Ocean Observatories Initiative

The OOI Ocean Education Portal

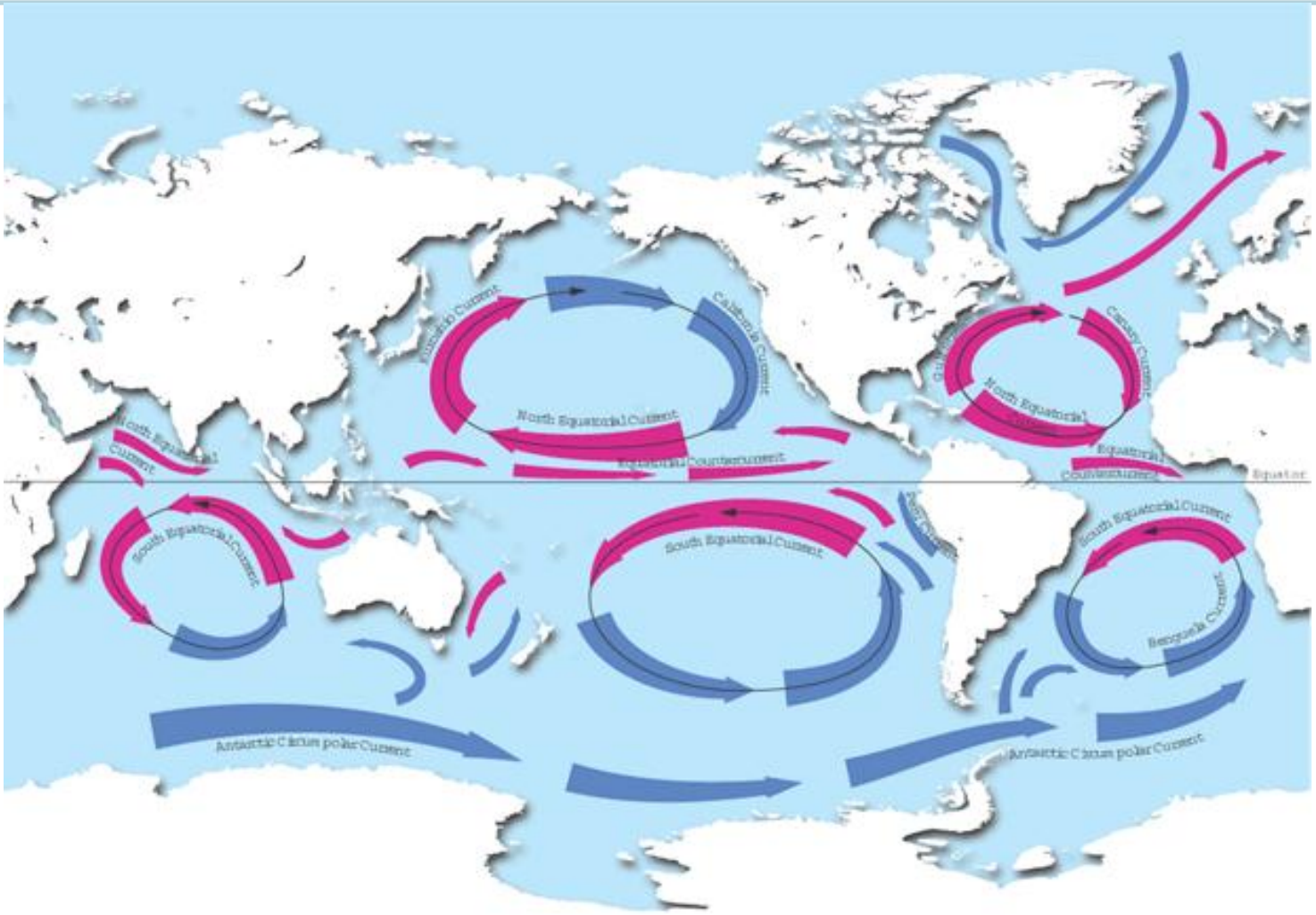
Ocean Sciences 2014
Workshop for 2YC Faculty

Sage Lichtenwalner & Janice McDonnell

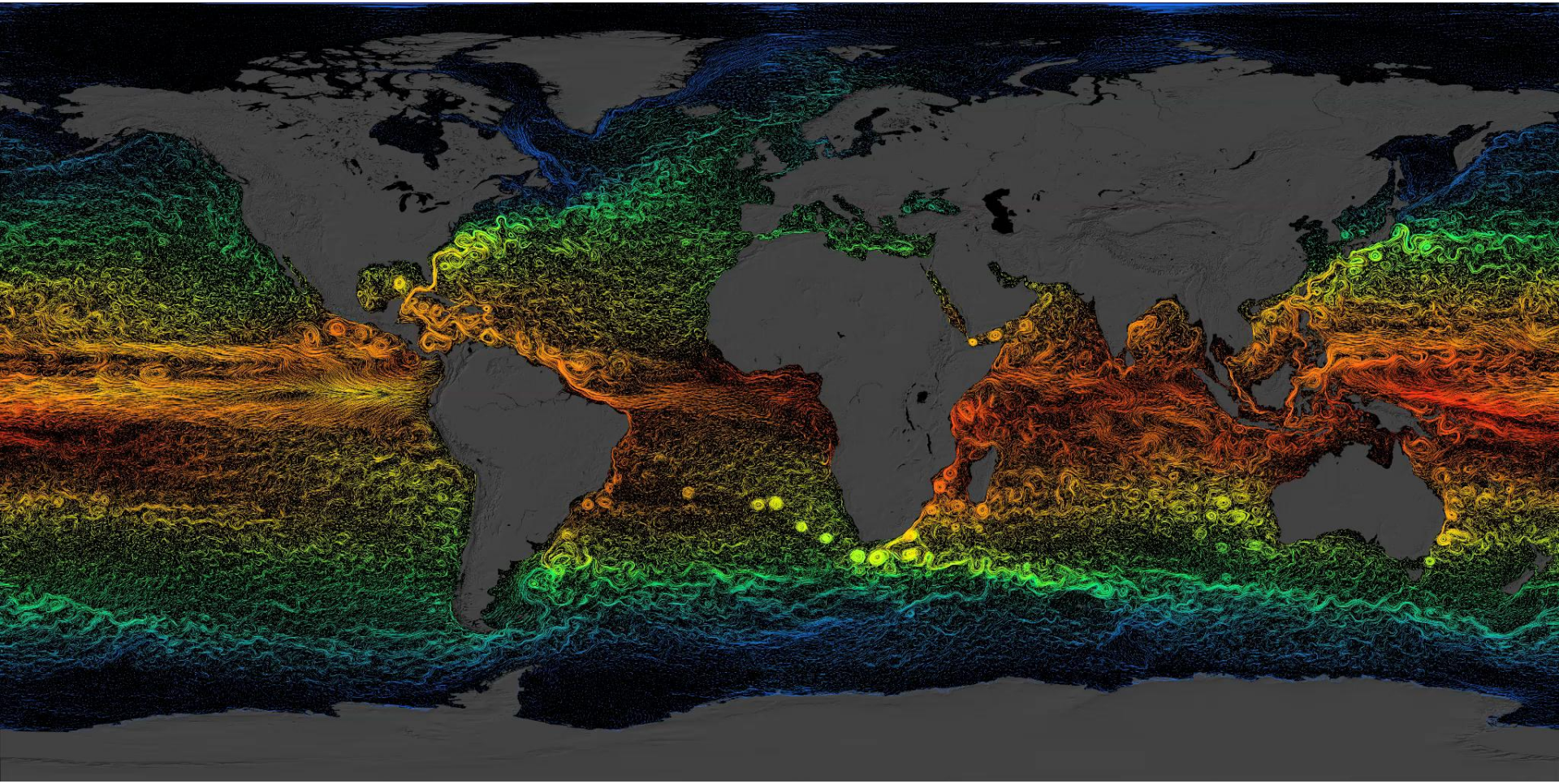
Agenda

- What is Data?
  - OOI Visualization Tools
- How can we use data in teaching?
  - The OOI Data Investigation Builder
  - An Example Data Investigation Activity
- Reflection

This is what we teach – 5 Ocean Gyres



But this is what the World Ocean looks like.

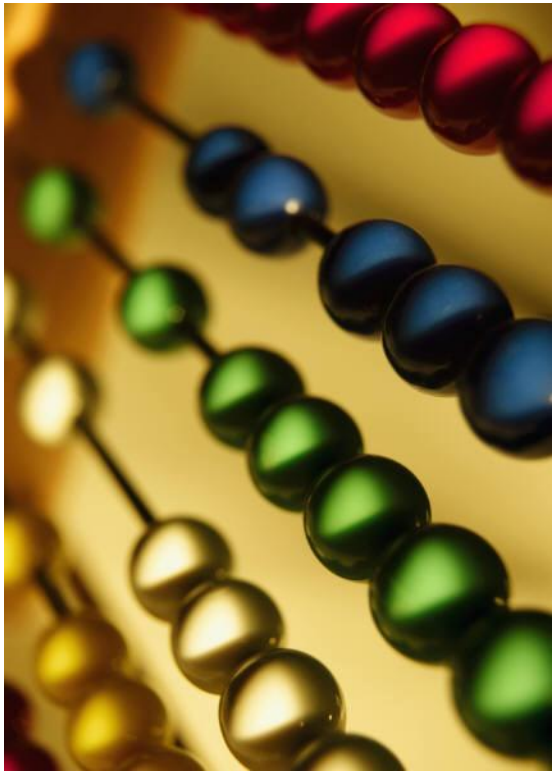


Complex Circulation defines the Ocean Gyres

What is Data?

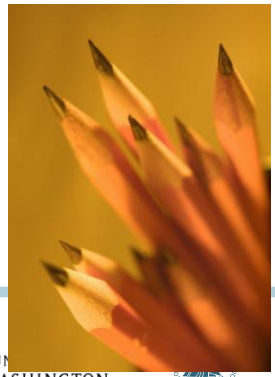
Survey Data Activity

Let’s start off by collecting some data right now!



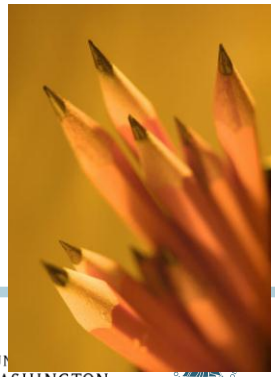
Where did you grow up?

1. Northeast
2. Southeast
3. Midwest
4. South Central
5. Northwest
6. Southwest
7. Outside of the “Lower 48”



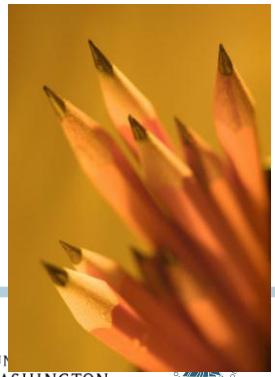
How many years have you been teaching?

1. Less than 5
2. 5 to 10
3. 10 to 20
4. 20+



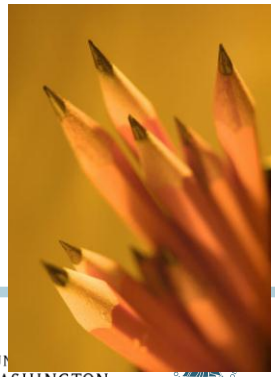
What is your favorite animal at the aquarium?

1. Class Actinopterygii
2. Class Asteroidea
3. Class Chondrichthyes
4. Family Delphinidae
5. Family Otariidae
6. Class Scyphozoa



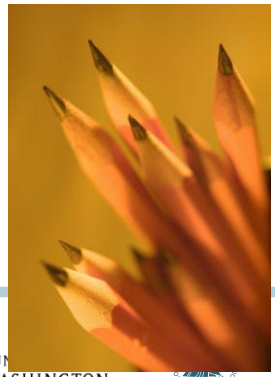
What is your favorite animal at the aquarium? - 2

1. Class Actinopterygii - Ray-finned Fish
2. Class Asteroidea - Sea Stars
3. Class Chondrichthyes - Sharks
4. Family Delphinidae - Dolphins
5. Family Otariidae - Sea Lions
6. Class Scyphozoa - Jellyfish



How do you define “data”?

1. A Star Trek character played by Brent Spiner.
2. A collection of facts from which conclusions may be drawn.
3. The raw material of information stored within a computer or file.
4. The information collected during a scientific study.
5. The numbers that come out of an instrument or machine.



What is Data?

Terminal — ssh — 193x31

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   0.1617   24.9951   0.0840   18   24   35   6   26   2001   0.0518   997.0888   1496.9050   1093   171   39.3956   74.1536   90
   0.0760   24.9743   0.0840   18   24   35   6   26   2001   0.0486   997.0917   1496.8380   1093   171   39.3956   74.1536   91
   0.0980   24.9698   0.0870   18   24   36   6   26   2001   0.0493   997.0934   1496.7910   1093   170   39.3956   74.1536   92
   0.0742   24.9681   0.0790   18   24   36   6   26   2001   0.0466   997.0918   1496.7540   1092   170   39.3956   74.1536   93
   0.0442   24.9563   0.0690   18   24   37   6   26   2001   0.0407   997.0903   1496.7130   1092   170   39.3956   74.1536   94
  32.1678   24.9343   0.2140   18   24   37   6   26   2001   5.4506   1001.1654   1502.6180   1090   170   39.3956   74.1536   95
  45.9313   24.9062   0.2800   18   24   37   6   26   2001   12.2996   1006.3049   1509.9500   1090   131   39.3956   74.1537   96
  46.3867   24.9023   0.3390   18   24   38   6   26   2001   17.4517   1010.1676   1515.4330   1089   131   39.3956   74.1537   97
  46.3803   24.8585   0.3910   18   24   38   6   26   2001   21.1735   1012.9729   1519.3580   1089   130   39.3956   74.1537   98
  46.3505   24.7866   0.4660   18   24   38   6   26   2001   23.8352   1014.9936   1522.1150   1087   130   39.3956   74.1537   99
  46.3062   24.7211   0.4540   18   24   39   6   26   2001   25.7259   1016.4345   1524.0270   1088   130   39.3956   74.1537   100
  46.1350   24.6607   0.3840   18   24   39   6   26   2001   27.0366   1017.4383   1525.3080   1088   129   39.3956   74.1537   101
  36.5877   24.6702   0.2860   18   24   40   6   26   2001   25.9051   1016.5833   1524.0120   1086   129   39.3956   74.1537   102
  45.0366   24.7071   0.2530   18   24   40   6   26   2001   26.9196   1017.3362   1525.0710   1086   129   39.3956   74.1537   103
  46.1190   24.7676   0.2950   18   24   40   6   26   2001   27.8559   1018.0238   1526.1020   1085   129   39.3956   74.1537   104
  46.2893   24.7945   0.3180   18   24   41   6   26   2001   28.5457   1018.5356   1526.8800   1085   135   39.3956   74.1537   105
  46.3521   24.7687   0.3820   18   24   41   6   26   2001   29.0482   1018.9222   1527.4270   1083   135   39.3956   74.1537   106
  46.0724   24.6512   0.5300   18   24   42   6   26   2001   29.3628   1019.1945   1527.6840   1083   131   39.3956   74.1537   107
  46.2877   24.4058   0.4620   18   24   42   6   26   2001   29.6788   1019.5044   1527.7850   1082   131   39.3956   74.1537   108
  46.2065   24.4704   0.3430   18   24   42   6   26   2001   29.8704   1019.6295   1527.8710   1082   131   39.3956   74.1537   109
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  44.5135   24.6327   0.3200   18   24   44   6   26   2001   26.9744   1017.3994   1524.8780   1081   137   39.3956   74.1537   112
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  45.6578   24.2337   0.3840   18   24   44   6   26   2001   28.5353   1018.6916   1526.1860   1079   138   39.3956   74.1537   114
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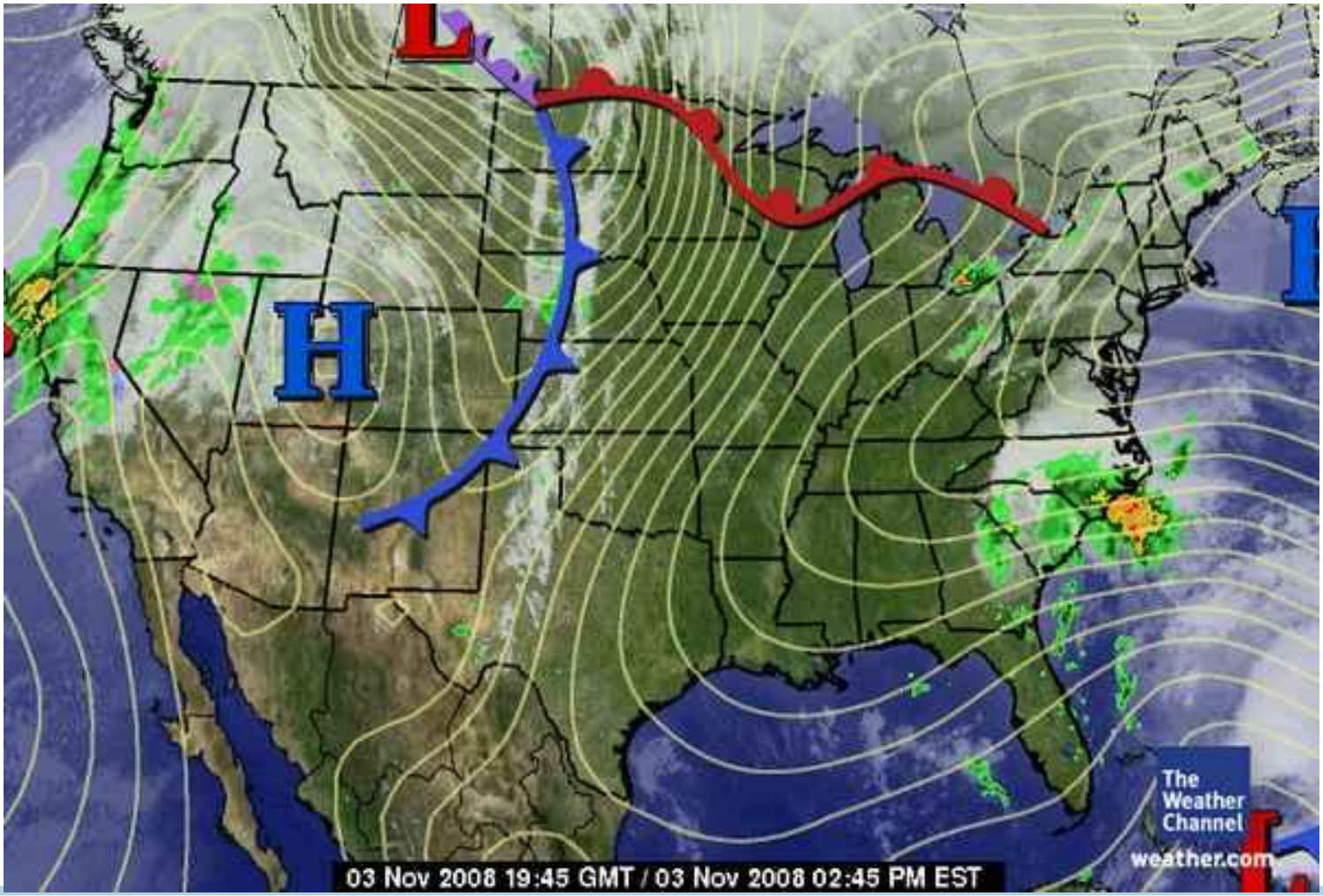
  45.8874   24.1944   0.4150   18   24   45   6   26   2001   29.4086   1019.3619   1526.6630   1077   136   39.3957   74.1538   116
  45.4137   24.0422   0.4790   18   24   46   6   26   2001   29.5924   1019.5449   1526.6700   1076   136   39.3957   74.1538   117
  45.3523   23.6426   0.4130   18   24   46   6   26   2001   29.7877   1019.8071   1526.4440   1077   136   39.3957   74.1538   118
--More--(35%)
```

And where can we find it?

Anywhere!

You can find plenty of data online, or you can collect it yourself.

Weather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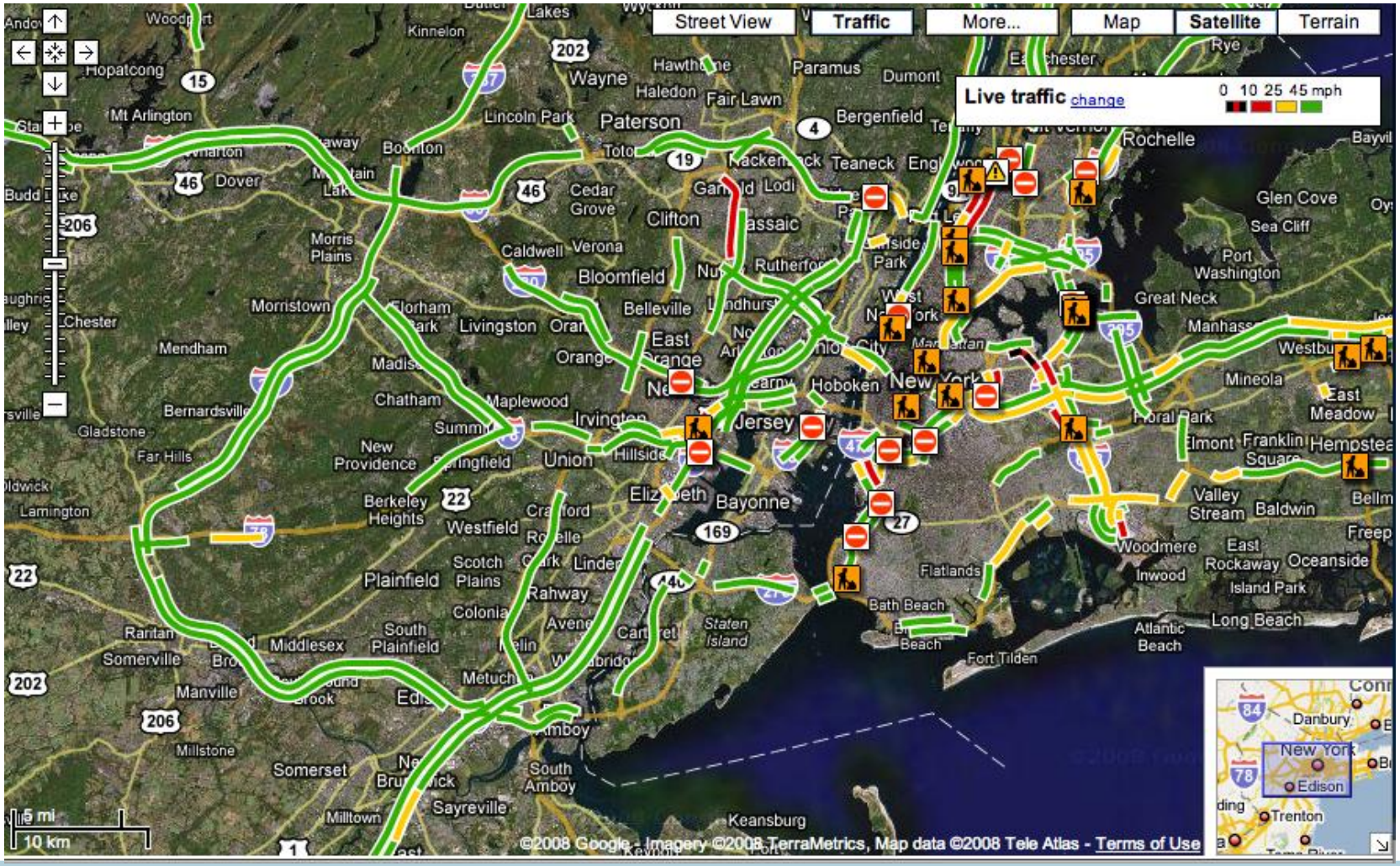
H
The Weather Channel
weather.com
03 Nov 2008 19:45 GMT / 03 Nov 2008 02:45 PM EST

Stock Market

Traffic


Street View
Traffic
More...
Map
Satellite
Terrain
Live traffic change
0 10 25 45 mph
Woodport
Kinnelon
Lakes
Hopatcong
Wayne
Hawthorne
Haledon
Paramus
Dumont
Rye
Mt Arlington
Lincoln Park
Paterson
Fair Lawn
Bergenfield
Rochelle
Boonton
Dover
Cedar Grove
Clifton
Passaic
Teaneck
Glen Cove
Sea Cliff
Morris Plains
Caldwell
Verona
Bloomfield
Rutherford
Port Washington
Great Neck
Morristown
Florham Park
Livingston
Belleville
East Orange
Hoboken
New York
Manhasset
Westbury
Mineola
Mendham
Chatham
Maplewood
Irvington
Jersey City
East Meadow
Bernardsville
Gladstone
Far Hills
New Providence
Union
Hillside
Elizabeth
Bayonne
Franklin Square
Hempstead
Lamington
Berkeley Heights
Westfield
Cranford
Roselle
Valley Stream
Baldwin
Freeport
Plainfield
Scotch Plains
Linden
Rahway
Woodmere
East Rockaway
Oceanside
Inwood
Island Park
Flatlands
Bath Beach
Long Beach
Atlantic Beach
Fort Tilden
Staten Island
Raritan
Somerville
Middlesex
South Plainfield
Manville
Metuchen
Millstone
Somerset
South Amboy
Sayreville
Milltown
Keansburg
Danbury
New York
Edison
Trenton
5 mi
10 km
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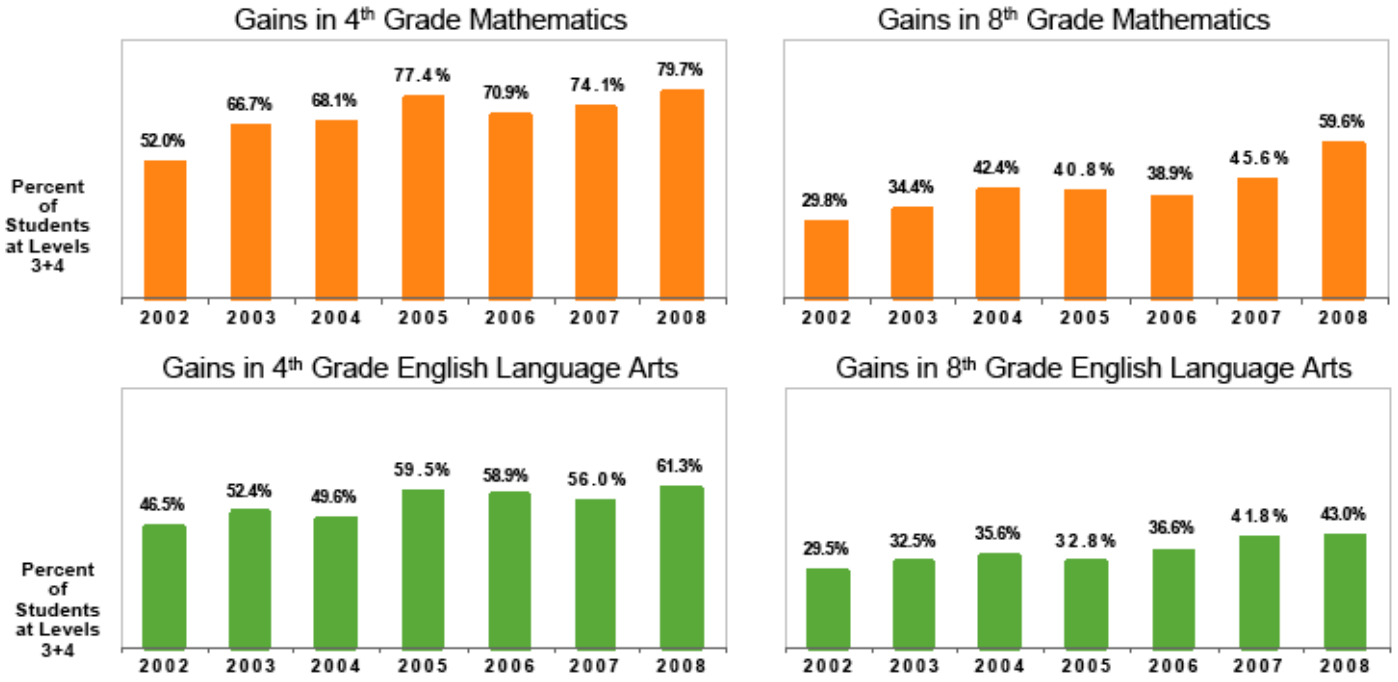
Education

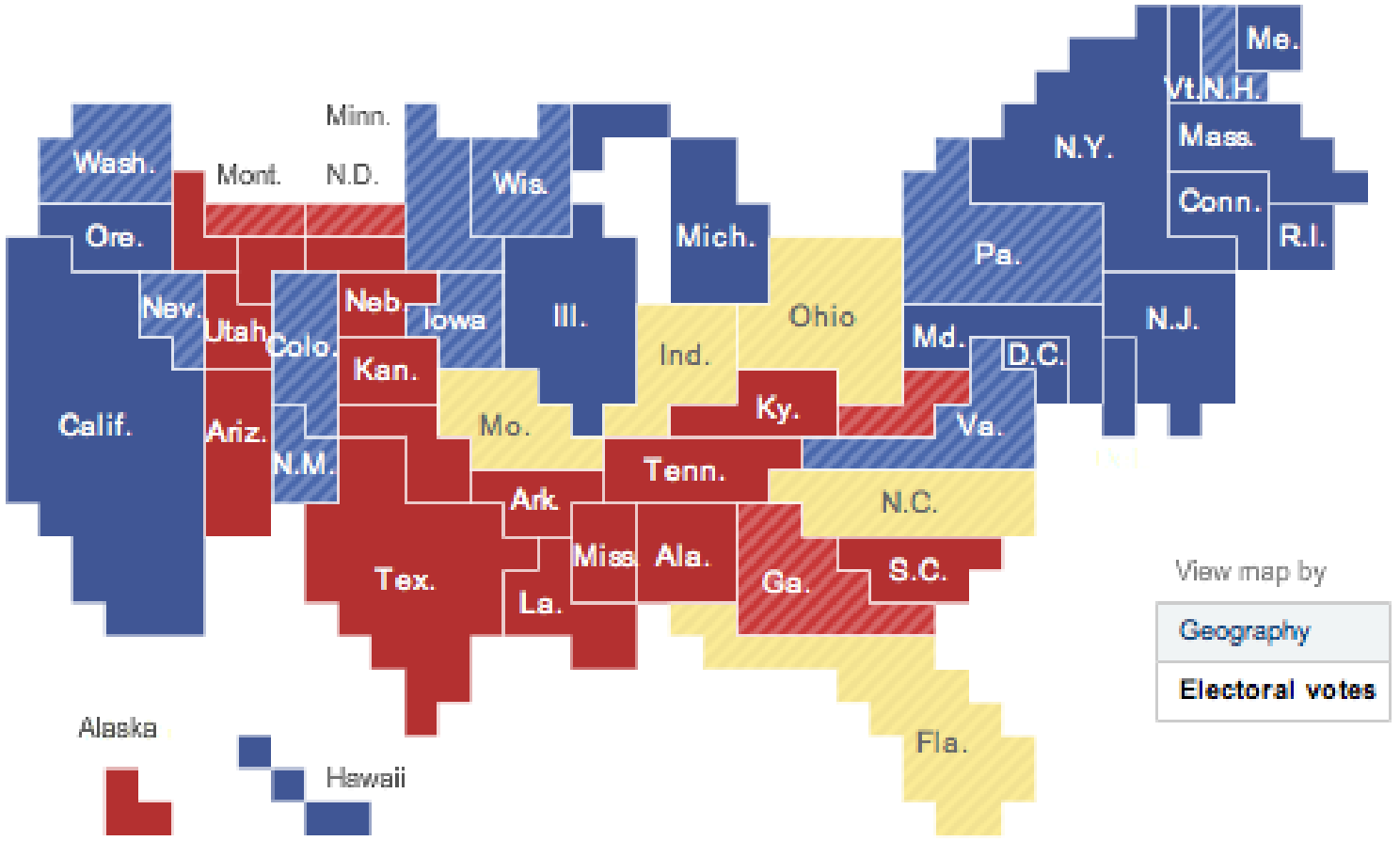
NYC STUDENTS MAKE SUSTAINED, STEADY PROGRESS IN MATH AND ELA



Since 2002, the percentage of students meeting or exceeding State standards is up 27.7 points in 4th grade math and up 29.8 points in 8th grade math. In ELA, the percentage is up 14.8 points in 4th grade and 13.5 points in 8th grade.

NYC Department of Education
Joel I. Klein, Chancellor

Election (2 views)



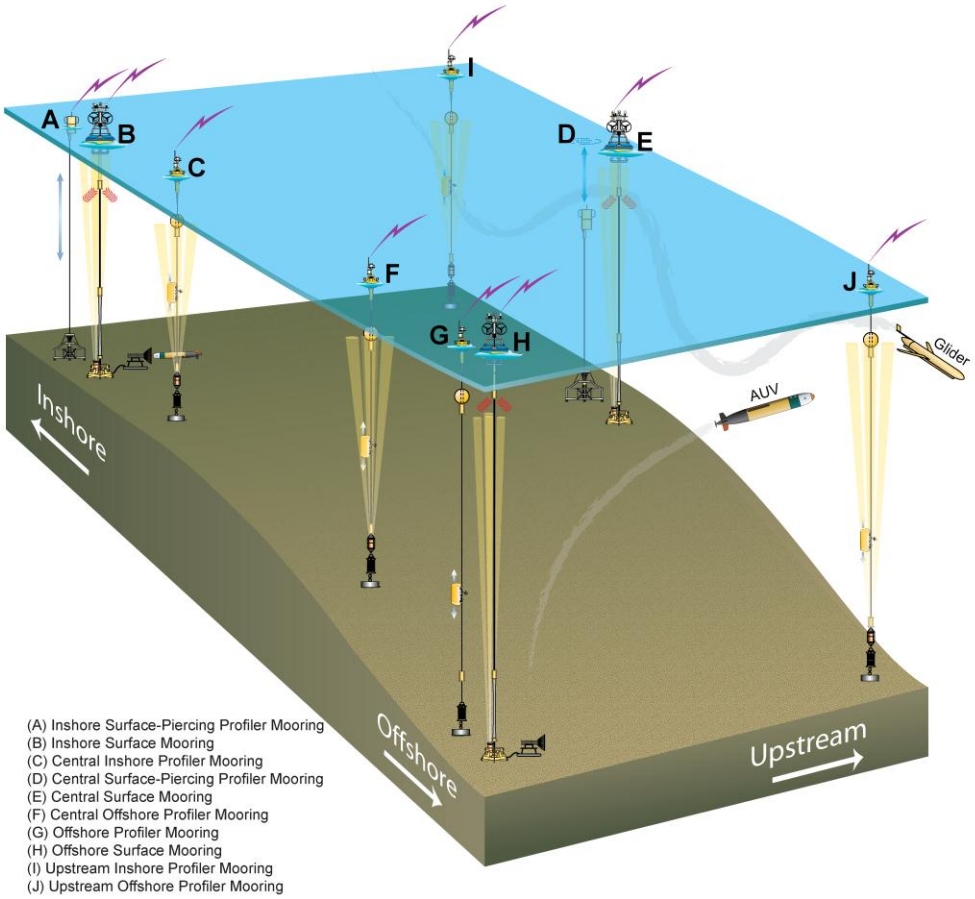
Obama 291 **163 McCain**

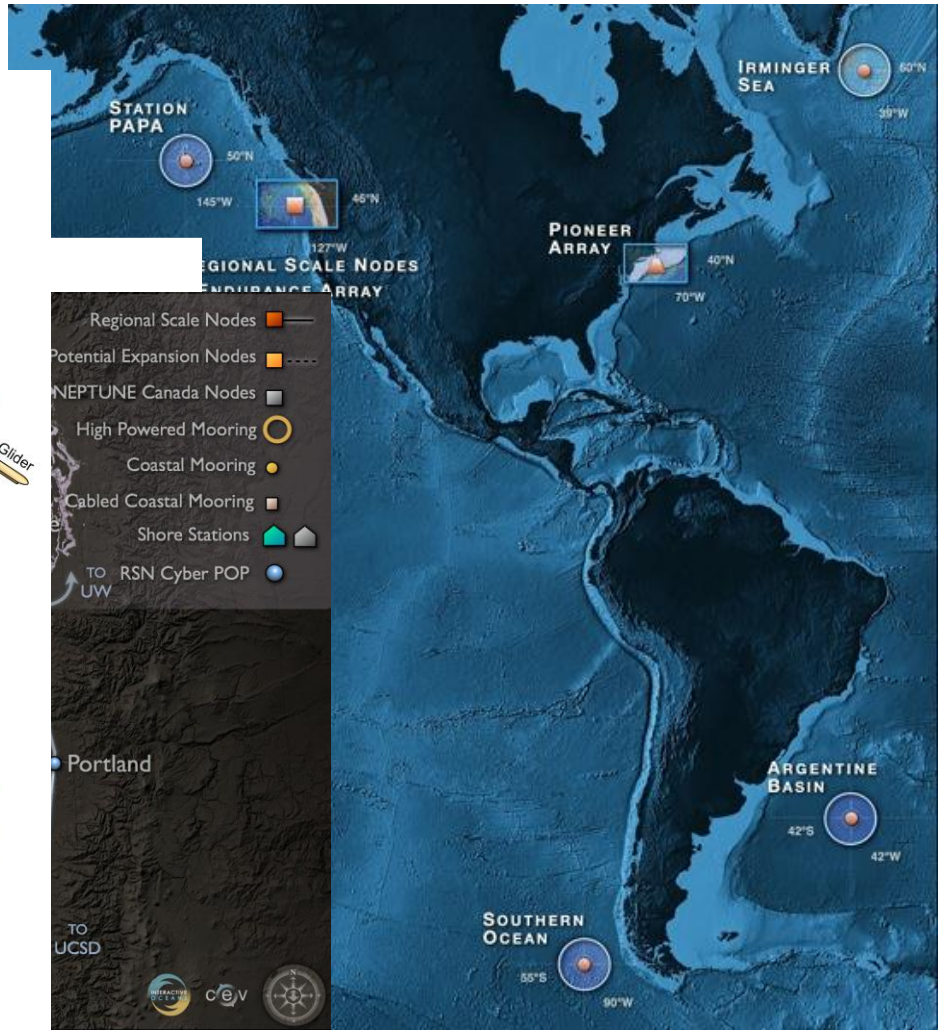
196 Solid Obama | 95 Leaning Obama | 84 Tossup | 26 | 137 Solid McCain

270 electoral votes needed to win

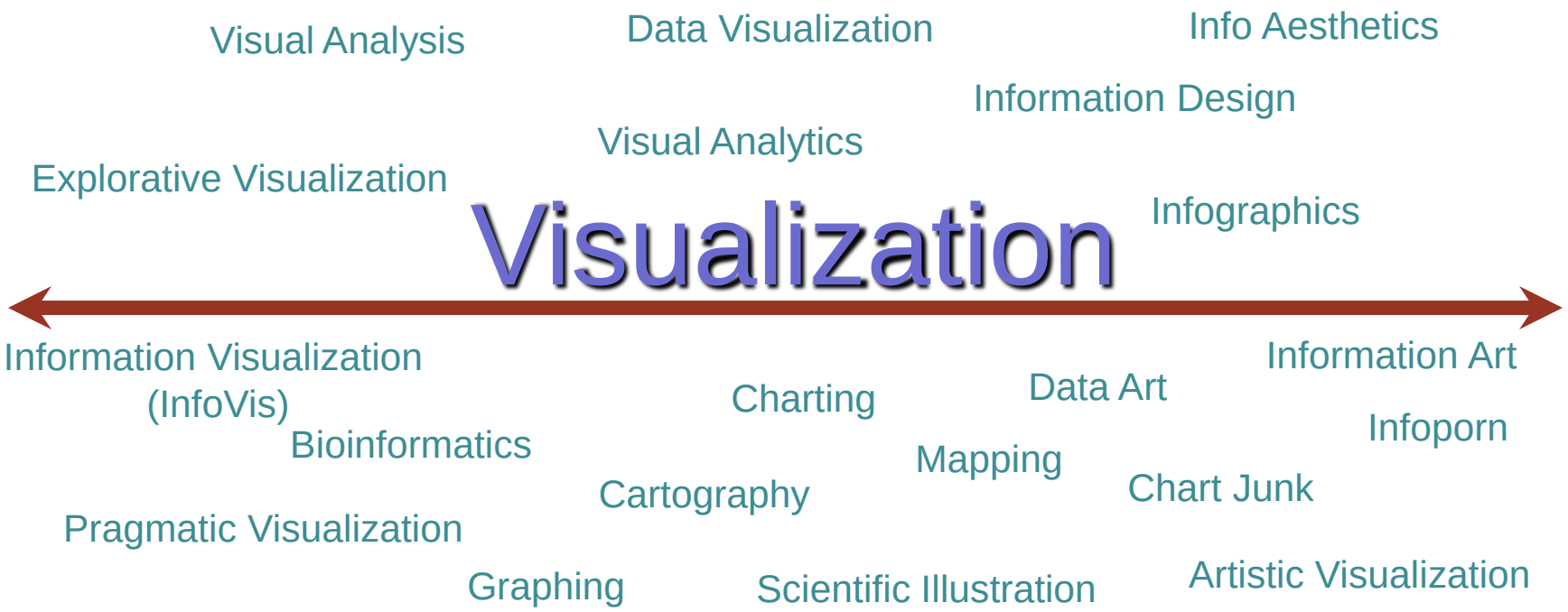
The Ocean Observatories Initiative

Global Regional Coastal





What is “Visualization”?



“*Visual analysis is not primarily about the pictures, but about finding ways to use our powerful visual systems to analyze data. It's analysis done in a visual way. It's visual exploration, visual data analysis, and visual presentation of results*.”

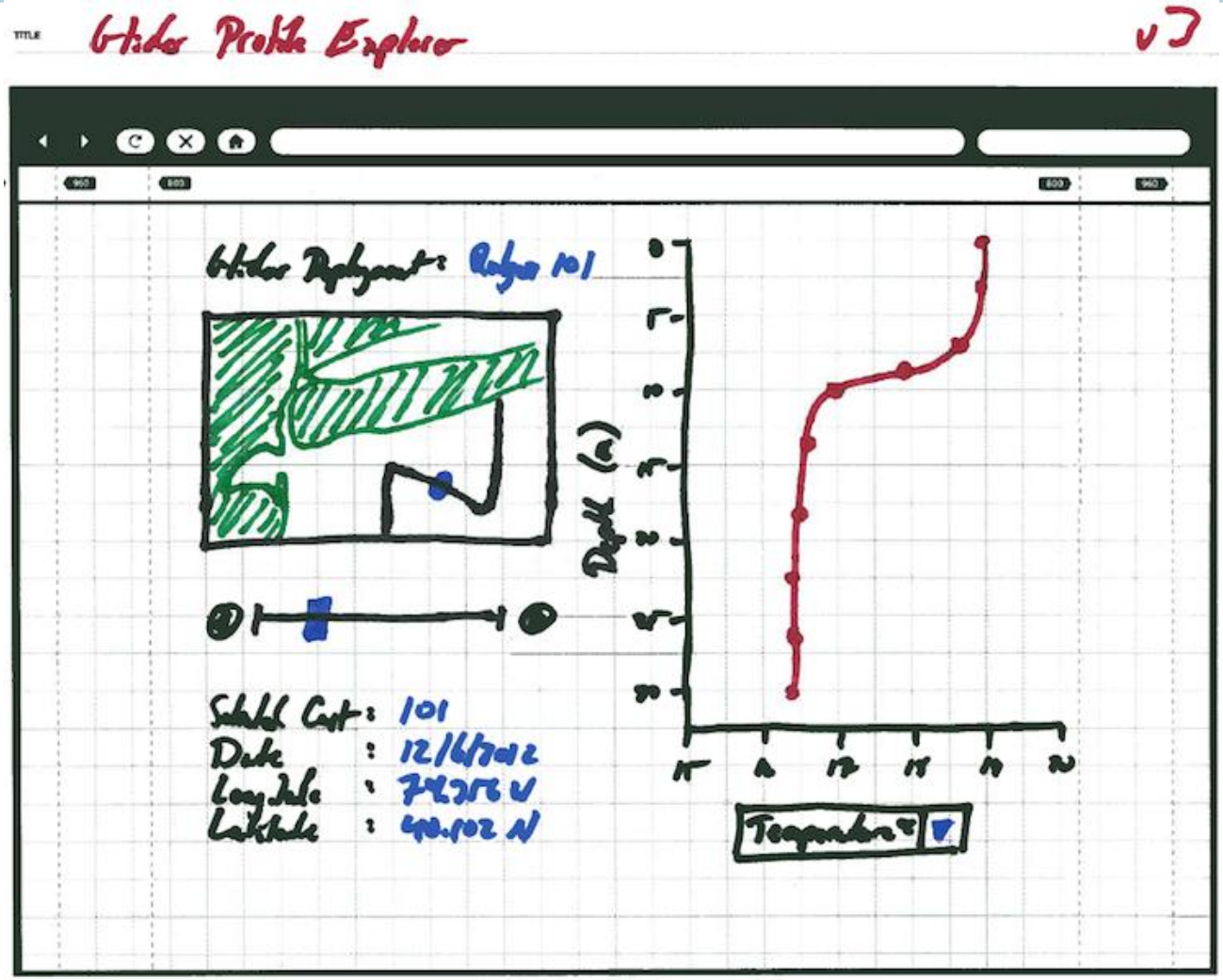
Robert Kosara, eagereyes.org

EPE Design Philosophy

EPE Visualization Tools are designed to be:

- **Simple**
  - Intuitive & easy to use
- **Interactive**
  - To support deeper understanding
- **Customizable**
  - Adapt them to fit your learning goals
- **Embeddable**
  - Place them in context within your lessons
- **Focused**
  - Learning outcome driven, not data driven – these are not your typical comprehensive data visualization tools
- **Educational**
  - Primary goal is to aid students' analysis and understanding of scientific processes, not dealing with data formats and graphing

An Educator's Visualization Tool

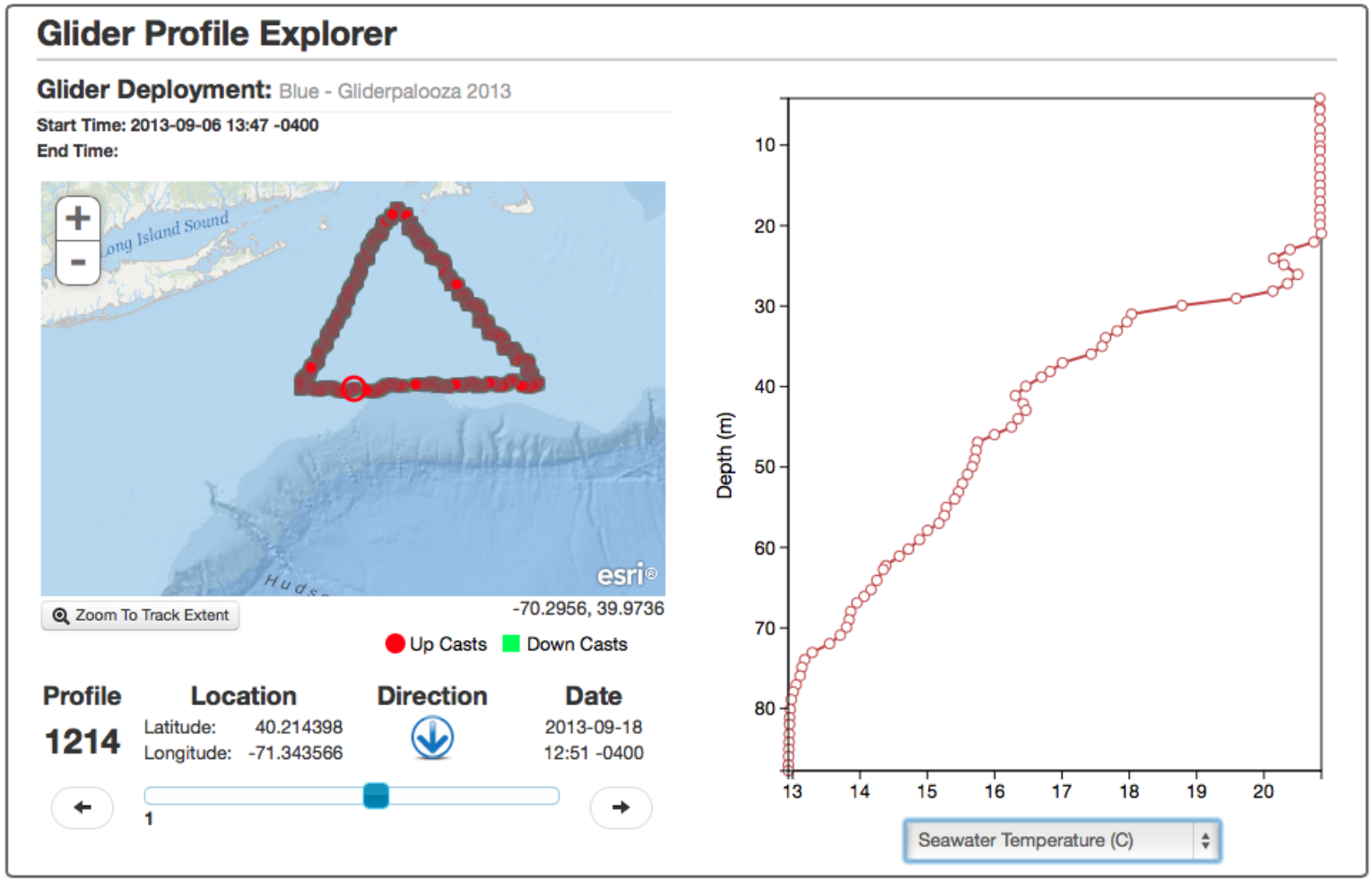


Driving Questions:

This tool will allow students to analyze single glider profiles (also called casts) to investigate the following questions:

- How do measurements vary over the depth of the water column?
- How does the shape of a particular measurement's profile vary over time and/or location?

Glider Profile Explorer



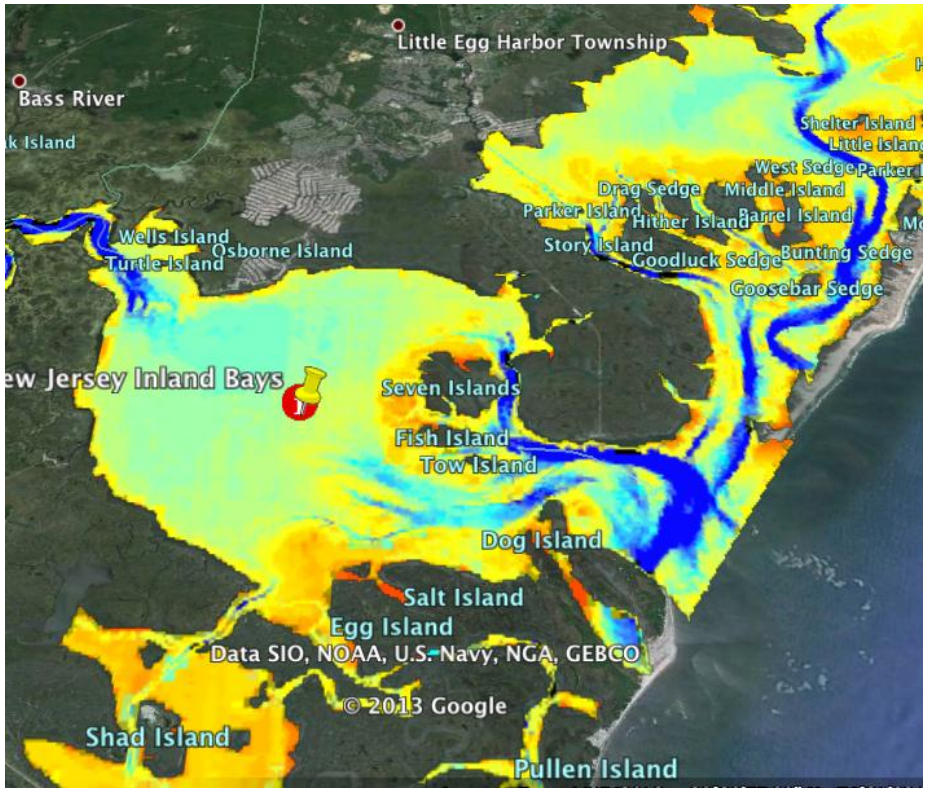
How can we use data in teaching?

Why are we doing this?

"The growth of big data has given rise to a whole new class of questions that need to be asked and answered. We need new tools to help students learn techniques for seeing patterns in data, and for analyzing and interpreting data in ways similar to those practiced by scientists and mathematicians."

—Wayne Harvey,

Vice President, EDC



Data-enhanced learning experiences..

including activities in which students collect and interpret their own data and/or those in which they explore research databases to answer questions.

Data enhanced learning experiences can:

- *Prepare students to address real-world complex problems;*
- *Develop students' ability to use scientific methods, including consideration of the values and ethics of working with data;*
- *Teach students how to critically evaluate the integrity and robustness of data or evidence and of their consequent interpretations or conclusions; and*
- *Provide training in scientific, technical, quantitative, and communication skills.*

*Manduca and Mogk 2002. Using Data in Undergraduate Science Classrooms (*Grant NSF-0127298)

Why is it important to teach with data?

Because science *is* "….the use of evidence to construct testable explanations and predictions..." (National Academy of Sciences)

Words (narratives, textbook descriptions, analogy/metaphor)
Physical models (static models (e.g. syncline)
working model (e.g. stream table)
Computer models
Drawings

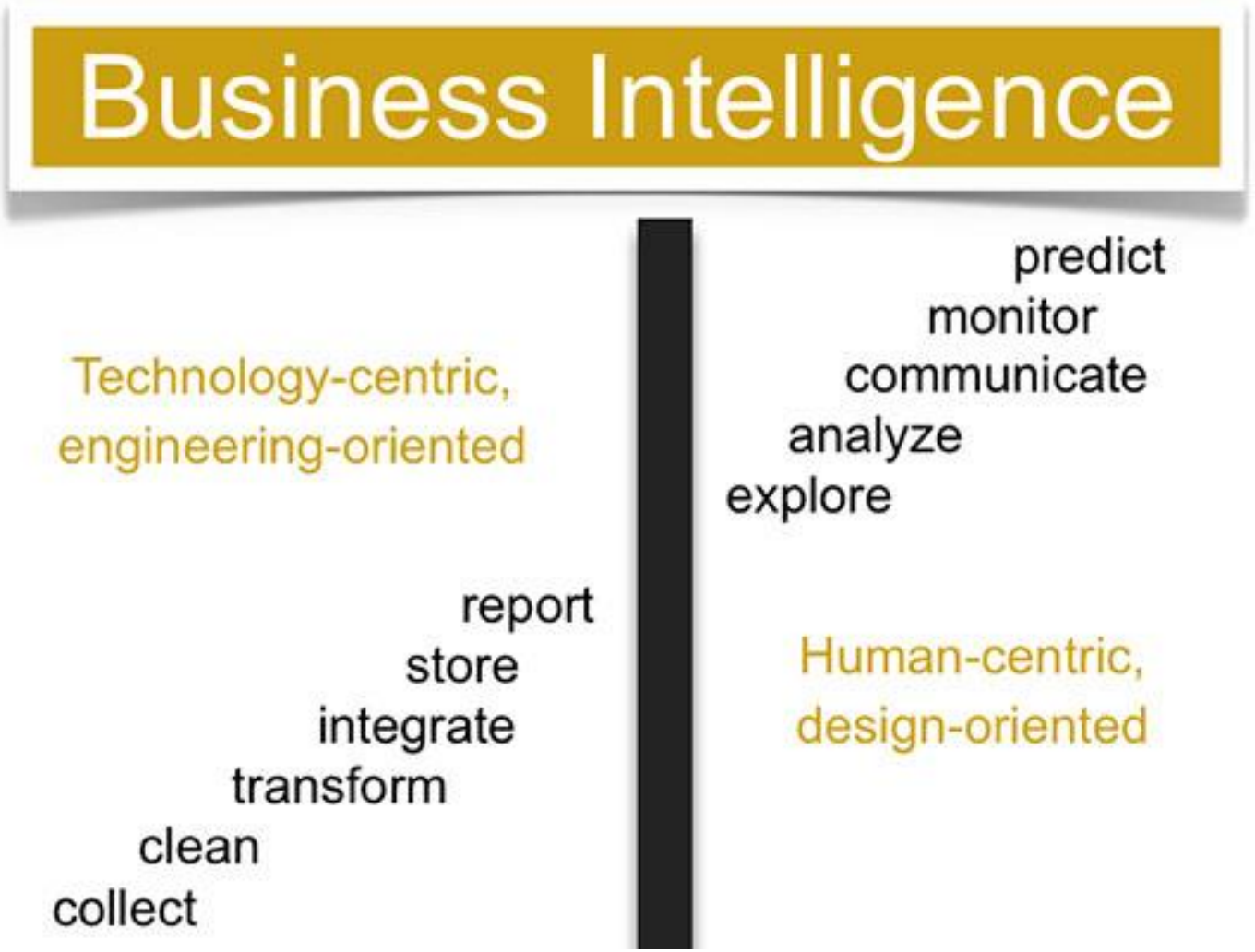
Explanations

Photographs, Video
Maps
Data-based visualizations (including graphs)

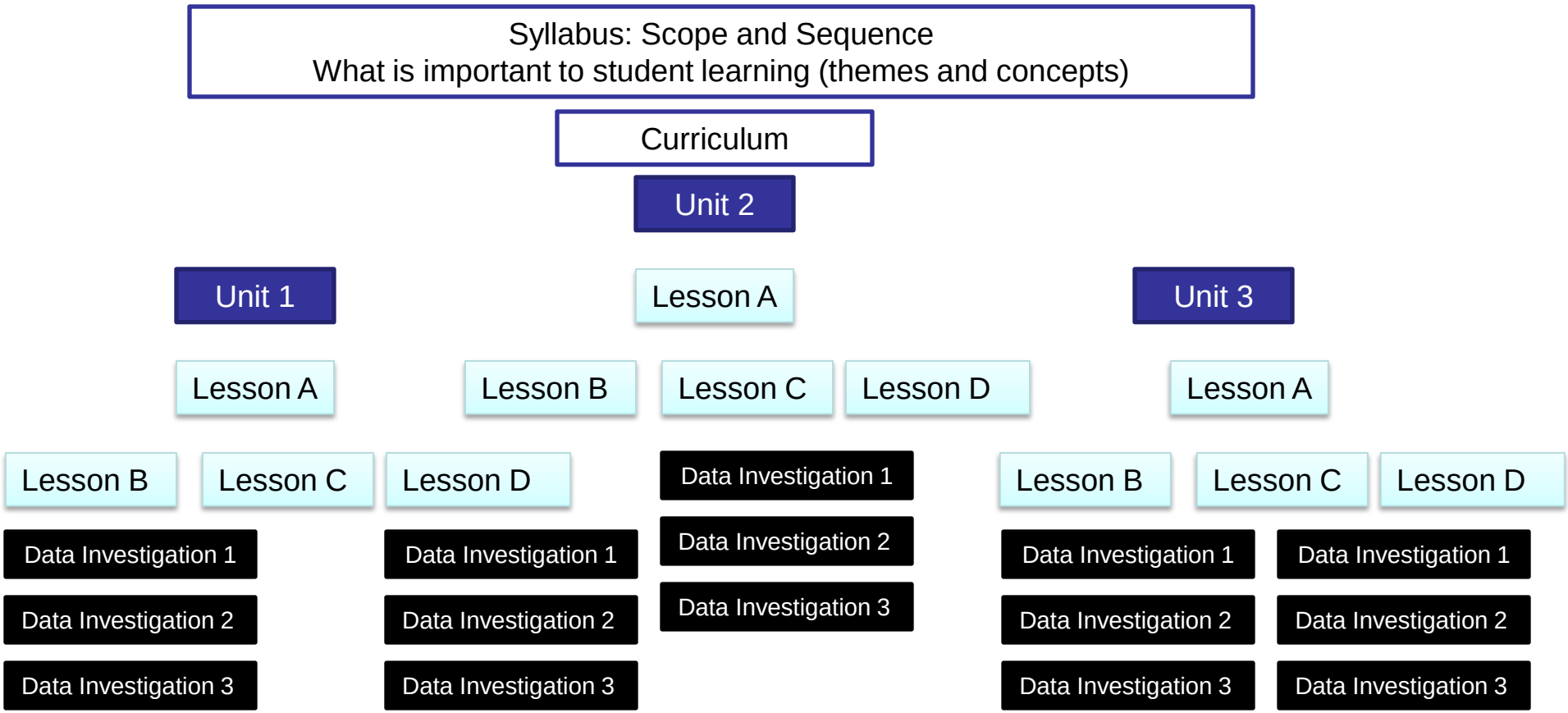
Evidence

Kastens 2010.

Are we stuck on the left?

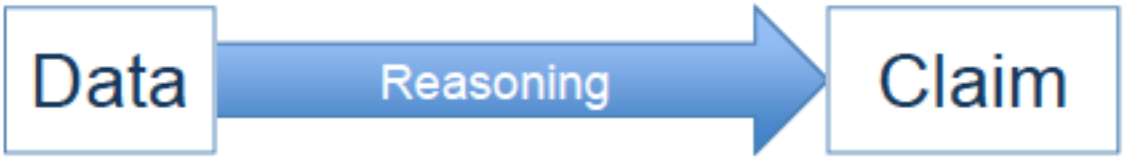


Terminology for the Data Investigation Builder



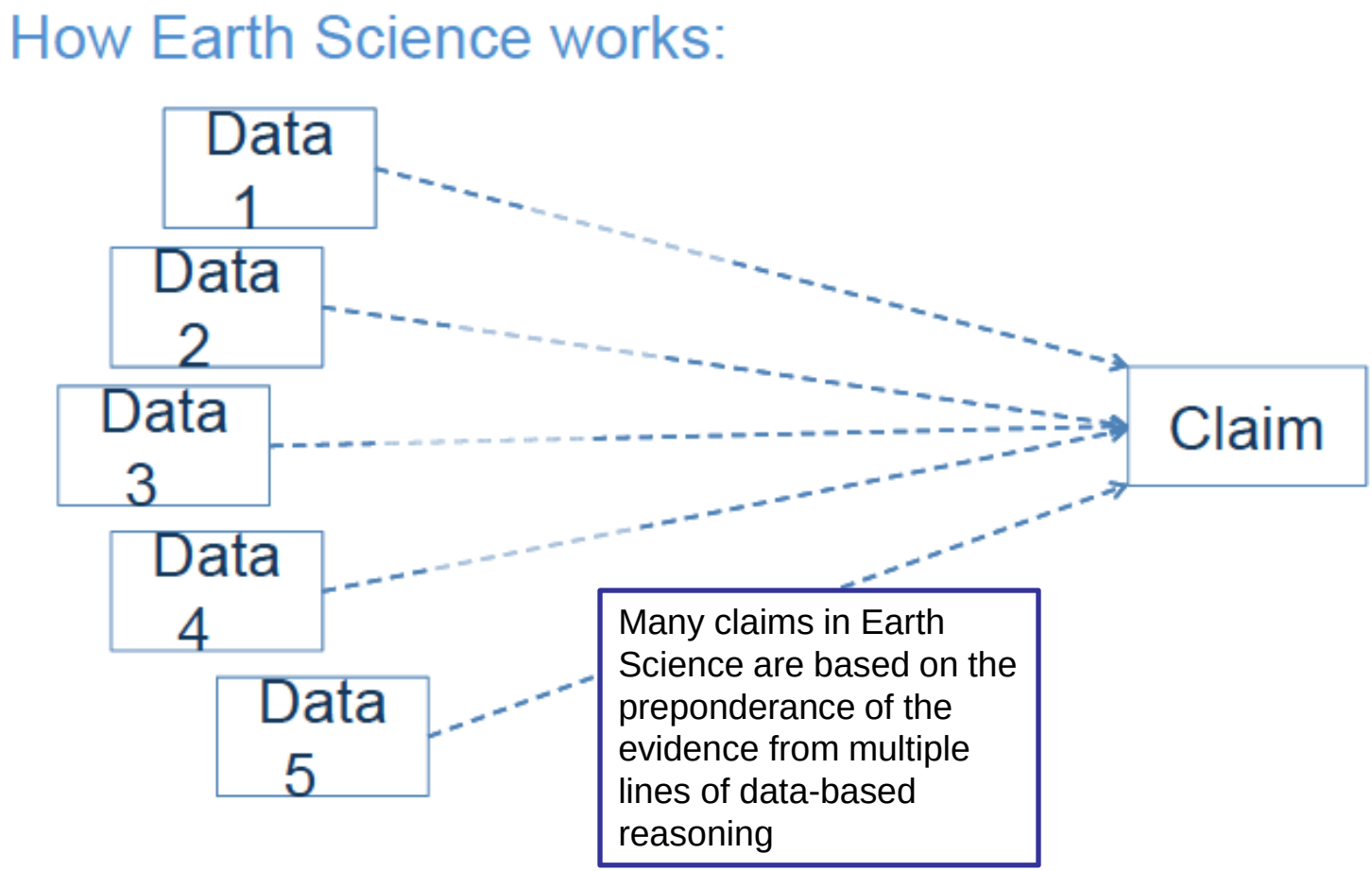
Claims, Evidence, and Reasoning

What students expect:



K. Kastens 2010. Oceans of Data Institute.

Claims, Evidence, and Reasoning



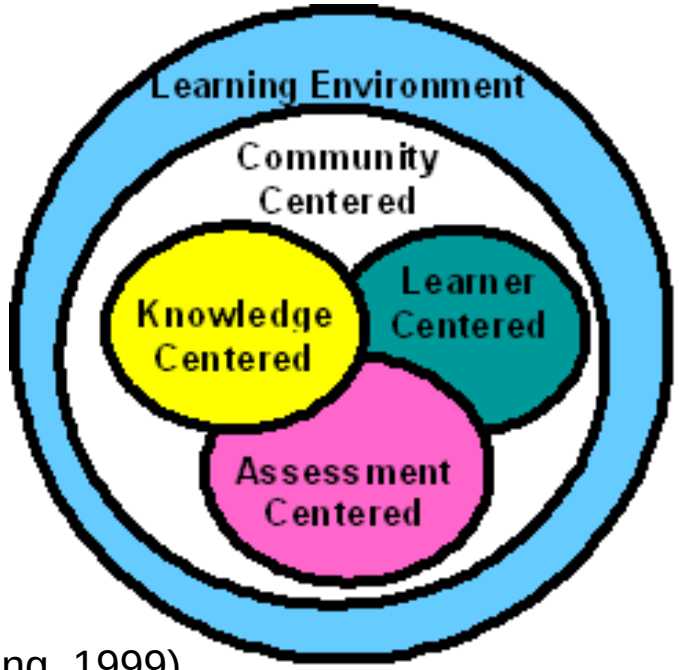
Student Argumentation Skills..

focused on analyzing evidence and backing up their claims. The ability to make and understand scientific claims, analyze evidence, and develop arguments from the analysis of data is critical to student learning success and to compete in the modern workforce.

Learning Sciences

Building theory in education through the design and empirical testing of learning environments that are:

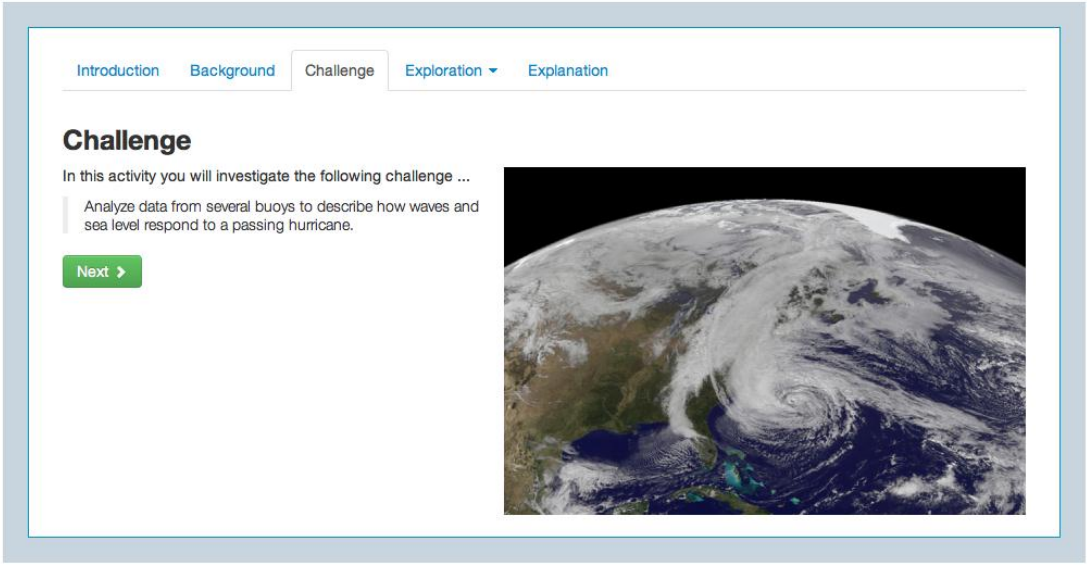
1. Knowledge centered
2. Learner centered
3. Assessment centered
4. Situated within a learning community



NRC: How People Learn (Bransford, Brown & Cocking, 1999)

Knowledge Centered

- Inquiry-based and organized around questions/problems
- Data driven activities.
- Investigations conclude with the development of a scientific explanation

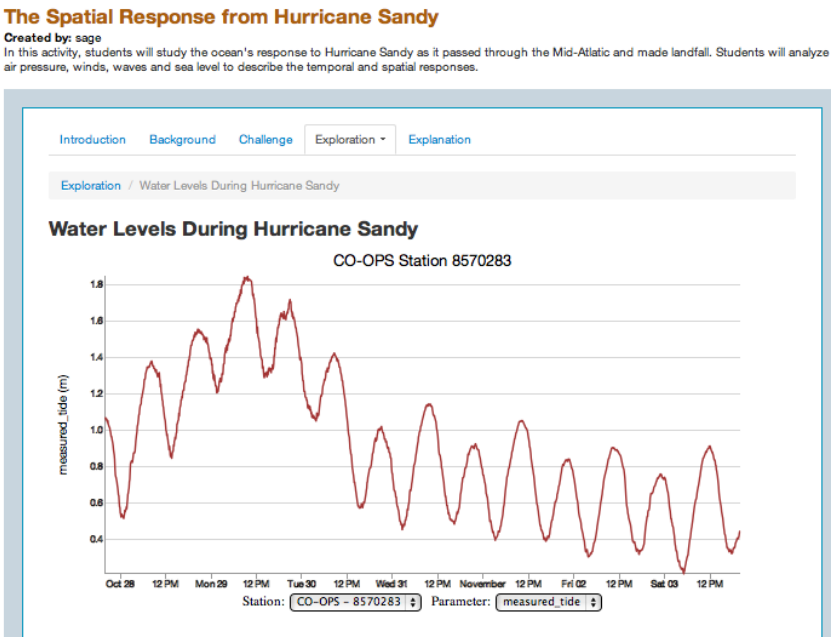


Mirrors scientific practice

(Duschl, 1990; Donovan & Bransford, 2005)

Student Centered

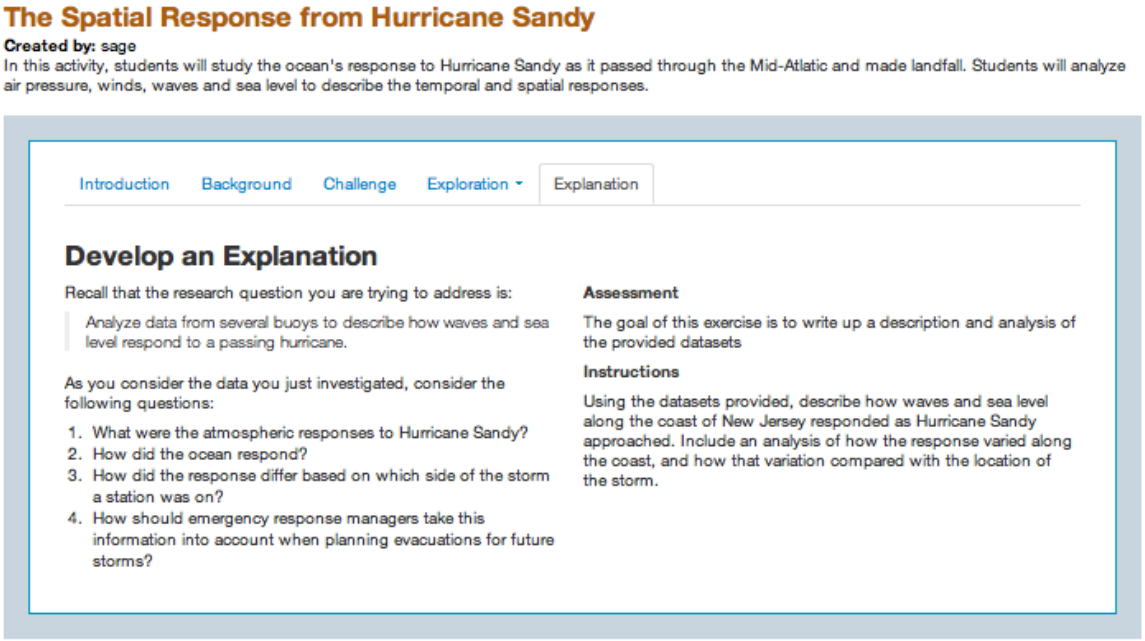
- Initial questions serve to surface students ‘prior knowledge
- Investigation help students build understandings of the core concepts
- There are opportunities to reflect on learning and compare initial ideas to final ideas



Surface, build, and revise ideas
(Driver et al., 1996; Ford & Forman, 2006)

Assessment Centered

- Formative assessment is critical for learning
- Supports professors in tailoring instruction to meet students' needs



The Spatial Response from Hurricane Sandy

Created by: sage

In this activity, students will study the ocean's response to Hurricane Sandy as it passed through the Mid-Atlatic and made landfall. Students will analyze air pressure, winds, waves and sea level to describe the temporal and spatial responses.

Introduction | Background | Challenge | Exploration | Explanation

Develop an Explanation

Recall that the research question you are trying to address is:

> Analyze data from several buoys to describe how waves and sea level respond to a passing hurricane.

As you consider the data you just investigated, consider the following questions:

1. What were the atmospheric responses to Hurricane Sandy?
2. How did the ocean respond?
3. How did the response differ based on which side of the storm a station was on?
4. How should emergency response managers take this information into account when planning evacuations for future storms?

Assessment

The goal of this exercise is to write up a description and analysis of the provided datasets

Instructions

Using the datasets provided, describe how waves and sea level along the coast of New Jersey responded as Hurricane Sandy approached. Include an analysis of how the response varied along the coast, and how that variation compared with the location of the storm.

Make thinking visible

(Black & Wiliam, 1998; Bransford, Brown & Cocking, 2000)

LET'S TRY IT OUT

Reflection

- How could you use this tool in your class or with your students?
- How can we make the tool easier to use?
- How can we make the tool more useful, that is, how should we modify or adapt this tool to support your learning goals?

A Framework for Using Data in Education

What Do Educators Want?

NERRS Real-Time Data Needs Assessment 2006
COSEE NOW Educator Survey 2008

Top requested features:

- Data visualization tools (ability to graph, map, chart data)
- Inquiry-based lessons/activities
- Lesson plans for teaching science concepts with RTD
- Locally relevant data sets
- Map interfaces
- Stories or case studies that show how scientists use real-time data.

Middle-school teachers were more likely to have students use:

- Computers at school as part of their lessons
- The Internet/websites at school as part of their lessons
- Real-time data (mostly student-collected data) as part of their lessons

Levels of Engagement

What can we as educators do to support learners at different levels, so they can successfully work with data, and build the next level of skill?

The three levels of engagement

- Orientation
  - Using data is very new to learners; they need a lot of guidance from the educator(s).
- Interpretation
  - Learners have basic data skills, and are practicing applying data to what they are studying about a topic.
- Synthesis
  - Learners are skilled at “reading” data, and can proceed to using it as evidence to construct conclusions about the science.

Four Categories of Data

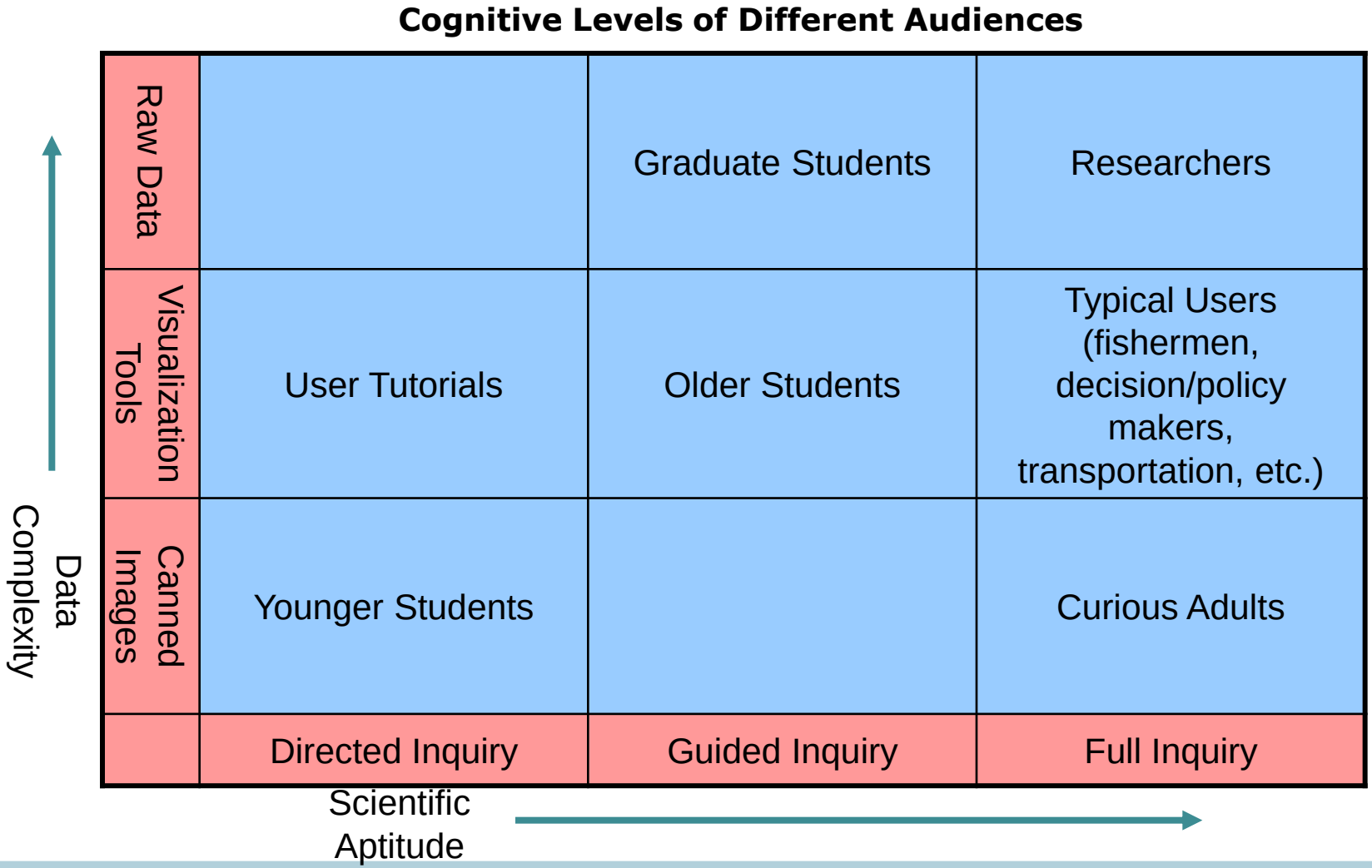
- **Real Time Data** (RTD)
  Data that are being collected currently, and can be accessed as they are collected to study current conditions or events

- **Archived data**
  Data that document past conditions or events; used to put present conditions into context

- **Simulated data**
  Data that look realistic, but were created using real data to emphasize a particular science concept or concepts

- **Learner Generated data**
  Data that are measured and/or calculated by learners as part of the activity.

A Framework for Data Visualization



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