The Biomes of Homewood: Interactive Map Software

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Abstract: To build a learning community, the General Biology faculty at Johns Hopkins University conducted collaborative, problem-based learning assignments outside of class in which students are assigned to specific areas on campus, and gather and report data about their area. To overcome the logistics challenges presented by conducting such assignments in a class of 300+ students, we developed a software environment in which faculty write and distribute assignments and student teams record and store observational data. Further, the software uses a map of the campus to assign teams to a specific area and to manage the data relevant to that area. Since students can view data submitted by all teams, the faculty have devised assignments requiring students to examine and compare data from one area to another, thereby promoting interaction among the student groups. Faculty and mentors review, provide comments, and grade the assignments. The mapping feature enables faculty to develop questions that build from previous years' data. General Biology student teams in AY 2005-2006, for example, will compare reported data gathered in 2004-2005 with their current observations. Further, data can be pooled from all of the Biomes to conduct a survey across the campus.

Introduction

The General Biology Course Design Project seeks to transform the undergraduate educational experience in the 300+ student General Biology course by invoking a number of pedagogical and technological changes (reviewed in Fambrough *et al.*, 2005). This course redesign project, funded by the Howard Hughes Medical Institute (HHMI) and supported by talented Hopkins University faculty and staff, supports the development of educational resources to be made available to the broader science community. To reach sound design solutions to foster such an environment, the team conducted a yearlong analysis of the course. The analysis process involved gathering qualitative and quantitative data from a number of different sources: students, General Biology course, course faculty, Biology department, other universities and courses, and current and/or emerging technologies and resources. Qualitative data were gathered through interviews, focus groups, surveys, and reviews while quantitative data were gathered through tests, surveys, and other formal reporting mechanisms (such as registration data, etc). Based on the findings of the analysis, the faculty and project team decided to tackle the following goals:

1. Increase student preparedness, knowledge acquisition and retention, and participation in the course (without increasing student or faculty load), in part through computer and web-based instructional resources.
2) Increase student motivation and engagement with the course material (in sum, get students to *enjoy* the course).
3) Enrich the learning experience for students by adopting rich, meaningful problem-based team assignments.
4) Enriching the teaching experience for faculty.
5) Develop a teaching framework and best practices for course redesign projects that could be applied to other large enrollment biology lecture courses.

The last goal addresses issues faced at many academic institutions: implementing and sustaining solutions after the initial grant funds are exhausted. Not being able to build new buildings for labs or to hire TA's to lead discussion groups; the team was faced with achieving the goals using existing resources.

Methods

To achieve the goals, the team developed the *Biomes of Homewood* software, a web-based, team collaboration tool used by faculty and students in the general biology course. Based on assignments the faculty piloted in smaller classes, the project team used the software to introduce active learning assignments. These assignments enrich student learning by requiring students to apply biology lecture and textbook material to actual areas on campus. Because of the logistics involved in managing a 300+ student course, students were placed in teams using the course management tool,

WebCT, team generator and randomly assigned to a particular region on campus (termed a biome), as represented on the map.

Assignments require students to apply concepts learned in class and from textbook material to complete simple weekly or biweekly tasks. Fall semester 2004 tasks included identifying producers, herbivores, carnivores, etc; examining effects of our recently emerged cicada brood; studying phylotaxy and leaf structure, and generally surveying the diversity of organisms within their "biome." Some of the activities are loosely based upon the book "Investigating Terrestrial Ecosystems" by Andrews & Moore (1986).

Much more than a homework tool, the *Biomes of Homewood* software enables faculty and students to accomplish a number of other tasks, including associating content and findings to a specific area on a map (in this case, a map of campus that has been divided into sections). Data can be collected at regular intervals throughout the semester and subsequent years to document changes occurring over time. With this feature, the biology faculty who currently use the map software plan to develop questions that build from previous years' data. General Biology student teams in AY 2005-2006, for example, will be asked to report changes about an area using reported data from 2004-2005 and the team's current observations. Data can also be pooled from all of the Biomes to conduct a survey across the campus. Since students can view data submitted by all teams, faculty devise assignments that require students to compare and contrast collected data from multiple biomes, thereby promoting interaction between the student groups.

The Biomes of Homewood Software

The *Biomes of Homewood* was written using a Rich Internet Application (Flash) that combines desktop functionality with the broad reach and low cost deployment of the web. Recognizing the need for ease-of-use, the development team programmed the *Biomes of Homewood* software to check the user's system for the necessary components: platform (Mac or PC), browser type and version, and Flash version. Users who do not have compatible systems are guided to online resources for downloading necessary files. To ensure security yet provide ease-of-use, the program uses the university authentication system; faculty and students login to the program using their university ID's and university-associated password. Navigation within the program occurs by using breadcrumbs found at the top of the active window (Figure 1).

Figure 1. The Biomes of Homewood Map

Student Functions.

Once students login, *The Biomes of Homewood* homepage displays the Course Name, Actions, Current Assignments, a Campus Map, a list of team members and their email addresses, and an aerial photograph taken from Arc-GIS (www.esri.com) displaying their assigned biome area (Figure 2).

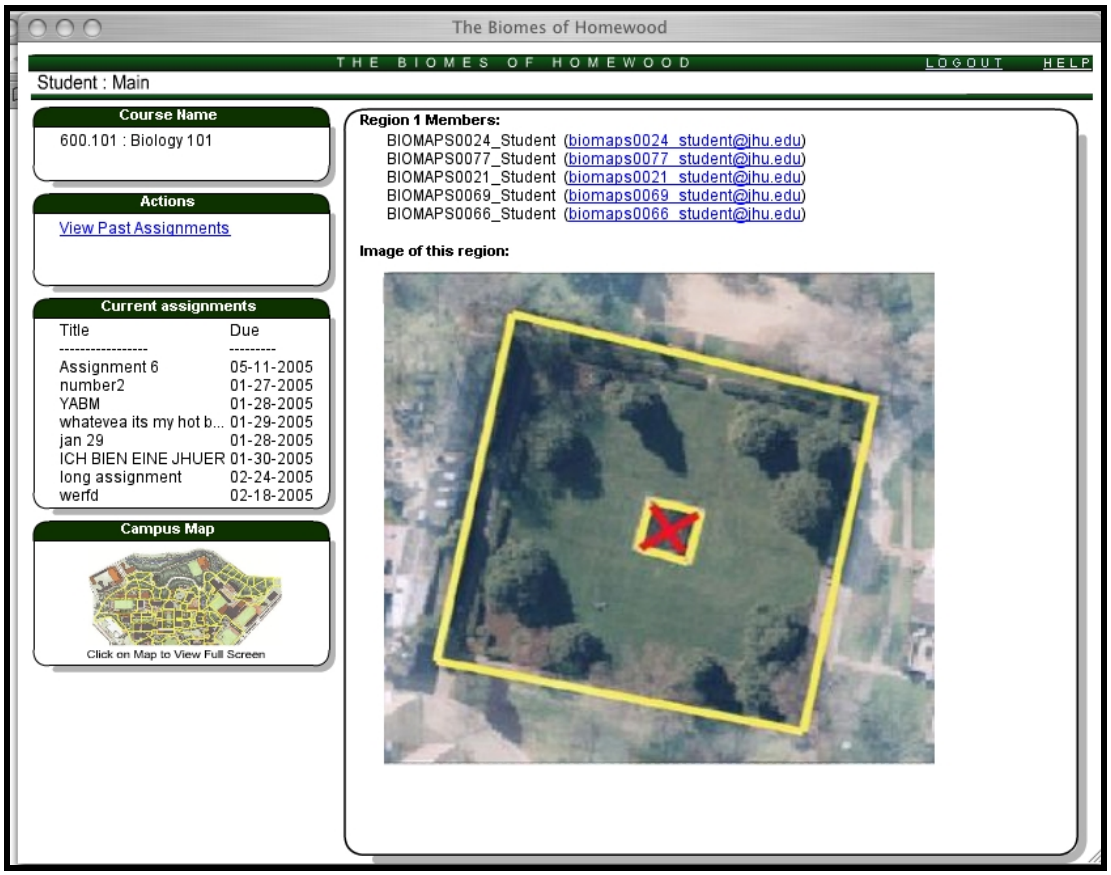


Figure 2. The Student Homepage Within the Interactive Map.

Actionable items on this screen include viewing current and past assignments, seeing a detailed map of all the biomes within the campus, and emailing their teammates by clicking directly on the email links. Selecting "Current Assignments" allows students to see all posted assignments that are due. Selecting one of the current assignments takes students to a page where they can view the assignment and media files (jpeg, swf, fla, mpeg) attached to the assignment by the faculty (see below). To enable students to print the assignment (thus enabling them to reference the assignment when in their biome or when away from their computer), they can view the assignment in a web browser. Viewing "Past Assignments" allows students within their assigned biome to see all their past assignments as well as their related scores. Selecting individual assignments allows students to see the completed assignments, comments and scores for each question in the assignment.

By selecting the Campus map, students can select any biome within the map and can view students' responses to past assignments. This functionality combined with comparative assignments written by faculty encourages interactivity between the students; the collection of students' responses in effect creates a "bioblog" of data related to the biome areas.

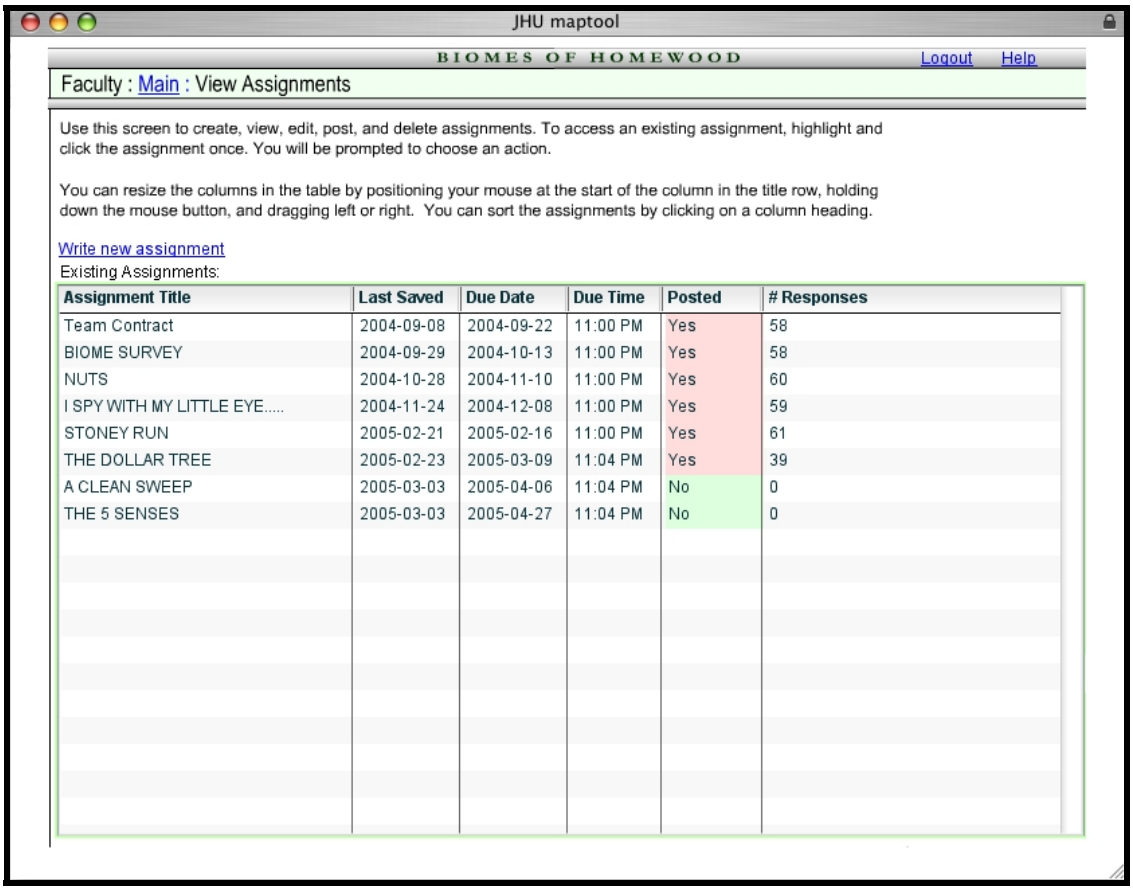
Faculty Functions.

After logging in to *The Biomes of Homewood*, faculty have three choices: View Assignments, Grade Assignments, and Management. "View Assignments" allows faculty to write new assignments, edit assignments, view existing assignments and post assignments. Creating new assignments is simple and straightforward: faculty enter assignment titles, directions, and questions in textboxes (adding additional textboxes as necessary via an "add question" button). Questions are added

one at a time with points allocated for each question by the faculty member. These scores can be weighted if necessary and the program will automatically display the weighted percentages.

To guide graders and student mentors, the program allows faculty to enter comments or correct answers to the questions in associated text fields that appear beneath each question. Faculty can augment questions by uploading media such as pictures, flash movies and sound files via a media uploader. This media is maintained in a faculty library that can be used in other assignments.

Finally, faculty set a due date and time for assignment submissions; the program will not accept entries posted after the deadline. Assignments can be saved (to allow revisions before posting them) or posted to students. Saved assignments can be edited by selecting an assignment from the list (Figure 3) and then selecting the "edit assignments" function. Faculty can edit posted assignments but will receive a warning that they are editing a live assignment that students may have already made entries to. By selecting an assignment and then viewing the assignment, the faculty member will preview the assignment exactly as it will appear to students.



Assignment Title	Last Saved	Due Date	Due Time	Posted	# Responses
Team Contract	2004-09-08	2004-09-22	11:00 PM	Yes	58
BIOME SURVEY	2004-09-29	2004-10-13	11:00 PM	Yes	58
NUTS	2004-10-28	2004-11-10	11:00 PM	Yes	60
I SPY WITH MY LITTLE EYE.....	2004-11-24	2004-12-08	11:00 PM	Yes	59
STONEY RUN	2005-02-21	2005-02-16	11:00 PM	Yes	61
THE DOLLAR TREE	2005-02-23	2005-03-09	11:04 PM	Yes	39
A CLEAN SWEEP	2005-03-03	2005-04-06	11:04 PM	No	0
THE 5 SENSES	2005-03-03	2005-04-27	11:04 PM	No	0

Figure 3. The Faculty View Assignments Screen.

In the "Grade Assignments" section, faculty select an assignment to grade from a list of assignments. With a specific assignment selected, a display of all student entries appears. After selecting a student submission to grade, faculty can provide feedback to each question and can assign a score to the answer. The program automatically tabulates the final score for the assignment, and faculty can release the grades if desired. While students can see other teams' assignments and faculty feedback, they cannot see the grades earned by other teams.

For courses with large enrollments or where students may be organized into teams faculty members may want to search for a particular student by name or ID. This is accomplished in the "Management" section of the faculty functions. Faculty can also download grades as an excel file for incorporation into an online gradebook, such as that in a course management system.

Teams.

Grouping the 300+ students into teams and using the *Biomes of Homewood* software enable the general biology faculty to conduct rich, substantive active learning assignments without imposing onerous grading and administrative tasks on themselves. Further, mentors - upperclassmen who

previously completed the General Biology course - assist in managing student needs and assignments. In particular, mentors act as facilitators to manage issues pertaining to interpersonal skills and team dynamics (Remocker & Storch 1992), help students understand team assignments and content, and provide substantive, constructive feedback to student assignments. Mentors have limited faculty access to the *Biomes of Homewood* software. While they cannot compose or edit assignments, they can view student teams' answers and can provide feedback and guidance. If appropriate and desirable, mentors can even grade student submissions. Mentors do have access to the "Management" section to view individual student records but cannot access the grades since the grade generator is password-protected.

Evaluations

Team Self Evaluation

As part of one of the assignments, students were asked about the following questions regarding teamwork and team dynamics. (Figure 4.) The questions were based upon Team Checkpoint (2001) from Boston University.

By having the student teams address these questions it helped them to identify areas in which their teams were weak. Goal setting, listening, trust, feedback and handling conflicts were not identified as being major issues for the teams. Decisions were sometimes problematic partly due to a lack of communication between team members and several teams indicated that they would change their method of communication to address this problem.

1. Outlining team goals and working as a team to achieve those goals.
2. Listening: Do team members listen to one another
3. Trust in teammates.
4. Giving feedback to teammates.
5. Handling conflicts.
6. Making decisions.
7. What procedures would you change for next semester i.e. decide on a fixed meeting time, change method of communicating with team members, reassign tasks to team members etc.

Figure 4. Topics on Teamwork and Team Dynamics

Pre- and Post-Surveys

Students were asked to complete an online survey using Zoomerang (www.zoomerang.com/, MarketTools, Inc.). Questions were designed as Personal Perception Indicators (PPI), a tool often used to assess the impact educational technologies have in instruction. The tool measures changes in growth, as reported by students. Given twice during the semester, the PPI compares students' perceptions about their knowledge, skills, and abilities pertaining to a specific topic at different points in time.

For the general biology course, the faculty used a five-point Lichert Scale PPI questionnaire regarding general biological concepts and environmental principles at the beginning and end of the semester. A sample question and the students' response are shown on the following page. (See Figure 5.)

Identify and explain examples of symbiosis within a biome.

	Low				High
Knowledge	1	2	3	4	5
Experience	1	2	3	4	5
Confidence	1	2	3	4	5

This would mean that

- I have a great deal of knowledge (response of 5) about identifying and explaining examples of symbiosis.
- I have an average amount of experience (response of 3) with identifying and explaining examples of symbiosis.
- I am not confident (response of 1) in my ability to identify and explain examples of symbiosis.

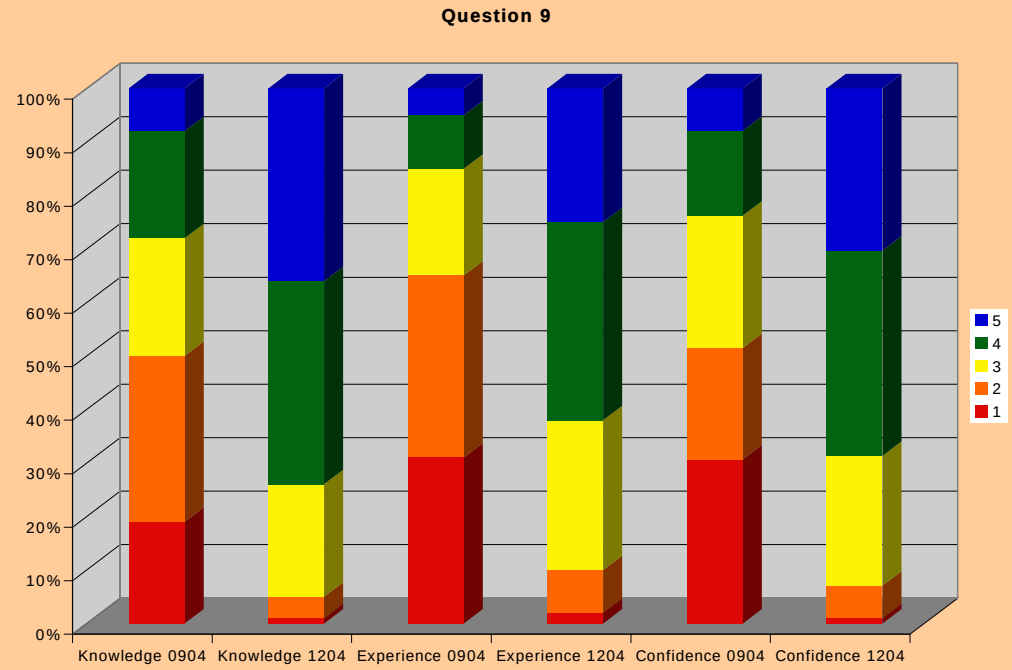


Figure 5. Student Pre- and Post-survey Question

In the pre-survey (0904) approximately 50% of students responses scored low (1's and 2's) on the Lichert scale and less than 30% scored themselves high (4's and 5's) on the Lichert scale. At the end of the semester, the post-survey (12-04) reveals less than 10% of students scored themselves low while over 50% of students scored themselves high in knowledge, experience and confidence regarding the biological principles they were asked to investigate within their assigned biome. Additional questions from this survey are available on request. Some biomes assignments were on topics *not* covered in class, and survey results were similar, thus indicating that the improvement was a result of performing the assignments themselves.

Focus Group

The JHU Center for Educational Resources, which supports faculty in the development of methodologies for the assessment of student learning in undergraduate education programs and initiatives, convened a focus group of 10 students at the end of the semester.

Students were interviewed about the Biomes of Homewood software and the assignments associated with it. Examples of the questions included in these interviews follow.

1. Do you like the Biomes assignments? Why or why not?
2. What do you think about the team aspect? How has it been working in a team and having to rely on other people?
3. Have the Biomes assignments helped you to form friendships, study groups or study partnerships?
4. How would you compare the Biomes of Homewood assignments with the regular weekly individual assignments?

Response: They take longer to complete:
- coordination 50% of time involved
- meeting 10%
- doing assignment 20%
- submitting 20%

Figure 6. Interview Questions.

The initial goal of the faculty members for this project was to create a vehicle by which students applied material from classroom lecture and the textbook to explore and appreciate the biological world around them. One student enthusiastically commented that she enjoyed getting outside of the classroom and appreciating the biology of the campus:

> "I can see what Dr. Fambrough was talking about when he said we should appreciate nature. These assignments actually get me out in the world, looking at trees, and enjoying the environment. I like them [the assignments]."

However, other students did not see the immediate relevance of the assignments to the content in class. Instead, they wanted faculty to state explicit connections between course material and assignments, even to be tested on the biomes material in class exams. For these students, the assignment grades were not sufficient in and of themselves.

The team aspect of the assignments was difficult for the students. In general the PPI questionnaire results indicate neutral to good ratings pertaining to team dynamics. Some teams were very well organized. These teams appear to have older and/or more seasoned students in them who help mitigate team difficulties. A solid contract developed by the teams as part of the first assignment helped these teams operate well. Some people formed friendships as a result of the Biomes project: one group, composed of 5 members all born in a different country who had never met before, forged strong friendships that would have been unlikely had they not worked together. Students do sit with group members in class but they generally study with their own friends. Noted difficulties for all teams include trying to find a common time to meet and communicating with other members. These issues, pertinent in all walks of professional life, took up most of the groups' time. Further, team assignments often have several non-participants (Walsh et al., 2005). In the general biology class, between 4-10 students did not participate in each assignment. The mentors, who were assigned 3 teams each, helped teams manage problem members, organize meeting times, and obtain equipment needed to complete assignments.

Results and Discussion

Students' learning has been deepened and enriched as a result of using the *Biomes of Homewood* tool. The *Biomes of Homewood* software has been effective in organizing students into teams, relaying contact information to the teams, and allowing students to complete assignments via the tool. All teams have been able to successfully complete all assignments in a timely manner. Unexpected, yet logical, results of using the tool are (1) improvements in students' ability to work in teams, and (2) improvements in students' time management skills. Working in teams necessarily requires students to grapple with issues of equity in contributing to and managing workloads. Students must collaborate closely in meeting deadlines, as the software prohibits submissions past the assignment deadline.

From the faculty perspective the *Biomes of Homewood* increased student motivation and engagement with course material; in sum, it allowed students to enjoy the course more and to develop a better appreciation of biology and their environment. Assignments that actually make students go out into the real world to look and find examples of organisms and topics covered in class provide an invaluable experience.

Overall the faculty thought that the tool enriched the teaching experience of the course while not placing any undue load on the faculty to prepare and submit assignments. The low number of students who actually missed a biome assignment indicates that student participation was high in this project, which helps student preparedness and knowledge acquisition. This tool helped us develop a teaching framework and best practices approach for course redesign projects that could be applied to other large enrollment lecture courses.

Initially built specifically for biology, the *Biomes of Homewood* tool currently applies to biology and environmental sciences. The team is developing the tool to accommodate content from any discipline. Medical faculty, for instance, could use an anatomical drawing of the circulatory system and have students or researchers enter data about specific points in the human body. Or, Astronomy and Physics faculty could use a map of the solar system and enter data about specific points on the map. Further information about the *Biomes of Homewood* and an online demo are available at http://www.cer.jhu.edu.

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