General Education Course: Is It Relevant?

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Abstract: The paper presents a teaching regime and evaluation criteria for a general education course in biology. The purpose of the course is to provide students with biological information to help them understand problems facing humans and some of the social and ethical aspects of these problems. Using input from students concerning what constitutes a good learning environment, the course is designed to give students the opportunity to control much of their own success in the course. The paper also examines how students respond to the variety of evaluation methods.

Key words: general education course, evaluation, student opinions, Boyer's commonalities

INTRODUCTION

Most courses in Biology have a specific focus, such as histology, embryology, or taxonomy; however, the focus of a General Education Course in Biology is not on specific subject matter. Instead, it provides students with information that fosters a better understanding of biologically related issues, which they will face some day as world citizens. Because "One of the most difficult courses to teach among a biology department's offerings is the general biology course for non-majors." (Anderson, 1984), we believe the material presented needs to be relevant to living in the "real world." We have designed a course, which we hope will accomplish this goal. The course is centered upon major problems facing humans now and in the future. The scientific content of the course prepares students to examine these problems and their ramifications with an informed background, i.e. information is provided as a means to examine problems, not as an end in itself. This examination requires that scientific and technological contributions are accompanied by social and ethical considerations with the goal that, long after students have completed the course, they will continue to use this approach to science for making informed decisions. Derting points out that the emphasis placed on ethics and its importance in the decisions our students will make throughout life is increasing in undergraduate education in the United States (Derting, 1994). As instructors, we believe our role is to educate, not to indoctrinate. We maintain the position that science is a way of life, which includes examining information and problems in a special way. A general education course should not be designed to turn students into biologists, but rather to help them understand how biologists attempt to solve problems and how biology relates to everyday life. Rogers and Ford point out that students do not acquire positive attitudes toward science just because they learn more science. They further state that instructors need to keep aware of the changes observed in the expectations and experiences of the student population (Rogers & Ford, 1997)

For this General Education Course in Biology we have constructed a method for student evaluation in agreement with student preferences outlined in Richard Light's book *Making the Most of College: Students Speak Their Minds*. He lists several factors that make for a better course, as indicated by students (Light, 2003). He states,

> "A large majority of students say they learn significantly more in

> courses that are highly structured with relatively many quizzes and short assignments. Critical to this preference is getting quick feedback from the professor, ideally with an opportunity to revise and make changes before receiving a final grade (p. 8)."
>
> "How students study and do their homework assignments outside of class is a far stronger predictor of engagement and learning than particular details of their instructor's teaching style (p. 51)."
>
> "Of all skills students say they want to strengthen, writing is mentioned three times more than any other (p. 54)."
>
> "They believe they can learn most effectively when writing instruction is organized around a substantive discipline (p. 59)."
>
> "In reference to science courses, students prefer those that have a modest rather than higher levels of competition for grades (p. 73)."

In keeping with these student recommendations, our course includes significant writing, frequent evaluations with rapid feedback to the students, outside homework, opportunity to improve their work, and minimum competition.

Ernest L. Boyer in a report in *Rethinking the Curriculum* entitled "Making the Connections: The Search for Our Common Humanity" states,

> "Today students live in a world that is economically, politically, and environmentally connected. The protective ozone layer is endangered. Our shorelines are polluted, and the tropical rain forests are being destroyed at the rate of 100,000 square kilometers every year. I worry that education in this country is becoming increasingly parochial at the very moment that human agenda is more global. Students are not becoming sufficiently well educated about the world they will inherit (Boyer, 1995)."

He further states than an undergraduate curriculum should be based on what he calls the *human commonalities*—those universal human experiences that are found among all people and all cultures on this planet. He then proposes the question, "What are these experiences that non-uniform people have in common?" We believe that Boyer's question can be extended to all living things, not just to humans. This approach has proven to be quite successful when applied to an introductory course for biology majors (Brett 1998).

Boyer lists the following 7 commonalities:

1. We all experience life: birth, growth, and death.
2. We all communicate with each other.
3. We all respond to the aesthetic.
4. There is an historic perspective; we all recall the past and anticipate the future.
5. We all organize ourselves into societies.
6. We are all embedded in Nature. We are interconnected.
7. We all seek to give meaning to our lives.

Whenever possible during the course, these commonalities are applied to the subject matter. Time is allotted during the scheduled class periods to examine material from these viewpoints and apply the process of Critical Thinking to the subject matter. At the conclusion of each unit, students respond to a series of objective questions to assure they know the factual content. Then they discuss a series of questions to help them apply the factual material to biologically related human problems or issues. A significant number of the discussion questions are controversial and stimulate diverse opinions. Whereas there is little disagreement among students about the answers to strictly biological questions, there is seldom unanimity in their consideration of social and ethical implications.

COURSE OUTLINE

The course examines biology as problems facing humans. Hopefully the text and class discussions will better equip students to examine problems of a biological nature facing all of us at the present time and from some time into the future, as well as helping them to arrive at informed decisions in considering these problems. The course is based upon five major problems or themes:

1. The environment and factors affecting it.
2. Human populations—causes and consequences.
3. Nutritional needs and meeting those needs for all humans.
4. Genetics, genetic engineering and their implications for humans.
5. "New" diseases—causes, treatments, and preventions.

SCHEDULE OF TOPICS

1. **The Environment and Factors Affecting It**
   - Spaceship earth
   - Major biotic components of ecosystems
   - Energy flow in ecosystems
   - The cycling of nutrients
   - Human ecology

2. **Human Population — Causes and Consequences**
   - Population growth and control
   - Structure and function of the male reproductive system
   - Structure and function of the female reproductive system
   - Fertilization and development
   - Contraception
   - New technologies for reproduction and problems associated with these technologies
   - Aging

3. **Nutritional Needs and Meeting Those Needs for All Humans**
   - Photosynthesis
   - Cells and energy
   - Nutrition and digestion
   - Humans and their food supplies
   - Possible solutions to the world's food problems
   - Diet
   - Muscle structure and function, and exercise and beneficial effects

4. **Genetics, Genetic Engineering and its Implications for Humans**
   - Cell organization
   - Cell reproduction
   - Chromosomal inheritance
   - Human genetics
   - Genetic disorders
   - Biotechnology

5. **"New" diseases—causes, treatments, and prevention**
   - Homeostasis
   - Immunity and disease
   - Sexually transmitted diseases
   - Major killers of the past
   - Cancer
   - Cardiovascular diseases

6. **Evidence for Evolution**

REQUIRED MATERIALS FOR COURSE EVALUATION

In a CCCR report entitled "Education", Branscomb states, "Too many Americans believe that you must be gifted to learn math and science; in fact, everyone can learn. Hard work, not innate talent, is the key to learning (Branscomb, 1993). As most instructors who have been in the trenches for a relatively long period of time know, no matter how hard the instructor works, students must do the learning. Therefore, we believe students must be involved in their own learning. Directing them to relate biological information to everyday life is one way to do this. Yorks acknowledging the often asked question, "Why do we have to learn this?", states that allowing and requiring students to relate concepts that they learn in the classroom to some aspect of their personal environment helps them answer the question themselves (York). Therefore, course evaluation includes a variety of requirements, which involve students in the process of learning; it does not consist merely of tests over memorized facts. Interestingly, the use of a variety of evaluation tools, in addition to tests, not only permits students to witness and evaluate biological information from many viewpoints, but also decreases the competitive nature of the course. This is in agreement with Light's findings (Light, p. 73).

REQUIREMENTS FOR THE COURSE AND THEIR VALUE

1. **Exams** 200
   There are four exams, including the final, worth 50 points each. The questions are taken from the lecture material covered since the previous exam. Each exam consists of about 60% objective, multiple choice, and matching questions, and 40% short discussion questions including commonality questions.

2. **Newspaper articles** 20
   During the 15 weeks semester, students are required to submit 10 articles from a newspaper or weekly magazine. Each article must "touch upon" information that has been or will be covered in the course. The article must be dated, indicating that it appeared during a specific week of the semester. Students may clip the article, if it is from their own newspaper or magazine, or they may photocopy it, if it is from a library holding. A brief paragraph in ink or by word processor, explaining the student's perspective on the significance of the information, is required. Articles are turned in for a minimum of 10 weeks during the semester; i.e., an article is turned in each of 10 weeks, not 2 to 10 articles in one week. The articles must be turned in as paper copy, not as email. This requirement causes the student to check recent news copy and provide the specific week's material.

3. **Bonus newspaper articles** 10
   Students may turn in as many as 5 extra articles. They receive 2 bonus points for each additional article for a possible 10 bonus points.

4. **Written essays** 20
   Two essays, each of 500 words minimum, are required. A satisfactory essay will receive 10 points; a less than satisfactory essay will receive an appropriate number of points. Topics for essays are included in the schedule and students are required to apply 5 of Boyer's commonalities in the text. In previous years, students were given the opportunity to write on any topic they believed applied to the course material; however, this was not found to be satisfactory as predicted in Light's discovery that students are more comfortable when writing around a substantive discipline (Light, p. 59). The due dates for the essays are included in the schedule, but students can submit their essays any time prior to the due dates. Submitting the essay before the due date permits the instructor time to review it and return it to the student for corrections, additions, and other improvements, if they are needed. This gives students the opportunity to improve their grades on the essays, which students appreciate (Light, p. 8). Regardless of when the essay is submitted, it is edited and returned rapidly to the student with the requirement that it be resubmitted before a grade is assigned. Most students require only one resubmission, but some require 2 or 3. No attempt is made to change the students' ideas or opinions, but only corrections and suggestions are provided that will enable them to state these in a clearer and acceptable form

5. **Bonus exercises** 10
   During the semester there are opportunities to earn bonus points by submitting satisfactory answers to problems or short essays on a variety of topics

6. **Photographic evidence of topics covered in the course** 20
   Students submit a minimum of five colored photographs taken by them during the semester, which illustrate principles or topics covered in the course. The photographs must illustrate different topics such as reproduction, genetics, pollution, or population. Each photograph most be accompanied by a short description of what the photograph illustrates. Students are to obtain duplicate copies so that their submitted photographs do not need to be returned. A class album is prepared containing some of the best responses to the assignment. If students don't own a camera, it is suggested they purchase an inexpensive, single-use camera for about $5.00. Their objection to this additional cost is overruled by the cost of their textbook, which is free from the Web.

Total points possible for the course 270

Grade determined on the basis of 250

ESSAY TOPICS

1. Pollution as caused by humans
2. World population problems
3. World nutritional problems
4. A genetic disease
5. A viral STD
6. Biotechnology

Each essay must include reference to a minimum of 5 of Boyer's commonalities. This requirement for students to use some thought and originality in their essays significantly reduces the likelihood that their essays will come from the Internet. If students submit their essays with a list of Boyer's commonalities at the beginning or end of the essays, they are returned with the instruction that the commonalities must be illustrated in the body of the text. All essays are graded only after the students make the necessary corrections. Without this requirement, students pay little attention to improving their writing. Moore, in his comments about students' essays, asks the question, "Do our marks and comments help students develop a writing style that will serve them well in their careers (Moore, 1994)?"As was indicated by students, they want to strengthen their writing skills (Light, p. 54); this will not occur, if the instructor does not serve as an editor to help them improve.

NEWSPAPER ARTICLES

Students tend to submit articles with short summarizing paragraphs; however, after one or two are returned, most students begin personalizing their narratives. If the articles are turned in on time, students are permitted to correct and resubmit the assignments without them being considered late. This leeway is only permitted for the first one or two articles.

These are a few examples of how students relate to news articles.

1. "Implant in Scalp Can Zap Headaches"—*Indianapolis Star*, Feb. 17, 2003. When I saw this article, it immediately sparked my interest. I have suffered from migraines for about six years. I still remember my first migraine and how awfully incapacitating it was. Little did I know then that it was the beginning of this horrible journey through migraine headaches. Thankfully, however, Midrin has worked for me in controlling my migraine headaches. However, I know that it might not always work, and I will have to turn to an alternative medication source. Therefore, I constantly have my eyes open for the newest information on headache research. The idea of a tiny electrode controlling a nerve and preventing severe pain is really exciting. The idea of spending $5,000 to $10,000 on a headache cure may sound absurd to some, but to those who suffer, it's definitely worth it.

2. "Antibiotic-Resistant Strep Germs Gaining Ground, Researchers Say"— *Indianapolis Star*, March 10, 2003. This article says, "Next year there will be up to 40% of the strains of strep that could become immune to penicillin and erythromycin." This means that more people will get sick from these strains and they will be harder to treat. Scientists will have to find new medicines. Meningitis is one of the diseases that is immune to drugs. Last week in my hometown, there were three cases they couldn't cure. This article touches upon the unit of immunity and disease.

3. "Obese Children Rate Quality of Life Very Low"—*Indianapolis Star*, April 13, 2003. Lindsey Tanner of the Associated Press says, "The quality of life for children who are considered to be overweight is a lot lower than expected." The article states, "15% of the nation's youth is overweight. After rating themselves physically, emotionally, and socially, it was found that their scores were very similar to those of children with cancer." I think that this article goes along with our section on nutrition and its effects. This article interested me because I was an overweight child and realized that I didn't want to go to school because of being teased and because I was ashamed of my body. Effects of that still follow me and even though I have come to terms with never being a super model, I still have a large fear of being overweight. Hopefully after this study, there will be more attention paid to obesity in youth and trying to help them and educate parents on proper eating habits for children.

PHOTOGRAPHS

The first semester that photographs were included in the evaluation, the instructions did not indicate that each photograph should illustrate a different topic; therefore, some students submitted five photographs on the same topic. The most common topic was pollution. By requiring 5 different topics, it is hoped that the students will become involved in and retain information from a variety of areas. A short description of what each photograph illustrates is required. Students who turn in their work before the deadline are offered the opportunity to improve their work and receive a better grade. Examples of photographs and descriptions are included in Figure 1.

Figure 1. *Examples of photographs and student descriptions.*

1. Pollution — Photograph of a "junkyard" or automobile graveyard

"The materials and debris found in the junkyard occupy around one half acre and cause a serious threat to the environment. The run offs from oil, antifreeze, steering fluid, battery acid, and Freon will be absorbed into the soil contaminating the land. When a heavy rain comes, the runoff from the junkyard will most likely find its way into a river or water supply of some kind, affecting wildlife and humans."

2. Contraception—Photograph of the contraceptive display in a store

"Condoms, vaginal contraceptive foam, and other forms of birth control are easily available at any drug store. While condoms are 85% effective, abstinence is 100% effective. The vendors at this particular store said that the birth control methods were moved to the "Baby Supply" area with the specific intent of sending a message. By this small act, they are allowing people to remember that pregnancy is a possibility if you are sexually active."

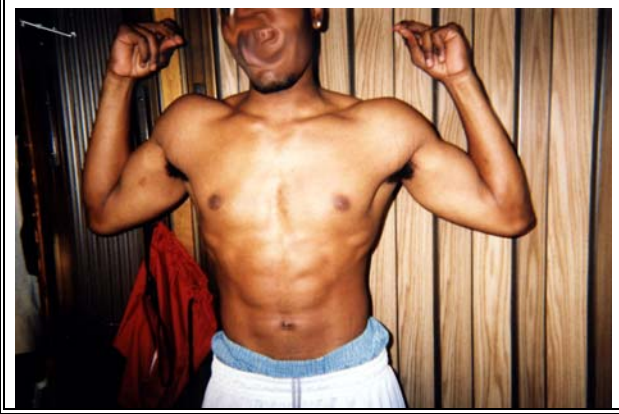
3. Genetics—Photograph showing inherited traits

"We inherit certain characteristics and traits from our parents and ancestors. My grandmother has type-one diabetes (Diabetes mellitus). It usually occurs in people under 30 years of age but may also appear at any age. In type-one the insulin producing cells of the pancreas (beta cells) have been destroyed leaving no insulin available to open the doors of the cell for glucose to enter. Cells then have no energy and blood glucose levels are excessively high. My aunt and grandmother both have type-one diabetes."

Figure 1. *Continued*

4. Fertilization and Development -- Photograph showing pregnant woman with young child.

"This photograph shows the process of fertilization and development. It shows that when an egg is fertilized this is what happens most of the time and the outcome is pregnancy. The woman goes through many stages when an egg is beginning to develop in her uterus. The mother goes through a lot of different stages for nine months and then the child is developed and birth occurs.



5. Exercise and Beneficial Effects -- Photograph shows a young man flexing his muscles.

"In this photograph it shows how when you take care of your body and exercise it shows in the body. This man's body is really in shape and he is cute as well as built really nice. It also shows that he has worked hard in many places and the outcome is what he looks like now. He is being rewarded for the hard work he has done with his body."

BONUS POINTS

Bonus points are earned for students' input on a variety of materials. Several examples are listed below.

1. Students are asked to find out the present population of the world and the United States, which requires that they become acquainted with the World Population Clock on the Web.
2. Students are required to present both sides of an argument, such as in the case of twins born to members of the U'wa tribe in Bogotá, Columbia. Customarily, the U'wa tribe abandons newborn twins in the forest or tosses them into the river, believing they are ill equipped for life and brings bad luck. Juan and Keila Aquablance were spared that fate when their parents left them in a public health clinic three days after their birth. The tribe demanded the babies be returned to the tribe; however, the health officials said the babies shouldn't be returned and should be placed for adoption. The tribe decided to fight the adoption process and demanded the children's return. Students were asked to present arguments to support both the tribe's rights and the babies' rights (actually, the health officials' decision).
3. Students are presented with a world map showing the multiple effects of global warming and asked to list the various areas and organisms being affected by increased warming.
4. Students are asked to present arguments for and against the requirement of medical personnel to make known that they are HIV positive.

As with essays, these papers are edited and returned to students, usually during the next class period; they are required to resubmit papers with corrections or suggested improvements.

RESPONSE OF STUDENTS TO EVALUATION TOOLS

How can instructors evaluate a teaching tool or technique when results of an educational experience often are not evident until long after the student leaves the class? In most cases, instructors settle on short-term evidence. Table 1 examines what percent of the class actually completed the different evaluation criteria, and Table 2 indicates the correlation of grades with student participation in the evaluation criteria. The data are for two classes. One class had an enrollment of 11 and was taught at a private college; the other had an enrollment of 43 and was taught at a state university. Comparing small and large classes is not ideal, but obtaining a small class at the university would have required using data from an honors class, in which case pre-college factors would have clouded the issue.

Table 1. *Response of Students to Evaluation Criteria*

	Private College Class of 11	State University Class of 43
Essays	10 (91%)	41 (95%)
Photographs	10 (91%)	32 (74%)
10 News articles	8 (73%)	24 (56%)
9	1	3
8		3
7	1	3
6		1
5		2
4		3
3	1	3
2		1
Bonus News articles (1-5)	6 (55%)	19 (44%)
Bonus points (1-10)	11 (100%)	37 (86%)

Table 2. *Correlation of Grades with evaluation responses.*

Letter Grade	Private College # Student (%)	State University # Student (%)
A	6 (55%)	5 (12%)
B	2 (18%)	7 (16%)
C	2 (18%)	15 (35%)
D		12 (28%)
F	1 (9%)	4 (9%)

Grade Obtained	Essays 20	Photographs 10	New Articles 20	Bonus News 10	Bonus 10
State University					
A	20.0	9.6	20.0	6.4	8.3
B	17.9	10.0	19.4	4.2	6.4
C	17.8	5.3	20.0	3.2	6.1
D	13.3	8.2	12.5	0.5	4.0
F	6.5	2.5	9.5	0.0	4.5
Private College					
A	18.4	10.0	20.0	3.7	6.2
B	19.0	10.0	19.0	5.0	7.0
C	18.0	10.0	17.0	0.0	5.5
D	0.0	0.0	0.0	0.0	0.0
F	5.0	0.0	6.0	0.0	1.0

Better than 90% of the students in both classes turned in essays. Ninety percent of the students in the small class turned in photographs; whereas, only 74% of the students in the larger class completed the assignment. There was a similar percent difference in the response to the requirement of 10 news articles; about 73% of the small class and 55% of the larger class turned in 10 articles, but all members of both classes turned in some news articles. Both classes showed a tendency to respond less to bonus new articles, 54% and 44%. Surprisingly, 100% of the small class and 86% of the larger class turned in some bonus work.

CORRELATION OF GRADES WITH COMPLETION OF EVALUATION REQUIREMENTS

In the larger class, the average number of points students earned for evaluation criteria, with the exception of tests, compared to their grades indicates a general tendency for them to submit fewer items as grades decrease from A to F. This drop is significant in the lower two grades: D and F. The same is true for the small class, but even the C students did not complete much of the bonus work. The grade distribution is also significantly different between the

two classes. The smaller class size and the type of student in a private school certainly have an affect on this.

The results indicate that students who participate in more of the activities used as evaluation criteria do better grade-wise, and as has been shown by other studies, students in small classes perform better than students in larger classes (Princeton Review). This holds true in both lecture and laboratory as indicated by Ghosh (Ghosh, 1999). One should not overlook the difference in the student population between an expensive, private college and a state university, which plays an additional role in the differences between the two classes (Princeton Review).

DISCUSSION

The purpose of introducing a variety of evaluation tools is three fold: to involve the students in their own education, to emphasize that biological information is present every day in places familiar to them, and to personalize the relationship between instructor and student in a large class. Having students take some ownership for their learning not only makes them teachers in the course, but also helps them retain important information. A frustration for many instructors is their inability to personalize the educational experience for students in large classes. There can be 100 to 200 students in a General Education course in Biology. Although it is difficult, actually impossible, to communicate with most of the students in a large class by "standard" means, i.e. asking them a question; this can be done outside of class by evaluating students' written material as it applies to news articles, photographs, and special problems. Written comments on the students' work and reference to some of the work in daily lectures create a more personal relationship; however, the instructor must be prepared to spend considerably more time than is required for a straight lecture-discussion presentation. Each instructor must decide if the extra work is worth it both for the student and for the instructor. Research has shown that students appreciate the extra work and learn more when there are frequent and rapidly returned evaluations. Several of the items used in this course lend themselves to this type of response.

The results, as indicated in Tables 1 and 2, suggest that the instructor's extra work was relatively worthwhile with A, B, and C students, but was not worthwhile in the case of D and F students. There is a tendency in colleges and universities to emphasize student retention; faculty are continually being asked to design methods for increasing retention, which has resulted in many faculty requiring less of the students. What often seems to be overlooked is the fact that learning is an active endeavor; although someone can guide and encourage them, the students have the ultimate responsibility for their learning. Years ago at a Sigma Xi seminar on teaching methods and philosophies, I was impressed with the results the speaker had been obtaining in his classes. When he opened the session to questions, I asked him what he did with students who didn't attend class and didn't turn in required work. Somewhat angrily he responded, "Some students want to screw themselves; let them." It is difficult for most instructors to follow this advice, but unless they want to continuously see themselves as failures, it may be necessary to do so. The message is "Do all you can as an instructor to encourage and help individuals become good students." Adapting to the classroom the Greyhound motto, "Leave the driving to us," instructors must finally leave the learning to the students.

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