A Plague of Too Much Data? Challenges and Opportunities for Using Authentic Data in the Classroom

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Data has Lots of Audiences

From “Why EPO?”, a NASA internal report on science education, 2005
Why is Data Important in Science Education?

Data is a critical component for understanding how science works. With it, we can:

- Design and conduct scientific investigations
- Understand the quality of data and the role of uncertainty in results
- Focus on quantitative analysis and reasoning
- Explore tools for visual representation

Virtual Observatories provide new mechanisms for collecting, manipulating, and aggregating data. They also provide the opportunity for new kinds of student experiences.
Data can be used to highlight the complexity of natural systems and the importance of an interdisciplinary approach to the natural world.

- Allows students to explore scenarios where they have to make real decisions regarding and using data.
- Given an appropriate level of structure and guidance, virtual observatories can be explored by the student in a way that promotes discovery-based learning.

**Connecting a student from their backyard to the world**
Important Things to Know About Teachers

1) The life of a teacher is one of limited time and high expectations. They have very little time to teach anything outside the standards, but almost all data can support those content goals.

2) Teachers are not scientists nor necessarily computer savvy.
   * Complex user interfaces can be a major barrier for utilization.
   * Offering visualization tools can be a good thing.

What are they looking for? DATA STORIES!!!
Prepackaged, refined data that addresses some specific aspect of the science they need to teach
Levels of Support from Science Institutes

- Provides educational support for the subject, but not necessarily access to ‘live’ data
- Access to ‘live’ data that is already packaged
- Access to ‘live’ data, using tools especially developed for general audiences
Educational Support -- Familiar Resources

The IRIS Education & Outreach (E&O) program, in collaboration with the seismological and educational communities, develops and implements programs designed to enhance seismology and Earth Science education in K-12 schools, colleges and universities, and in adult education.

- Lessons and Resources For Educators
- Professional Development for Educators
- School Seismographs
- IRIS/USGS Museum display
- Summer Internship Opportunities
- IRIS/SSA Distinguished Lectureship
- IRIS Educational Affiliate Membership
Packaged Data

To view the products from a specific month, select the bar in that month in the table below. To move to the previous or next year, select the arrow at the left or right below.

<table>
<thead>
<tr>
<th>Chlorophyll (SeaWiFS)</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>Feb</td>
</tr>
</tbody>
</table>

Chlorophyll (SeaWiFS) June 2006

SeaWiFS Chlorophyll Concentration (mg/m$^3$)

- >0.01
- 0.1
- 1.0
- 10
- 50
‘Live’ Data with Full Support

Buffer of Uniform Data

Virtual Net: | AFTAC |
Define data filter: (asterisk is a wildcard)

Select region: -90 <= LAT <= 90, -180 <= LON <= 180

Welcome to the NVO DataScope
If you have comments or suggestions send us feedback.

Table of recent transients/GRBs
What do we know about a given point or region in the sky?
To find out, just enter a target or position. The NVO DataScope will show you the results from hundreds of resources.

Position:
Use a target name (e.g., 3c273) or position (e.g., 10 10 10.1, 20 20 20.2)
Size: 0.25 (in degrees, max is 2)

Run query: Submit Query | Reset
Skip cache? Refresh registry? Do not add to list of recent queries?

Some recent queries:
- mrk 421 (0.25)
- ngc 3590 (0.25)
- 288.83, 11.011 (0.1333)
- 288.83, 11.010 (0.1333)
- 243.00, 55.399 (0.54)

Positions may be entered in decimal (dd.d, sdd.d) or sexagesimal (hh mm ss.s, dd mm ss.s) notation or as targets recognized by SIMBAD.
The Size should be entered in decimal degrees.
What do these successful programs have in common?

- They develop an educational context
- They treat educators as a class of users
- They constrain the user interface to limit choices -- *Already knowing what teachers and students are going to ask for*...
What is a Virtual Observatory?

It’s a distributed data system….

• Access to multiple data sets through a single portal
• User interface that takes care of database idiosyncracies
• Allows users to interact with wide variety of data seamlessly
• Often also involved specialized data tools
Virtual Radiation Belt Observatory

Near Real Time Data
- GOES
- POES

Long Term Archival Data
- Los Alamos
- The Aerospace Corporation
- University of Maryland
- National Aeronautics and Space Administration

Gateway to distributed data

Nowcast/Forecast Models

CISM End-to-End Models

Assimilation of Extreme-Event Data

Climatology Models

User Interface and Displays

GOES
POES

Climatology Models
The Many Flavors of VOs!

No part of the Earth and its Environment Untouched

- Atmospheres
- Oceans
- Geology and Hazards
- Sun-Earth Connection
- Biospheres

Not to mention, our Universe!
It’s not just the subject areas that are wide reaching….It’s also about the data….

real time vs. archived
raw data
images
spectral data
time series

How you receive the data…
ascii files
excel spreadsheets
fits files
level 2 and 3 data products

You may also have tools on hand to help....
So…..
*The data are there,*
*They are a tremendous opportunity*

*How do you get at it?*
This is an Emerging Field...

The best VOs are taking a smart approach:

- Starting with a conversation between educators, scientists and technologists
- Working to develop the educational context
- Using teachers and curriculum developers as consultants to inform their architecture
- Leveraging programs through existing educational channels (NASA, NSF, NSTA...)

Start by Googling “Virtual Observatory”.
Right now, This is a VO issue....

Virtual Observatories are recognizing the need to look outward, to bring their data to a broader set of audiences.

Several are developing a ‘non-specialist’ use case for the VOs... The framework that will allow them to serve the needs of teachers and students...
Semantic mediation layer - SWEET, ...

VO_1 \leftrightarrow VO_2 \leftrightarrow VO_3

DB_2 \leftrightarrow DB_3 \leftrightarrow DB_n

Education, clearinghouses, other services, disciplines, etc.
What is a Non-Specialist Use Case?

Someone should be able to query a virtual observatory without having specialist knowledge.

Teacher accesses internet goes to An Educational Virtual Observatory and enters a search for “Aurora”.
Teacher receives four groupings of search results:

1) Educational materials:
   http://www.meted.ucar.edu/topics_spacewx.php and http://www.meted.ucar.edu/hao/aurora/

2) Research, data and tools: via VSTO, VSPO and VITMO, knows to search for brightness, or green/red line emission

3) Did you know?: Aurora is a phenomena of the upper terrestrial atmosphere (ionosphere) also known as Northern Lights

4) Did you mean?: Aurora Borealis or Aurora Australis, etc
What does a VO need to make this happen?

- A set of rules that define the users needs…Use Case!
- This use case can be applicable across VOs…
- But there are some other kinds of visionary leaps that have to be made…