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Integrating Technology, Field Experience and Collaboration in an Undergraduate Biology Research Course

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Integrating Technology, Field Experience and Collaboration in an Undergraduate Biology Research Course

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Final Report (1/15/2013)

Goals

The purpose of our project was to develop an upper-level core research biology course to incorporate field, technological, and social tools needed in the professional world. Although a broad need for such a combination of skills has been identified (AAAS 2011), faculty are in need of teaching materials for robust field research courses that engage multiple students in collaborative research.

The new course strengthens the biology and environmental science research curricula by incorporating: 1) direct field experience; 2) peer-to-peer learning and teamwork; and 3) technological skill building.   The course showcases camera-traps, a simple but powerful field tool, and the processing of resulting wildlife photos as the model to introduce students to field-based technology.

Deliverables and activities

- The new course developed exercises and protocols to employ camera-trapping, team work and technology
- The students used the Pleasantville campus as a laboratory to study the presence of carnivores
- The course is currently being taught. There have been 2 field deployments and the class is currently working on techniques to analyze the results that include inspecting images and creating data sets, using statistics to analyze their data, and using visualization tools to present their results including PowerPoint, Excel and GIS.
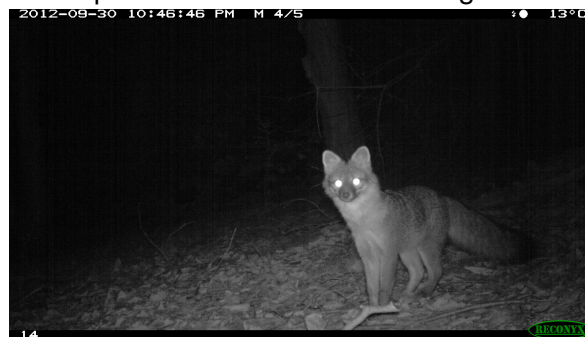

Figure 1. Fox on the Pleasantville Campus

BIO490 - Research Methods in the Biological Sciences

This course is required of biology majors and is "writing enhanced" the students develop a research paper that includes developing a hypothesis, understanding research methods, developing a research design, and presenting a project based on their research. Technology, Field work and collaboration is incorporated throughout this process.

- Students were divided into teams (bobcat, coyote, etc.)
- Teams went into the field to deploy cameras
- Students use GPS to record the location of the cameras
- Once the cameras are retrieved (after 1 or two weeks), students extract images
- Students analyze the images and develop a spreadsheet type database
- Students learned to analyze the results using statistical techniques such as ANOVA and Regression
- Students develop their presentation using different technologies including GIS, Excel graphs and PowerPoint.

Next Steps (and a request to utilize funds into 2013)

1. Complete class and class presentations
2. Sign up for GIS training related to putting deployments on the Web (ArcGIS Online) – this will be done by the researchers after the class is over
3. Present the results of the class at a conference related to science pedagogy in the Spring, 2013

Appendix (developed materials/exercises/course notes are on the Blackboard website)
1. Course Syllabus
2. Sample Excel Statistics Assignment
3. GIS assignment

Biology 490: Introduction to Research in the Biological Sciences
CRN: 71038
Writing Enhanced Course (see statement below)

Tuesdays 1:25-4:10   **Fall 2012 Syllabus**

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Office Hours: (To be arranged)

Required Texts: Doing Science: Design, Analysis, and Communication of Scientific Research, 2nd Editition, by Ivan Valiela, Oxford University Press 2009

Other Required Materials: Access to a computer with internet connection, Microsoft Office, and Microsoft Powerpoint, either a USB memory key or CD drive (write capable) for saving presentations

NOTE-Requirements for the Field: Please make sure you dress appropriately – that means clothes that can get dirty/wet: shoes, long pants and long sleeve shirt. You should bring (or share) insect repellant, and if it's sunny you may want to have a hat and some sunscreen. All field trips will be on the Pleasantville Campus.

Date	Topics	Reading
9/11	Class Mechanics; Obtaining Scientific Information; Technology Overview	CH1
9/18	Field Exercise	
9/25	Elements of Scientific Data; Collaborating with technology	CH2
10/2	Research Design; Introduction to Spreadsheets	CH4
10/9	Introduction to Databases Image analysis and recording	
10/16	ETS Exam	
10/23	Statistical Analysis; Introduction to Analytics for the Sciences	CH 3
10/30	Communication of Scientific Information; Analytics II	CH 5
11/13	Data Visualization (GIS)	CH 8, 9, 10

11/20	Writing a Science Paper; Visualization (Charts)	CH 6
11/27	Creating Talks, Posters, and Presentations; Presentation Tools (PowerPoint)	CH 7
12/4	Presentations	Final Paper Due
12/11	Presentations	

Grading:

Final Project	50 %
Homework	50%
TOTAL	100 %

Grade Scale:

A	100%-94%	B-	83%-80%	D+	69%-67%
A-	93%-90%	C+	79%-77%	D	66%-60%
B+	89%-87%	C	76%-74%	F	below 60%
B	86%-84%	C-	73%-70%		

Learning Objectives / Outcomes (course goals for students):
Upon completion of this course, students should be able to:

1. explain the nature and goals of science and be able to distinguish these from pseudoscience and junk science.
2. explain how scientists develop and test hypotheses and be familiar with how the scientific method can be used to address important questions in biology.

3. identify an appropriate statistical procedure to describe a data set and test a hypothesis.
4. find and extract essential information from scientific publications and evaluate it critically.
5. write up the results of a scientific research project in a manner suitable for publication.
6. communicate the findings of a scientific research project in a talk delivered at a scientific meeting.
7. use and apply technology in the field and research process
8. use and apply technology in the communication of scientific research

BIO490 – Introduction to Research in Biological Sciences
Technology – Assignment 1
Basic Excel Skills

In this exercise we will review and drill some basic excel skills:

- Entering Data
- Formatting a spreadsheet
- Using Simple functions

This exercise simulates putting the data entered din the field into an excel spreadsheet. Field collected data needs to be analyzed in a number of ways – the first step may be simple "descriptive statistical' analysis (e.g. sum, average, etc.).

1. Download the Excel template from the Blackboard site. It contains 13 days of data based on analysis of images from a single camera deployment.

	Date	Coyote	Deer	Squirrel	Raccoon	Other		Total Count	Average	Max	Min	Median
5	Tuesday, September 18, 2012	11	6	4	2	0		5	4.6	11	0	4
6	9/19/2012	6	1	1	9	2						
7	9/20/2012	10	5	7	4	8						
8	9/21/2012	2	10	6	1	3						
9	9/22/2012	0	5	3	5	1						
10	9/23/2012	5	0	1	5	0						
11	9/24/2012	3	2	0	2	2						
12	9/25/2012	4	7	1	6	10						
13	9/26/2012	4	5	8	5	0						
14	9/27/2012	10	3	6	10	2						
15	9/28/2012	2	0	4	5	6						
16	9/29/2012	9	1	6	6	10						
17	9/30/2012	3	11	10	2	9						
18												
19	Total Count											
20	Average											
21	Max											
22	Min											
23	Median											

For each day and for each species, compute the Total Count, Average Count, Maximum, Minimum and the Median (we'll look at other statistics later in the semester).

2. Format the Spreadsheet
   a. Add a Title that includes what the spreadsheet is about, your name, and a date):

   > *BIO490 Camera Trap Project Data*
   > *9/18/2012-9/30/2012*
   > *Prof. Dan Farkas*

   b. Put the dates in a readable format: Monday, September 17, 2012.
   c. Format headings (e.g. bold, underline, italics).

3. Place your completed spreadsheet in the Documents Section, this week's folder

BIO490 – Introduction to Geographic Information Systems

In this exercise we will create a web-based GIS Model of our camera data
.

Create an ESRI account.

In order to use ArcGIS Online, a web-based tool for creating maps, it is necessary to have a free global ESRI account.

1. Go to the website: http://www.arcgis.com
2. In the upper right, click to "Sign In"
3. On the next page, you'll set up an ArcGIS Personal Account: "Create a Personal Account"
4. Fill in the information and the click "Create My Account"
5. Go back to the sign-in page and sign-in

Download the Camera Trap Data

1. On Blackboard go to Documents -> BIO490-Technology —-> BIO490-GIS.
2. Download *BIO490 - GIS - Camera Trap Data*

Create a map

1. At the top of the main page, select "Map"
2. In the upper right, enter 861 Bedford Road, Pleasantville, NY and hit the Enter or Return Key on your keyboard
3. Choose a Base map:
    a. There is a toolbar above your map, select "Basemap"
    b. I like the one that comes up by default (Topographic), but you can experiment with others. Try "Bing Maps Hybrid".
4. Navigate the map.
    a. There is a zoom bar on the left. Try zooming in and out. If you double click on the map it will zoom in a bit.
    b. You can also Pan (move the map around) by holding the left mouse button down anywhere on the map and moving around (it's like grabbing it).
5. Save the map. At the toolbar above your map is a Save button. Save the map. In the fields that come up enter the following information:
    a. Title: BIO490 – *yourlastname* – Fall 2012 Camera Deployments
    b. Tags: BIO490, Camera Trap, Deployments, Carnivore
    c. Summary: This map shows the camera deployments of the different teams
    d. Save in folder: Use the default folder
    e. "Save Map"
    f. Above the toolbar is a click for "My Content". If you click (and choose my content) you will see a list of your maps (only 1 for now).
    g. Click on the title of your map and you come to an information page.
    h. For now, select "Open" -> Open in" ArcGIS.com map viewer"

6. Adding layers to a map.

There are a number of different types of files that can be added to a map.

Shapefiles have spatial information in them (Lat/Long) and hold all kinds of data across many organization sectors (science, environment, business, public safety, military, agriculture, public health, economics, education, transportation). We won't use shapefiles in this exercise. Most base maps are shapefiles too: roads, lakes, rivers, , towns, etc.

CSV (Excel) files that have Latitude and Longitude as fields in the file. Our camera deployment files are a good example of this.

      i. In the toolbar above your map, select "Add" -> Add a layer from a file
     ii. Browse to the folder that contains the exercise file downloaded from Blackboard
    iii. Select the file -> Open -> Import Layer
    iv. Zoom out a little so that the entire campus is visible and you will see the points of our deployment.
     v. Move the cursor over one of the points and left click to see the attribute data.

7. Save the map.

Sharing and Disseminating the GIS Model

At some point it is necessary to share your data and results with others. We are going to create a "Web Application" that will generate a URL that you can embed or email to others. The first link you copy will be to the map development environment. The second one will be to a web-page that is an implementation of your map for sharing.

Sharing the development environment

1. In the toolbar at the top of your map, select "Share".
2. In the Dialog Box that opens up, check "Everyone (public)"
3. Copy the "Link to this Map" and place in the Assignment link in blackboard.

Creating a Web-based map

1. At the bottom, select "Make a Web Application". (note that you can share current map on Facebook and Twitter)
2. Choose the first template, "Basic Viewer"
3. Select Publish ->Preview to see what your map will look like.
4. While we will go with this template – you can preview some of the others.
5. Select Publish ->Publish

6. Give it a Title: BIO490 Fall 2012 – *yourlastname* – Camera Deployments

7. In the last line is a link to "go to the item now" which brings you to a configuration screen. You can also get there by clicking on the title in your My Contents list. This brings you to a description and information page. There is a button all the way to the right for configuration. Select it.

8. In the Panel on the right, select a color, everything else can default. Save the settings (lower right)

9. Back on the Information Page you have to share the map. Choose share from the Toolbar and select "Everyone (public). Click OK.

10. You will see a URL for your web-based map.

11. Copy this link and paste it along with the development URL in the Assignment link in Blackboard.

12. Click it and you will see your map on the Web!

What to submit.

1. THe URL for the ArcGIS Online development environment in the assignment link in Blackboard.

2. The URL for the Web-based map in the assignment link in Blackboard.