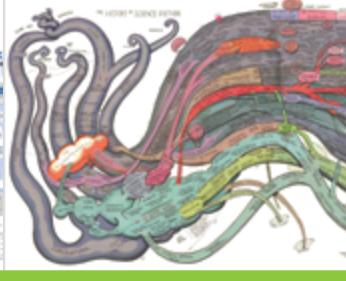
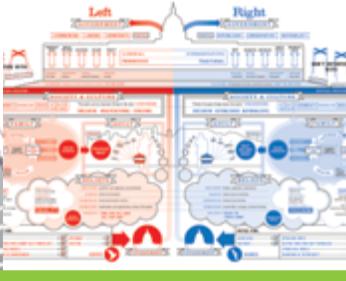
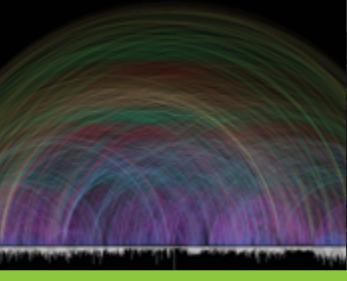
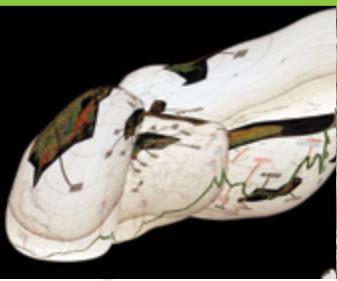
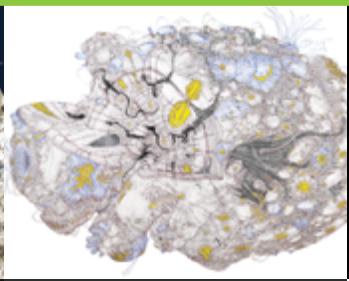




PLACES & SPACES &

MAPPING SCIENCE



ANNUAL REPORT 2012

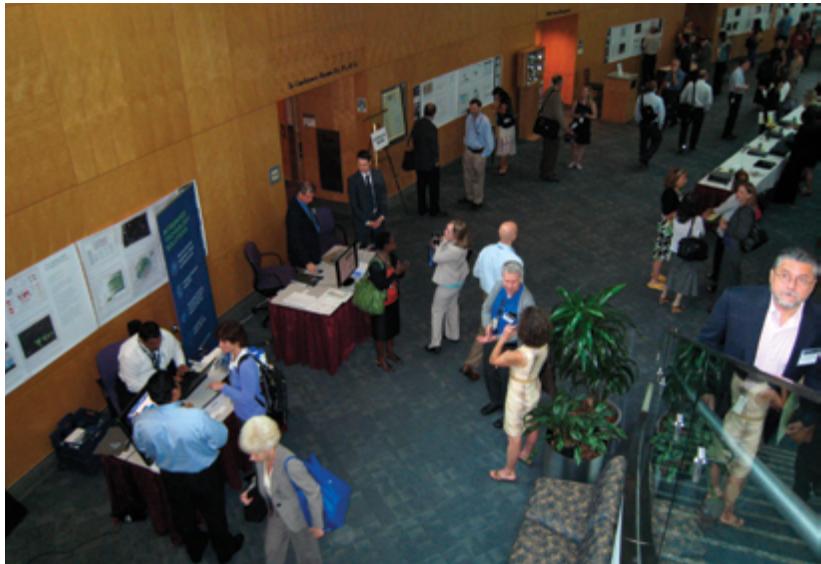
INTRODUCTION

For centuries, cartographic maps of earth and water have guided human exploration. They have marked the border between the known and the unknown, firing the imagination and fueling the desire for new knowledge and new experience. Over time, geographic maps became more accurate, more sophisticated, but the thirst for discovery, along with the need for maps to guide our travels, remains undiminished.

Today, our opportunities for discovery reside less in physical places than in abstract spaces. The sea of information is one such space, and it is ever growing, ever changing. Search engines can retrieve facts from this ocean of data, but they cannot answer larger questions about the seascape as a whole: How big is this ocean? How can we navigate to the useful islands of knowledge? How is knowledge interlinked on a global scale? In which areas is it worth investing time, effort, and resources?

Drawing from across cultures and across scholarly disciplines, the *Places & Spaces: Mapping Science* exhibit demonstrates the power of maps to address these vital questions about the contours and content of human knowledge. Created by leading figures in the natural, physical, and social sciences, scientometrics, visual arts, social and science policymaking, and the humanities, the maps in *Places & Spaces* allow us to better grasp the abstract contexts, relationships, and dynamism of human systems and collective intelligence. Individually and as a whole, the maps of *Places & Spaces* allow data to tell stories which both the scientist and the layperson can understand and appreciate.

Now entering its ninth year, the exhibit has traced the evolution of science maps, featuring the best examples of knowledge domain mapping, novel location-based cartographies, data visualizations, and science-inspired art works. Along the way, *Places & Spaces* has featured historically significant firsts in science mapping, including the first map of science, “The



Places & Spaces at the National Institutes of Health in Washington, D.C.

Structure of Science” (Boyack and Klavans 2005), the first “Wikipedia Map of Science” (Herr, Holloway, et al. 2009), and the first “Clickstream Map of Science” (Johan Bollen, et al. 2009). The exhibit has also brought to life the history and evolution of data visualization with Charles Joseph Minard’s landmark “Napoleon’s March to Moscow” (1869), Wattenberg and Viegas’ “History Flow Visualization of the Wikipedia Entry on Abortion” (2006), the SENSEable City Lab’s “Mobile Landscapes: Using Location Data from Cell Phones for Urban Analysis” (Williams, Ratti, et al. 2006), and the concept map “Death and Taxes” (Bachman 2009).

The maps that make up the exhibit are chosen annually in a process that begins with a call for maps that correspond to a particular theme or address the concerns of a particular audience. Then, a team of international reviewers and exhibit advisors select the most stunning and innovative maps from those submitted. Next, the top-10 maps are prepared for viewing by a general audience through large-format, high-resolution printing. Since many of the exhibit's maps were originally designed for inclusion in scientific papers or PowerPoint slides, this can be quite a dramatic transformation. Finally, the finished maps are included in an exhibition for public display at libraries, science museums, and national science academies.

Overseeing this process is an exhibit team comprised of two curators and paid staff based at Indiana University in Bloomington, Indiana. The team coordinates the display of maps at different venues, manages the map submission and review process, and organizes workshops and events (see page #). The exhibit team benefits from expert input from an international advisory board (see pages 9-10).

Funding for *Places & Spaces* is provided by the National Science Foundation under grants IIS-0238261, CHE-0524661, IIS-0534909, and IIS-0715303; the James S. McDonnell Foundation; and Thomson Reuters. Additional funding comes from the Cyberinfrastructure for Network Science Center, University Information Technology Services, and the School of Library and Information Science—all three located at Indiana University. Some of the data used to generate science maps is from Thomson Reuters and Elsevier. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation or other sponsors.



Places & Spaces at the National Academy of Sciences in Washington, D.C.



THOMSON REUTERS



James S. McDonnell Foundation



CNS
Cyberinfrastructure for
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INDIANA UNIVERSITY
BLOOMINGTON

LETTER FROM THE CURATORS



Katy Börner



Todd Theriault

The end of the calendar year is always an occasion for reflection and meaning-making. Looking back at 2012, two themes emerge for us that not only capture the spirit of the past year but also serve as compass points to guide the exhibit going forward: *audience* and *experience*.

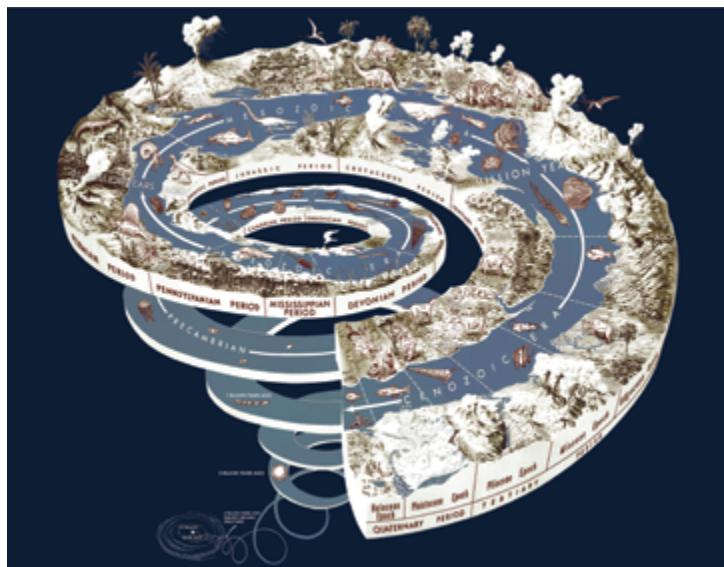
The Exhibit Audience—One of the immense pleasures of curating an exhibit such as this is to witness the ways in which audiences respond to the maps themselves. Such reactions, of course, often include an intellectual appreciation for the work of the many science map-makers featured in the exhibit. Especially gratifying, however, is to see how this intellectual response is so often accompanied by a strong emotional current, an excitement and delight that capture not only the pleasures of scientific discovery but also the keen sense of wonder that prompts scientific endeavor in the first place. At their most powerful, the maps of *Places & Spaces* impart to the audience both a sense of *what* scientists do and a feeling for *why* scientists do what they do.

It is in this rich pleasure of discovery, of course, that the work of science most resembles the play of children. The exhibit has long recognized this and has included from early on works designed to engage and inspire the next generation of explorers and visionaries. In 2012, however, young audiences received top priority as *Places & Spaces* debuted ten new science maps, accompanied by three hands-on activities, intended primarily for kids.

“Science Maps for Kids,” the exhibit’s 8th iteration, represents a first in the world of science mapping, and it carries on a pedagogical imperative established from the very outset of *Places & Spaces*: introduce audiences to new worlds by first meeting them in their own. In the case of “Science Maps for Kids,” the exhibit advisory board selected maps that presented challenging

ideas in accessible and engaging ways. These ten new maps communicate such heady subjects as statistics, scientometrics, narratology, big data, and information visualization through the kid-friendly vernacular of Twitter feeds, sci-fi movies, and manga comics.

Whether by employing fresh approaches, seeking out unexpected venues, or utilizing the latest forms of social media, *Places & Spaces* continues its mission of bringing new and diverse audiences into an understanding of the power, potential, and beauty of science mapping. But just as the exhibit’s audience is expanding and changing, so too is the way audiences may experience the exhibit broadening and evolving as well.



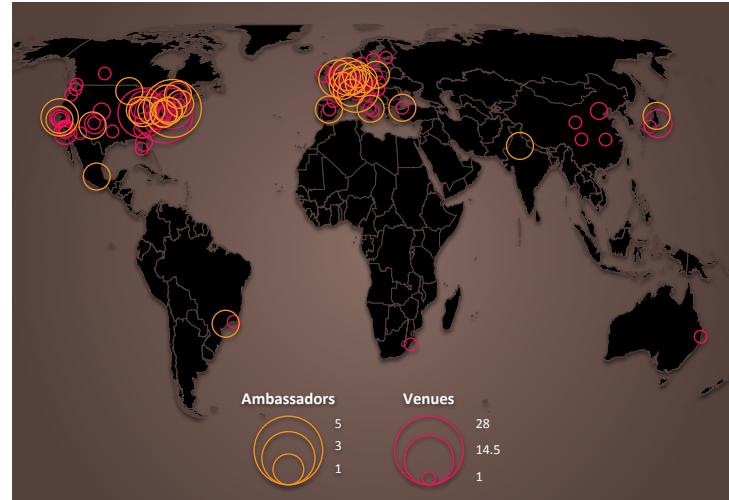
VIII.1 Geologic Time Spiral: A Path to the Past

The Exhibit Experience—The year 2012 saw dedicated efforts to provide future audiences with new ways of experiencing the exhibit. Through our archival efforts, generations of scholars from all over the world will be able to use the maps for solitary research or classroom learning long after the ten-year exhibit project itself has run its course. For the more immediate future, our designers are partnering with technicians from university libraries to develop digital versions of the exhibit to display on large-screen media walls and immersion theaters. Ideally, this will allow for greater flexibility of presentation and open up possibilities for bringing dynamic elements of animation and interactivity to the map display.

Whatever form *Places & Spaces* may take in the future, there is still no substitute for the experience of seeing the physical maps up close and personal, of pausing to examine fine details or stepping back to take in the larger sweep of historical and technical development, of gathering with fellow exhibit-goers to discuss discoveries and insights gleaned along the way. Visitors to the exhibit during its residency at Northeastern University in February also enjoyed the radiant three-dimensionality of Ingo Günther's WorldProcessor globes, while attendees of the Smithsonian Folklife Festival in July had the opportunity to explore the exhibit's Illuminated Diagram and ask questions of its designers.

As in previous years, *Places & Spaces* could be found in some of the world's most fascinating museums and prestigious storehouses of knowledge, appearing as part of the Google-sponsored exhibit tracing the intellectual ancestry of the internet at Belgium's Mundaneum Museum and adorning the walls of the National Academy of Sciences in Washington, D.C.. This year, too, the *Places & Spaces* poster exhibit remained a seasoned traveler, with appearances at over twenty venues throughout Europe, Asia, and North America.

A Word of Thanks—In closing, we would like to acknowledge the many men and women that make the exhibit a success: our advisory board for their intellectual guidance, our exhibit ambassadors for their tireless efforts to promote



Geospatial Visualization of Exhibit Ambassadors & Venue Locations

science mapping, and the 2012 exhibit venue hosts for providing hospitable and intellectually stimulating environments. The commitment of all of these individuals is what has made *Places & Spaces* the vital exhibit it is today.

So to all the friends of the exhibit—thank you for your support, your encouragement, and your good cheer. It is our sincerest hope that your contributions are abundantly evident to everyone who sees these maps.

Todd Theriault & Katy Börner

ACCOMPLISHMENTS

10 New Maps

The 8th iteration of *Places & Spaces*, “Science Maps for Kids,” debuted on October 12th, 2012, adding ten new maps and three hands-on activities to the exhibit. This iteration’s focus on science maps designed specifically for young audiences is unprecedented for an exhibit of this kind. You can see vivid digital copies of all ten new maps and zoom into their finest details at scimaps.org/exhibit_info/#8.

SCIENCE MAPS FOR KIDS 2012



Venues

The first 7 iterations of the exhibit—accompanied by the Illuminated Diagram, WorldProcessor Globes, and the Hands-On Science Maps for Kids—enjoyed a successful two-month residency from February 2nd to March 30th at Northeastern University in Boston, MA. In June, the Illuminated Diagram was featured at the Smithsonian Folklife Festival. Towards the end of the year, select maps from the exhibit also appeared at the Mundaneum Museum in Mons, Belgium, and at the National Academy of Sciences in Washington, D.C.

Workshops

The JSMF Workshop on Plug-and-Play Macroscopes (scimaps.org/meeting/121116), held on November 16-17 in Bloomington, IN, was designed to bring together system architects from major tool development efforts to exchange know-how and discuss work in progress.

Special Events

One of the most fascinating additional elements of the exhibit, the Illuminated Diagram, took its place on the National Mall in Washington, D.C. for the annual Smithsonian Folklife Festival. Visitors to the ID display witnessed demonstrations by the diagram’s designers and gained hands-on experience using this powerful tool.



Smithsonian Folklife Festival patrons stop to enjoy the Illuminated Diagram Display

AcademyScope

During the second half of 2012 and into this year, we collaborated with the National Academy of Sciences in Washington, D.C., resulting in a state-of-the-art, interactive touch-screen visualization called *AcademyScope*.

Using a 55-inch, multi-touch screen, viewers can explore all reports published by the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council—from twenty years ago to today.

The **Automatic Mode** of the visualization shows the 100 most frequently downloaded reports of the previous seven days as well as newly released reports. Displayed downloads, including download totals, are current within the minute.

The **Interactive Mode** supports browsing and exploration by topic, subtopic, and individual report. Users can select a topic on the right to reveal all of its subtopics, and touch one of the subtopics to display all reports in that area and their relatedness to each other. (Links between reports are automatically generated based on the incidence of shared key terms and phrases.) Touching any report brings up detailed information on the right side of the display. There's also a QR code that allows users to download a PDF of the report to their smart device.

To learn more about the design and programming of *AcademyScope*, visit youtube.com/watch?v=pdqKBna1Fos, or scan the QR code.



Acknowledgements: Katy Börner (initial concept, design & interactivity consultation), Chin Hua Kong (lead software developer), Samuel Mills (graphic design), Adam Simpson (programming), Bhumi Patel (programming), Rohit Alekar (programming).



The *AcademyScope* team talks through the final details of the project. From left to right: CNS's Chin Hua Kong, Katy Börner, and Samuel Mills; NAS's Alphonse MacDonald and Stephen Mautner.



Sub-topic network bubbles are sized based on the number of publications in each sub-topic



Selecting a year from the bar graph highlights that year's publications in the network graph

FINANCES/NUMBERS

Finances

Exhibit finances are managed by the Cyberinfrastructure for Network Science Center at the School of Library and Information Science at Indiana University. Shown below are exhibit income and expenditures for 2012. Exhibit revenues come from map sales, venue contributions, and support by the Cyberinfrastructure for Network Science Center.

2012 EXPENSES*

Salaries	\$50,442
Design & Venue Acquisition	\$18,255
Workshops & Events	\$2,258
Total	\$70,955

2012 REVENUE*

CNS Support	\$45,522
Map Sales	\$11,470
Venue Contributions & Other Revenue	\$13,963
Total	\$70,955

*This report covers the exhibit's 2012 fiscal year: January 1 through December 31, 2012.

Exhibit in Numbers (since 2005)

Exhibit Maps: 80
Map Makers: 210
Display Venues: 196

Press Items: 162
Workshops Organized: 21
Web Page Visitors in 2012: 451,133



Places & Spaces at the University of North Texas in Denton, TX



Places & Spaces at OECD in Paris, France

GOALS FOR 2013

We reviewed a total of 53 maps for the 9th Iteration of the exhibit, and “Science Maps Showing Trends and Dynamics” could very well be our strongest collection of maps yet. We are also making plans for our tenth and final iteration, “Science Mapping Frontiers.” The hope is that this iteration will be both a consolidation of the exhibit’s strengths and a boundary-pusher that points toward the future of science mapping.

Maps from the physical exhibit will continue to be on display at the Mundaneum Museum in Mons, Belgium, through July 1st. Selected maps will also be featured in the Upstairs Gallery of the National Academy of Sciences until June 1st. And we are hopeful that the full exhibit, including the debut of the 9th iteration, will be on display at Ohio State University this summer.

As the exhibit continues to grow, it requires larger and more sophisticated display spaces. We intend to proactively contact possible venues to ensure a continued display of the full exhibit while accommodating requests for custom displays of individual exhibit components. We are also developing digital displays of the exhibit that can be featured on large-screen media walls.

A number of workshops are planned. The first one took place at IUB on March 25-26 and was entitled **Exploiting Big Data Semantics for Translational Medicine**. It was a focused workshop that brought together invited leading practitioners in semantic technologies, network science and visualization, and computational translational medicine to identify the most critical areas for collaboration between these fields to maximize impact on the next generation of disease treatments. Another workshop on **Standards for Science Mapping and Classifications** will take place at the 14th International Society of Scientometrics and Informetrics Conference, Vienna, Austria, on July 15 and will bring



Ingo Günther's WorldProcessor Globes on display at Northeastern University in Boston, MA

together researchers and practitioners interested in the scientific development and proper usage of science classifications and science maps.

The *Atlas of Knowledge: Anyone Can Map* book will be submitted to MIT Press in August to ensure its availability in stores by Christmas 2014.

Finally, we will continue our efforts toward archiving the exhibit maps, accompanying books, and digital files in major map libraries around the globe. This will ensure that interested patrons can examine high-resolution prints up close and that maps are preserved for future generations.

EXHIBIT ADVISORS



Gary Berg-Cross

Co-Principal Investigator of the NSF-sponsored SOCoP-INTEROP Project



Bob Bishop

Chairman and founder of BBWORLD Consulting Services Sàrl and President of the ICES Foundation



Kevin W. Boyack

President of SciTech Strategies, Inc.



OECD, Paris, France



Donna J. Cox, MFA, Ph.D.

Director of the Advanced Visualization Laboratory (AVL) at the National Center for Supercomputing Applications and Director of the Illinois eDreamInstitute at the University of Illinois at Urbana-Champaign



Bonnie DeVarco

Media X Distinguished Visiting Scholar at Stanford University



Sara Irina Fabrikant

Associate Professor of Geography and head of the Geographic Information Visualization and Analysis (GIVA) group at the GIScience Center, University of Zürich, Switzerland



Marjorie M.K. Hlava

President, Chairman and founder of Access Innovations, Inc. and the founding Chair of the SLA Taxonomy Division



Peter A. Hook

Law librarian and doctoral student at the School of Library and Information Science at Indiana University, Bloomington



Manuel Lima

Senior UX Design Lead at Microsoft Bing, Fellow of the Royal Society of the Arts, and founder of VisualComplexity.com



André Skupin

Associate Professor of Geography at San Diego State University, California



Eric Rodenbeck

Founder and Creative Director of Stamen and member of the Board of Directors of the Kenneth Rainin Foundation



Deborah MacPherson

Specifications and research at Cannon Design, technical standards development for Building Information Modeling (BIM), and Projects Director for the nonprofit organization Accuracy & Aesthetics



Lev Manovich

Professor at the Visual Arts Department, University of California, San Diego, California, and Director of the Software Studies Initiative at California Institute for Telecommunications and Information Technology



Carlo Ratti

Architect, Engineer, and Director of the Senseable City Lab at the Massachusetts Institute of Technology



Moritz Stefaner

Freelance designer on the crossroads of data visualization, information aesthetics, and user interface design in Germany



Stephen Uzzo

Vice President of Science and Technology for the New York Hall of Science and faculty member of the New York Institute of Technology Graduate School of Education



Caroline Wagner

Wolf Chair at the John Glenn School of Public Affairs and North American Editor of the *Science & Public Policy* journal



Benjamin Wiederkehr

Founding Partner and Managing Director of Interactive Things, a user experience design and information visualization studio in Zürich, Switzerland

COSI Science Museum, Columbus, OH



BRING THE EXHIBIT HOME

Purchase a Map of Science

Any visit to the *Places & Spaces* exhibit is sure to be memorable, but many attendees find themselves wanting to take with them something more tangible than memories. Those individuals will be delighted to learn that all exhibit maps are available for purchase at our online store (scimaps.org/store). All maps are 24" x 30" and come in three quality levels to choose from: high-quality matte or glossy inkjet, a higher-quality version printed with premium archival ink on archival paper, and a highest-quality option mounted on foam core and edged with black metal framing.

Adorn your home or office with a series of beautiful and fascinating maps of science!

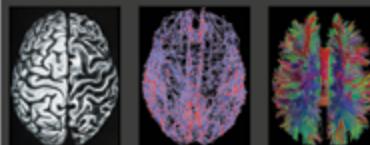
In addition, some fans of the exhibit find the theme of a particular iteration especially relevant to their personal interests or to the interests of their colleagues. To meet this need, poster versions of each iteration are also available at the *Places & Spaces* online store. These impressive versions consist of two posters per iteration, with each poster measuring around 67" x 36". The posters feature all ten maps from the iteration, their descriptions, and colorful photos and interesting exhibit information.

Having trouble deciding which maps to claim for your own? View all the amazing maps that make up the *Places & Spaces* exhibit at scimaps.org/exhibit_info. Once there, you can click on individual maps and zoom in to see the wealth of detail and clarity of presentation that reward repeated viewing. Purchasing a map of science ensures that such viewing will always be available to you in the comfort of your home or office.

Matte or
Glossy Inkjet:
\$45 per map*



The Human Connectome



Axotomy: White is colored for fiber tract densities seen from the top of the brain. Axotomy is a carefully selected area to reveal a solid surface or entire the dorsal white matter. Connectome: Shows the connections of brain regions together with "white" matter. Neuroanatomy: A new MRI technique called diffusion tensor imaging for our brain's and behavior.

Semi-Glossy Premium
Archival Ink on Archival
Paper: \$100 per map*

Laminated Foam
Core with Black
Metal Framing:
\$250 per map*



*Cost of shipping not included
and varies by location

HOST THE PHYSICAL EXHIBIT

Bring *Places & Spaces* to Your Institution

Put your institution on the map by hosting *Places & Spaces* at your university, museum, or library. The exhibit consists of high-resolution maps (90 as of Fall 2013), map labels, and introductory panels for each iteration. Included as well are additional elements such as the Illuminated Diagram, Ingo Günther's WorldProcessor Globes, and the Hands-on Science Maps for Kids. Exhibit curators will be happy to speak with you more about the benefits of hosting *Places & Spaces* and the logistics involved in doing so.

Or share these educational science maps with your whole school or institution by becoming an official exhibit host!

Potential hosts concerned about space should know that while the exhibit is at its best when displayed as a cohesive whole in a continuous space, it has also been presented to great effect as smaller conceptual units in separate (but not too distant) spaces. We can discuss with you the arrangements that best suit your situation in order to arrive at the perfect communion between exhibit and venue.

Over its nine-year history, *Places & Spaces* has appeared at some of the world's most renowned institutes of knowledge and learning, like the National Academy of Sciences, Stanford University, the Chinese Academy of Sciences, University College Dublin, and many more (see scimaps.org/exhibitions for a complete list of venues). Contact us at cns@indiana.edu today to begin the process of bringing *Places & Spaces* to your own valuable institution.



Places & Spaces at the University of North Texas in Denton, TX



Places & Spaces at the National Academy of Sciences in Washington, D.C.

HOST THE DIGITAL EXHIBIT



Places & Spaces on Indiana University's IQ Wall



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

Think Outside the Frame!

Recently, our designers have been working with IT experts from universities around the country to create an exhibit experience that is truly larger than life. The *Places & Spaces* Digital Display is a dazzling showcase for these stunning maps of science, taking the viewer through the evolution of science mapping from its earliest beginnings to its most cutting-edge developments.

Don't have enough wall space for the physical exhibit? You can display the complete exhibit on a single wall!

In bringing *Places & Spaces* to the big screen, great care has been taken to preserve the maps' rich color and clarity. Thus, the large-screen display offers a presentation that is grand in scale, but without sacrificing the qualities that audiences of the exhibit have come to treasure and expect. You can display the maps on your institution's digital wall, or project them onto a light surface for an equally impressive experience. We'll work closely with you on customizing the display to perfectly fit your space.

This unique production had its debut in 2012 at the IQ-Wall in the Herman B Wells Library at Indiana University. Next, it will be on display at North Carolina State University's state-of-the-art Immersion Theater in the newly opened James B. Hunt Jr. Library. To learn how to bring the *Places & Spaces* Digital Display to a theater near you, please contact us at cns@indiana.edu.

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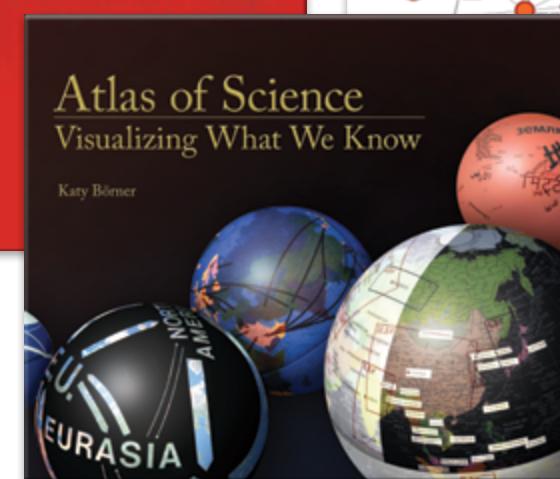
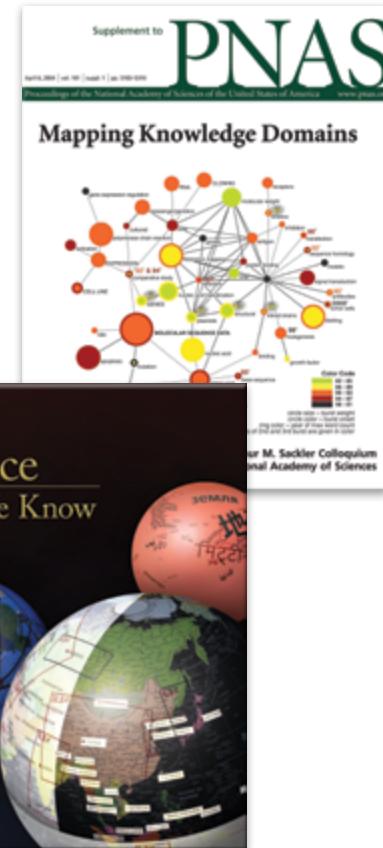
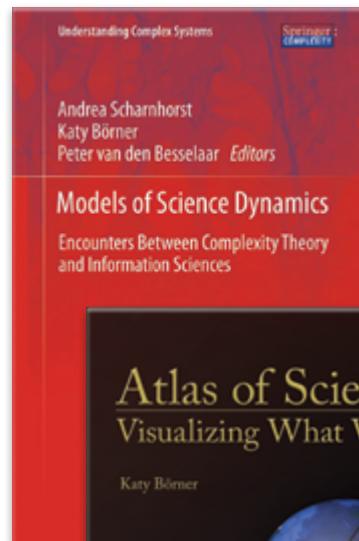
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Tools

Science of Science (Sci2) Tool (sci2.cns.iu.edu) is a desktop application that was specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of data sets at the micro (individual), meso (local), and macro (global) levels.

Data

The Scholarly Database (sdb.cns.iu.edu) provides easy access to more than 26,000,000 papers, patents, and grants from major databases such as MEDLINE, U.S. Patent and Trademark Office, National Science Foundation, and National Institutes of Health. Users can register for free to cross-search these databases and to download result sets as dumps for science of science research and science policy practice.



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