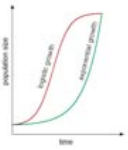
STEM in Secondary Education:
Quantitative Literacy in Population Ecology

Instructor's Guide


Quantitative Literacy in Population Ecology

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Course Description

This mini hybrid course aims to teach quantitative literacy concepts and skills necessary to help students make sense of real-world situations. This course will take students through the steps of collecting, analyzing and presenting data from a given set of scientific data about population ecology. By the end of the course, students will be able to predict the impact of environmental changes for a specific species population and propose a possible solution for conservation and sustainability within the species' ecosystem.

Rationale or Need

Over a decade ago, "national and international studies showed that most U.S. students left high school with far below even minimum expectations for mathematical and quantitative literacy" (Steen, 1999). Students did not have the technical and quantitative skills needed to compete in the employment world. According to Steen, "despite years of study and experience in an environment drenched in data, many educated adults remained innumerate" (1999). They did not have a basic foundation for collecting, analyzing and presenting data. Now with the massive amount of distributed content and data via the Internet, "the need to establish levels of quantitative literacy becomes ever more important" (Steen, 2002).

Quantitative literacy is closely related to mathematics and the skills are oftentimes confused with those taught in mathematics (Manaster, n.d.). Quantitative literacy is the "quantitative reasoning capabilities required of citizens in today's information age" (Steen, 2002). Basically, it is the analysis of data. Some of the skills include arithmetic equations, percentages, ratios, simple algebra, measurement, estimation, logic, data analysis, and geometric reasoning (Steen, 1999).

Lynn Arthur Steen, a professor of mathematics at St. Olaf College, observes (1999):

> Educators know all too well the common phenomenon of compartmentalization, in which skills or ideas learned in one class are totally forgotten when they arise in a different context. Students need to learn numeracy in multiple contexts—in history and geography, in economics and biology, in agriculture and culinary arts. . . . All teachers need to help students think of mathematics not just as tasks on school worksheets but as something that arises naturally in many contexts.

Therefore, a mini online course that teaches quantitative literacy concepts and skills is necessary to help students make sense of real-world situations. This course will take

students through the steps of collecting, analyzing and presenting data from a given set of scientific data about population ecology. By the end of the course, students will be able to predict the impact of environmental changes for a specific species population and propose a possible solution for conservation and sustainability within the species' ecosystem.

Why the web?

Many digital tools, available on the Internet, "have had a profound effect on how we learn, through radical shifts in the way we find things out, communicate, collaborate, create, share or play" (Clark, 2011). These include Google, Wikipedia, YouTube, Dropbox, and Twitter just to name a few. These tools provide opportunities to overhaul traditional methods of teaching by allowing for asynchronous sessions, reply of presentations, collaboration by multiple users, and content publishing.

Many higher education intuitions have already made the move to offering classes online using many of the aforementioned digital tools. According to the Pew Social & Demographic Trends website, out of "1,055 college and university presidents interviewed for the Pew Research survey, 77% reported that their institution offers courses for which the instruction takes place exclusively in an online environment" (Taylor et al., 2011). Slowly, online learning is moving into K-12 classrooms where teachers have more flexibility for any-time learning and differentiated instruction. This mini course provides a solution for increasing quantitative literacy via online instruction delivery.

Intended Audience

Target audience are 9th grade Biology students at Punahou School. Students have laptops connected to the school's wireless network. They are digital natives with prior experience navigating through the school's Moodle course websites in middle school. One of Punahou School's initiatives is focused on sustainability; hence, the final project for the course aims to connect the mini course topic of STEM and population ecology to the theme of sustainability and conservation.

Syllabus

Instructors' Information

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Course Content

- Coral Reef Biology
- Scientific Data I: Random Sampling, Data Table, and Graphs
- Coral Reef Ecosystems
- Scientific Data II: Interpreting Tables and Graphs
- Coral Reef Conservation

Major Course Objectives

- Students will be able to describe physiological, ecological, and behavioral strategies used for successful population growth.
- Students will be able to compare random sampling with data obtained by an actual count.
- Students will be able to construct a basic graph with provided data.
- Student will be able to predict the impact of environmental changes on the organisms in an environment.
- Students will be able to interpret data given a table or graph and describe trends regarding population relationship.
- Students will be able to propose a possible solution for conservation and sustainability of an organism in an ecosystem.

Class Meetings

The Coral Reef Ecosystem hybrid mini course meets F2F for 4 hours per week on the Punahou campus and online asynchronously through Laulima and Wikispaces.

Course Methodology

This hybrid mini course is designed to supplement the 9th grade Biology curriculum at Punahou School. It will be delivered primarily over the internet in an online environment through Laulima and Wikispaces. To access the course, students will need a web browser such as Safari, Chrome, Firefox, or Internet Explorer and reliable internet connection. The course activities will consist of online presentations, individual and team projects, and computer-based assessments through online surveys and quizzes. Interaction will conduct mainly through e-mail, asynchronous discussions, and F2F meetings. Assignments will be submitted to the instructors through Laulima assignment.

Software and hardware required

- Software: Web browser with Adobe Flash Player, Google Sites, QuickTime
- Hardware: Computer and Internet connection

General Course Conduct and Policies

Students are expected to review all presentations, visit assignment websites, participate in online activities, and submit all assignments in a timely manner.

Assignment Submission

All assignments are due on the date specified. Assignments should be submitted through Laulima assignments as a Microsoft Word (.doc) or Adobe Portable Document File (.pdf). For each calendar day the assignment is submitted late, 10% will be deducted from points earned for that assignment.

Communication Tools

As this course will be conducted mostly online, communication is important for success in the course.

- *Discussion and Private Messages in Laulima* serves are the most important way to communicate with instructors and peers throughout the course.
    - *Questions* to be used for general questions and/or comments relating to course content.
    - *Class Discussions* to be used for participating in class discussions as assigned.
    - *Student Lounge* to be used for other questions/topics amongst students.
- *E-mail* instructors or peers for messages that are private or to arrange collaboration with team members
- *Q & A during F2F meetings*. Instructors will allow the last 10-15 minutes of F2F meetings for questions and clarifications about the online course. Additionally, at the first F2F meeting, instructors will guide students on how to use Laulima and Wikispaces. Tutorials will also be posted in Laulima Resources.

General Message Protocol

Every discussion posts or e-mail message must have the following:

1. The subject line describing the content.
2. Content should be free of typos or grammatical errors.
3. Sign every message with a name you would like to be called.

Course Requirements

Week and Module Title	Assignments/Assessments	Points
Week 1 Coral Reef Biology	1. Self-Introduction in Laulima Discussion 2. Pre-module survey 3. Discussion post on Coral Reef Interactive website and Great Barrier Reef Virtual Tour 4. Post-module survey	10 10 10 10
Week 2 Scientific Data I: Random Sampling, Data Table, and Graphs	1. Random Sampling activity 2. Practice questions 3. Quiz on Laulima	20 10 50
Week 3 Coral Reef Ecosystems	1. Discussion post: Effect of carbon dioxide on corals 2. Understanding Ocean Acidification Packet (collaborate with a partner)	10 30
Week 4 Scientific Data II: Interpreting Tables and Graphs	1. Graphing Deer Population Growth activity 2. Practice questions 3. Quiz on Scientific Data Interpretation	20 10 50
Week 5 Coral Reef Conservation	1. Screenshot of Coral Reef Game 2. Multimedia Conservation Poster 3. Exit Survey	10 50 10
	Total	310

Grading Scale

93-100 …….A	87-89 ……..B+	77-79 ……..C+	67-69 ……..D+	<60 ……. F
90-92 ……...A-	83-86 ……..B	73-76 ……..C	63-66 ……..D	
	80-82 ……..B-	70-72 ……..C-	60-62 ……..D-	

Instructor's Note

1. The course management system used in this course is primarily Laulima, but Wikispaces, which is found in the tools section, is used to guide students in their learning process. Students of this course may not be familiar with Laulima, so you as an instructor need to encourage students to explore all the tools such as Announcements, Syllabus, Mailtool, Discussion and Private Messages, Assignments, Test and Quizzes, and Gradebook. In the Resources tool there are links to Laulima and Wikispaces tutorials.

2. This is an online asynchronous course and it may be a new learning environment for some students. Fortunately, all students are technology natives. You will need to keep excellent communication with the students in order to ensure their completion of assignments and tests and quizzes.

3. Each week has its own assignments, which are listed in each weekly module via Wikispaces. Remind students to submit their assignments through Laulima in the Assignment tool.

4. The course evaluation has been embedded into the mini online course via Wikispaces; however, you need to ask students not to do it until they are guided to do so. They can read or click on the choices, but should not hit the "Submit" button until the end of the course in Week 5 – Mini-Course Exit.

5. The Conservation Poster, which is the final project, is due in week 5. The grading criteria can be found below in Assessment Rubric.

Timeline

Week1	Coral Reef Biology
April 2 - 8	Science Content • components • reproduction • nutrition • competition • population growth Assignments 1. Self-Introduction in Laulima Discussion 2. Pre-module survey 3. Discussion post on Coral Reef Interactive website and Great Barrier Reef Virtual Tour 4. Post-module survey
Week 2	**Scientific Data I: Random Sampling, Data Table, and Graphs**
April 9 - 15	Math Content • probability • random sampling process • parts of a graph and data table including title, independent variable, dependent variable, scale, and x and y ordered pairs Assignments 1. Random Sampling activity 2. Practice questions 3. Quiz on Laulima
Week 3	**Coral Reef Ecosystems**
April 16 - 22	Science Content • populations • habitats • ecosystem dynamics • factors affecting ecosystems Assignments 1. Discussion post: Effect of carbon dioxide on corals 2. Understanding Ocean Acidification Packet (collaborate with a partner)
Week 4	**Scientific Data II: Interpreting Tables and Graphs**
April 23 - 29	Math Content • interpret tables and bar graphs • linear relationships, exponential growth, and logistic growth Assignments 1. Graphing Deer Population Growth activity 2. Practice questions 3. Quiz on Scientific Data Interpretation
Week 5	**Coral Reef Conservation**
April 30 - May 6	Science Content • natural threats • human threats • protection and monitoring Assignments 1. Screenshot of Coral Reef Game 2. Multimedia Conservation Poster 3. Exit Survey

Assessment Rubric

Conservation Poster Assessment

Category	9 - 10: excellent	7 - 8: good	4 - 6: average	1 - 3: poor	score
Content and Accuracy	Covers topic in-depth with details and examples. Subject knowledge is excellent.	Includes essential knowledge about the topic. Subject knowledge appears to be good.	Includes essential information about the topic but there are 1-2 factual errors.	Content is minimal OR there are several factual errors.	
Visual Design	Makes excellent use of font, color, graphics, effects, etc. to enhance the presentation. All borrowed graphics have a source citation.	Makes good use of font, color, graphics, effects, etc. to enhance to presentation. All borrowed graphics have a source citation.	Makes use of font, color, graphics, effects, etc. but occasionally these detract from the presentation content. Most borrowed graphics have a source citation.	Use of font, color, graphics, effects etc. but these often distract from the presentation content. Several borrowed graphics do not have a source citation.	
Organization and Mechanics	Content is well organized using headings or bulleted lists to group related material. All items of importance on the poster are clearly labeled. No misspellings or grammatical errors.	Uses headings or bulleted lists to organize, but the overall organization of topics appears flawed. Almost all items of importance on the poster are clearly labeled. Three or fewer misspellings and/or mechanical errors.	Content is logically organized for the most part. Several items of importance on the poster are clearly labeled. Four misspellings and/or grammatical errors.	There was no clear or logical organizational structure, just lots of facts. Labels are too small to view OR no important items were labeled. More than 4 errors in spelling or grammar.	
Originality	Product shows a large amount of original thought. Ideas are creative and inventive.	Product shows some original thought. Work shows new ideas and insights.	Uses other people's ideas (giving them credit), but there is little evidence of original thinking.	Uses other people's ideas, but does not give them credit.	
Cooperation	Partners show respect for one another's ideas, divide the work fairly, and show a commitment to quality work and support for each other.	Partners show respect for one another's ideas and divide the work fairly. There is commitment by some members toward quality work and support of one another.	Partners show respect for one another's ideas and divide the work fairly. There is little evidence of a commitment toward quality work in the group.	Partners argue or are disrespectful of other's ideas and input. Criticism is not constructive nor is support offered. The work is mostly done by one or two people.	

Follow Up Activities

Students will need to fill out the mini course Exit Survey at the end of Week 5. For further reinforcement of topics covered in the min course, the following are additional resources.

Science Content

- Ccean Acidification Activity
  http://coralreef.noaa.gov/education/oa/curricula-activities.html
  - pH scale
  - carbon footrpint
  - climate change

Math Content

- Basic Statistics Course either at high school or college
- StatWeb: Online Module to teach basic statistics for Biological Sciences
  http://www.dur.ac.uk/stat.web/

Resources

Course URLs

Wikispaces site for mini course
http://etec632s12stem.wikispaces.com/

Laulima site for mini course
http://tinyurl.com/laulima-stem-minicourse

Support and Tutorials

Introduction to Wikispaces YouTube video
http://youtu.be/50MenxCNYAI

Laulima support for students
http://www.hawaii.edu/talent/laulima_students.htm

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