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

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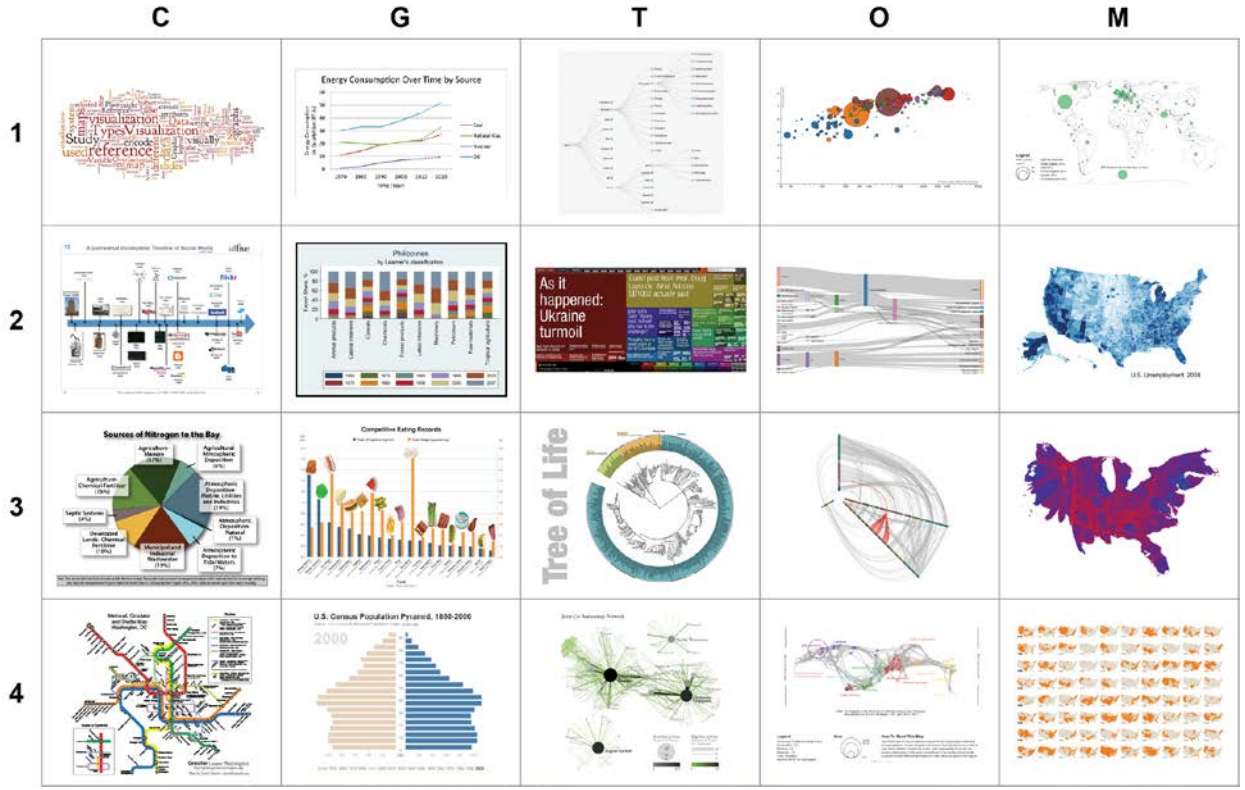
Data Visualization Literacy

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).

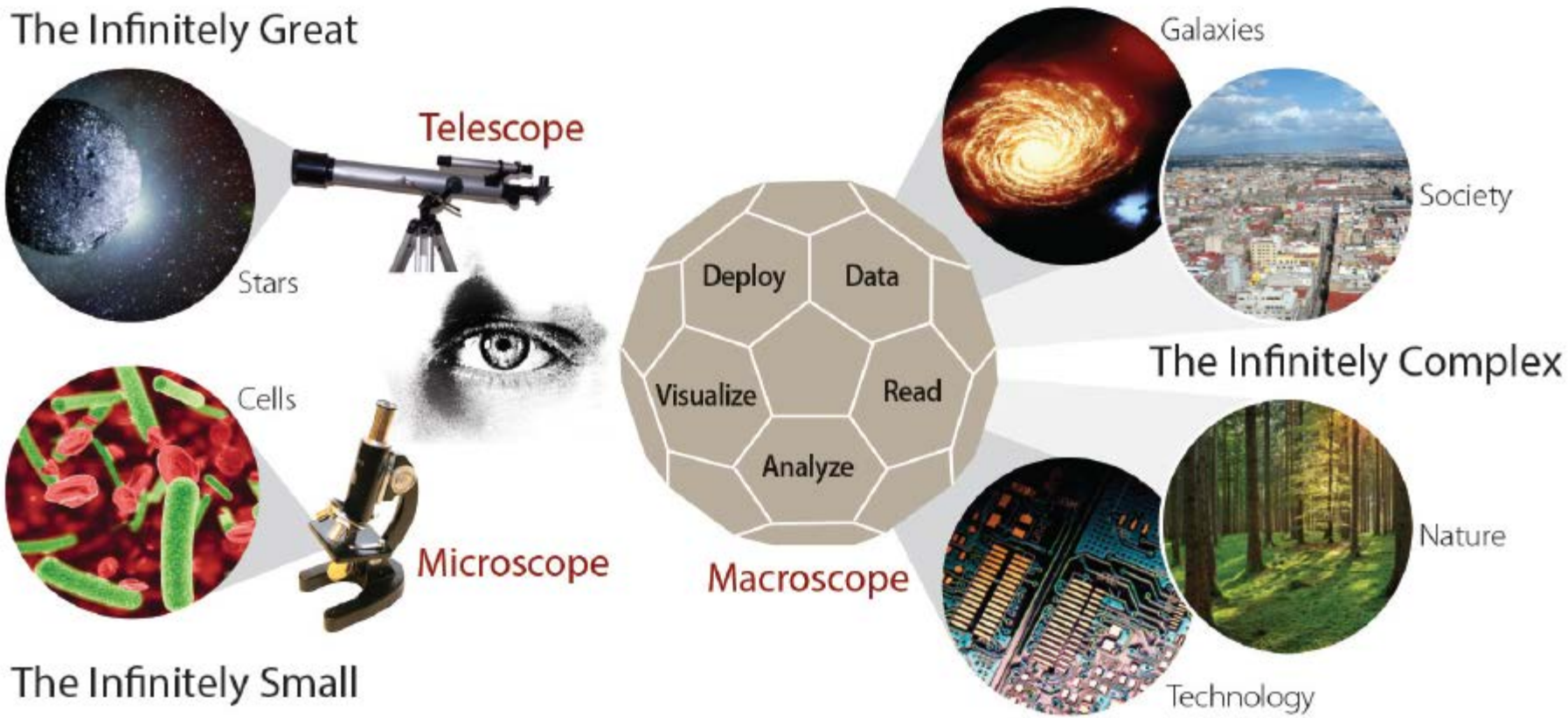
Data Visualization Literacy

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

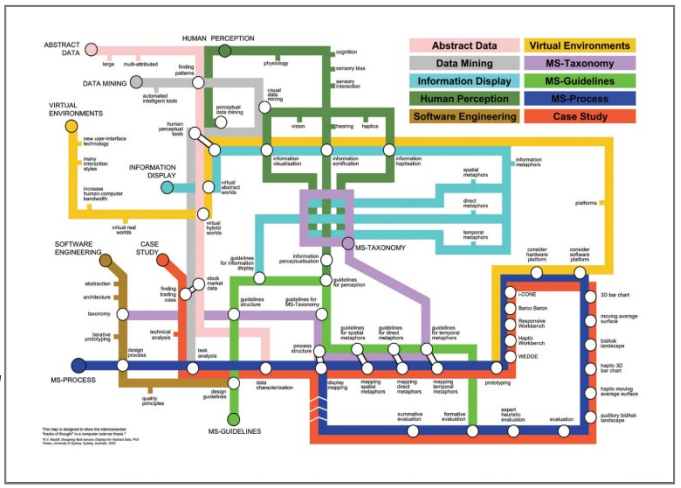
Microscopes, Telescopes, Macroscopes Plug-and-Play Macroscopes



Different Question Types

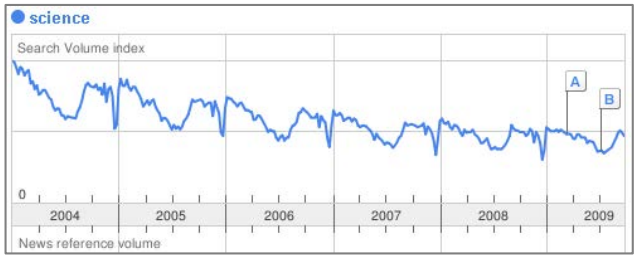
Terabytes of data

Descriptive & Predictive Models



Find your way

Find collaborators, friends

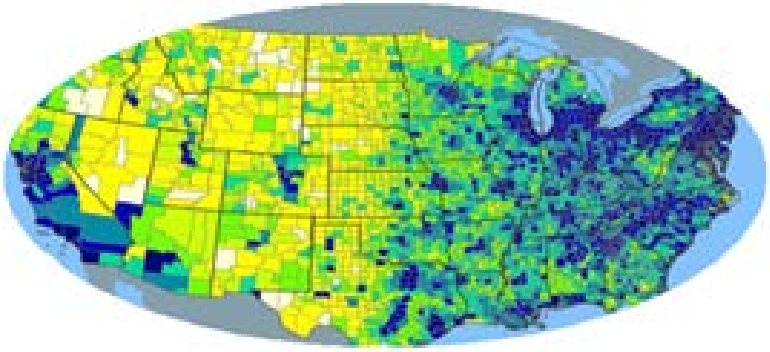


Identify trends

Different Levels of Abstraction/Analysis

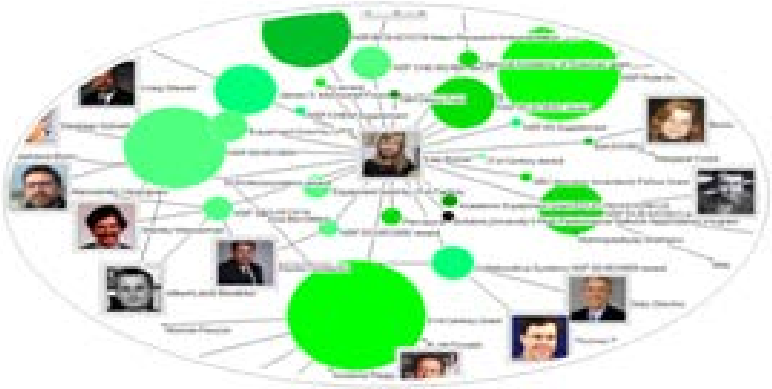
Macro/Global

Population Level



Meso/Local

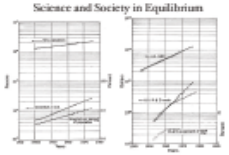
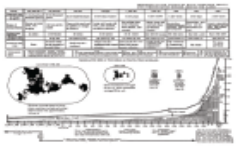
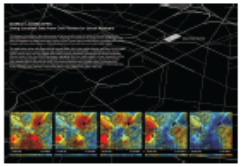
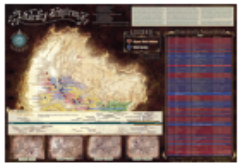
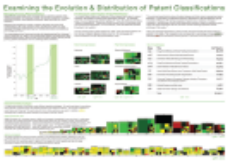
Group Level

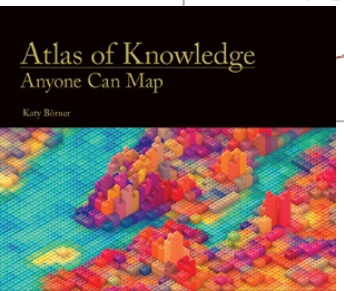


Micro

Individual Level

Tasks

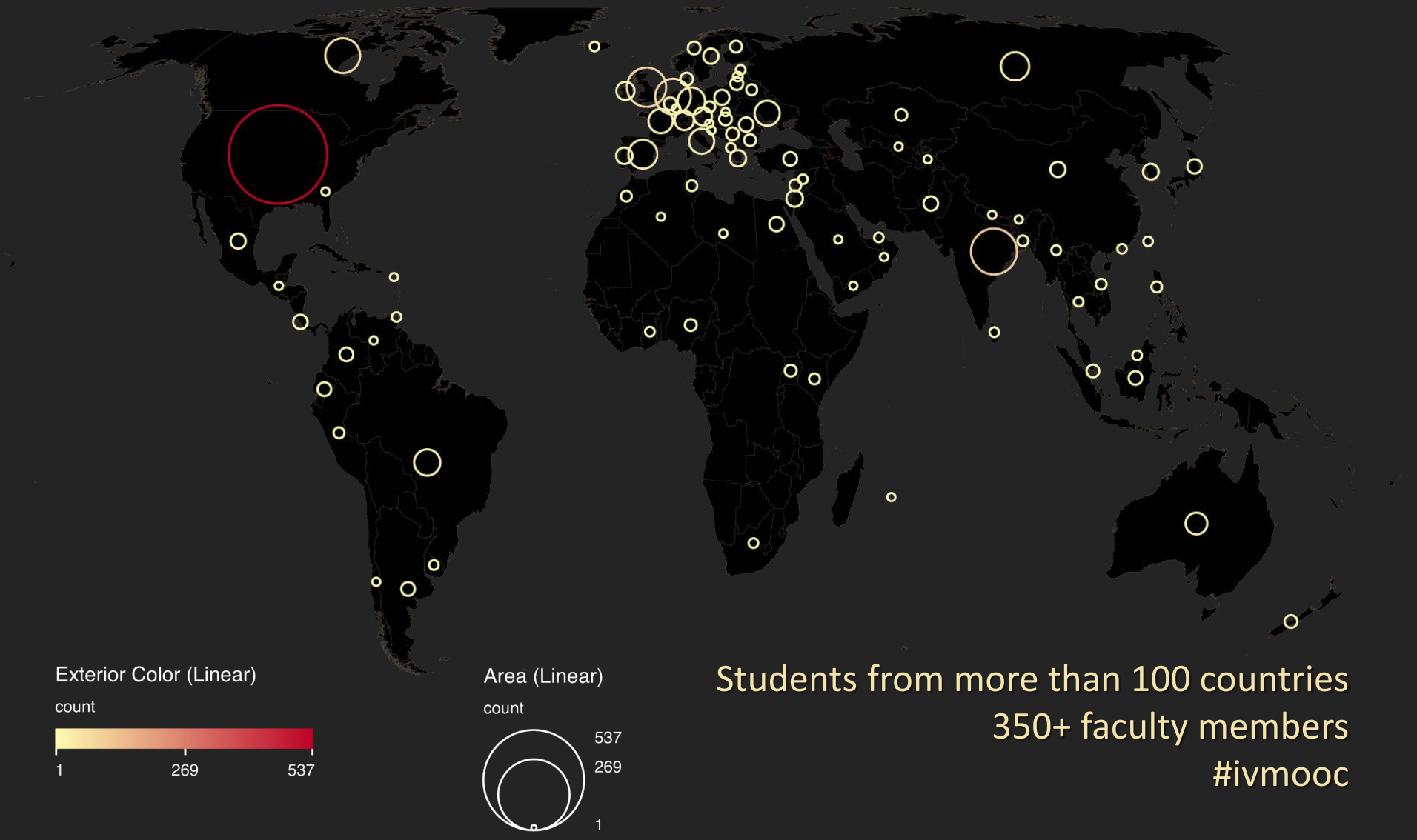
TYPES	LEVELS MICRO: Individual Level about 1–1,000 records page 6	MESO: Local Level about 1,001–100,000 records page 8	MACRO: Global Level more than 100,000 records page 10
Statistical Analysis page 44	 Knowledge Cartography page 135	 Productivity of Russian life sciences research teams page 105	 Number 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

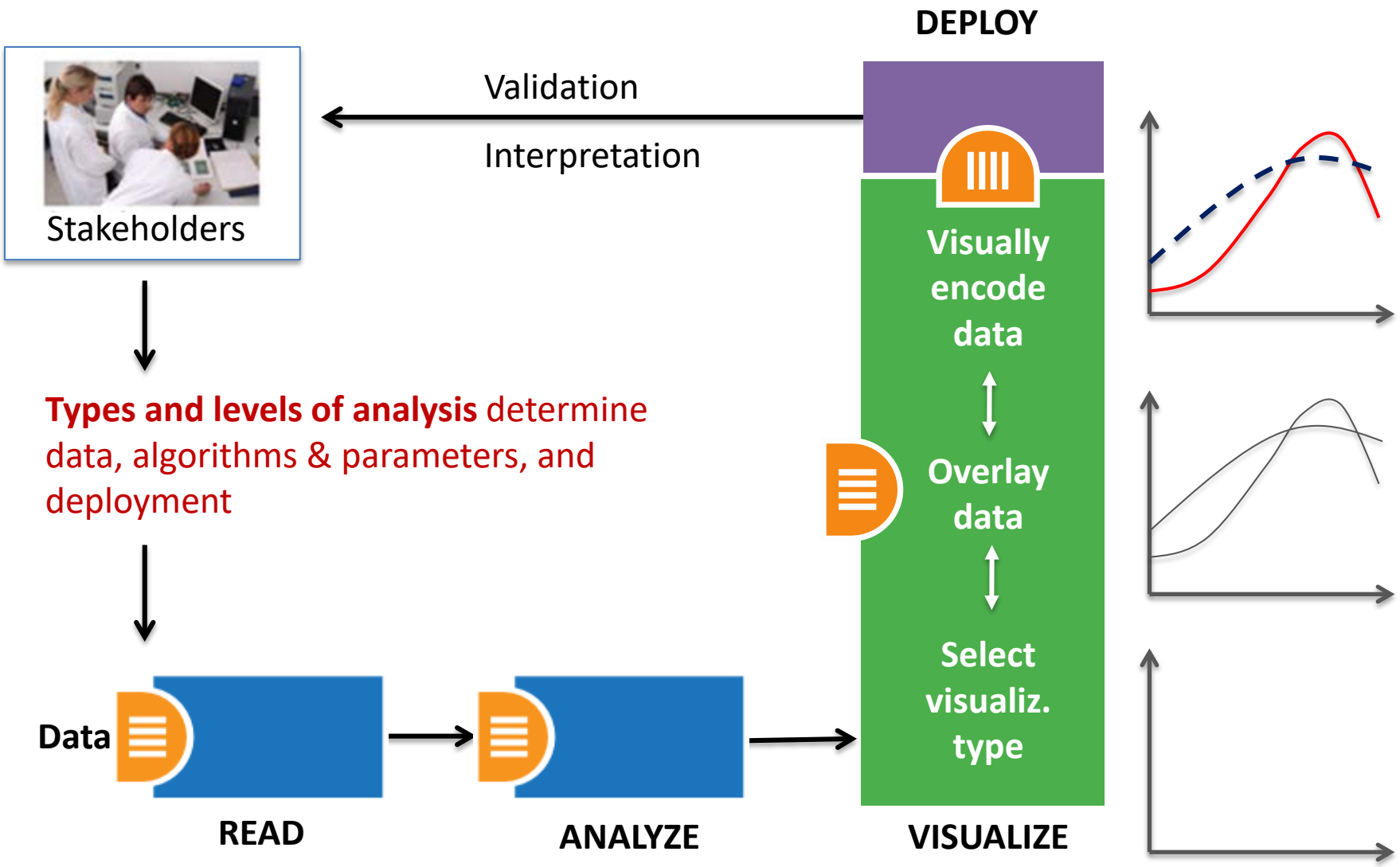
Register for free: http://ivmooc.cns.iu.edu. Class restarts Jan 9, 2018.

The Information Visualization MOOC
ivmooc.cns.iu.edu

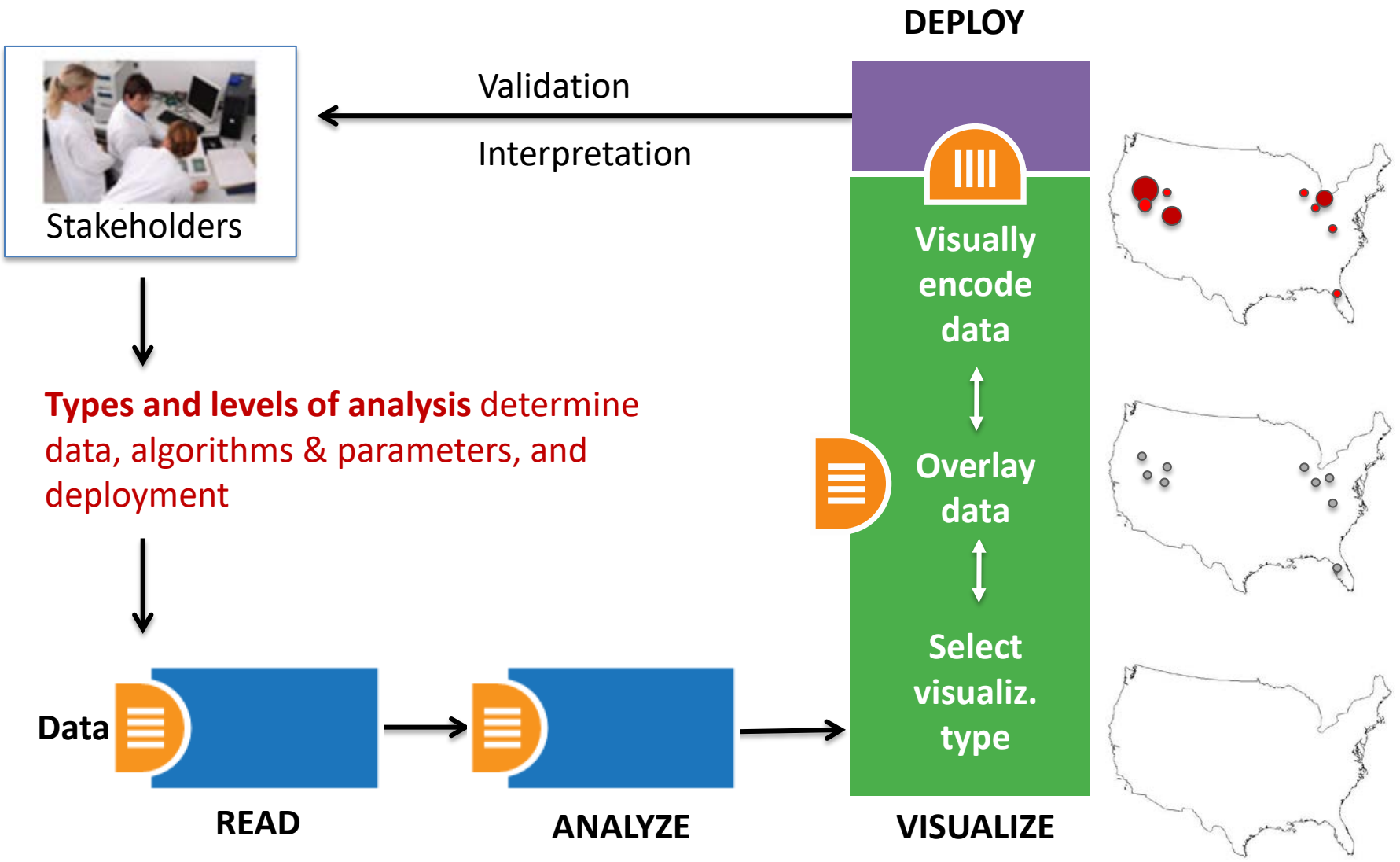


Students from more than 100 countries
350+ faculty members
#ivmooc

Needs-Driven Workflow Design

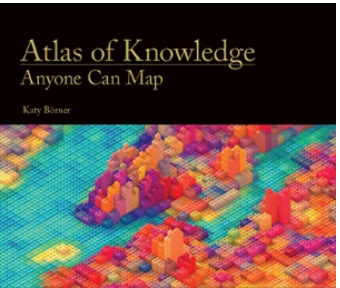


Needs-Driven Workflow Design



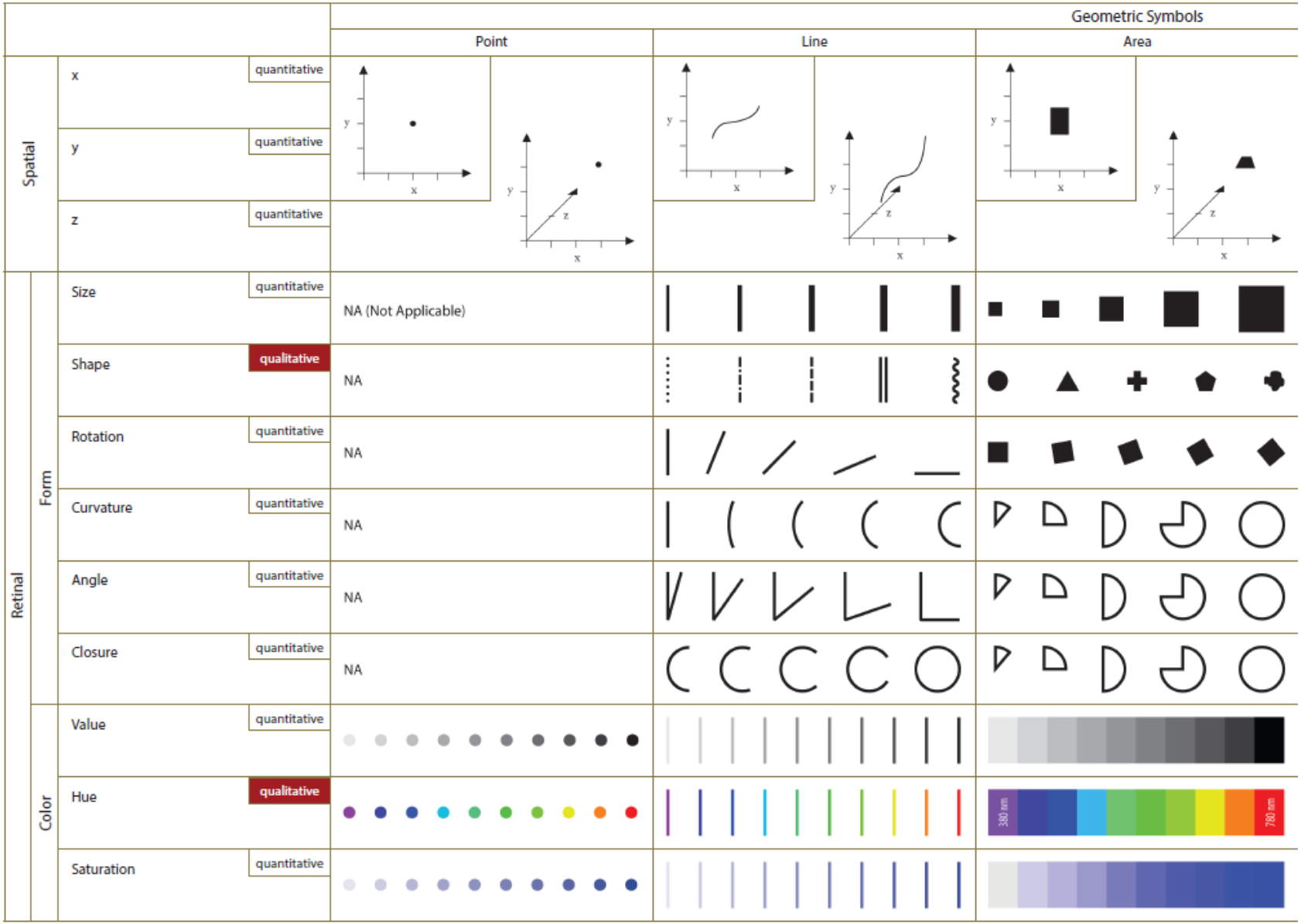
Visualization Framework

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

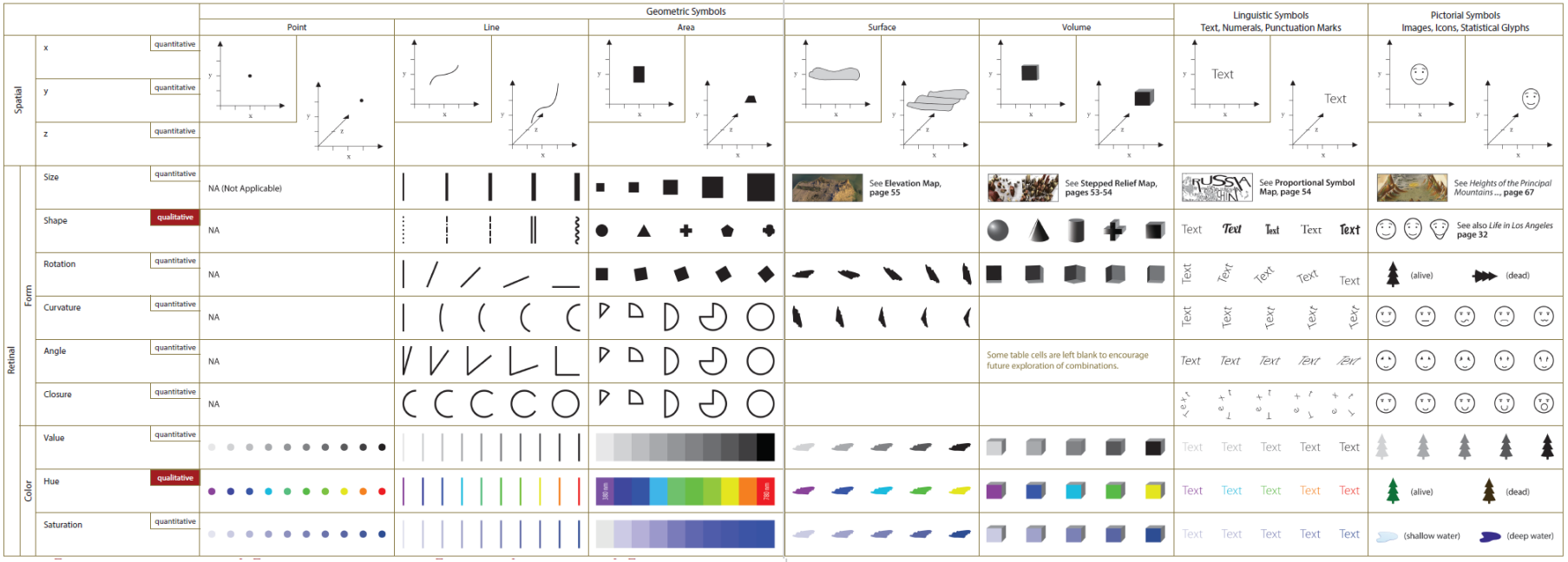


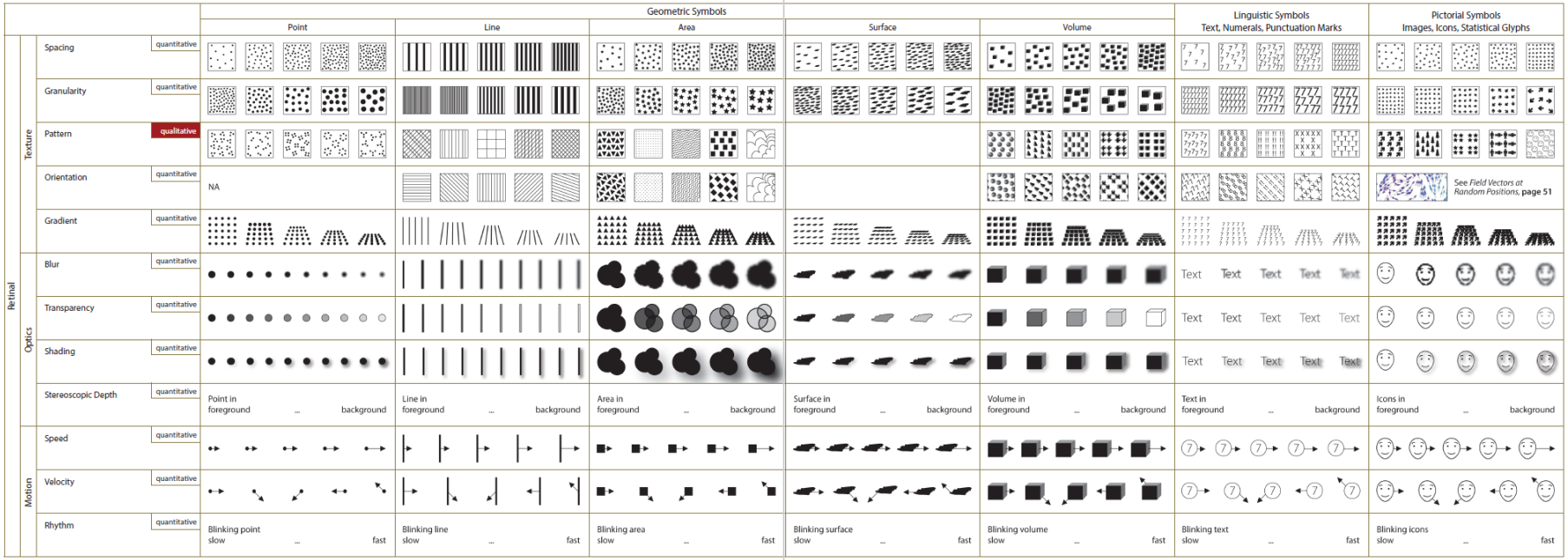
See *Atlas of Science: Anyone Can Map*, page 24

Graphic Variable Types Versus Graphic Symbol Types



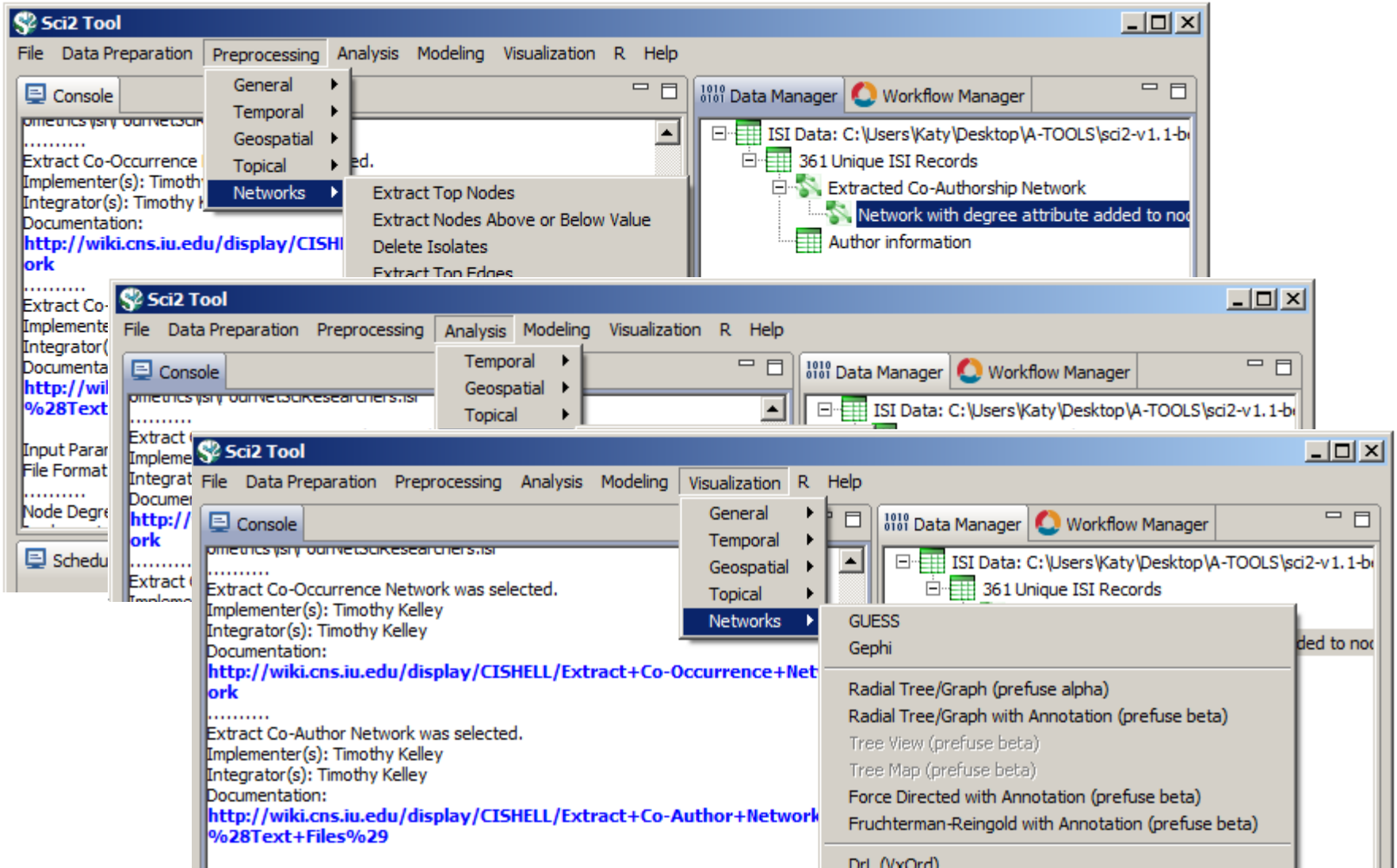
Graphic Variable Types Versus Graphic Symbol Types





Sci2 Tool Interface Components Implement Vis Framework

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

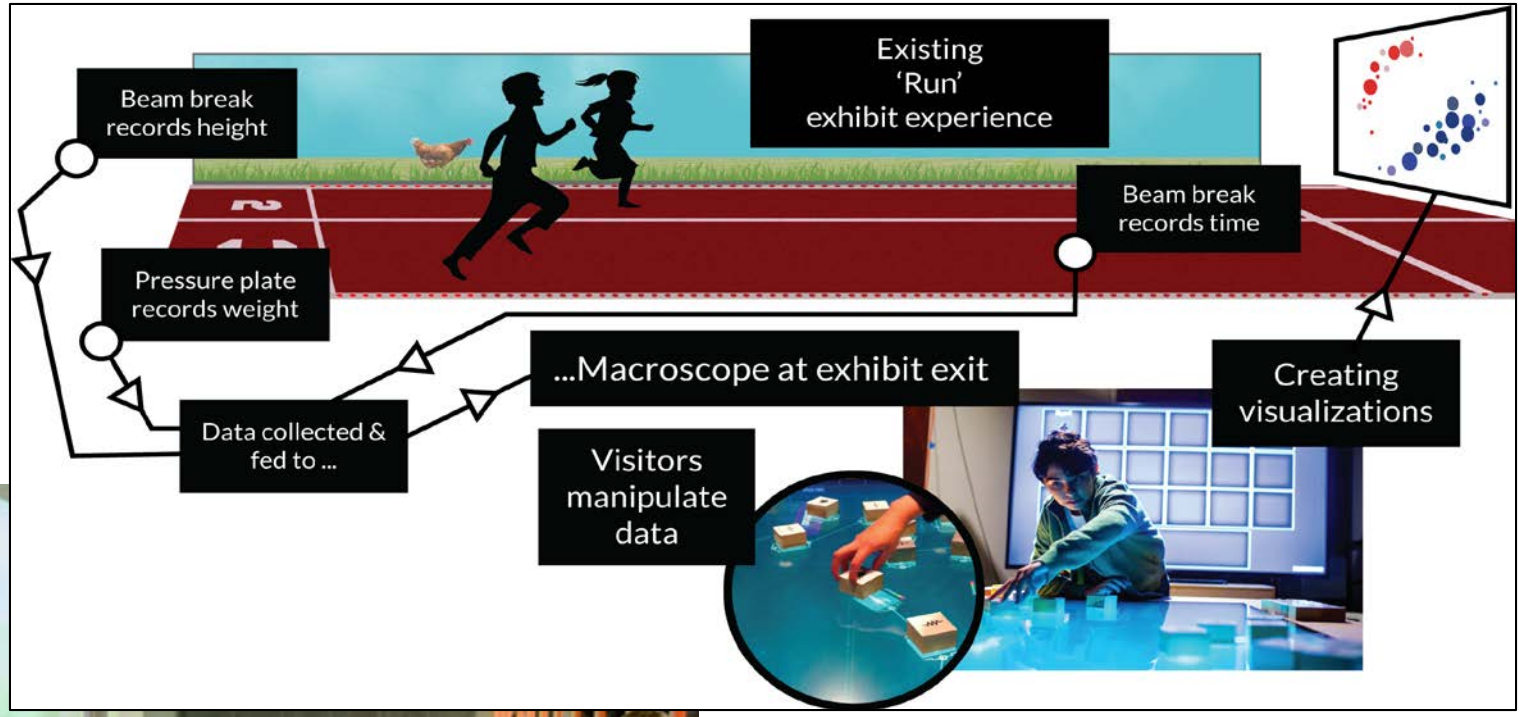


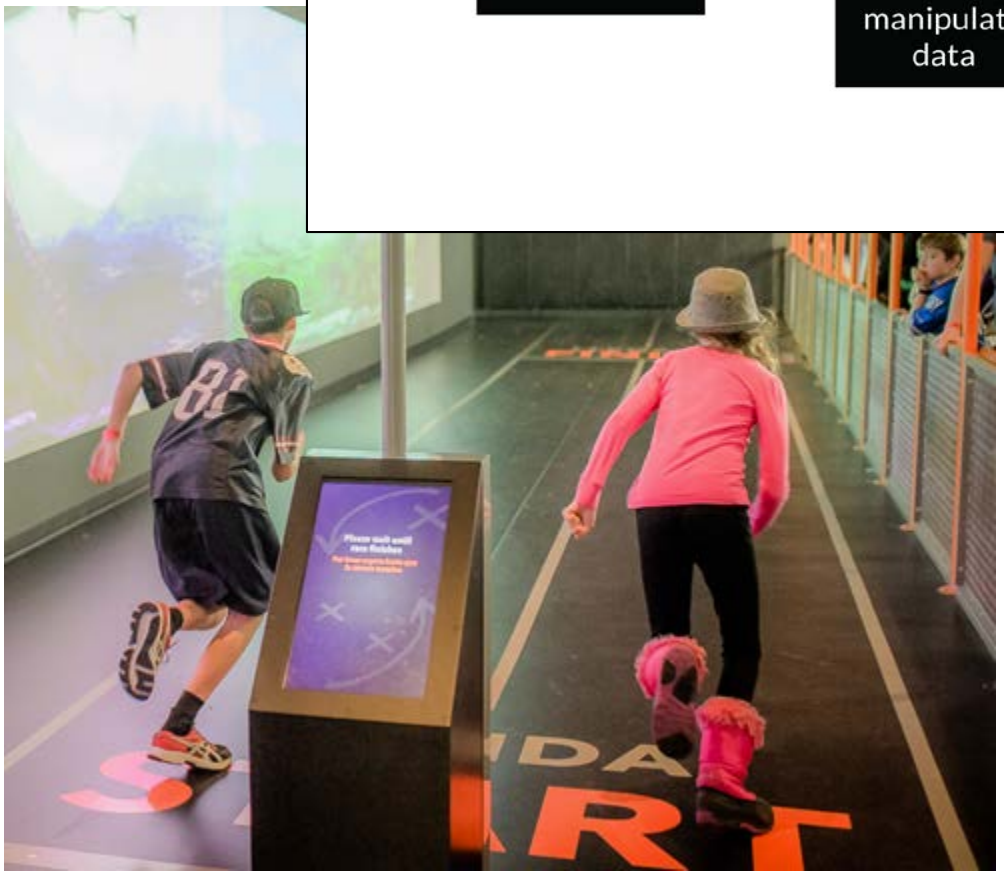
Data Visualization Literacy: Research and Tools that Advance Public Understanding of Scientific Data

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)

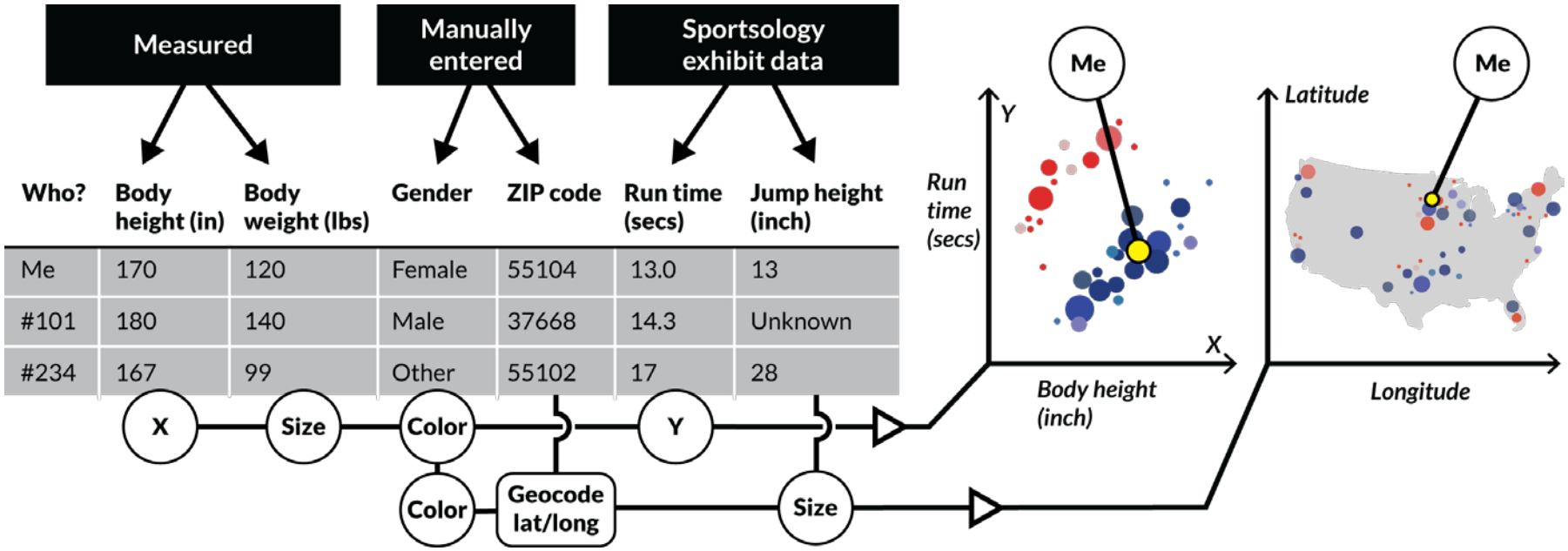
Sportsology @ Science Museum of Minnesota

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

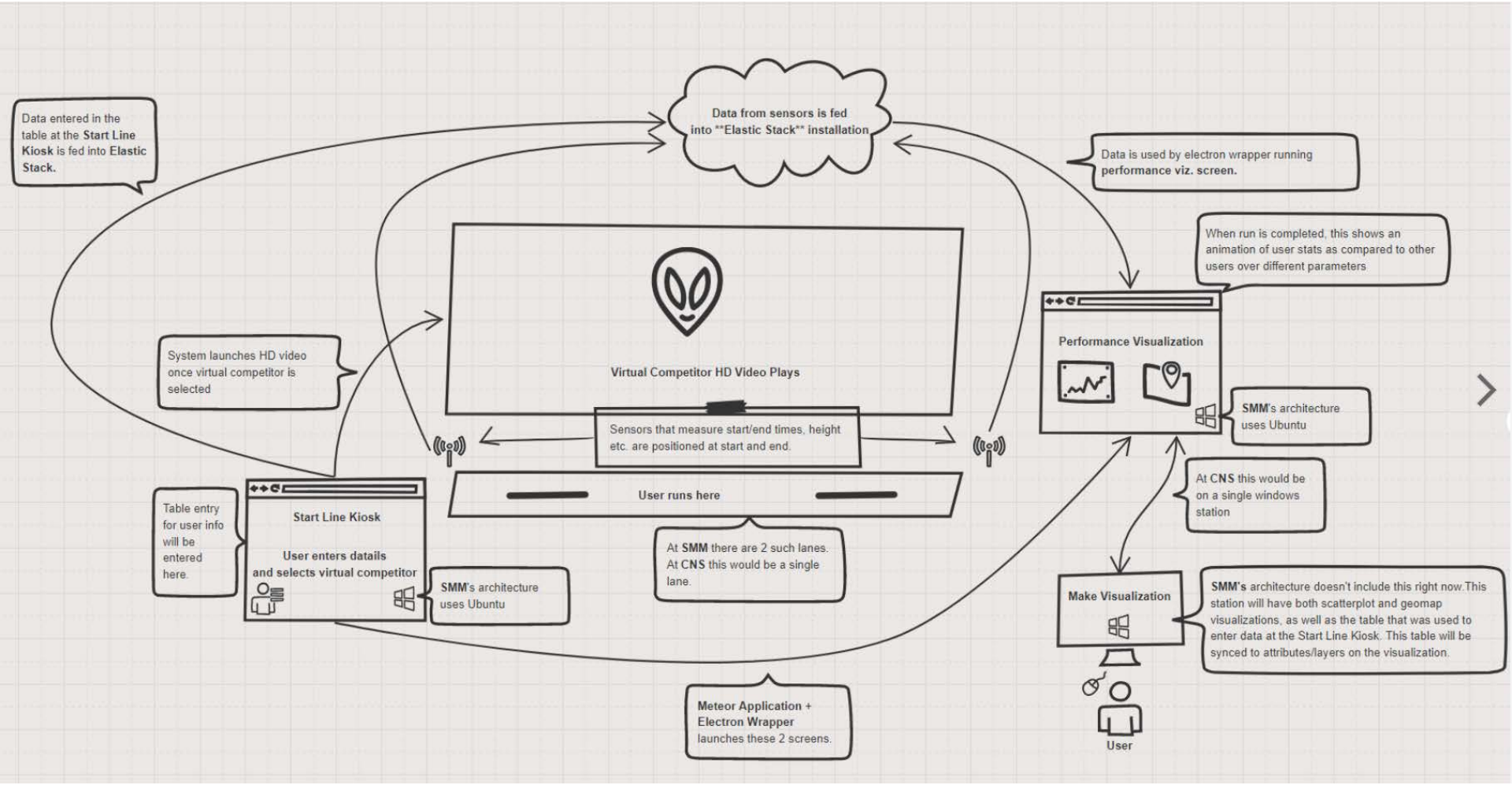




Sketch of the *Run* exhibit including data collection (top) and macroscope add-on that lets interested visitors explore more complex data visualizations using table-top displays.



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.



Combine SMM and CNS code and expertise to perform data federation via Elastic Stack and render *Performance Visualization* and *Make Visualization*

SCWS Session: Visualizing STEAM Data in Support of Smart Decision Making
November 15-17, 2017, Tokyo, Japan. http://scws2017.org

Arthur M. Sackler COLLOQUIA

Upcoming Colloquia

Unless otherwise indicated, most Sackler colloquia are held at the Arnold and Mabel Beckman Center, in Irvine, California.

Science of Science Communication III

November 16-17, 2017; Washington, D.C.
Organized by **Karen Cook**, **Baruch Fischhoff**, Alan I. Leshner, and Dietram A. Scheufele

Register Now ▸▸

Sign up to receive information about live webcast here

Modeling and Visualizing Science and Technology Developments

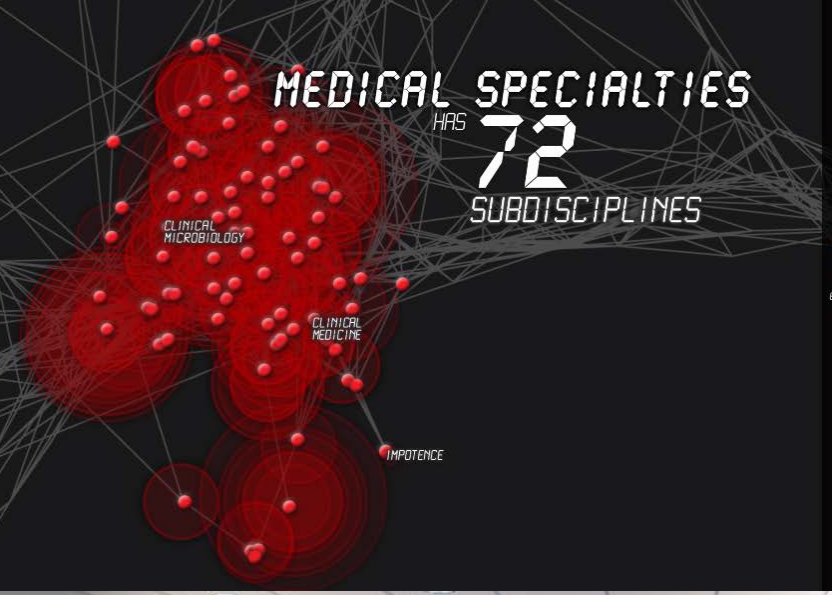
December 4-5, 2017; Irvine, CA
Organized by Katy Börner, William Rouse, **H. Eugene Stanley**, and Paul Trunfio

Register Now ▸▸

Economics, Environment, and Sustainable Development

January 17-18, 2018: Irvine, CA
Organized by: **Simon Levin**, **Stephen Carpenter**, **Gretchen Daily**, **Sir Partha Dasgupta**, **Paul Ehrlich**, **Geoffrey Heal**, **Catherine Kling**, **Jane Lubchenco**, and **Stephen Polasky**

http://www.nasonline.org/programs/sackler-colloquia/upcoming-colloquia



Science Forecast S1:E1, 2015

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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