Teachers’ Learning…

…through distributed spatial analysis technologies and human support system online

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Virtual Immersion in Science Inquiry for Teachers
What is the VISIT?

VISIT is an Online Collaboratory for secondary school science teachers to participate in ongoing scientific investigations of contemporary problems in their localities through applying spatial analysis technologies. VISIT is a three-year project supported by a grant from the National Science Foundation Teacher Enhancement program.

VISIT provides teachers, scientists and students with tools and online environments for locating and using large scientific data bases, visualizing and analyzing data, collaborating with each other, and building scientific knowledge together. The overall technology application is called distributed geographic information systems (DGIS). The DGIS tools being composed support data mining, scientific investigation, knowledge base, curriculum integration, instruction management, learning assessment, and online participation.
Teacher Enhancement Goals. Learn to:

- Conduct investigations that support process and content curriculum objectives in science and technology.
- Work with large and multiple scientific data sets
  - Locate, acquire, use relevant data to support student work
  - Use software tools to mine and analyse data, reason, solve problems
- Participate in, facilitate online community of peers, scientists.
- Access and apply scientific knowledge needed to interpret and understand findings
- Work with local community to manage projects relevant to community & student interests
- Develop and apply rubrics to assess learning and products.
Developers (Core Team)

- Eastern Michigan University
  - School of Education
  - Center for Environmental Information Technology Applications (CEITA)
- Detroit Public Schools teachers & administrators
- Boston area Metropolitan Alliance Teachers
- Government agencies; university consultants
VISIT Support for Teachers’ Investigations

Curriculum connections; School-based collaborations

Software tools

Scientific Data Sets

Scientific reasoning, knowledge base

Online Course & Community; Forums

Local community scenarios

Assessment & Quality Assurance

Collaborators: Peers & Scientists

Face-to-Face Activities

Tutorials & Hands-on Exercises
Design Criteria for VISIT Tools (technical viewpoint)

- Easy-to-use from school and home computers connected to Internet.
- Teachers and scientists can learn quickly how to use all tools and participate in community.
- Teachers’ software tools are either “free” (e.g. ArcExplorer, ArcVoyager) or commonly available in school (e.g. Excel).
- Teachers’ tools are general-purpose. Teachers and students can apply them in wide range of topics, data sets.
- All tools, data, knowledge base, community interactions work through the same interface on the WWW (“seamless operation”).
- Use state-of-art online technologies for all functions.
- Take advantage of existing datasets, WWW-based materials.
- Schools, school districts, and communities can adopt and tailor the VISIT tools to their local curriculum, data infrastructure, topics.
Main Tools for Teachers’ Investigations

**data mining**
What is the data? What are relationships between attributes (parameters), between spatial themes, and between attributed spatial themes? -> Science and Spatial Data Sets
-> Metadata and Scientific Visualization -> RPO Data, CAMEO; ArcVoyager, ArcView, MarPlot, EnviroMapper; etc.

**Scientific reasoning**
What is your study question? How do scientists look into the question? Which data can help explore the question? How the data can be manipulated or analyzed to investigate an answer? -> Spatial Query and Analysis, Visual Interpretation and Presentation -> DataView, ALOHA, etc.

**knowledge base**
Accessing knowledge and experience concerning “Data Mining” and Scientific Reasoning” from a group of applied scientists and researchers through network and collaboratory! -> Collaboratory Archiving and Searching Engine -> Jumps to other Web sites or servers

**curriculum integration**
The context for defining a study question with reference a target class, a specific grade, and related teaching/learning standards -> School District Curriculum Standards -> Jumps to other Web sites or servers
Desired VISIT Collaboratory Functions:

- Managing the VISIT project and community.
- Communicating and collaborating among teachers, scientists, students, technologists, administrators.
- Building, searching, retrieving, accessing and evaluating knowledge and instructional materials.
- Storing, searching, retrieving and analyzing scientific data and metadata.
- Demonstrating and illustrating VISIT pilots of scientific investigations.
- Analytical tools (components) to support subject analysis in chemistry, environmental science, earth science, biology, and ecology.
- Gathering, analyzing and communicating VISIT evaluation data.

http://www.emich.edu/visit/
Elements of VISIT Collaboratory Infrastructure

Collaboration
- Communication
- Curriculum development
- Explorations, exhibitions
- Science help desk
- Knowledge base (sci. & cur.)
- Search, Glossary...

Spatial/Scientific Database
- Spatial data (GIS layers)
- Chemical data (attributes)
- Scientific visualization
- Meta-data
- Spatial data mining
- Spatial data analysis

Scientific Investigations
- Water quality analysis
- Environmental hazards analysis
- Radon analysis
VISIT Collaboratory  http://www.emich.edu/visit/
VISIT System Design: A Distributed N Tier Server Model
Investigation themes and related data are managed and analyzed through:
- Universal Data Access (UDA) - Microsoft Data Access Components (MDAC)
- ActiveX Data Objects (ADO)
- Remote Data Services (RDS, formerly known as Advanced Database Connector - ADC)
- Object Linking and Embedding Database (OLE DB)
- Open Database Connectivity (ODBC)

Mapping tools are developed by customizing ESRI (Environmental Systems Research Institute) products - MapObjects, and MapObjects Internet Map Server.

Analytical tools will be developed by applying ActiveX, Servlets, and JSPs.
How Teachers Will Access VISIT Databases in VISIT

GIS data server

VISIT end users

Chemical data

MO & MO-IMS
Data tree structures
Can be locally accessed!

GIS-DBMS
ArcView shape files
ArcExplorer
Online mapping & download
ArcVoyager
Desktop analysis & mapping
Excel
Append chemical data to ArcView shape DBF file

Can be Web enabled or locally accessed!
Teacher Tools for Scientific Investigations

Chemistry (subject) analysis

Web-enabling

Spatial data analysis

Spatial data process

ASP/COM

RPO DATAVIEW

ArcExplorer

ArcVoyager

Excel

ArcView

(the water quality illustration)
Web-enabling River Rouge Project DataView - Water Quality Analysis by Locations

Welcome to Explore Water Quality Data Online

About || Search Location || Search Parameter || Thematic Data

You can search the water quality database by Township DETROIT
Web-enabling River Rouge Project DataView - Water Quality Analysis by Parameters

Welcome to Explore Water Quality Data Online

These are parameters contained in the data sets

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Description</th>
<th>Record number</th>
<th>Related parameters</th>
<th>Time series</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain Flow</td>
<td>Precipitation</td>
<td>588924</td>
<td>CSO</td>
<td>1990-99</td>
<td>IN</td>
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<tr>
<td></td>
<td>River water flow</td>
<td>540844</td>
<td>Rain, CSO</td>
<td>1990-99</td>
<td>CFS</td>
</tr>
<tr>
<td></td>
<td>quantity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WTRTEMP</td>
<td>Water temperature</td>
<td>202563</td>
<td>WTRTEMP, CSO</td>
<td>1990-99</td>
<td>C</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved oxygen</td>
<td>183052</td>
<td>CSO</td>
<td>1990-99</td>
<td>MG/L</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Web-enabling River Rouge Project DataView - An Illustration of Water Quality Analysis
Sequence of Learning & Collaboration of the Core Team Members - 3 Stages

- **STAGE I, Orientation** (about 8 weeks starting in April 2000)
  - Recruitment core team teachers,
  - Collaboratory intro, intro tools & data,
- **STAGE II, Pilot investigations** (about 12 weeks)
  - Prepare cases, learn tools, mine data,
  - Collaboratory team
- **STAGE III, Investigation and curriculum integration** (about 13 weeks)
  - Teachers’ own projects and classroom curriculum integration
Stage I Collaboratory Orientation

- Peer-moderated online classes
- “Getting to know you” exercises, “Water Cooler”
- Weekly assignments/dropbox
- Forums for reflection, peer teaching
- Stage I Course “path” contains instructional materials, links to tools, data sets, exercises, examples
STAGE I, Investigation Orientation

- Scenario addressing general topic of community concern,
- Introducing local data & sources,
- Becoming comfortable with the technologies
- In context of HS science curriculum.
- Meeting peers and supporters in cyberspace.
Stage I Data Orientation

- Exploring sources & types of data available, parameters,
- Using online tools well matched to those data sources and types.
- Locating some metadata.
- Question-generating purpose.
Stage I Collaboratory Support

❖ “Getting to know you” activities, team building
❖ Course structure –
  ❖ weekly assignments/dropbox
  ❖ Discussion questions on Forums,
❖ Peer facilitators
❖ Hands-on tutorials, exercises
Stage 1 Building Collaboratory Support - an Example

Message No. 283: posted by Bill Hamilton (bhamilton) on Thu, Jul. 6, 2000, 14:33
Subject: Teneshia's trials with Bill

Teneshia is acting as a test subject to develop the use of the EPA ENVIROMAPPER with Bill's facilitation.

The purpose of this collaboration is to determine how online mapping capabilities can be used to aid secondary school science teachers.

Step 1: Teneshia will contact Bill relative to the use of the Enviromapper, through this forum thread.

Step 2: Bill will instruct Teneshia on Enviromapper Navigation and request from T. environmental info for her geographic and subject matter interests.

Step 3: T. will transmit findings to Bill with relevant questions as to how this data can be used in her classroom.

Step 4: Developing pathways to Cameo suite...(to be continued as the limits of Enviromapper are encountered through experience of the team.)
Stage I Software Tools

- Motivational first steps: Accessible on the Web
- Easy to learn, little or no installation issues
- Fast intro to a topic, data sets, local geography

Examples:
- Enviromapper (EPA)
- DataView (web-enabled by CEITA)
- ArcExplorer and ArcVoyager (ESRI)
- Water-on-the-Web Visualizations tools
- Emergency planning tools from EPA:
  - CAMEO: Computer-Aided Management of Emergency Operations
  - MARPLOT: Mapping software for the Cameo suite
  - ALOHA: Computational modeling for atmospheric dispersion of chemicals
  - Landview III from Census Bureau
Stage I Building Technical skills

- Install software & data sets from web or CD
- Follow guided tours & tutorials
- Some ftf workshop/tech support needed
- Examples:
  - Cameo/Marplot/Aloha/Landview suite for Environmental Hazards topics
  - DataView for Rouge River data mining
  - ArcView for various spatial analyses
Stage I “Laying Groundwork” Activities

- Making contacts in the local community relevant to the topic of planned future investigations.
  - E.g. Randy Raymond meeting with local Fire Department; EPA contacts; Police Dept.
  - E.g. Friends of the Rouge; Rouge Project Office
Sequence of VISIT Project Development
- 4 Phases

- **Phase 1.** (now) **Core Team** works in prototype Collaboratory:
  - to develop Investigations for other teachers
  - while trying out and revising tools, interface, materials (some offline on CD).
  - Core Team and staff add more tools, functions as we go along and the investigations require them.

- **Phase 2.** (fall 2000) Core Team recruits and facilitates *pilot teacher investigators*
  - in revised, operational Collaboratory environment using limited number of data sets and topics.
  - teacher investigators from pilot schools provide feedback.

- **Phase 3.** (Winter 2000) Core Team and other teacher leaders facilitate and recruit VISIT *teacher explorers*
  - in operational Collaboratory
  - with broader range of topics, data.

- **Phase 4.** (Fall 2001) Nationwide Implementation of the VISIT Model
VISIT Benchmarks

- Idea is to have several Teacher Investigators and Explorers from a school working in VISIT, to get local support and ftf workshop opportunities.
- SY 2000-2001 Pilot test; 50 teachers
- SY 2001-2002 Pilot test; 250 teachers
- SY 2002-2003 Field test; 720 teachers
## Course Plan: Teacher Investigators

<table>
<thead>
<tr>
<th>Venue</th>
<th>Total Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-day regional/metropolitan face-to-face workshop</td>
<td>15 hours</td>
</tr>
<tr>
<td>In-school, 2-4 hour, hands-on, face-to-face workshops with school-based teacher team, led by school-based facilitator, or a Core Team member</td>
<td>10 hours</td>
</tr>
<tr>
<td>Online Community weekly interaction facilitated by Core teachers</td>
<td>25 hours</td>
</tr>
<tr>
<td>Individual-conducted hands-on VISIT structured exercises in data mining, science reasoning, spatial data analysis, curriculum &amp; standards connections, and assessment</td>
<td>20 hours</td>
</tr>
<tr>
<td>Individual one-on-one consultations online with teacher leaders, scientists, science help desk</td>
<td>6 hours</td>
</tr>
<tr>
<td>Reviewing case studies of scientific investigations similar to mine</td>
<td>4 hours</td>
</tr>
<tr>
<td>Defining, conducting my own investigation</td>
<td>20 hours</td>
</tr>
<tr>
<td>Integrating my investigation with curriculum and standards</td>
<td>10 hours</td>
</tr>
<tr>
<td>Planning, conducting, reporting on classroom-based activities with students</td>
<td>25 hours</td>
</tr>
<tr>
<td>Assessing quality of my own and/or my students' work</td>
<td>5 hours</td>
</tr>
<tr>
<td>Total</td>
<td>140 hours</td>
</tr>
</tbody>
</table>
Important URLs used by VISIT Core Team

- VISIT Webpage  http://www.emich.edu/visit/
- VISIT Collaboratory  http://208.31.12.69
- CEITA Webpage http://ceita.acad.emich.edu
- VISIT FTP site ftp://visit@geodata.acad.emich.edu  
  (the passwd: visit)
- Washtenaw County DEIS  
  http://www.co.washtenaw.mi.us/DEPTS/Eis.htm
- Rockman Core Team Survey http://survey.rockman.com/visit.htm
- Water on the Web http://wow.nrri.umn.edu/wow/index.html
- Download ArcExplorer:  
  http://www.esri.com/software/arcexplorer/aedownload.html
- ESRI Virtual Campus http://campus.esri.com/index.cfm  
  (click Courses and then Free Modules)