SCWS 2017
Connecting the World
for a Sustainable Future

Science Centre World Summit 2017 , 15-17 November, Tokyo

Parallel Session C-2 | Sustainability | Panel

Visualising STEAM Data in Support of Smart Decision Making

Thursday 16 Nov 2017

10:55-12:10

7F Miraikan Hall

Moderator

Katy Börner
Victor H. Yngve Distinguished Professor of Engineering and Information Science / Director, Cyberinfrastructure for Network Science Center, Indiana University
United States

Session Concept:

Being able to “read and write” data visualisations is becoming as important as being able to read and write text. Understanding, measuring, and improving data and visualisation literacy is important for understanding STEAM developments and to strategically approach global issues.This session features presentations by researchers and practitioners that develop approaches, tools, and experiences which aim to improve and use the data visualisation literacy of their users. Visualisations of water, global warming, biodiversity, energy, and infectious diseases, health, urban growth and STEAM data will be featured. We will demonstrate how data visualisation can be used to open rich dialogues around crucial issues and serve as a powerful means of making information accessible, salient, and memorable. Discussions will focus on how to best use the power of big data and the continuously evolving set of data mining and visualisation tools to empower the personal and professional decision making by diverse stakeholdersto achieve sustainability.

Speakers

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Stephen Miles Uzzo

Chief Scientist, New York Hall of Science

United States

Immersive visualisation can revolutionize museum visitor engagement with complex sustainability ideas. Connected Worlds is a large-scale museum experience for visitors to learn about the coupling of human and natural systems.

Yuko Harayama

Executive Member, Council for Science, Technology and Innovation

Japan

Evidence-based decision making advocated by the OECD is expending into the field of Science, Technology and Innovation (STI) policy arena. Data visualisations support policy makers to move in this direction.

Tit Meng Lim

CEO, Science Centre Singapore

Singapore

The digital age sees a growing trend of EPIC learning, a process that is Experiential, Participatory, Image-drive and Connected to social networks. Visualisation is now an integral part of knowledge acquisition and knowledge creation.

Hans Gubbels

Director, Museumplein Limburg

Netherlands

Data visualisation for smart decision making processes is best to allow for large scale citizen co-creation in order to strengthen outcomes on moral and ethical grounds and societal support on implementation.

Big Data for Little Kids

Stephen Miles Uzzo

Chief Scientist, New York Hall of Science
United States

"Immersive visualization can revolutionize museum visitor engagement with complex sustainability ideas. Connected Worlds is a large-scale museum experience for visitors to learn about the coupling of human and natural systems."

Evidence-Based Policy Making & Policy Need for Science Education

Yuko Harayama
Executive Member, Council for Science, Technology and Innovation
Japan

"Evidence-based decision making advocated by the OECD is expending into the field of Science, Technology and Innovation (STI) policy arena. Data visualizations support policy makers to move in this direction."

EPIC Learning and Visualizations

Tit Meng Lim
CEO, Science Centre Singapore
Singapore

"The digital age sees a growing trend of EPIC learning, a process that is Experiential, Participatory, Image-drive and Connected to social networks. Visualization is now an integral part of knowledge acquisition and knowledge creation."

Visualization and Citizen Co-Creation

Hans Gubbels
Director, Museumplein Limburg
Netherlands

"Data visualization for smart decision making processes is best to allow for large scale citizen co-creation in order to strengthen outcomes on moral and ethical grounds and societal support on implementation."

Kommunikations-Computing

Data Visualization Literacy

Katy Börner (Moderator)
@katycns
Victor H. Yngve Distinguished Professor of
Engineering and Information Science
Director, Cyberinfrastructure for Network Science Center
Indiana University
United States

"Being able to "read and write" data visualizations is becoming as important as being able to read and write text. Understanding, measuring, and improving data and visualization literacy is important for understanding STEAM developments and to strategically approach global issues."

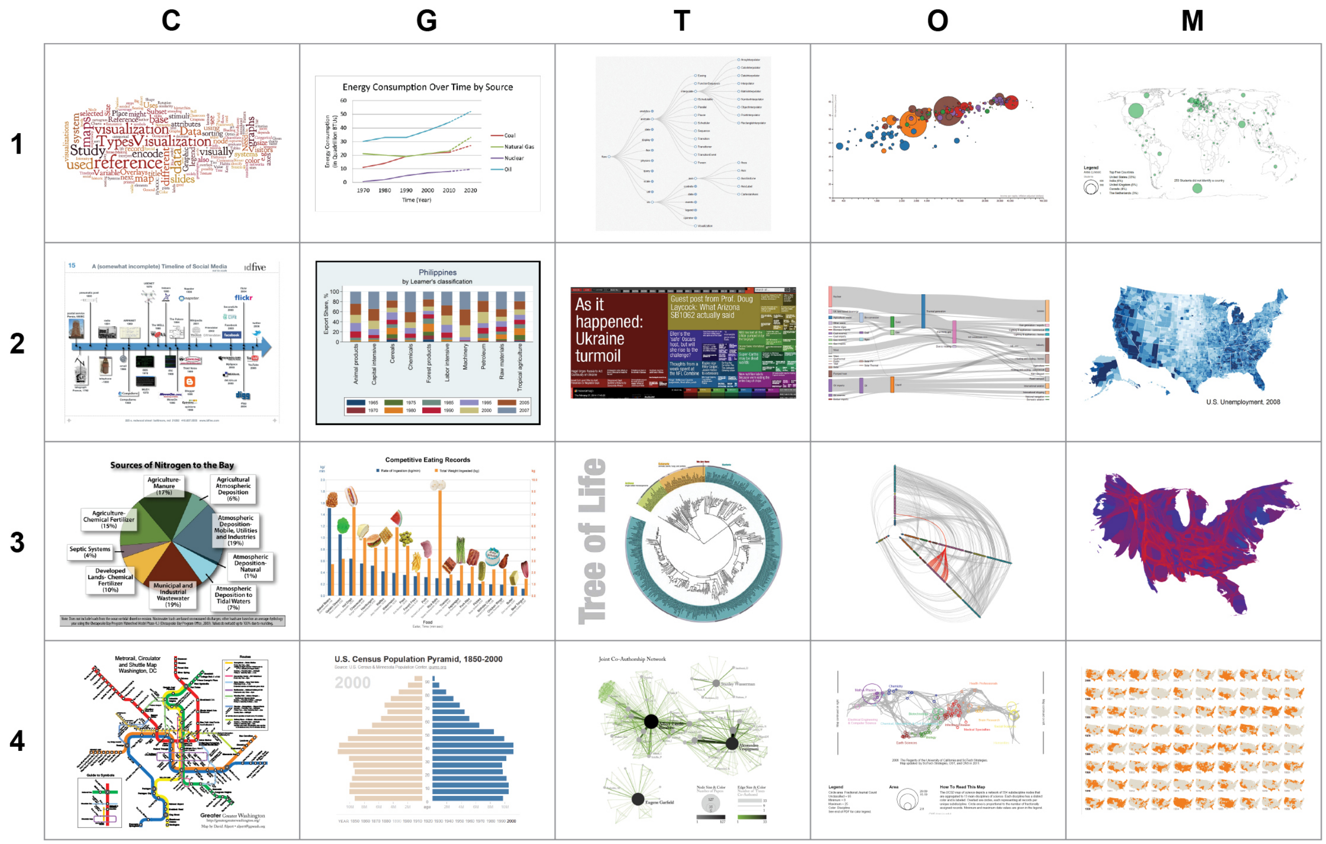
Data Visualization Literacy

Data visualization literacy (ability to read, make, and explain data visualizations) requires

- *literacy* (ability to read and write text, e.g., in titles, axis labels, legend),
- *visual literacy* (ability to find, interpret, evaluate, use, and create images and visual media), and
- *data literacy* (ability to read, create, and communicate data).

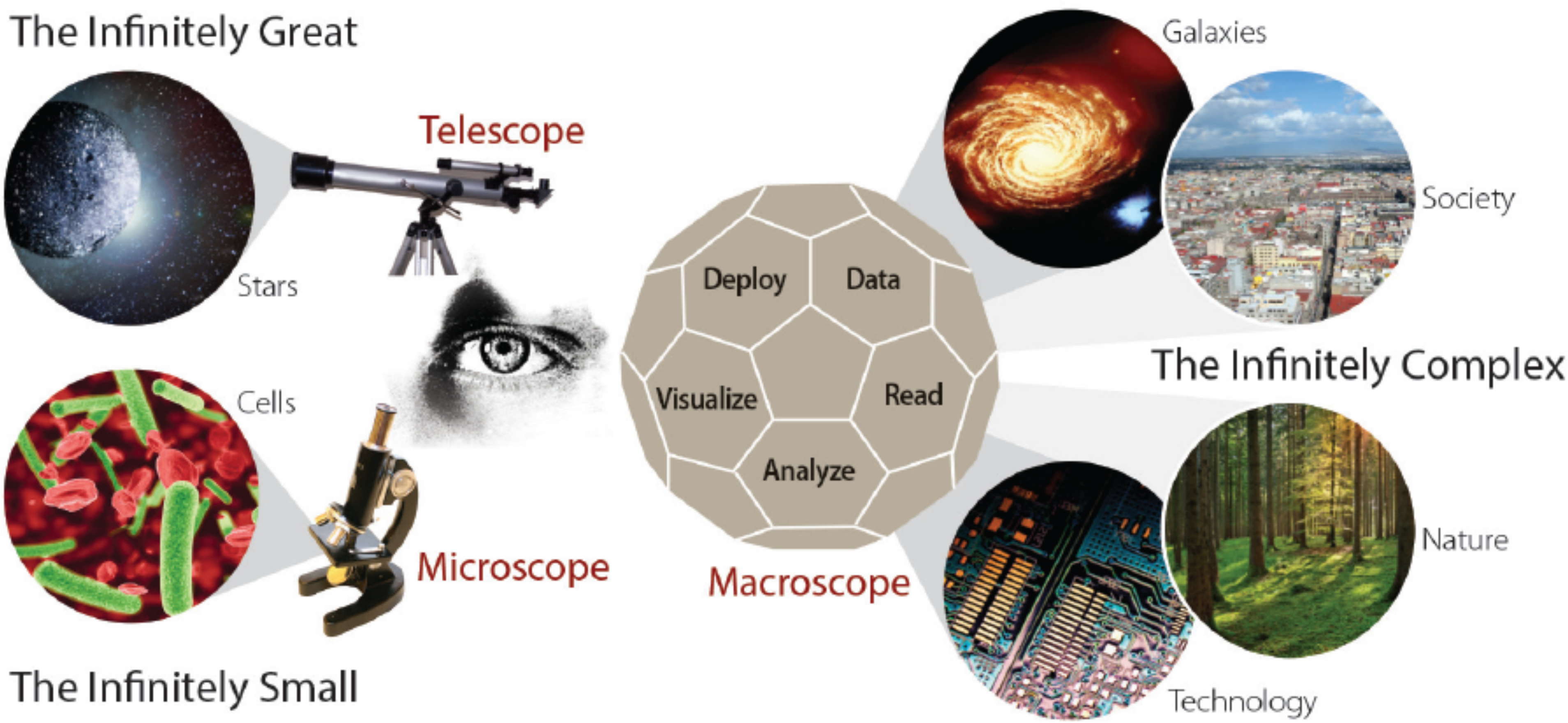
Data Visualization Literacy

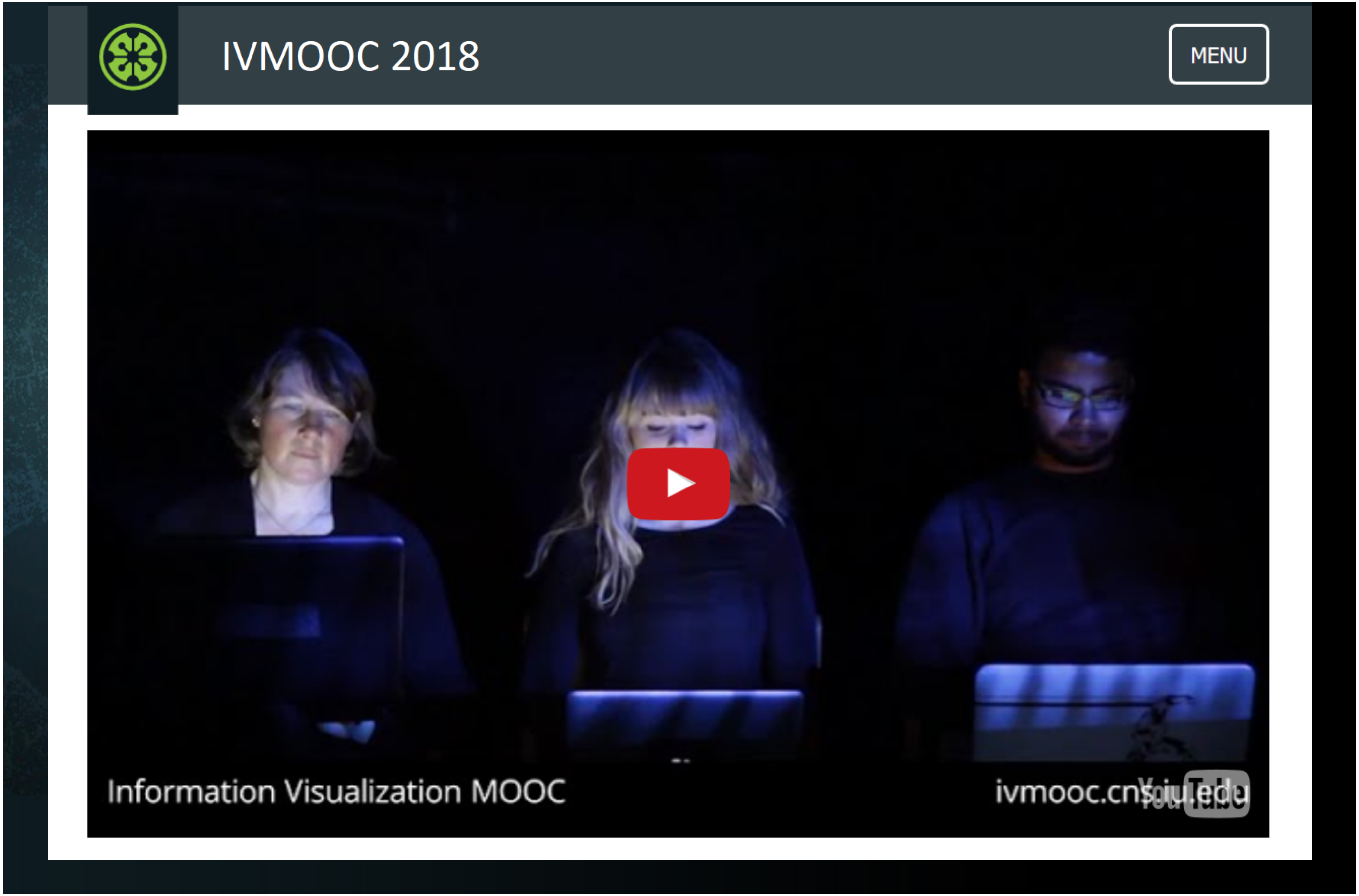
Is rather low: Most science museum visitors in the US cannot name, read, or interpret common data visualizations.



Börner, Katy, Joe E. Heimlich, Russell Balliet, and Adam V. Maltese. 2015. Investigating aspects of data visualization literacy using 20 information visualizations and 273 science museum visitors. *Information Visualization 1-16.* http://cns.iu.edu/docs/publications/2015-borner-investigating.pdf

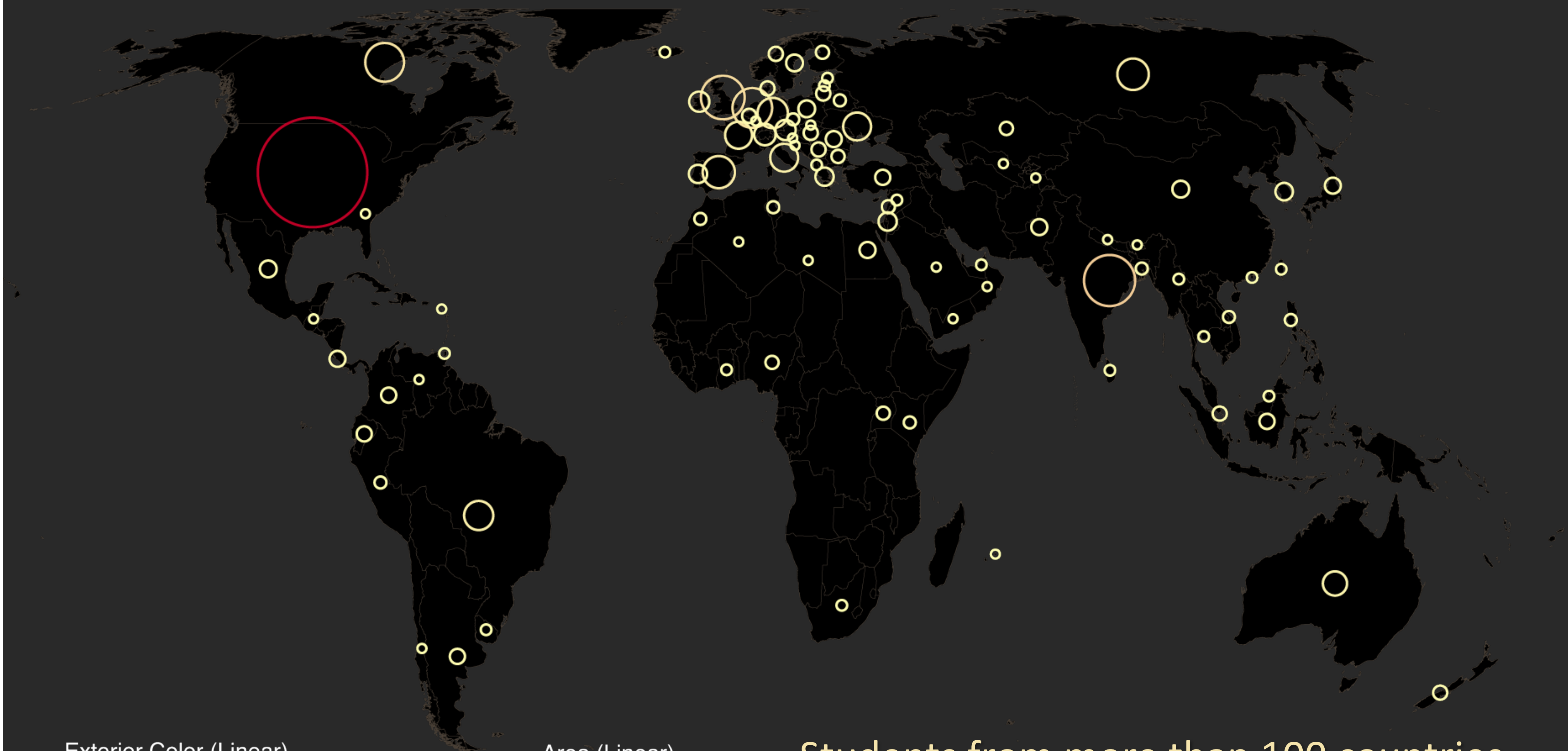
Microscopes, Telescopes, Macroscopes Plug-and-Play Macroscopes

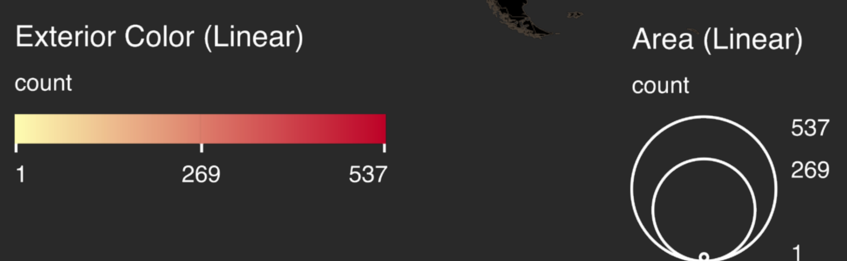




Register for free: http://ivmooc.cns.iu.edu. Class restarts Jan 9, 2018.

The Information Visualization MOOC
ivmooc.cns.iu.edu





Students from more than 100 countries
350+ faculty members
#ivmooc

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

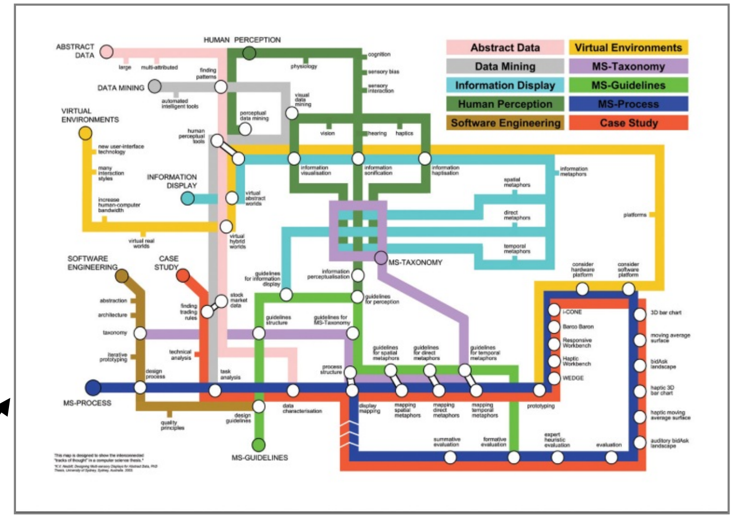
Part 2: Students work in teams on client projects.

Final grade is based on Homework and Quizzes (**10%),** Midterm (**20%**), Final (**30%**), Client Project (**30%**), and Class Participation (**10%**).

Different Question Types

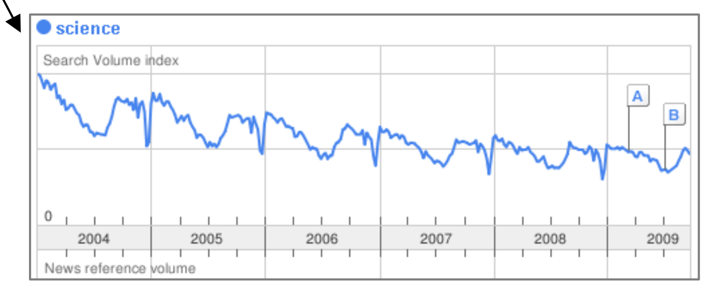
Terabytes of data

Descriptive & Predictive Models



Find your way

Find collaborators, friends

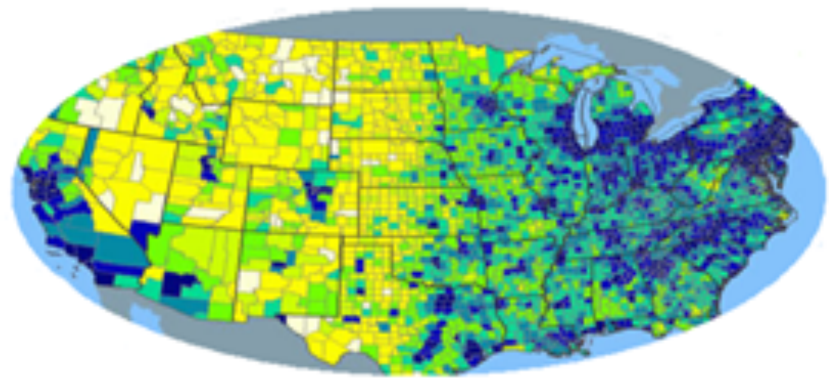


Identify trends

Different Levels of Abstraction/Analysis

Macro/Global

Population Level



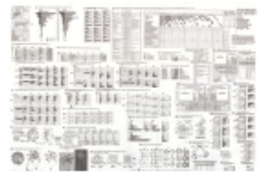
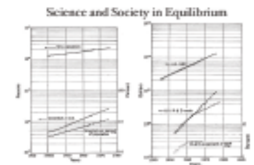
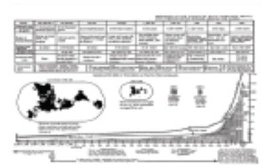
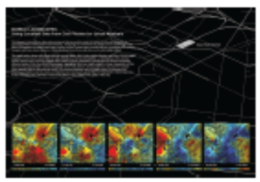
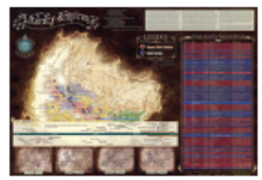
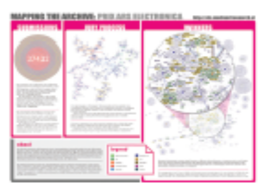
Meso/Local

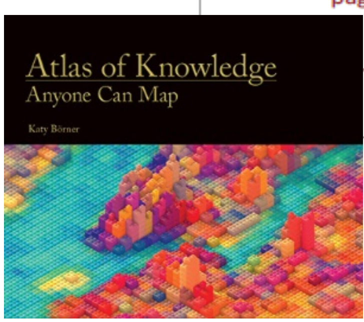
Group Level

Micro

Individual Level

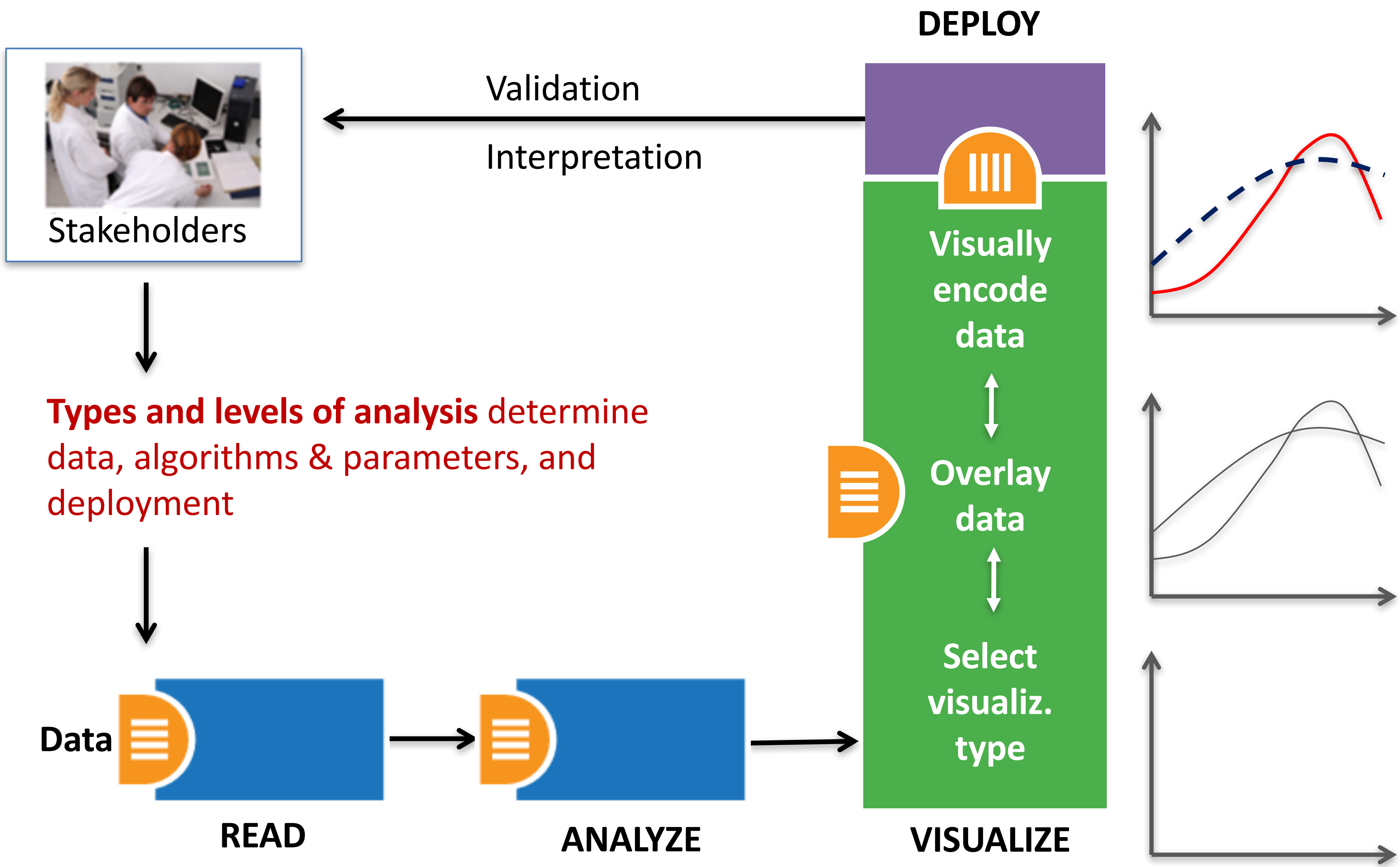
Tasks

TYPES \ 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
Statistical Analysis page 44	 Knowledge Cartography page 135	 Productivity of Russian life sciences research teams page 105	 Number of scientists versus population and R&D costs versus GNP. page 103
WHEN: Temporal Analysis page 48	 Visualizing decision-making processes page 95	 Key events in the development of the video tape recorder page 85	 Increased travel and communication speeds page 83
WHERE: Geospatial Analysis page 52	 Cell phone usage in Milan, Italy page 109	 Victorian poetry in Europe page 137	 Ecological footprint of countries page 99
WHAT: Topical Analysis page 56	 Evolving patent holdings of Apple Computer, Inc. and Jerome Lemelson page 89	 Evolving journal networks in nanotechnology page 139	 Product space showing co-export patterns of countries page 93
WITH WHOM: Network Analysis page 60	 World Finance Corporation network page 87	 Electronic and new media art networks page 133	 World-wide scholarly collaboration networks page 157

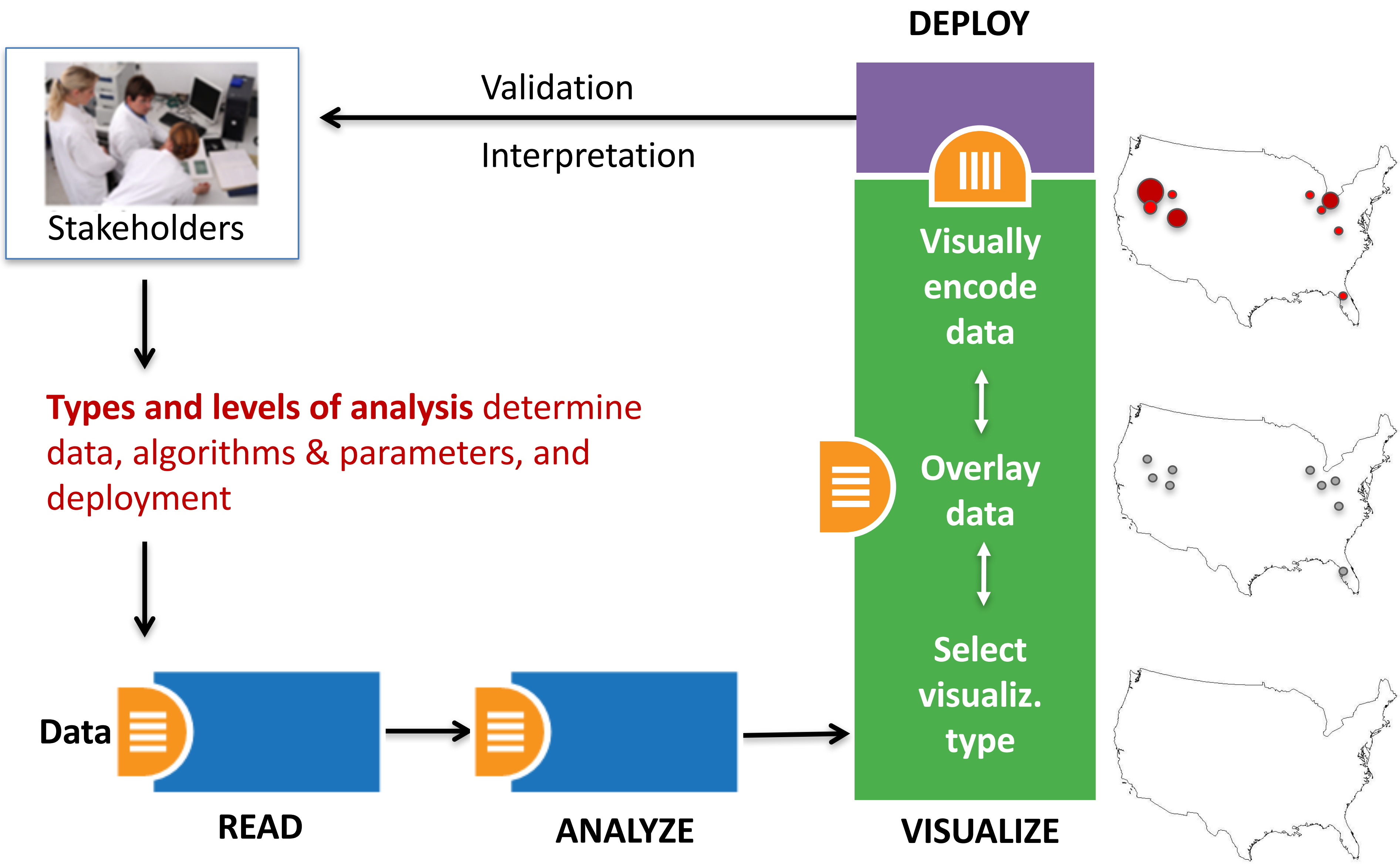


See *Atlas of Science: Anyone Can Map*, page 5

Needs-Driven Workflow Design

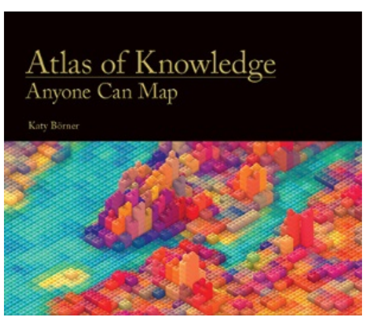


Needs-Driven Workflow Design



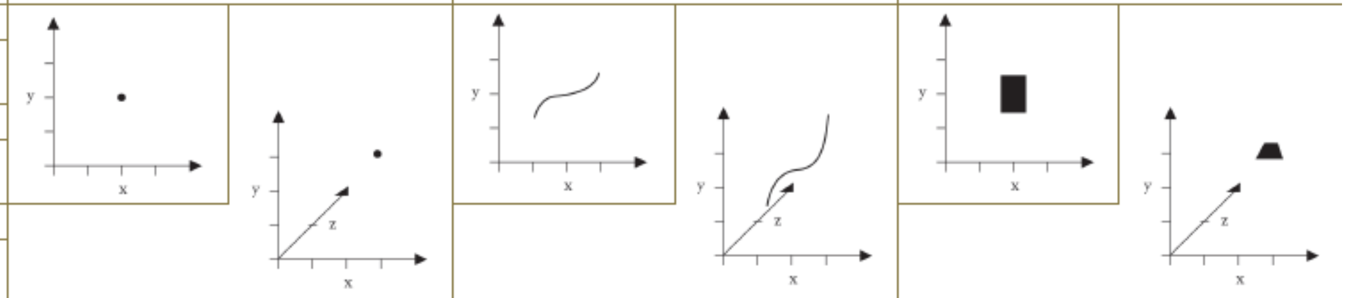
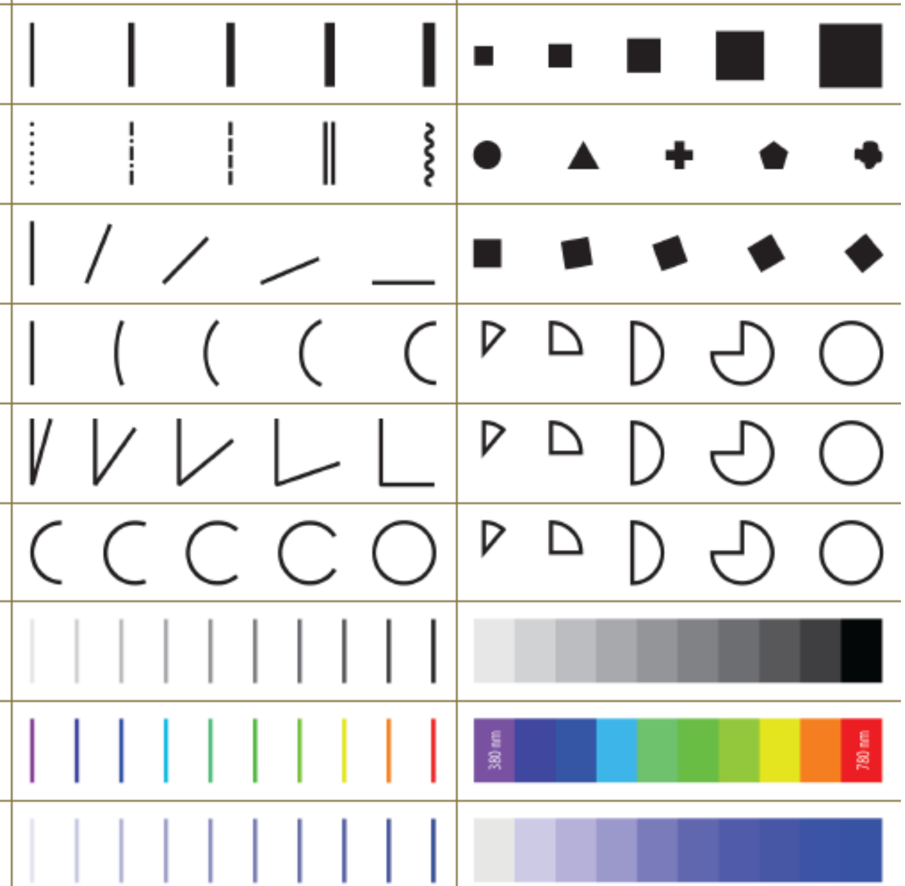
Visualization Framework

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
• categorize/cluster	• nominal	• table	• geometric symbols	• spatial	• overview
• order/rank/sort	• ordinal	• chart	point	position	• zoom
• distributions	• interval	• graph	line	• retinal	• search and locate
(also outliers, gaps)	• ratio	• map	area	form	• filter
• comparisons		• network layout	surface	color	• details-on-demand
• trends			volume	optics	• history
(process and time)			• linguistic symbols	motion	• extract
• geospatial			text		• link and brush
• compositions			numerals		• projection
(also of text)			punctuation marks		• distortion
• correlations/relationships			• pictorial symbols		
			images		
			icons		
			statistical glyphs		

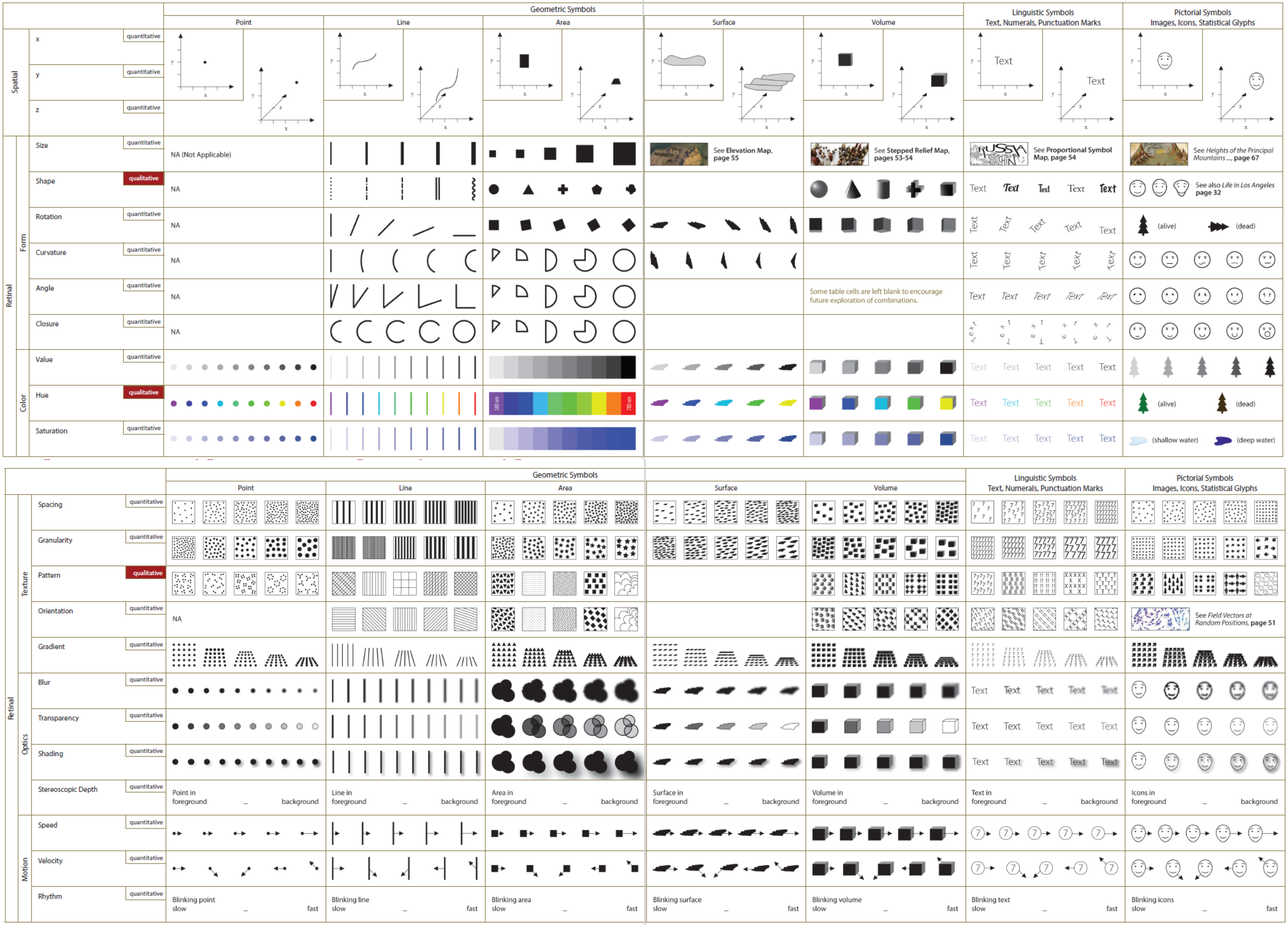


See *Atlas of Science: Anyone Can Map*, page 24

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			
		Hue	qualitative			
		Saturation	quantitative			

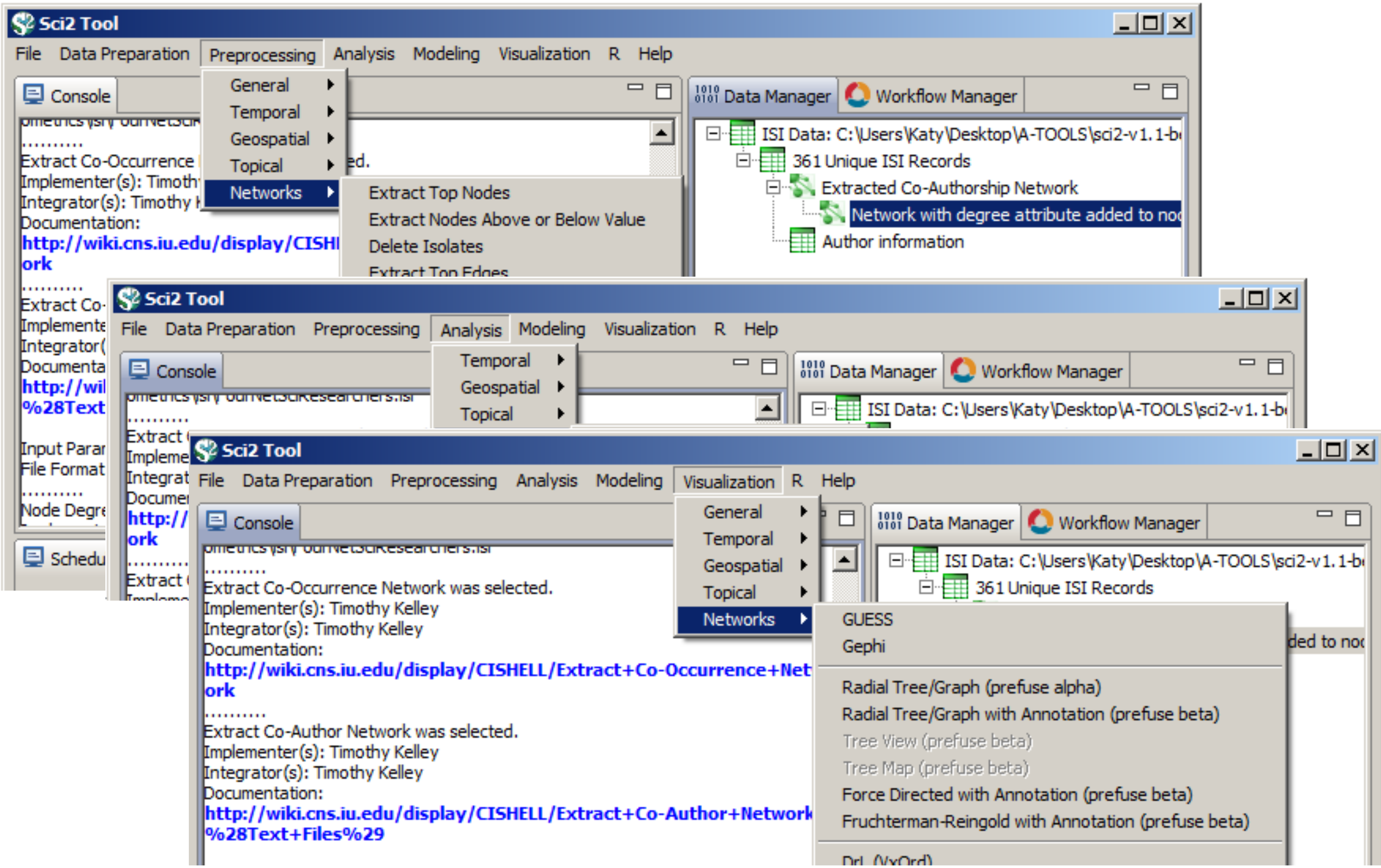
Graphic Variable Types Versus Graphic Symbol Types



CNS Cyberinfrastructure for Network Science Center

Sci2 Tool Interface Components Implement Vis Framework

Download tool for free at http://sci2.cns.iu.edu

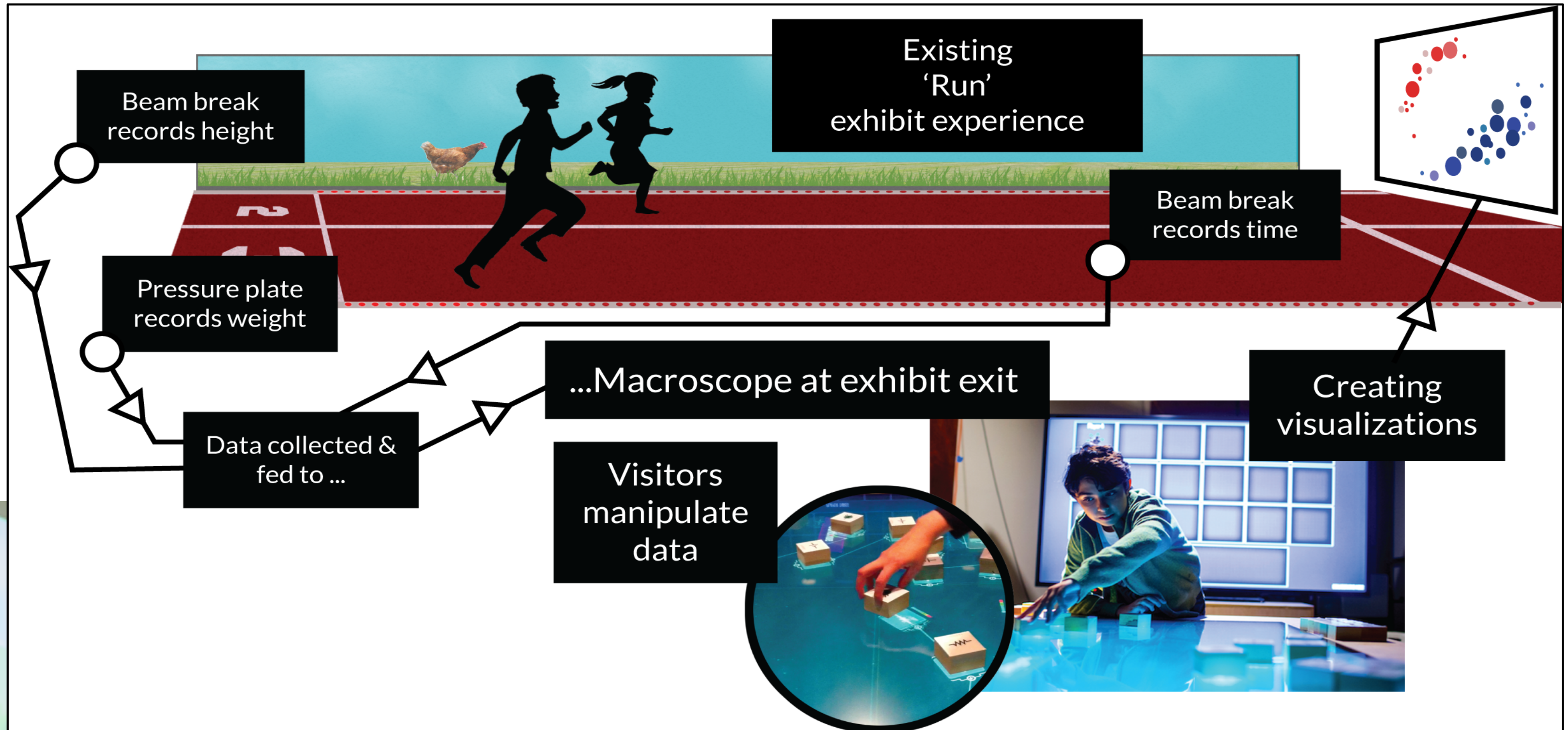


Data Visualization Literacy: Research and Tools that Advance Public Understanding of Scientific Data

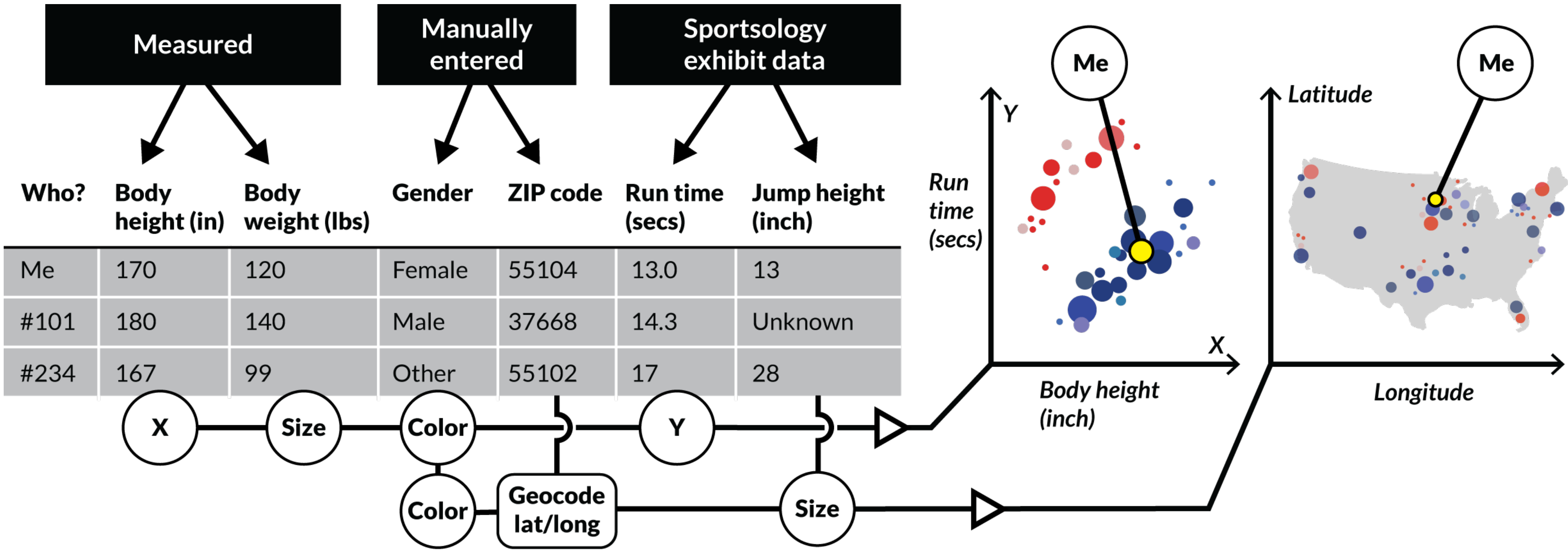
NSF Org:	DRL Division Of Research On Learning
Initial Amendment Date:	June 13, 2017
Latest Amendment Date:	June 13, 2017
Award Number:	1713567
Award Instrument:	Standard Grant
Program Manager:	Arlene M. de Strulle DRL Division Of Research On Learning EHR Direct For Education and Human Resources
Start Date:	August 1, 2017
End Date:	July 31, 2021 (Estimated)
Awarded Amount to Date:	$1,355,236.00
Investigator(s):	Katy Borner katy@indiana.edu (Principal Investigator) Kylie Peppler (Co-Principal Investigator) Bryan Kennedy (Co-Principal Investigator) Stephen Uzzo (Co-Principal Investigator) Joe Heimlich (Co-Principal Investigator)

Sportsology @ Science Museum of Minnesota

https://www.youtube.com/watch?v=oy34R45EfBg



Sketch of the *Run* exhibit including data collection (top) and macroscope add-on that lets interested visitors explore more complex data visualizations using table-top displays.



xMacroscope general setup and activity—Raw data on left is converted to visualization on right by dragging and dropping (or connecting) column headers to axes, paint buckets, size, and shape.

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

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