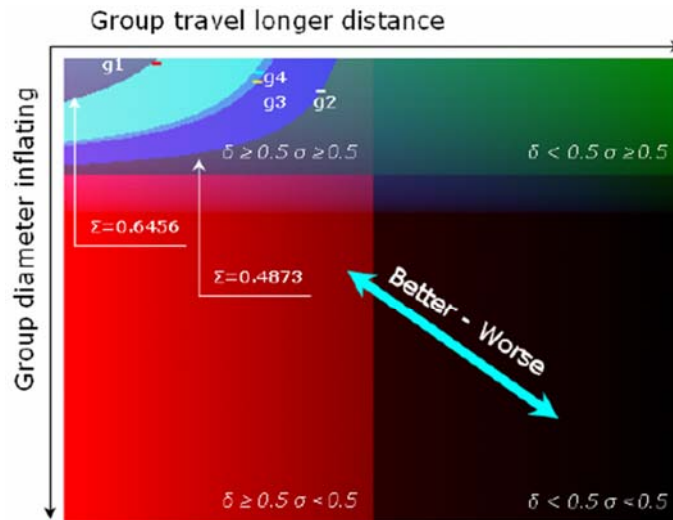


Figure 1. Group Coherence Space, colored by the different measures, showing the positions of four groups

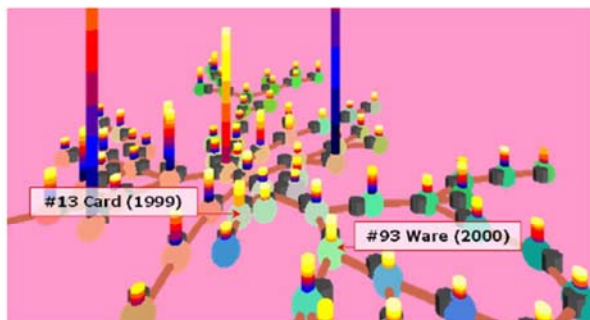


Figure 2. A visualization model of citation patterns.

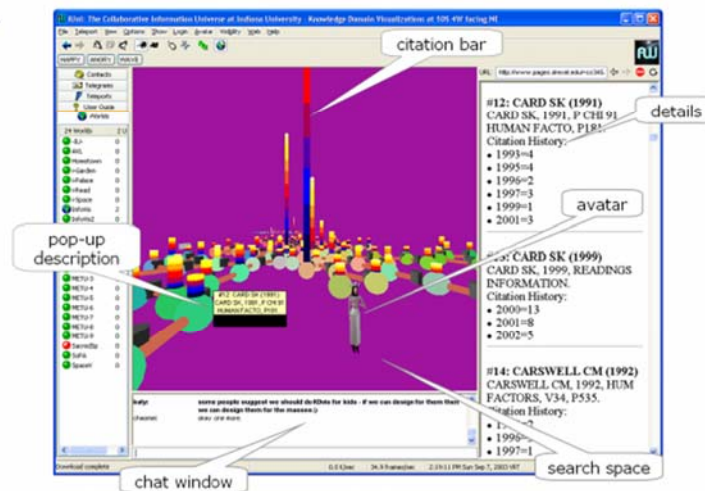


Figure 3. The user interface of the collaborative information visualization environment. 10

I think we've got the general themes question pretty close  
yeah the colors seem to cover date ranges  
go to dataset #2?

I think so, I wrote down part of what we discussed

ok

try and to the same so one of us may get it close  
since they will be slightly different

who's this?

probably a bot for monitoring

\*shakes hands\*

or another user logged in to watch the fun

ok

more tuft

got it (I figured he'd be most cited again)

83

84

82,83,84

yep

yep

most cited seems pretty clear

looks like 82 and 83

this tallest one is tuft 82

oops, not published in 2000 though

but the publish dates are wrong

yep

nodes further from center are more recent

k

no that's not a trend

k, common themes seem to be interaction design and analysis

any idea about the most recently cited and published?

no, i've been looking for that the whole time

it's a bit difficult to grasp the patterns

seems like it shouldn't

i found a 1999

#18

good

is it near other recent publications

here



### InfoVis Group 3

S5 - blue

S6 - red

Semantically indented chat sequences aim to reveal underlying connections between users' navigational movements and the contents of their discourse in a situated manner.

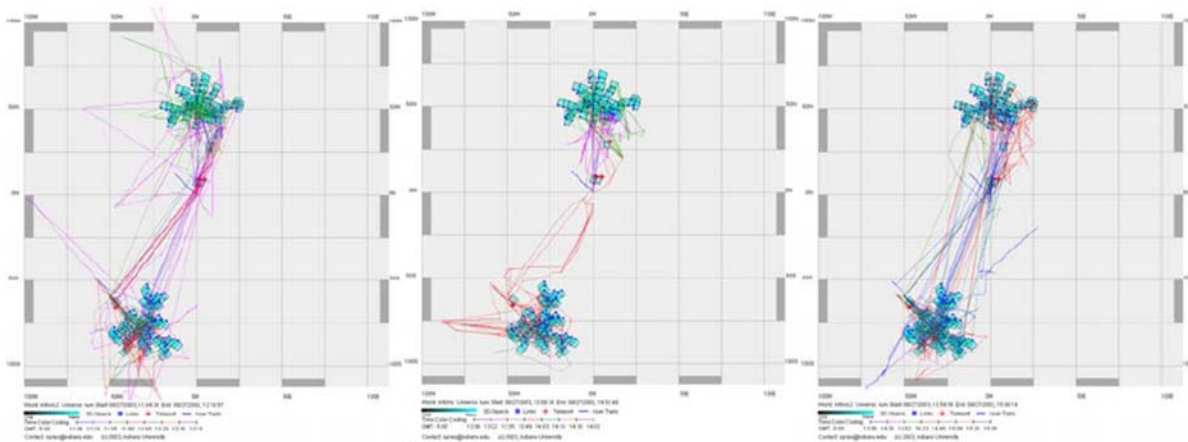


Figure 7. Group activity maps: Group 2 (left), Group 3 (middle), and Group 4 (right).



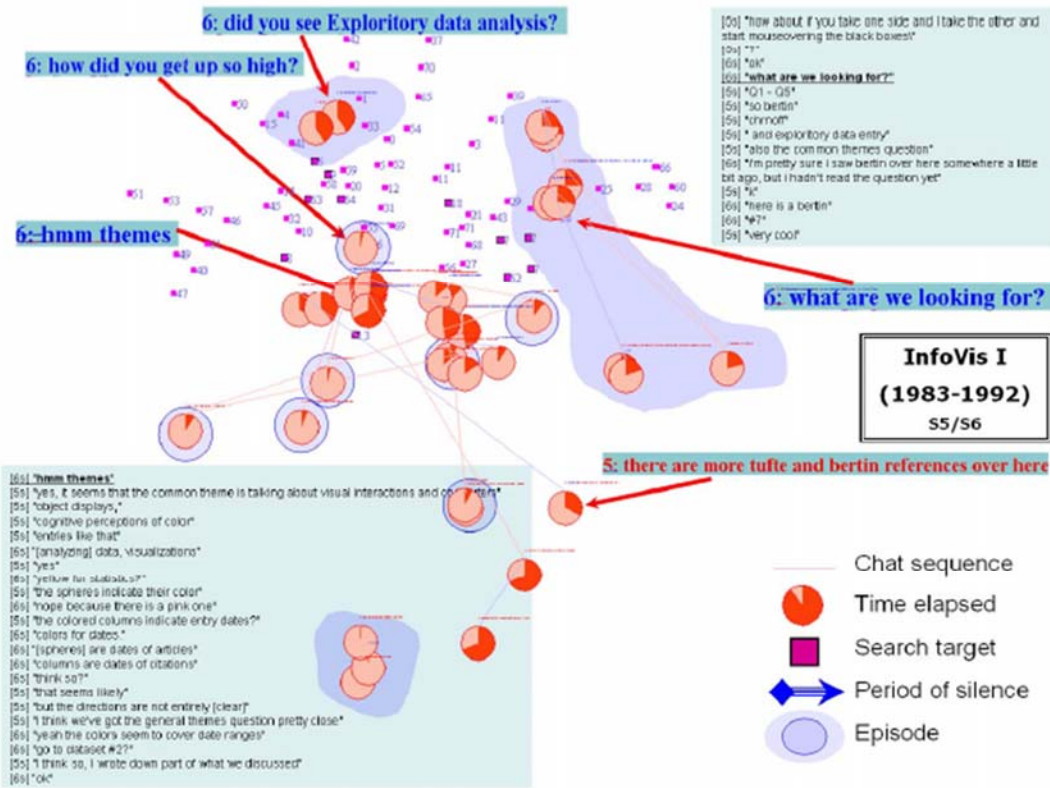


Figure 10. Episodes of collaborative search by Group 3.

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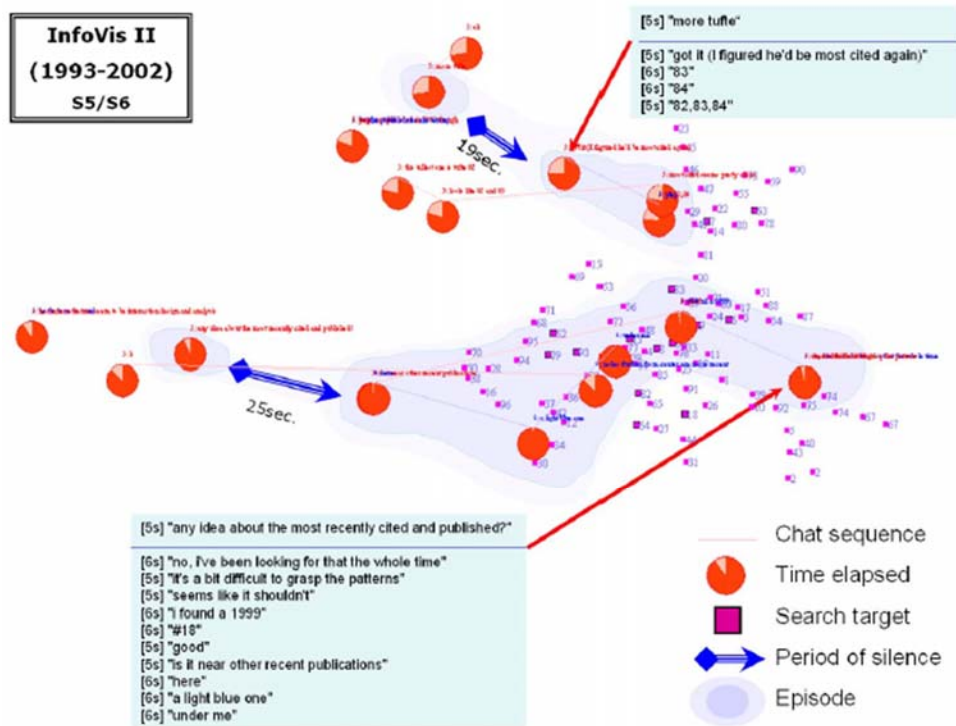


Figure 11. Episodes containing extended intervals of silence while group members being engaged in individual search.

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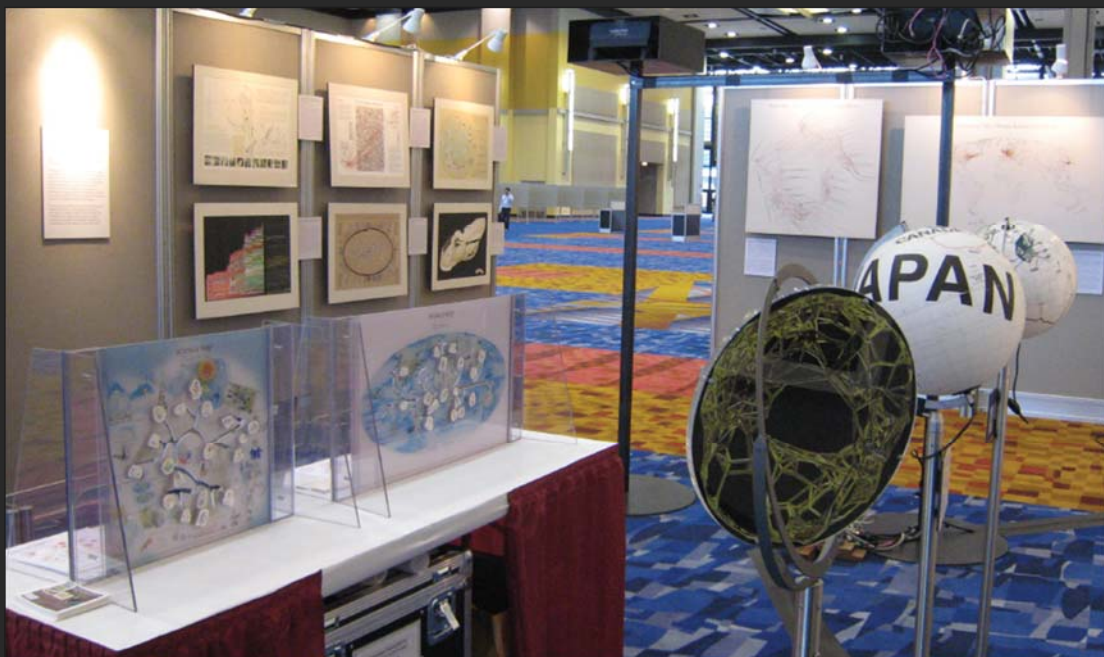
## 2<sup>nd</sup> Example

Teaching children a holistic understanding of science.

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### Mapping Science Exhibit – 10 Iterations in 10 years

<http://scimaps.org/>





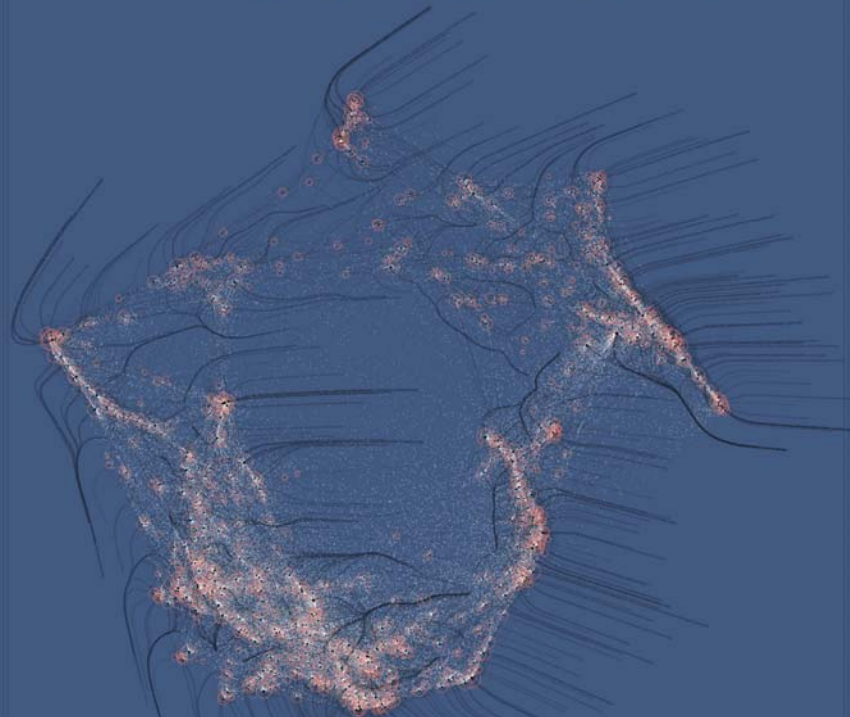


Science Maps in “Expedition Zukunft” science train visiting 62 cities in 7 months 12 coaches, 300 m long  
Opening was on April 23<sup>rd</sup>, 2009 by German Chancellor Merkel

<http://www.expedition-zukunft.de>

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### TOPIC MAP: HOW SCIENTIFIC PARADIGMS RELATE



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# Inventors & Inventions



Hands-On Science Maps for Kids, by Flavia Palmer (Illustrations), Julie Smith (Data Acquisitions), Elisha Hardy and Katy Bomer (Graphic Design), BLOOMINGTON, IN 2006. Courtesy of Indiana University. Learn more at [www.sciencemaps.org](http://www.sciencemaps.org). This map plots the locations of where scientific papers were published; each light green dot represents 10 or fewer papers; they are scattered around the exact location for visibility, within a labelled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illuminated diagram" display which used a computer and two projectors, projecting spots of light on the screen to highlight different kinds of scientific research (in a jolting move of scientific paradigms) and the areas in the world where such research is concentrated. Brain map generated by Ben Brubaker and Paul Brubaker, visualization by Ben Brubaker. Photo credit: Elisha Hardy. This research is available at [www.sciencemaps.org](http://www.sciencemaps.org). Photo credit: Elisha Hardy. This research is available at [www.sciencemaps.org](http://www.sciencemaps.org).

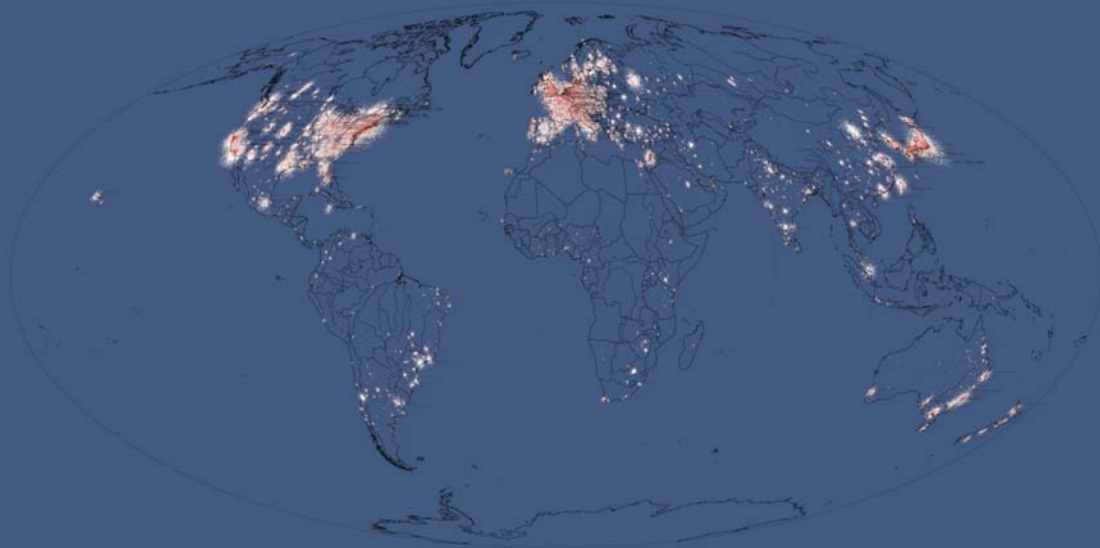
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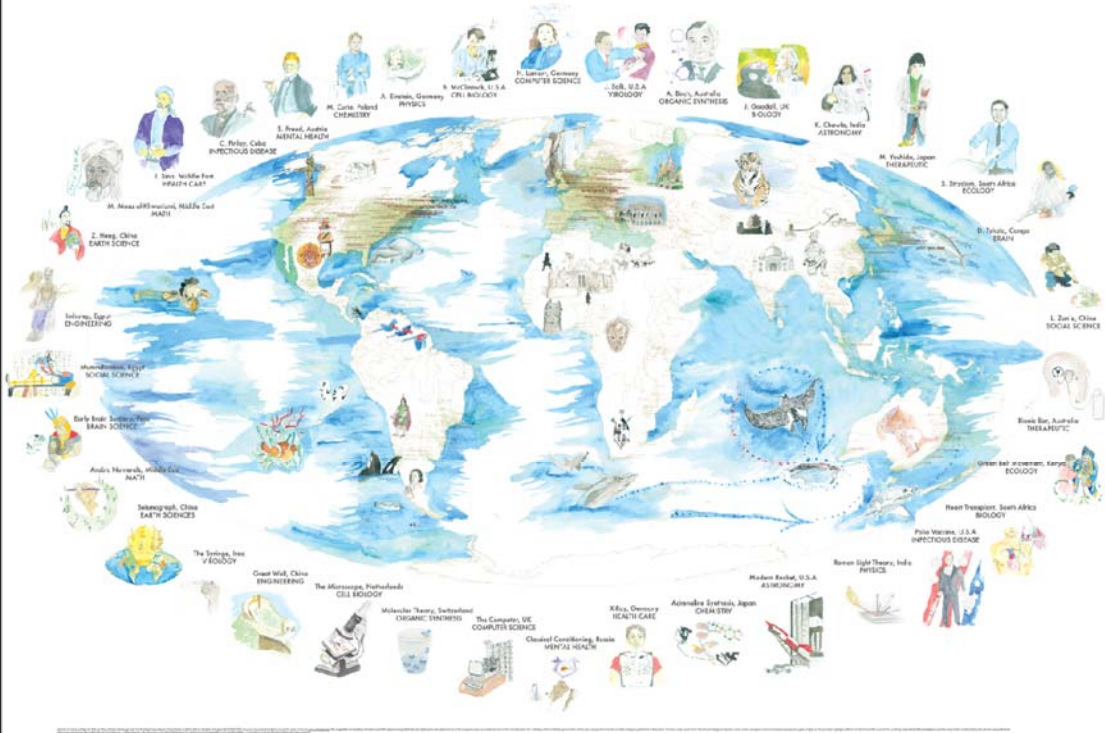


## GEOGRAPHIC MAP: WHERE SCIENCE GETS DONE



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## Inventors & Inventions



Science Puzzle Map for Kids by Filene Palmer, Julie Smith, Elisha Hardy and Katy Börner, Indiana University, 2006.  
 (Base map taken from Illuminated Diagram display by Kevin Boyack, Richard Klavans, and W. Bradford Paley.)

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# Inventors



Hands-On Science Maps for Kids, by Filipe Palmer (Painting), Julie Smith (Data Acquisitions), Elisha Hardy and Katy Bower (Graphic Design), BLOOMINGTON, IN 2006. Courtesy of Indiana University. Learn more at [www.scimaps.org](http://www.scimaps.org). This map plots the locations of where scientific papers were published; each light green dot represents 10 or fewer papers; they are scattered around the exact location for visibility, within a labeled green circle whose size is proportional to the number of papers published in that place. The base map is part of an "illuminated diagram" display which used a computer and two projectors, projecting spots of light on the prints to highlight different kinds of scientific research like a stiling map of scientific paradigms and the areas in the world where such science was performed. Base map research by Kevin Baskin and Dick Klawns, cartography by John Dugovic, data from Thompson ISI, graphics and typography by W. Bradford Falgout. Copyright © 2006 W. Bradford Falgout, all rights reserved.





**My Science Story**  
By \_\_\_\_\_

There are seven main fields of science. They are...

social science, mathematics, physics, chemistry, earth science, medicine, and psychology. I like to study earth science.

**Color earth science green.**

Earth scientists study the weather, plants and trees, marine life, insects, and much more.

I like insects. They are interesting to look at and study.

**Color in the insect.**

Butterfly, Bee, Scorpion

There are many types of insects in the world. Bees, butterflies, and beetles are just a few.

I want to be an entomologist when I grow up. Then I can study insects all the time.

**Activities:**  
 Solve the puzzle.  
 Navigate to 'Earth Science'.  
 Identify major inventions.  
 Place major inventors.  
 Find your dream job on the map.

Börner, Katy, Uzzo, Stephen M., Palmer, Fileve, Davis, Julie M., Hardy, Elisha F. and Hook, Bryan J. (2009) Teaching Children the Structure of Science. SPIE Conference on Visualization and Data Analysis, San Jose, CA, Jan 19-20, 2009. Vol. 7243, pp. 724307: 1-14.

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## Call for Maps (<http://scimaps.org/call>)

The 8th iteration of the Mapping Science exhibit is devoted to science maps that kids aged 5-14 can use to gain a more holistic understanding and appreciation of science and technology. Each map should be engaging and fun to peruse yet **should have at least one concrete learning objective**. Among others, the maps might depict:

- A concept map telling a science story,
- Famous adventures, encounters, or discoveries in science history,
- Zooms in-out of the world of science,
- Surprising, scary, wonderful, and exciting scientific activities,
- Timelines of science and technology development and inventions,
- Exhibit holdings at different science museums (location, subject matter, etc.),
- A map of school science curricula, projects, or science textbook contents, or
- Career trajectories in science.

Maps are intended to give children the exciting opportunity to immerse in, explore, or navigate the landscape of science and to find their own place.

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Venue suggestions are welcome. Information on how to host the exhibit is at <http://scimaps.org/host>.



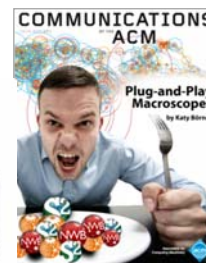
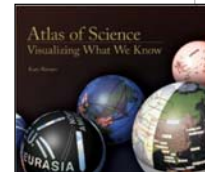
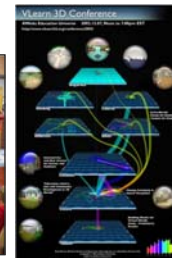
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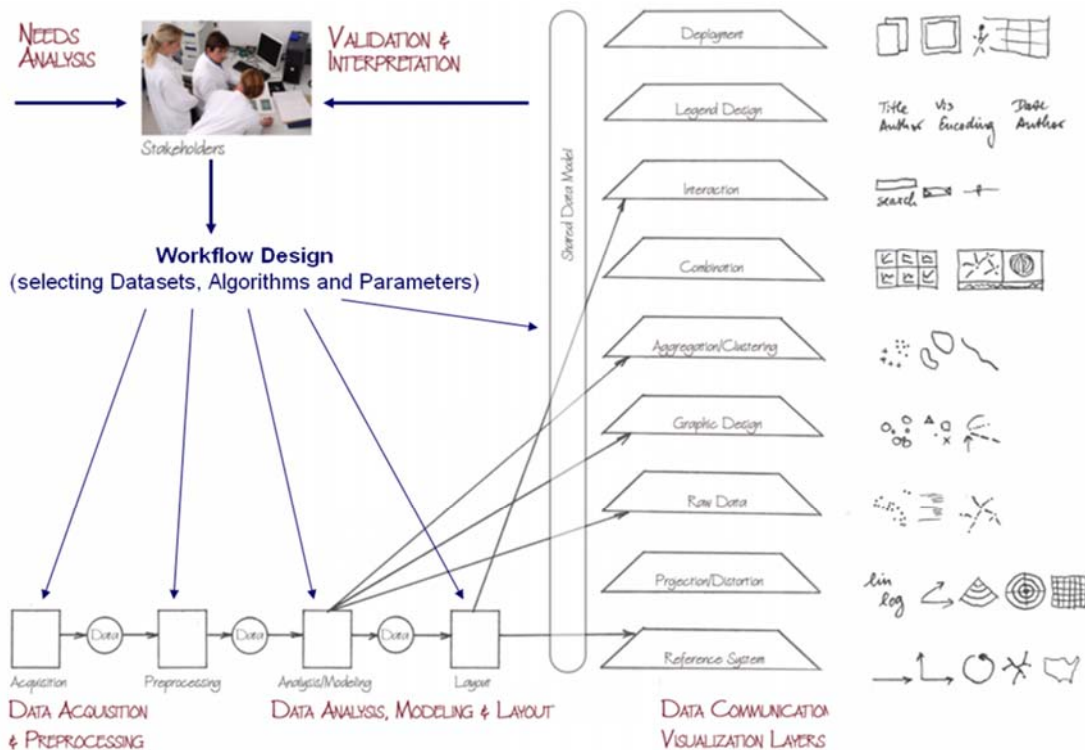
# Overview

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2. **Theory:** Learn from and combine approaches from psychology, cartography, computer science, information visualization, statistics, graphic design.
3. **Practice:** Plug-and-play macroscope tools that commoditize data mining and visualization.



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**Needs-Driven Workflow Design** using a modular data acquisition/analysis/modeling/ visualization pipeline as well as modular visualization layers.

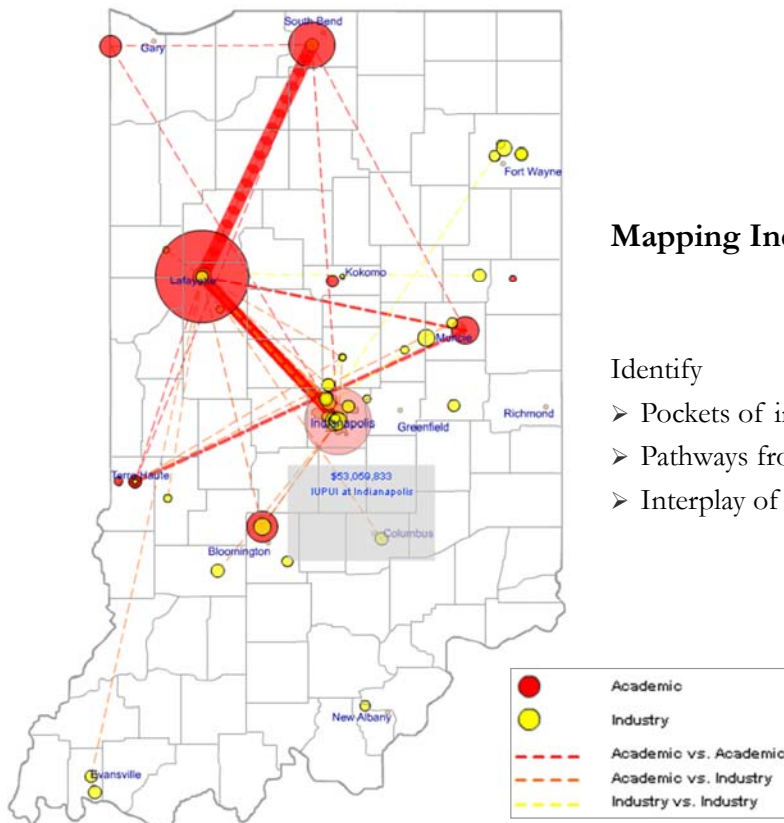


## Type of Analysis vs. Level of Analysis

	<b>Micro/Individual</b> (1-100 records)	<b>Meso/Local</b> (101-10,000 records)	<b>Macro/Global</b> (10,000 < records)
<b>Statistical Analysis/Profiling</b>	Individual person and their expertise profiles	Larger labs, centers, universities, research domains, or states	All of NSI, SA, all of sci
<b>Temporal Analysis (When)</b>	Funding portfolio of one individual	Public bursts of PNAS	113 Years of P Research
<b>Geospatial Analysis (Where)</b>	Career trajectory of one individual	Wrapping a s intellectual l	PNAS
<b>Topical Analysis (What)</b>		research	VxOrd/Topic r NIH funding
<b>Network Analysis (With Whom?)</b>	NSI work of one	work	NIH's cy



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## Mapping Indiana's Intellectual Space

Identify

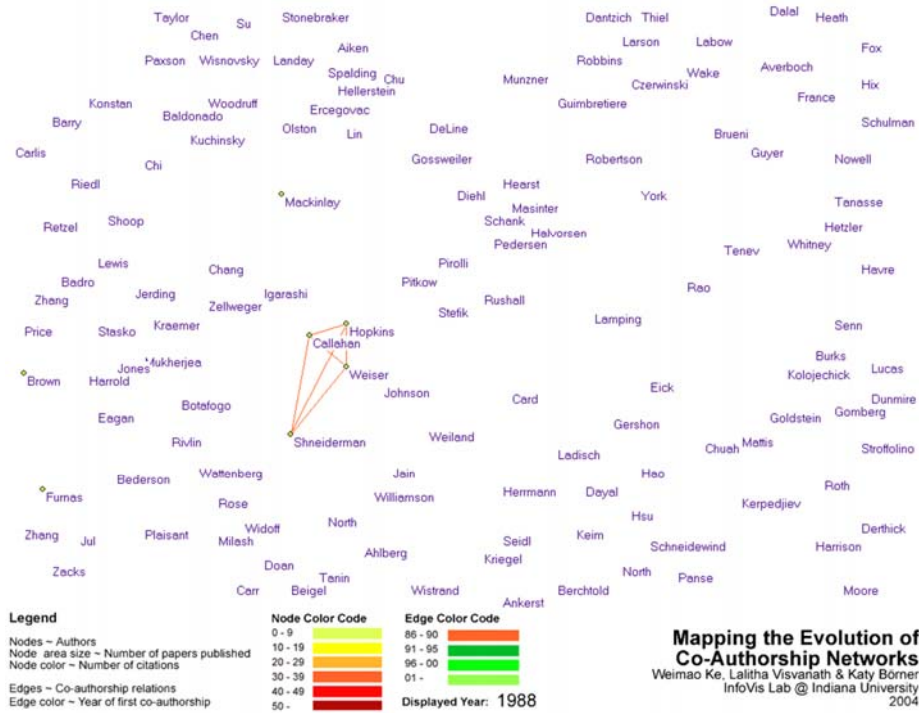
- Pockets of innovation
- Pathways from ideas to products
- Interplay of industry and academia

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# Mapping the Evolution of Co-Authorship Networks

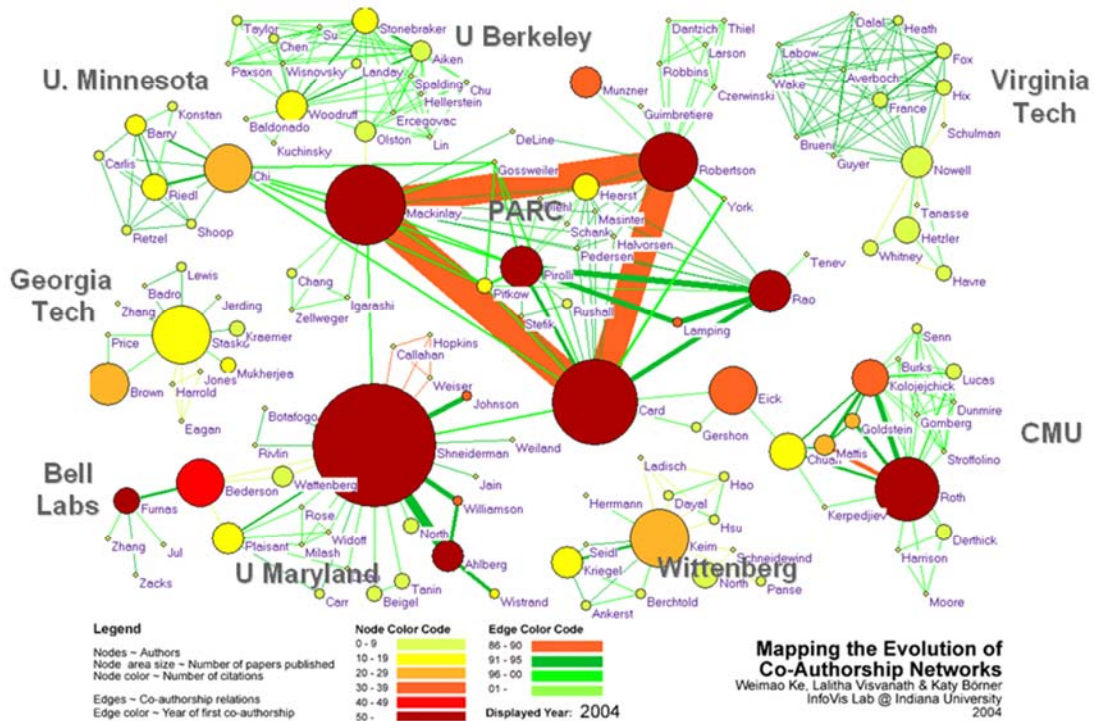
Ke, Visvanath & Börner, (2004) Won 1st price at the IEEE InfoVis Contest.



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# Mapping the Evolution of Co-Authorship Networks

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



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

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



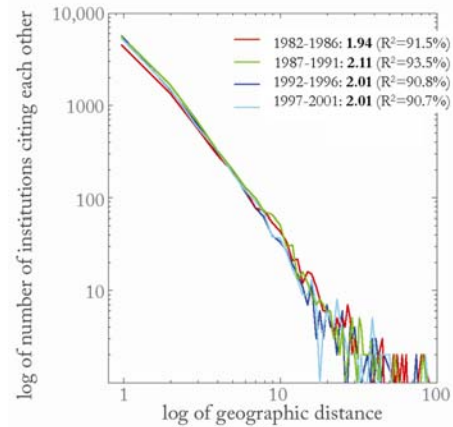
### Research questions:

1. Does space still matter in the Internet age?
2. Does one still have to study and work at major research institutions in order to have access to high quality data and expertise and to produce high quality research?
3. Does the Internet lead to more global citation patterns, i.e., more citation links between papers produced at geographically distant research institutions?



### Contributions:

- Answer to Qs 1 + 2 is YES.
- Answer to Qs 3 is NO.
- Novel approach to analyzing the dual role of institutions as information producers and consumers and to study and visualize the diffusion of information among them.



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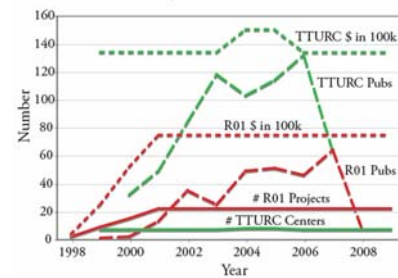
## Mapping Transdisciplinary Tobacco Use Research Centers Publications

Compare R01 investigator based funding with TTURC Center awards in terms of number of publications and evolving co-author networks.

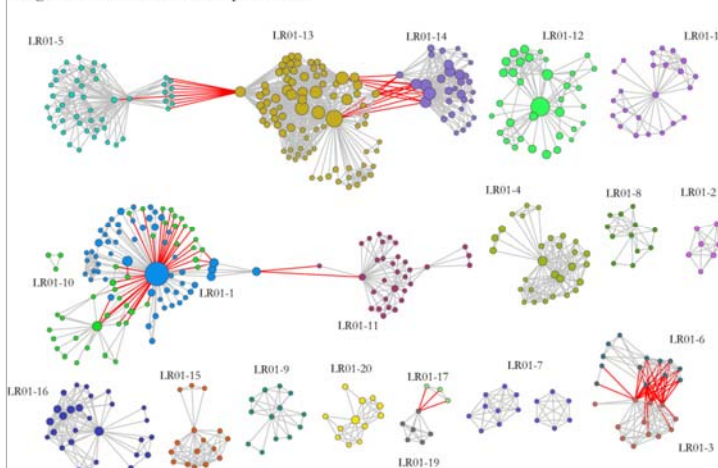
Zoss & Börner, *forthcoming*.

Supported by NIH/NCI Contract HHSN261200800812

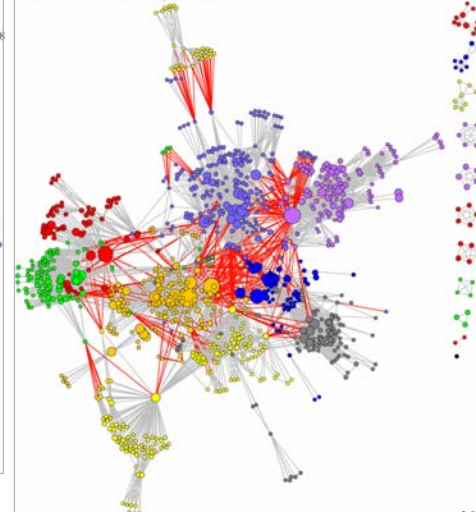
R01 & TTURC Project Information



Longitudinal R01 Co-Authorship Network



TTURC Co-Authorship Network

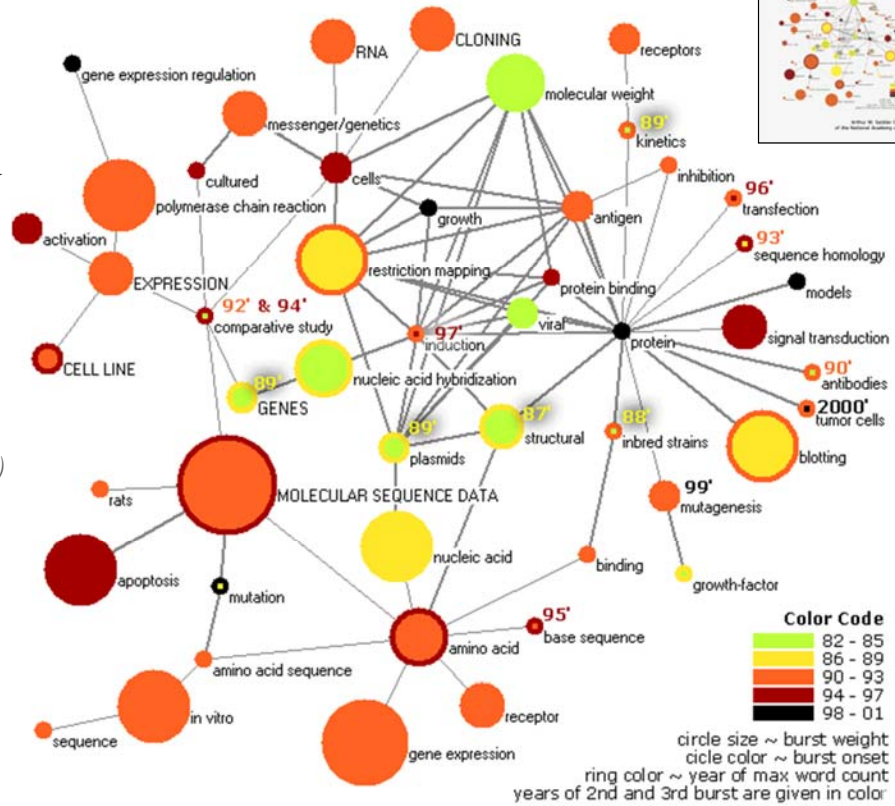


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## Mapping Topic Bursts

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

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



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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>

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[http://www.pnas.org/content/vol101/suppl\\_1/](http://www.pnas.org/content/vol101/suppl_1/)

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<http://ivl.slis.indiana.edu/km/pub/2007-borner-arist.pdf>

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

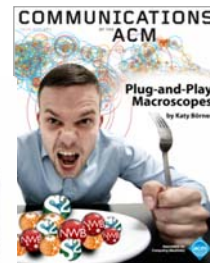
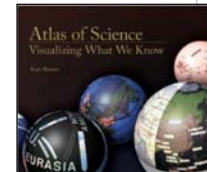
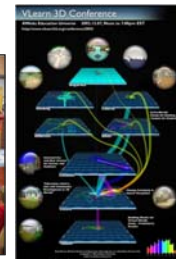


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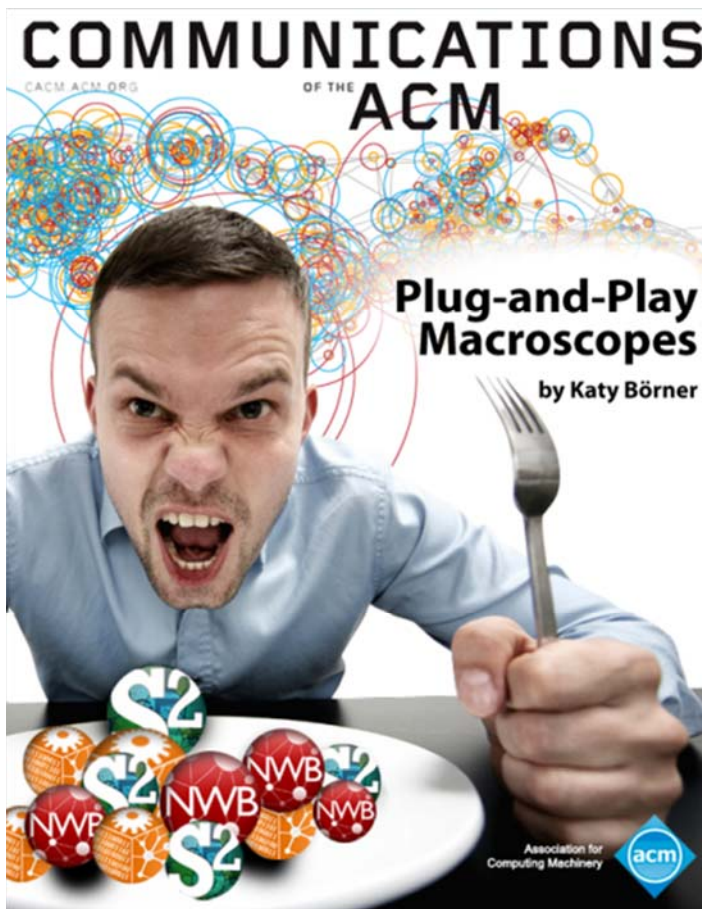


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Börner, Katy. (March 2011). Plug-and-Play Macroscopes. *Communications of the ACM*, 54(3), 60-69.

Video and paper are at <http://www.scivee.tv/node/27704>

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## Designing “Dream Tools”

Many of the best micro-, tele-, and macrosopes are designed by **scientists keen to observe and comprehend what no one has seen or understood before.** Galileo Galilei (1564–1642) recognized the potential of a spyglass for the study of the heavens, ground and polished his own lenses, and used the improved optical instruments to make discoveries like the moons of Jupiter, providing quantitative evidence for the Copernican theory.

Today, scientists **repurpose, extend, and invent new hardware and software** to create **“macrosopes”** that may solve both local and global challenges.

Plug-and-play macrosopes **empower** me, my students, colleagues, and 100,000 others that downloaded them.

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## Macrosopes

Decision making in science, industry, and politics, as well as in daily life, requires that we make sense of data sets representing the structure and dynamics of complex systems. Analysis, navigation, and management of these continuously evolving data sets require a new kind of data-analysis and visualization tool we call a macroscope (from the Greek macros, or “great,” and skopein, or “to observe”) inspired by de Rosnay’s futurist science writings.

Macrosopes provide a “vision of the whole,” helping us “synthesize” the related elements and enabling us to detect patterns, trends, and outliers while granting access to myriad details. Rather than make things larger or smaller, **macrosopes let us observe what is at once too great, slow, or complex for the human eye and mind to notice and comprehend.**



Microscopes



Telescopes



Macrosopes

44



## Macroscopes cont.

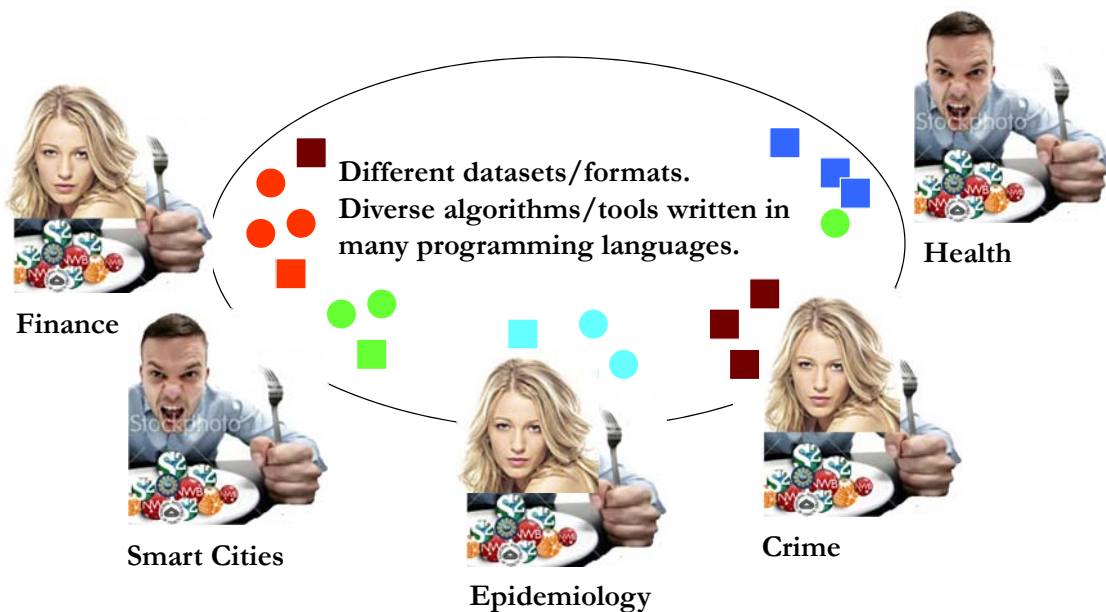
While microscopes and telescopes are physical instruments, **macroscopes resemble continuously changing bundles of software plug-ins.** Macroscopes make it easy to select and combine algorithm and tool plug-ins but also interface plug-ins, workflow support, logging, scheduling, and other plug-ins needed for scientifically rigorous yet effective work.

They make it easy to share plug-ins via email, flash drives, or online. To use new plugins, simply copy the files into the plug-in directory, and they appear in the tool menu ready for use. No restart of the tool is necessary. **Sharing algorithm components, tools, or novel interfaces becomes as easy as sharing images on Flickr or videos on YouTube. Assembling custom tools is as quick as compiling your custom music collection.**

45



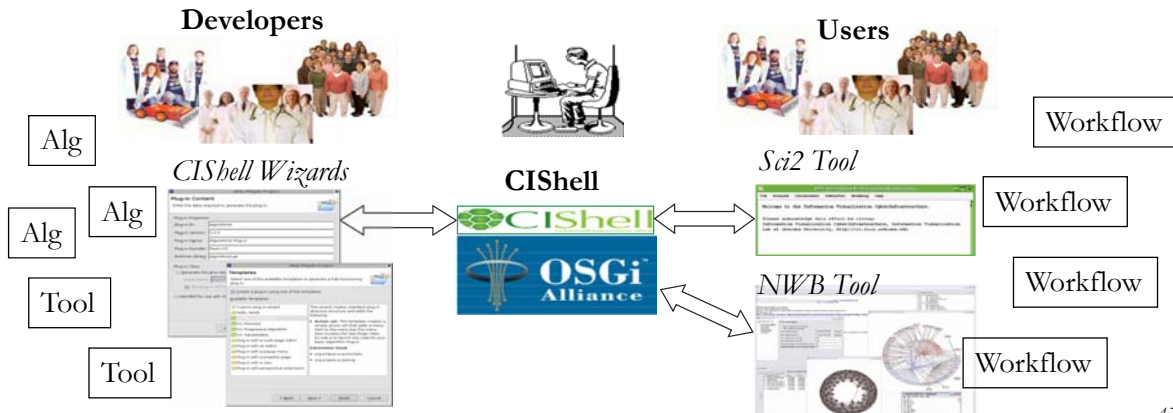
## Macroscopes Serve International, Interdisciplinary Scholars, Practitioners, and Students




46



- CIShell (<http://cishell.org>) is an open source software specification for the integration and utilization of datasets, algorithms, and tools.
- It extends the Open Services Gateway Initiative (OSGi) (<http://osgi.org>), a standardized, component oriented, computing environment for networked services widely used in industry since more than 10 years.
- Specifically, CIShell provides “sockets” into which existing and new datasets, algorithms, and tools can be plugged using a wizard-driven process.



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Edit Add

1 Added by [Micah Linnemeier](#), last edited by [Micah Linnemeier](#) on Mar 16, 2011 ([view change](#))

## About the Cyberinfrastructure Shell

The Cyberinfrastructure Shell (CIShell) is an open source, community-driven platform for the integration and utilization of datasets, algorithms, tools, and computing resources. Algorithm integration support is built in for Java and most other programming languages. Being Java based, it will run on almost all platforms. The software and specification is released under an Apache 2.0 License.

CIShell is the basis of [Network Workbench](#), [TexTrend](#), [Sci²](#) and the upcoming [EpiC](#) tool.

CIShell supports remote execution of algorithms. A standard web service definition is in development that will allow pools of algorithms to transparently be used in a peer-to-peer, client-server, or web front-end fashion.

## CIShell Features

**A framework for easy integration of new and existing algorithms written in any programming language**

Using CIShell, an algorithm writer can fully concentrate on creating their own algorithm in whatever language they are comfortable with. Simple tools are provided to then take their algorithm and

## Learn More...

- [CIShell Papers](#)
- [CIShell Powered Tools](#)
- [Algorithms](#)
- [Plugins \(coming soon\)](#)
- [Misc. Tool Documentation](#)
- CIShell Web Services (coming soon)
- [Screenshots](#)

## Getting Started...

- [Documentation & Developer Resources](#)
- [Download](#)

## Getting Involved...

- [Contact Us](#)

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**CIShell Powered**  
Tools Portal

**Cyberinfrastructure Shell (CIShell)**  
CIShell supports the plug-and-play of datasets and algorithms and their bundling into custom tools that serve the specific needs of a user group or research community. It has been applied to develop diverse custom tools, see below. Feel free to take plugins from any of these tools to design your personal dream tool.

Visit the **CIShell wiki** to learn more about using CIShell as a platform for your tool!

Provided by the [Cyberinfrastructure for Network Science Center](#) at Indiana University.

Learn more about existing CIShell-powered tools below.

**Network Workbench Tool (NWB)**  
The NWB Tool supports researchers, educators, and practitioners interested in the study of biomedical, social and behavioral science, physics, and other networks. It comes with a 77-page [user manual](#).

Gallery

**Science of Science Tool (Sci<sup>2</sup>)**  
The Sci<sup>2</sup> Tool was specifically developed for science policy makers and researchers that study science by scientific means. It supports the temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels. There exists a [112-page user manual](#) and 24 hours of [NIM tutorials](#) in this tool.

49

The Network Workbench (NWB) tool supports researchers, educators, and practitioners interested in the study of biomedical, social and behavioral science, physics, and other networks.

In February 2009, the tool provides more 169 plugins that support the preprocessing, analysis, modeling, and visualization of networks.

**It has been downloaded more than 110,000 times since December 2006.**



**NetworkWorkbench**  
A Workbench for Network Scientists

Home People Research Publications Community Download Documentation Dev Zone About

Summary  
Network Workbench: A Large-Scale Network Analysis, Modeling and Visualization Toolkit for Biomedical, Social Science and Physics Research. This project will design, evaluate, and operate a unique distributed, shared resources environment for large-scale network analysis, modeling, and visualization, named Network Workbench (NWB). The envisioned data-code-computing resources environment will provide ...  
[more](#)  
[How to cite this project](#)

News & Updates

- 5.1.09 Kaelble, Steve. 2009. [Mapping the Future of Knowledge, Research & Creative Activity](#), 31, 2: 12-15. [Website](#) accessed 5/1/09
- 3.23.09 [1.0.0 beta 5 Released](#)
- 1.23.09 Ann Mcranie's [tutorial abstract](#) for Sunbelt 2009
- 11.4.08 Two NWB PIs featured in "[Connected—The Power of Six Degrees](#)." 2008. Anna Maria Talas, Director. Australian Broadcasting Corporation, Ltd. [YouTube](#) [Full Video](#) (300MB)

Download 1.0.0 beta 5 Release  
Note: save the download as jar

Select Your Operating System  
Windows (XP & Vista) **DOWNLOAD**

Getting Started  
See more [documentation](#)

Get Involved

Herr II, Bruce W., Huang, Weixia (Bonnie), Penumarthy, Shashikant & Börner, Katy. (2007). Designing Highly Flexible and Usable Cyberinfrastructures for Convergence. In Bainbridge, William S. & Roco, Mibail C. (Eds.), *Progress in Convergence - Technologies for Human Wellbeing* (Vol. 1093, pp. 161-179), *Annals of the New York Academy of Sciences*, Boston, MA.

50

## Computational Proteomics

What relationships exist between protein targets of all drugs and all disease-gene products in the human protein–protein interaction network?

*Yildirim, Muhammed A., Kwan-II Goh, Michael E. Cusick, Albert-László Barabási, and Marc Vidal. (2007). Drug-target Network. Nature Biotechnology 25 no. 10: 1119-1126.*



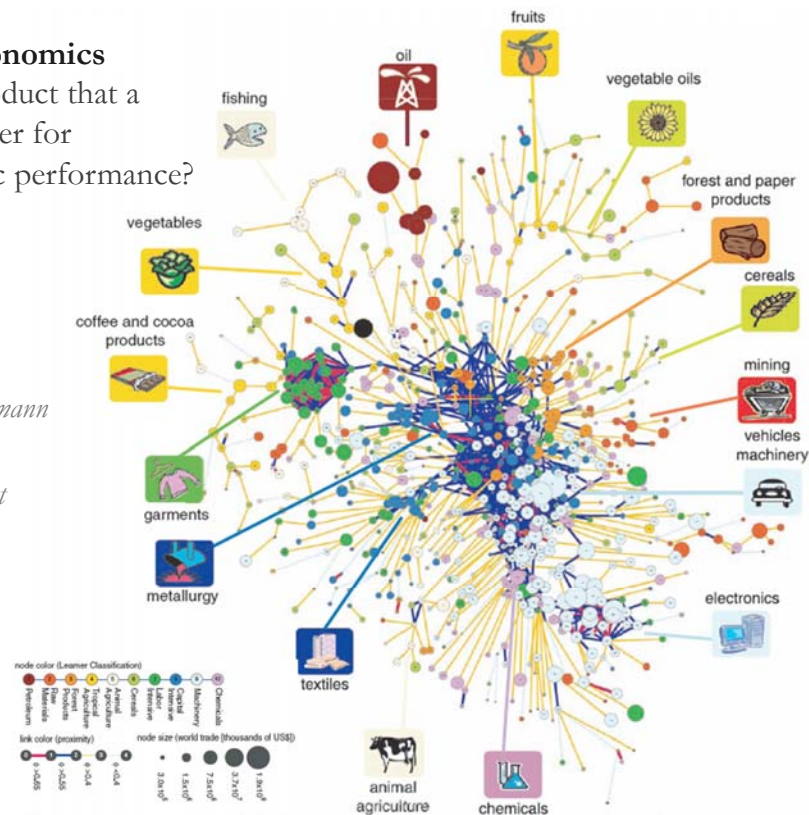
**Figure 2** Drug-target network (DT network). The DT network is generated by using the known associations between FDA-approved drugs and their target proteins. Circles and rectangles correspond to drugs and target proteins, respectively. A link is placed between a drug node and a target node if the protein is a known target of that drug. The area of the drug (protein) node is proportional to the number of targets that the drug (the number of drugs targeting the protein). Color codes are given in the legend. Drug nodes (circles) are colored according to their Anatomical Therapeutic Chemical Classification, and the target proteins (rectangular boxes) are colored according to their cellular component obtained from the Gene Ontology database.

51

## Computational Economics

Does the type of product that a country exports matter for subsequent economic performance?

*C. A. Hidalgo, B. Klinger, A.-L. Barabási, R. Hausmann (2007) The Product Space Conditions the Development of Nations. Science 317, 482 (2007).*



**Fig. 1.** The product space. (A) Hierarchically clustered proximity matrix representing the 775 SITC-4 product classes exported in the 1998–2000 period. (B) Network representation of the product space. Links are color coded with their proximity value. The sizes of the nodes are proportional to world trade, and their colors are chosen according to the classification introduced by Leamer.

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## Computational Social Science

Studying large scale social networks such as Wikipedia

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

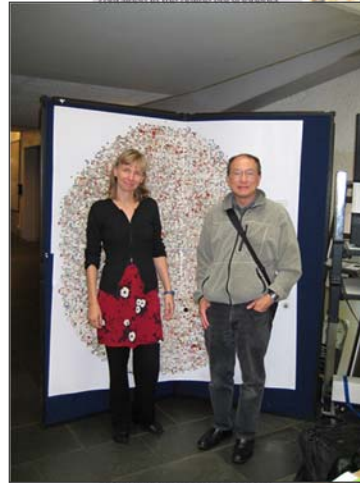


## Second sight

Image: Bruce W. Hest and Todd M. Holloway

### Power struggle

How do you keep track of the bobbling mass of information that is Wikipedia? This chaotic-looking mosaic is one attempt to show which topics are contained in the online encyclopedia.



Articles that the most-viewed pages at the time of writing include entries on Sheffield Wednesday football club, Mikhail Gorbachev and pigs). The mosaic has been commended in a competition for images that visualise network dynamics, coinciding with this week's International Workshop and Conference on Network Science in Bloomington.

www.newscientist.com



19 May 2007 | NewScientist | 53

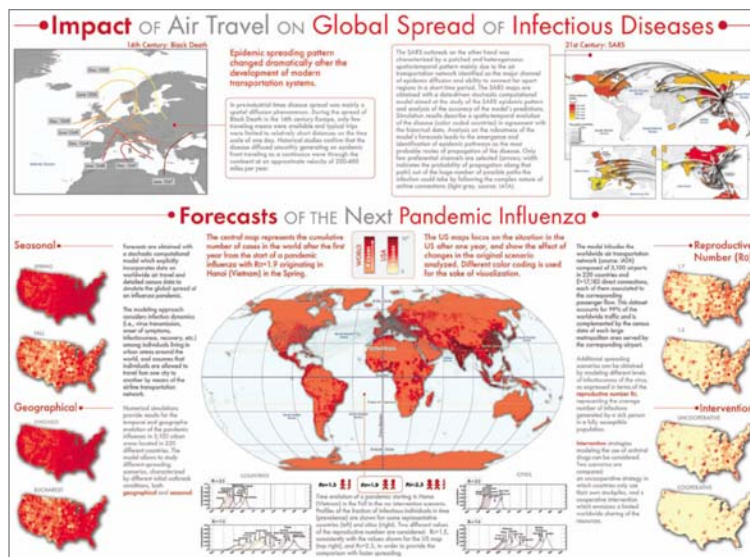
## Computational Epidemics

Forecasting (and preventing the effects of) the next pandemic.

*Epidemic Modeling in Complex realities, V. Colizza, A. Barrat, M. Barthelemy, A. Vespignani, Comptes Rendus Biologie, 330, 364-374 (2007).*

*Reaction-diffusion processes and metapopulation models in heterogeneous networks, V. Colizza, R. Pastor-Satorras, A. Vespignani, Nature Physics 3, 276-282 (2007).*

*Modeling the Worldwide Spread of Pandemic Influenza: Baseline Case and Containment Interventions, V. Colizza, A. Barrat, M. Barthelemy, A.-J. Valleron, A. Vespignani, PLoS-Medicine 4, e13, 95-110 (2007).*

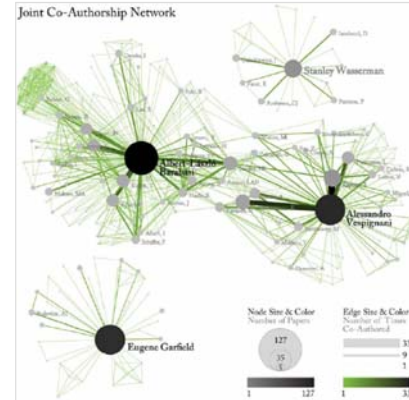
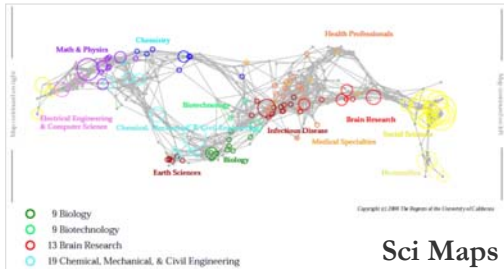




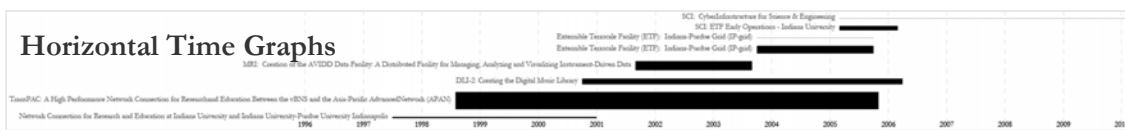
## Sci² Tool – “Open Code for S&T Assessment”

Users come from 40+ countries

OSGi/CIShell powered tool with NWB plugins and many new scientometrics and visualizations plugins.



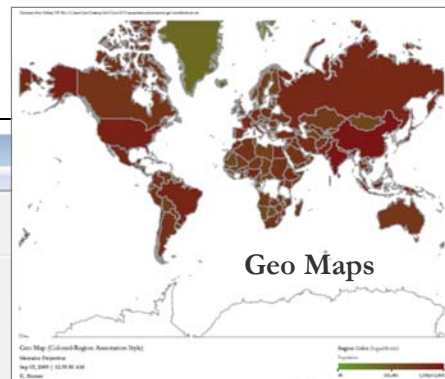
GUESS Network Vis



Börner, Katy, Huang, Weixia (Bonnie), Linnemeier, Micah, Dubon, Russell Jackson, Phillips, Patrick, Ma, Nianli, Zoss, Angela, Guo, Hanning & Price, Mark. (2009). *Retz-Netzwerk-Red: Analyzing and Visualizing Scholarly Networks Using the Scholarly Database and the Network Workbench Tool. Proceedings of ISSI 2009: 12th International Conference on Scientometrics and Informetrics, Rio de Janeiro, Brazil, July 14-17. Vol. 2, pp. 619-630.*



## Sci² Tool Vis cont.



**Sci² Tool**

File Preprocessing Modeling Analysis Visualization Scientometrics Help

Console

Welcome to the Science of Science Tool (Sci²). The development of this tool is supported in part by the National Science Foundation, the Network Science Center and the School of Informatics at Indiana University, the National Science Foundation and IIS-0715303, and the James S. McDonnell Cyberinfrastructure portal (<http://sci.slis.indiana.edu>).

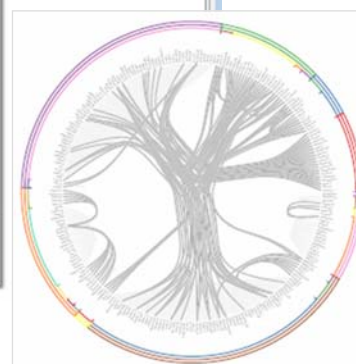
The primary investigators are Katy Börner, Ingrid Isenhardt, and SciTech Strategies Inc. The Sci² tool was developed by J. Duhon, Patrick A. Phillips, Chintan Tank, a Cyberinfrastructure Shell (<http://cishell.org>) for Network Science Center (<http://cns.slis.indiana.edu>). Many algorithm plugins were derived from the Network Workbench Tool (<http://nwb.slis.indiana.edu>).

Please cite as follows:  
Sci² Team. (2009). Science of Science Tool. In Sci² Strategies Inc., <http://sci.slis.indiana.edu>.

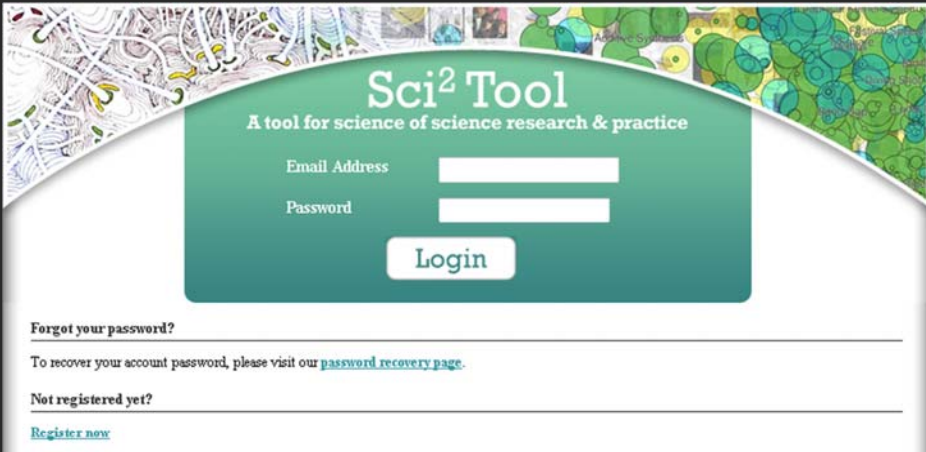
Scheduler

Remove From List  Remove completed

!	Algorithm Name	Date	Time	% Con
<input checked="" type="checkbox"/>	Extract Co-Author Netw...	09/03/2009	00:15:20 AM	100%
<input checked="" type="checkbox"/>	Load and Clean ISI File	09/03/2009	00:15:05 AM	100%







**Sci<sup>2</sup> Tool**  
A tool for science of science research & practice

Email Address

Password

Login

Forgot your password?  
To recover your account password, please visit our [password recovery page](#).

Not registered yet?  
[Register now](#)

**Tutorials**  
Katy Börner (2010) Science of Science Research and Tools (12 Tutorials). Reporting Branch, Office of Extramural Research/Office of the Director, National Institutes of Health, Bethesda, MD.  
Scott Weingart, Biberstine (2010) Science, Indiana

- Tutorial #01: [Science of Science Research](#)
- Tutorial #02: [Network Science / Information Visualization](#)
- Tutorial #03: [CIShell Powered Tools: Network Workbench and Science of Science Tool](#)
- Tutorial #04: [Temporal Analysis—Burst Detection](#)
- Tutorial #05: [Geospatial Analysis and Mapping](#)
- Tutorial #06: [Topical Analysis & Mapping](#)
- Tutorial #07: [Tree Analysis and Visualization](#)
- Tutorial #08: [Network Analysis and Visualization](#)
- Tutorial #09: [Large Network Analysis and Visualization](#)
- Tutorial #10: [Using the Scholarly Database at IU](#)
- Tutorial #11: [VIVO National Researcher Networking](#)
- Tutorial #12: [Future Developments](#)

<http://sci2.cns.in.edu>  
<http://sci2.wiki.cns.in.edu>

Geetha Senthil (2010) [Multidisciplinary Nature of Work With Reference to PIs and ICs Within a Portfolio](#). PA Group at NIH.  
NIH Office of Extramural Research and Katy Börner (2010) [Network Visualizations Using SPIRES Data and the Sci2 Tool](#). Office of Extramural Research at NIH.

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Downloaded on 2012.04.30 from <http://www.nsf.gov/awardsearch>

## Award Search

Send Comments | Award Search Help

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**Hint:** The text field below 'Search Award For' searches the title, abstract, and award number fields.

**Search Award For:**

**Restrict to Title Only:**

**Program Information**

**NSF Organization:**  [NSF Org Lookup](#)

**Program Officer:**

**Element Code:**   All  Any [Element Code Lookup](#)

**Reference Code:**   All  Any [Ref Code Lookup](#)

**Hint:** This "Program" box searches both program element and program reference names and codes. Program names are sometimes entered. For best results, please use the program look up function to select the program you are searching for. Free text searches can return incorrect results.

**Program:**  [Program Lookup](#)

769 active awards with NSF Organization 'DRL'  
891 unique PIs funded by 73 different 'Programs'  
Sum of 'Awarded Amount to Date' is \$994,385,568

58



12-LAK-DRL-NSF-2012.04.30.csv - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View Acrobat

Calibri 11

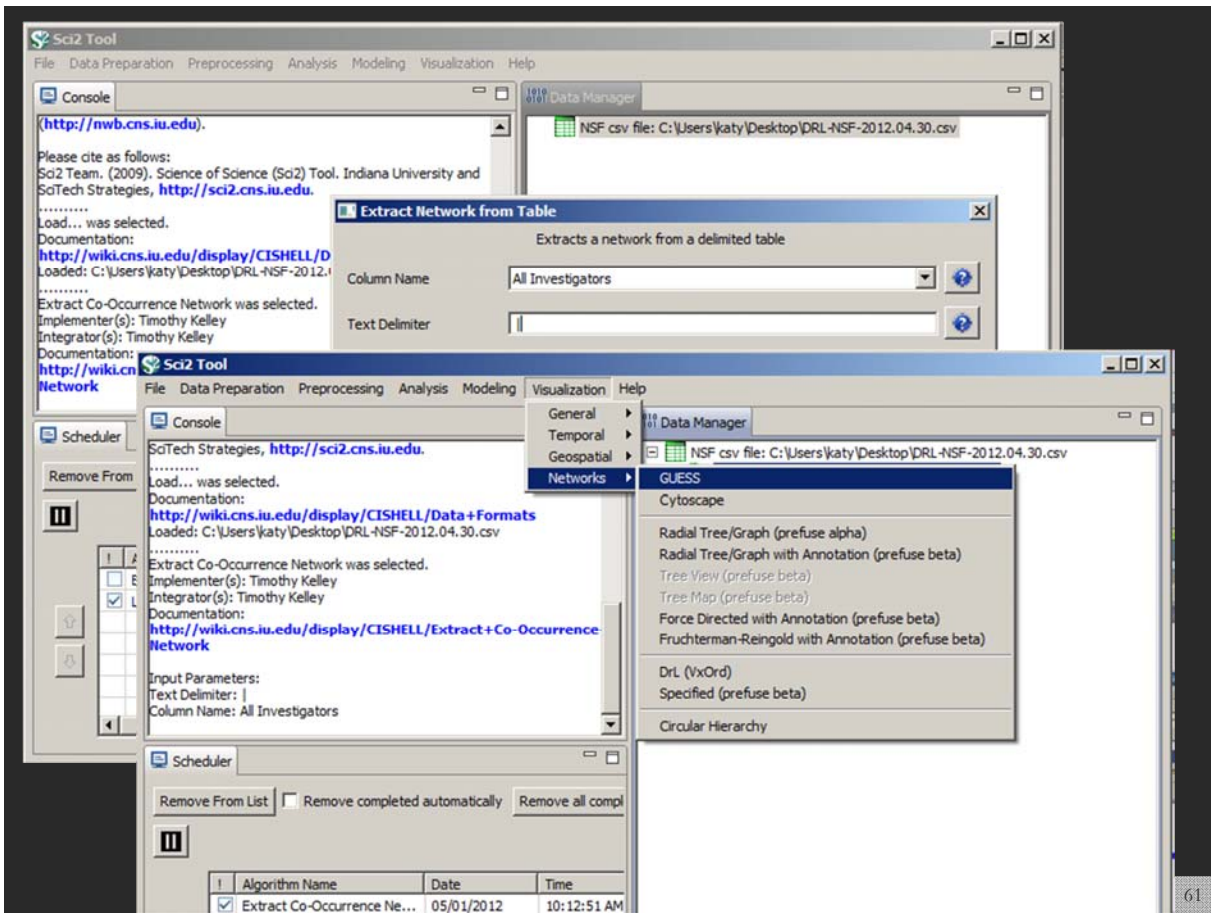
Clipboard Font Alignment Number Editing

J1 All Investigators

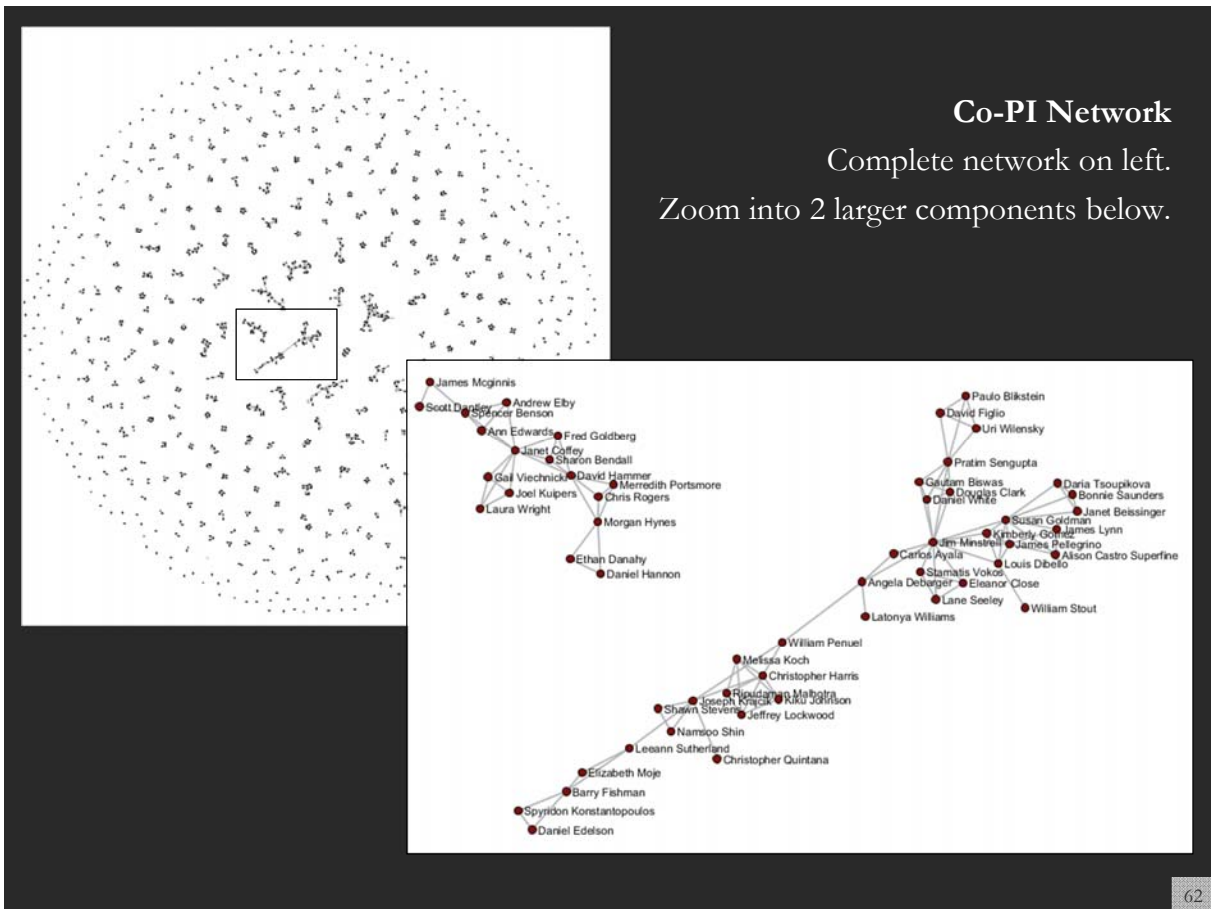
Award Nu	Title	NSF Or	Program(s)	Start Date	Organization	Expiration Date	Awarded An	Abstract	All Investigators
1	119787	Center for Informal Learning	DRL	TEACHER	1-Jan-02	Exploratorium	30-Jun-12	11656749	The Center for Informal Learning
2	227586	Center for Proficiency in Teaching Mathematics	DRL	CENTERS f	1-Nov-02	University of Georgia	31-Oct-12	10876014	The University of Georgia
3	333879	Center for the Study of Mathematics Education	DRL	DISCOVER	1-Jan-04	University of Mississippi	30-Jun-13	11110996	The Center for the Study of Mathematics Education
4	353412	Nurturing Mathematics	DRL	DISCOVER	1-Sep-04	North Carolina State University	31-Aug-12	3692090	"Nurturing Mathematics"
5	426253	Mid-Atlantic Center for Mathematics Education	DRL	DISCOVER	1-Sep-05	University of Maryland	31-Aug-12	10781711	The Mid-Atlantic Center for Mathematics Education
6	426421	National Center for Education Research	DRL	DISCOVER	15-Sep-04	Utah State University	31-Aug-12	10382284	The National Center for Education Research
7	439352	Collaborative Research	DRL	DISCOVER	1-Sep-04	University of Michigan	31-Aug-12	5166699	Building on Collaborative Research
8	447542	CAREER: Fostering Mathematics Learning	DRL	REESE   REE	1-Sep-05	CUNY City College	31-Aug-12	823772	The Center for Mathematics Learning
9	447611	CAREER: Knowledge Integration	DRL	REESE   REE	15-May-05	Michigan State University	30-Jun-12	679830	The Center for Mathematics Learning
10	448319	CAREER: Learning and Teaching Mathematics	DRL	REESE   EDI	15-Apr-05	Worcester Polytechnic Institute	31-Mar-13	646075	The Center for Mathematics Learning
11	448649	CAREER: Developing Mathematics Learning	DRL	REESE   REE	1-Jul-05	San Jose State University	31-Aug-12	532852	The Center for Mathematics Learning
12	452419	The Impact of Informal Learning	DRL	INFORMA	1-Apr-05	Franklin Institute	30-Sep-12	1205758	The Center for Informal Learning
13	455582	The Impact of Online Learning	DRL	DISCOVER	1-Jul-05	University of Michigan	30-Jun-12	2532358	This five-year project
14	455679	Policy Research Initiative	DRL	TEACHER I	1-Jun-05	Texas Engineering Experiment Station	31-May-12	2414082	This project
15	455685	Change Associated with Mathematics Learning	DRL	TEACHER I	15-Jul-05	University of Rhode Island	30-Jun-12	2247148	The CAREI
16	455752	Project NEXUS: The Mathematics Learning Environment	DRL	TEACHER I	15-Jul-05	University of Maryland	30-Jun-12	1605937	This research
17	455781	Development of K-8 Mathematics Learning	DRL	TEACHER I	1-Jul-05	University of Delaware	30-Sep-12	2243932	This research
18	455785	Investigating the Mathematics Learning Environment	DRL	DISCOVER	1-Jun-05	San Diego State University	31-May-12	2595127	This five-year project
19	455786	Temple University Science Education Research	DRL	TEACHER I	1-Aug-05	Temple University	31-Jul-12	2438317	This five-year project
20	455819	Investigating the Mathematics Learning Environment	DRL	TEACHER I	1-Jul-05	Syracuse University	30-Jun-12	2480891	Increasing Mathematics Learning
21	455828	Using Practice as a Strategy for Mathematics Learning	DRL	TEACHER I	1-Aug-05	University of Michigan	31-Jul-12	1499210	This five-year project
22	455866	Strategic Integration of Mathematics Learning	DRL	TEACHER I	1-Oct-05	University of Oregon	30-Sep-12	1849495	This research
23	514421	First International Mathematics Learning Study	DRL	DISCOVER	15-Sep-05	Michigan State University	28-Feb-13	4197607	The project

769 active awards with NSF Organization 'DRL'  
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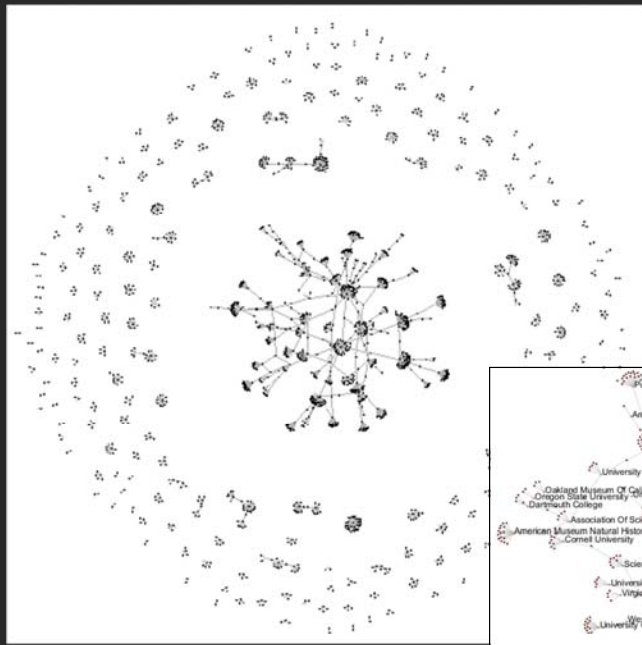




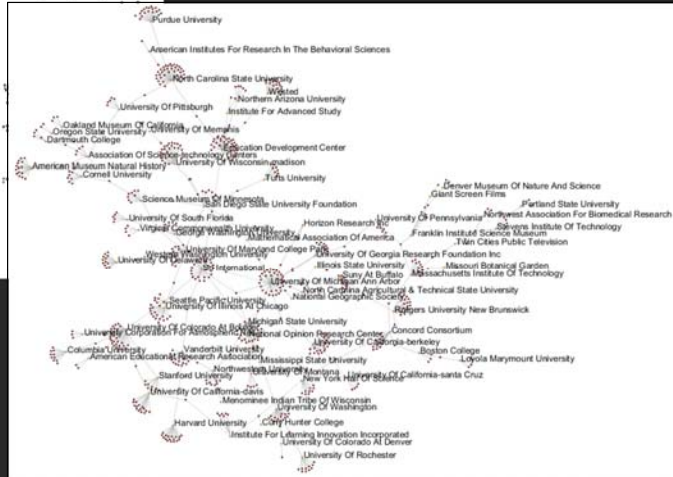
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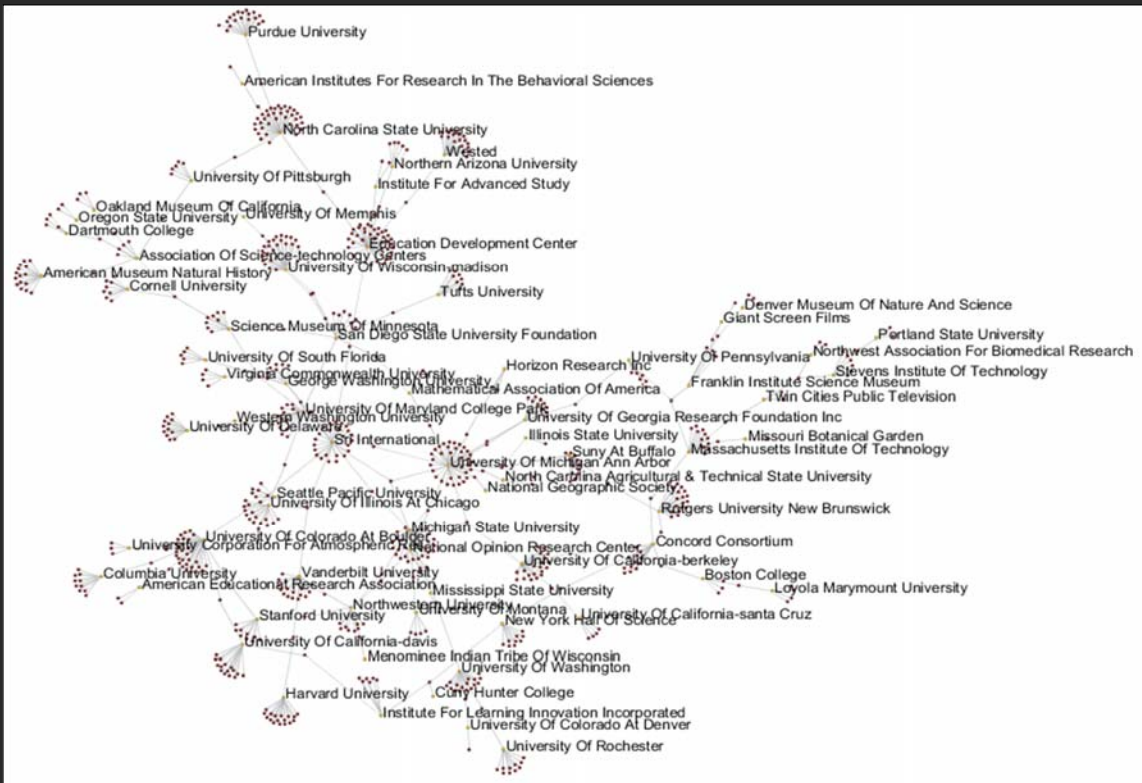
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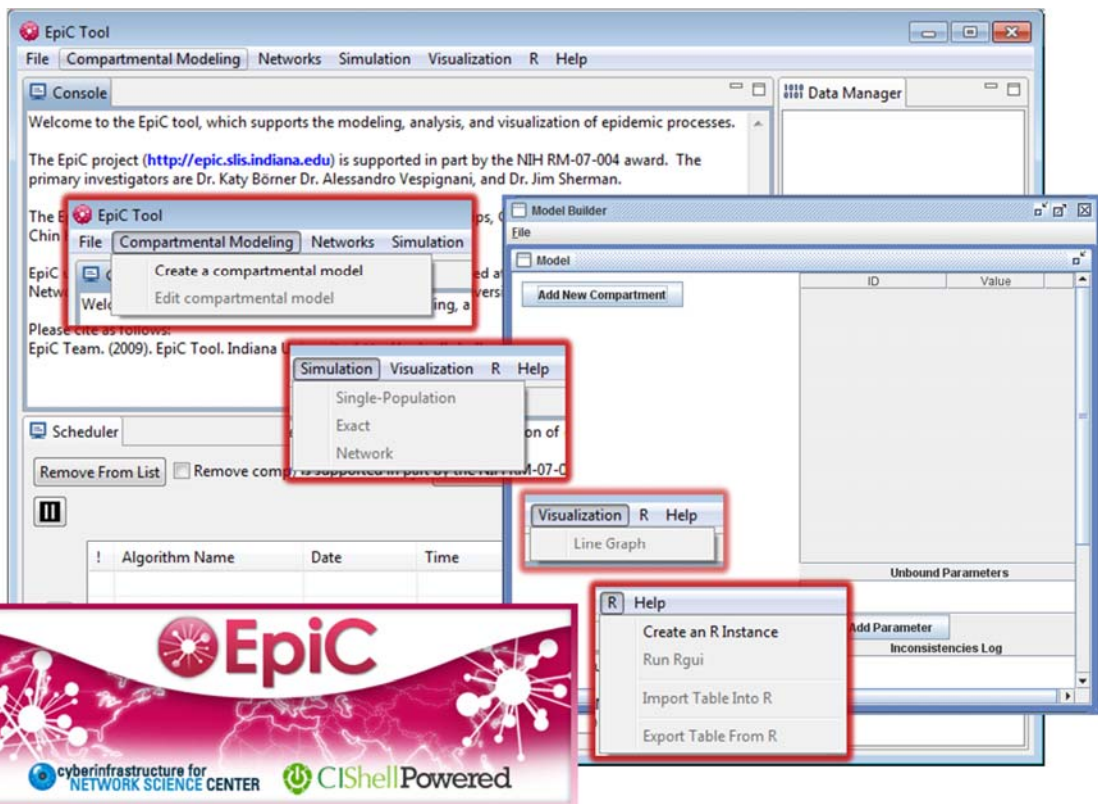
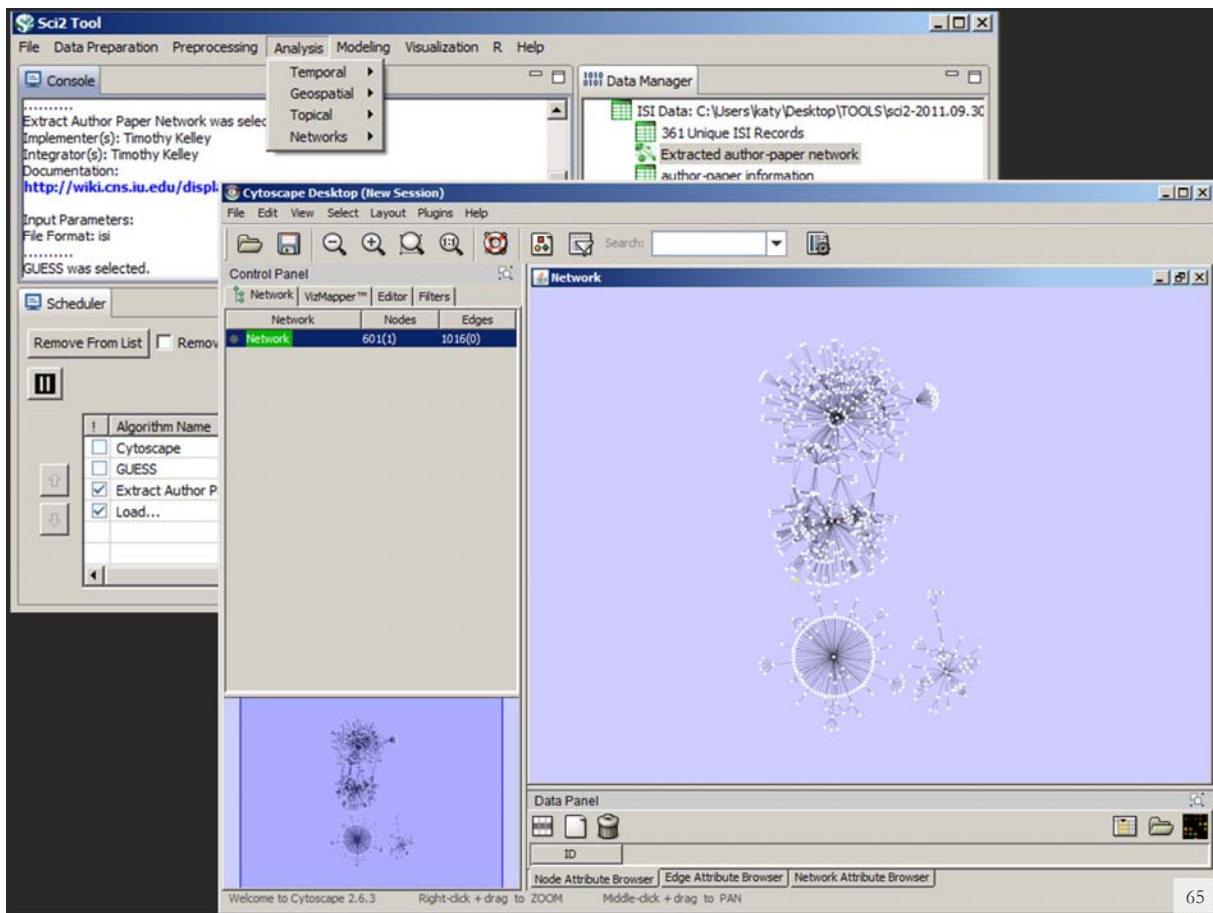
**Bimodal PI-Institution to  
Co-PI Network**  
Complete network on left.  
Largest component with 786  
nodes is below.



**Bimodal PI-Institution to Co-PI Network. Largest component with 786 nodes.**







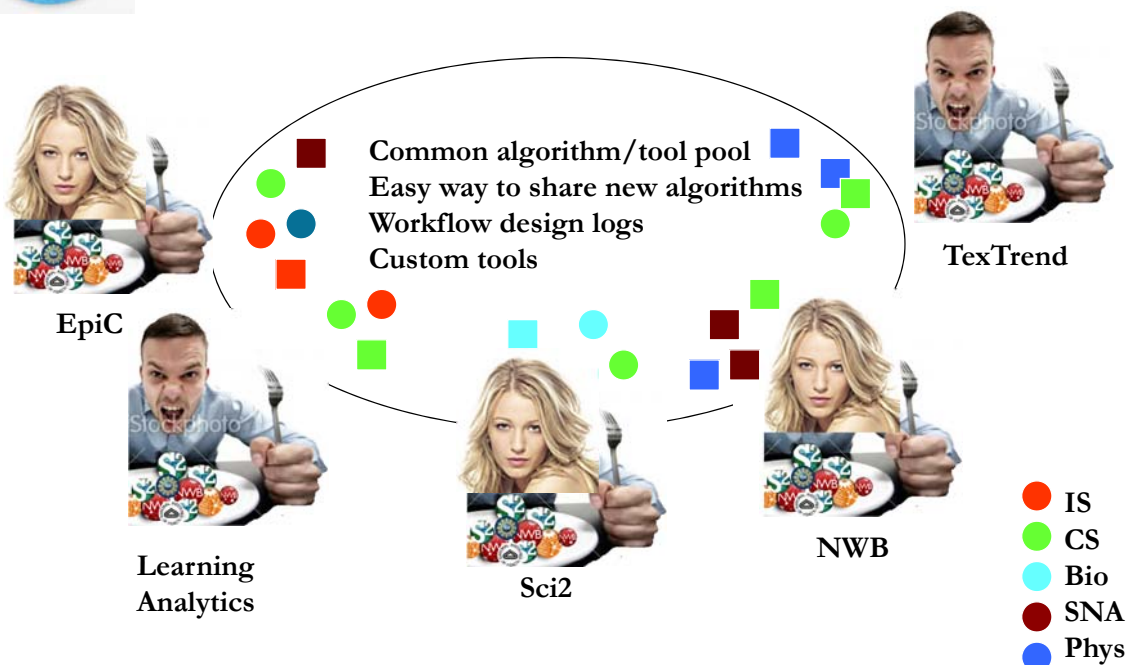
A number of other projects recently adopted OSGi and/or CIShell:

- USA**
- *Cytoscape* (<http://cytoscape.org>) Led by Trey Ideker at the University of California, San Diego is an open source bioinformatics software platform for visualizing molecular interaction networks and integrating these interactions with gene expression profiles and other state data (Shannon et al., 2002).
  - *MAEviz* (<https://wiki.ncsa.uiuc.edu/display/MAE/Home>) Managed by Jong Lee at NCSA is an open-source, extensible software platform which supports seismic risk assessment based on the Mid-America Earthquake (MAE) Center research.
- Europe**
- *Taverna Workbench* (<http://taverna.org.uk>) Developed by the myGrid team (<http://mygrid.org.uk>) led by Carol Goble at the University of Manchester, U.K. is a free software tool for designing and executing workflows (Hull et al., 2006). Taverna allows users to integrate many different software tools, including over 30,000 web services.
  - *TEXTrend* (<http://texttrend.org>) Led by George Kampis at Eötvös Loránd University, Budapest, Hungary supports natural language processing (NLP), classification/mining, and graph algorithms for the analysis of business and governmental text corpuses with an inherently temporal component.
  - *DynaNets* (<http://www.dynanets.org>) Coordinated by Peter M.A. Sloot at the University of Amsterdam, The Netherlands develops algorithms to study evolving networks.
  - *SISOB* (<http://sisob.lcc.uma.es>) An Observatory for Science in Society Based in Social Models.
- As the functionality of OSGi-based software frameworks improves and the number and diversity of dataset and algorithm plugins increases, the capabilities of custom tools will expand.

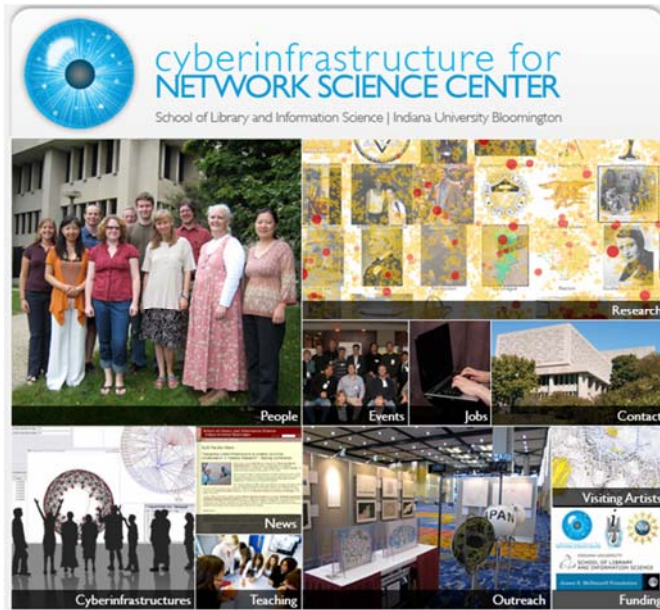
67



### Macrosopes Can be Easily Customized



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All papers, maps, tools, talks, press are linked from <http://cns.iu.edu>

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