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Cover image: Starfish in a tide pool on the Oregon coast. Photo courtesy of Carlos Cruz.

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Deadlines for Submissions

July 1, 2005 for the August 2005 Issue **November 1, 2005 for the December 2005 Issue**

Born for a Noble Cause? -- -*A case study on Fanconi Anemia*

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Abstract: The fictional case study presented here is not based on one case, but is actually based on several cases. College students enrolled in a bioethics course for non-majors wrote it. The case entails the thought processes and decision-making involved in order to save one child suffering from a genetic disorder by producing another child, a "designer baby." Nursing majors from a freshmen level college General Biology course participated in the suggested activities.

Keywords: Fanconi Anemia, bioethics, in-vitro fertilization, preimplantation genetic diagnosis

MY STORY

The day I was born I had the potential to save my brother's life. My name is Gene. I am a designer baby. I was designed, created, and born for the specific purpose of saving his life. My brother was diagnosed with Fanconi Anemia (FA), an illness that is fatal unless a successful bone marrow transplant can be performed. My parents first thought was that they would be more than happy to donate marrow to their child, but neither of them was a match nor was any other member of their extended family. It was around this time that their doctor suggested having another child who could be a donor. Having a basic knowledge of biology, my parents knew that the odds of a new child being a match was 25% along with a 25% chance of the new child also having Fanconi Anemia. These did not seem like very good odds to them, so they sought out a doctor who could ensure that the new baby would be a genetic match and would not have the disease. This doctor was a specialist in the area of *in-vitro* fertilization (IVF) and preimplantation genetic diagnosis (PGD). IVF is the creation of an embryo in a lab using donated sperm and eggs. PGD is the testing of early embryos for specific traits prior to implantation inside the mother. This process allows parents to create babies screened for specific traits. In my specific case, my parents designed me to be a match for my brother and to not possess the gene for FA. This would guarantee that I would be born healthy and that I would be a genetic match for my brother so that I could donate bone marrow which could be used to save his life.

Now that my parents knew they could create a child to save the one they already had, they had to decide if they should and also if they would. They were in an extremely emotional state at the time. They had to deal with this decision, while also coping with my brother's illness. They were under an extreme amount of stress at the time and facing a very difficult decision. They had to consider whether or not it was right to create a new child to save their firstborn. They had to face the prospect of raising another child, paying for the expensive procedure to create him, and of the reaction of their friends and families regarding whatever decision they made. It was a very difficult decision for them. They agonized over it. They consulted with doctors, lawyers, clergy, friends, and family. After learning all that they could and weighing the consequences of either decision they made the only decision they really could, to save the life of their child.

This is where I come in. Having decided that they wanted to go ahead with having me, they needed to design me. They wanted to ensure that I would be a match for my brother and that I would not have FA. They accomplished both of these goals through the use of PGD. The embryo that would

eventually become me was implanted into my mother and nine months later I was born. After my birth, bone marrow was harvested from my hip. This bone marrow was transplanted into my brother. This healthy bone marrow would hopefully cure his FA.

THE TECHNOLOGY BEHIND THE STORY

In-vitro fertilization is accomplished through a simple yet costly procedure. The average cost for a procedure to be completed is approximately $12,400 in the United States (WebMD Health, 2003). First, the woman is sedated to avoid discomfort and pain. Then, using the ultrasound-guided-trans-vaginal method, eggs are retrieved through a needle, which is inserted through the vaginal wall into the ovaries (Cooper Center, 2004). From there, the retrieved eggs are immediately examined by an embryologist under a microscope. Retrieved egg(s) are then placed into an incubator to allow the eggs to mature. The male donor is asked to donate his sperm to fertilize the egg. The egg(s) and sperm are then combined in a special culture fluid in an incubator and observed. The observation typically lasts approximately eighteen hours after insemination and the beginning stages of development. Once the egg is fertilized, it can undergo PGD, and then be placed in the uterus of the woman. Hormones are given to the mother to sustain the pregnancy (University of Texas, 1997). The pregnancy is then followed through to term. Figure 1 indicates the milestones required for the necessary procedures to produce a designer baby.

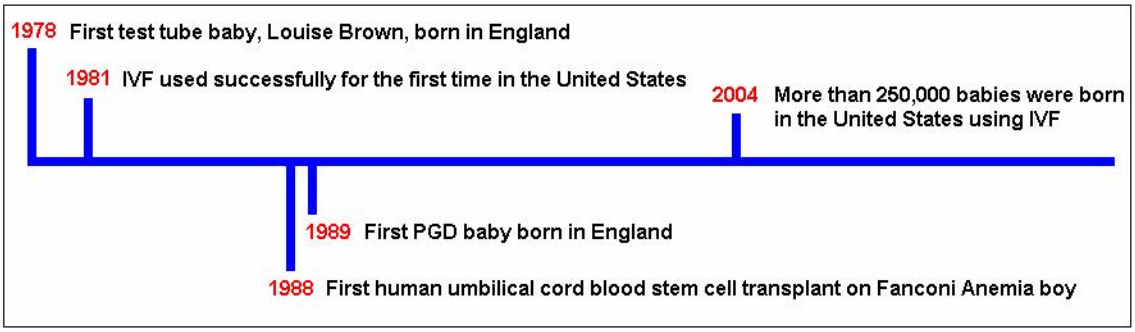

***Figure 1**. A timeline of developments in reproductive technology.*

As mentioned, PGD can be used to screen an embryo that will be genetically, a compatible match for his or her sibling. PGD is an expensive procedure, $4,500 dollars to $5,500 dollars, and that is in addition to the cost of IVF. PGD genetically tests embryos to see if they have chromosomal defects, abnormalities, genetic diseases and/or a certain compatibility (PGD: Reproductive Specialty Center, 2004). The test is done three days after IVF takes place, when the fertilized egg has divided into eight cells (Center for Genetics, 2004). These eight cells contain all the same genetic information specific to that individual; therefore, to test the potential child for genetic diseases, a doctor has to remove one of the eight cells and analyze it (The Infertility Center, 2004). After the cells have been screened, the embryos that contain genetic diseases and/or do not genetically match the needs of their sibling will either be discarded or frozen. The embryos that do meet all the criteria will then be implanted into the mother's uterus (Figure 2). They will hopefully attach to the uterine wall, develop for nine months, and be delivered as a full term normal baby (Monash, 2004).

What is Fanconi Anemia (FA)?

Fanconi anemia (FA) was first described by a Swiss pediatrician, Guido Fanconi. In 1927, Dr. Fanconi published his clinical observations on brothers who had inherited several abnormal physical conditions and who also experienced bone marrow failure. These children suffered severe life-threatening aplastic anemia. Their blood systems could not successfully combat infection. In addition, as a result of anemia, they were chronically fatigued. Because their platelet counts were low, they suffered spontaneous bleeding. Thus, when research was conducted it was found out that Fanconi anemia is an "inherited" anemia. It is one of several rare genetic conditions that lead to aplastic anemia. No one has yet explained why FA patients develop bone marrow failure. Understanding can come only after the FA genes have been isolated and studied. However, scientific studies show that almost all FA patients will eventually experience marrow failure. Some scientists believe that the interaction between toxic environmental factors and an FA patient's genetic vulnerability to marrow failure may contribute to aplastic anemia (Fanconi Anemia, 2004). Individuals with Fanconi Anemia should avoid x-rays, chemotherapeutic agents, and other environmental exposures. Other symptoms include severe aplastic anemia, hypoplasia of the bone marrow and patchy discoloration of the skin. Thus, treatment usually consists of bone marrow transplant.

Fanconi anemia is a recessive disorder. Both parents must be carriers of a recessive FA gene for their child to be born with this disorder. If both parents carry the recessive gene, the chances are one in four that any of their children will inherit the disease. Scientists call this pattern of inheritance autosomal recessive (Figure 3).

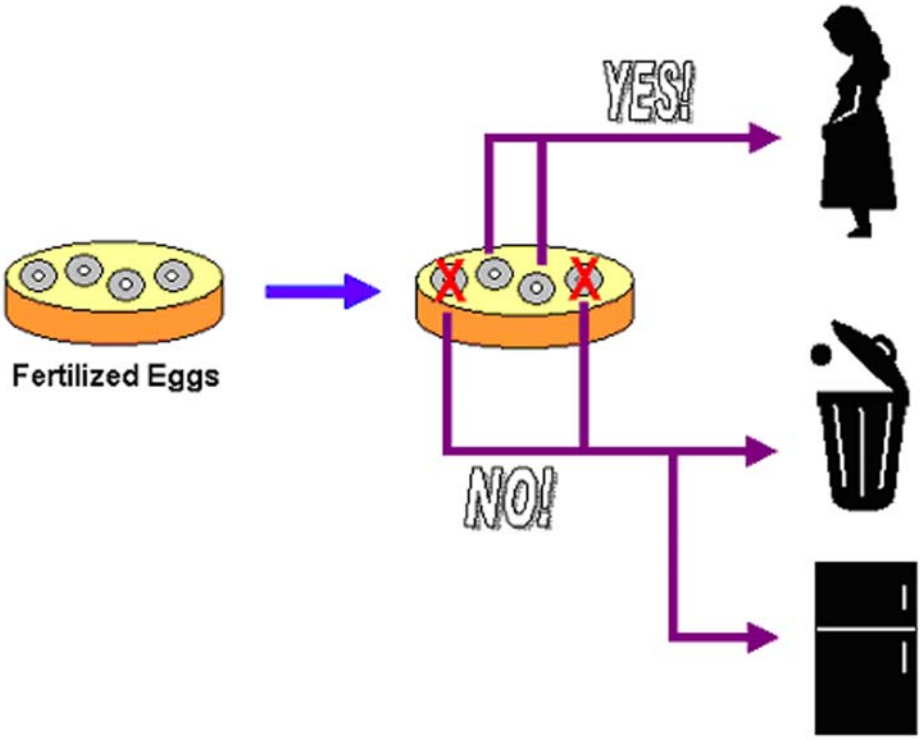

Figure 2. *Fertilized eggs are screened for genetic defects and compatibility. The eggs that are defect free and genetic matches are implanted into the mother's uterus. The eggs that are incompatible or contain genetic defects (labeled X) are either frozen or discarded. Graphics created by Gloria Lu.*

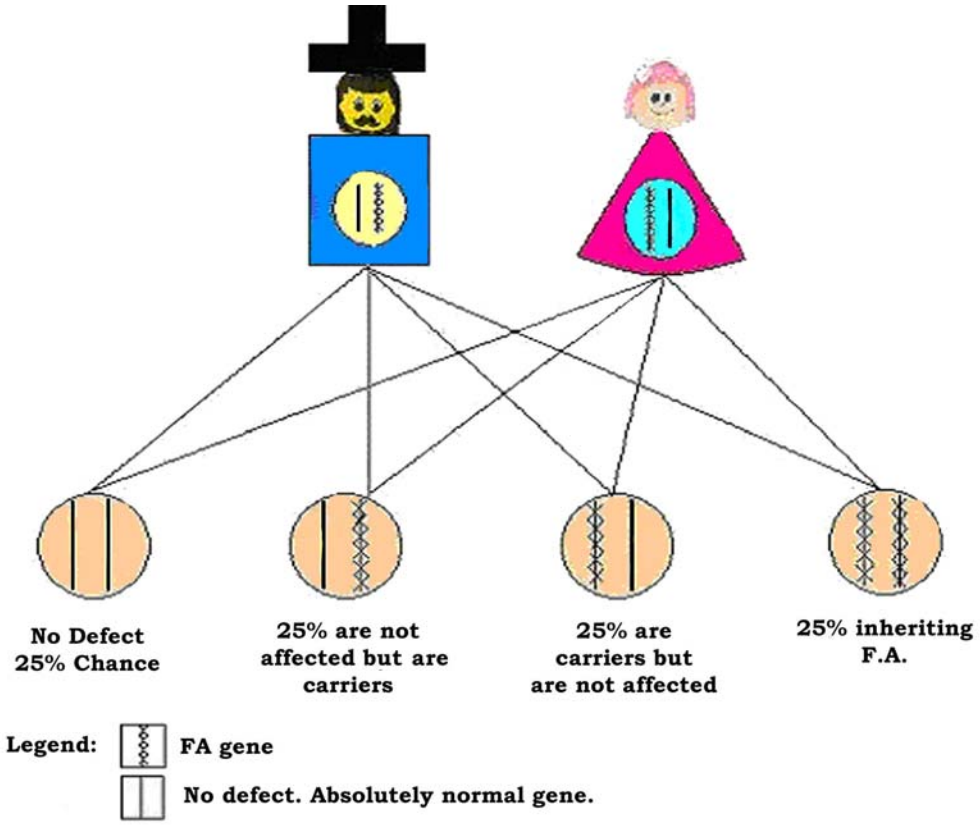

Figure 3. *Above represents the probability of inheriting the Fanconi Anemia if both parents are carriers for the FA gene. The disease spreads if both parents pass the defective gene onto their offspring. Graphics created by Hira Shafqat*

DIAGNOSIS

FA usually reveals itself before children are 12 years old, but, in some very rare cases, no symptoms are present until adulthood. FA patients are usually smaller than average. They may feel extreme fatigue and have frequent infections. Nosebleeds or easy bruising may be a first sign of the disease. Blood tests may reveal a low white blood cell, red blood cell or platelet count or other abnormalities. Sometimes Myelodysplasia (a rare blood disorder that is associated with dysfunctional bone marrow, resulting in a failure of production of red blood cells, white blood cells and platelets.), acute myelogenous leukemia (which is a cancer of the myeloid line of white blood cells (Free Definition, 2004), or squamous cell carcinoma (a type of cancer usually developed in the epithelial layer of the skin and sometimes in different mucous membranes of the body) are some of the diseases that result through FA. Some of most common defects are listed in Table 1.

While the total number of FA patients is not documented, scientists estimate that the number of people carrying a defective gene is between 1 in 100 and 1 in 600 (Fanconi Anemia, 2004).

Table 1. *Physical defects associated with Fanconi Anemia*

- Hand and arm anomalies: misshapen, missing or extra thumbs or an incompletely developed or missing radius (one of the arm bones).
- Skeletal anomalies of the hips, spine, or ribs.
- Kidney problems, including missing or horseshoe kidney.
- Skin discoloration (café-au-lait spots); portions of the body may have a suntanned look.
- Small head or eyes.
- Mental retardation or learning disabilities.
- Low birth weight.
- Gastrointestinal difficulties.
- Small reproductive organs in males.
- Defects in tissues separating chambers of the heart.

PROGNOSIS AND TREATMENT

The reported survival time of patients with Fanconi anemia is highly varied, ranging from 2 to 25 years. Frequent screenings can ensure early diagnosis of the cancers associated with Fanconi anemia. Individuals with Fanconi anemia may wish to store their own bone marrow in case a later treatment diminishes their existing bone marrow. Bone marrow is a spongy tissue found inside bones. The bone marrow in the breastbone, skull, hips, ribs and spine contains stem cells that produce the body's blood cells (red blood cells, platelets, and white blood cells). If a patient develops a disease of the blood cells he or she may require high doses of chemotherapy to destroy the cancer. However, this also destroys normal blood cells. In these cases, transplantation of healthy bone marrow may save a patient's life. Transplanted bone marrow will restore production of white blood cells, red blood cells, and platelets. The healthy bone marrow may be taken from the patient prior to chemotherapy or radiation treatment, or it may be taken from a donor (Bone Marrow Transplant, 2004). This is why Gene was created to donate bone marrow to his brother and save his life from the deadly disease.

THE REST OF THE STORY

I do not have the gene for FA and am a normal, healthy child. I have always been glad that my very existence could save the life of my brother. We have been closer than most siblings and have shared a special bond. I have had no ill physical effects from the procedure and I will be eternally grateful that I could save my brother. However, I will still have questions about the way and reason I was created. Although I love my brother, I have always had feelings of inferiority in regards to our relationship. I have always felt as if he were more important than me due to the lengths that my parents went to save him. My existence is merely a side effect of his treatment for an illness. So even though it may be true that many younger children feel inferior with no real reason, I think that I have a legitimate reason to feel inferior. I will have to live with the knowledge that I was not wanted for my own sake, but for the benefit of my older brother. So while I am a relatively normal child physically, I do have to live my life with my own, very unique emotional burdens.

Suggested Activities:

Activity 1

Divide the class into four groups. Each group should conduct a survey targeting a different group

(i.e. boys vs. girls, athletes vs. non athletes, children vs. adults). The groups should decide which questions they believe are relevant.

In our own survey we asked university students the following three questions, which we felt were relevant. Are you in favor of genetic testing on embryos (figures 4a and 4b)? Are you in favor of creating and testing an embryo in order to save an older sibling (figures 5a and 5b)? Are you in favor of destroying the embryos that do not match (figures 6a and 6b)?

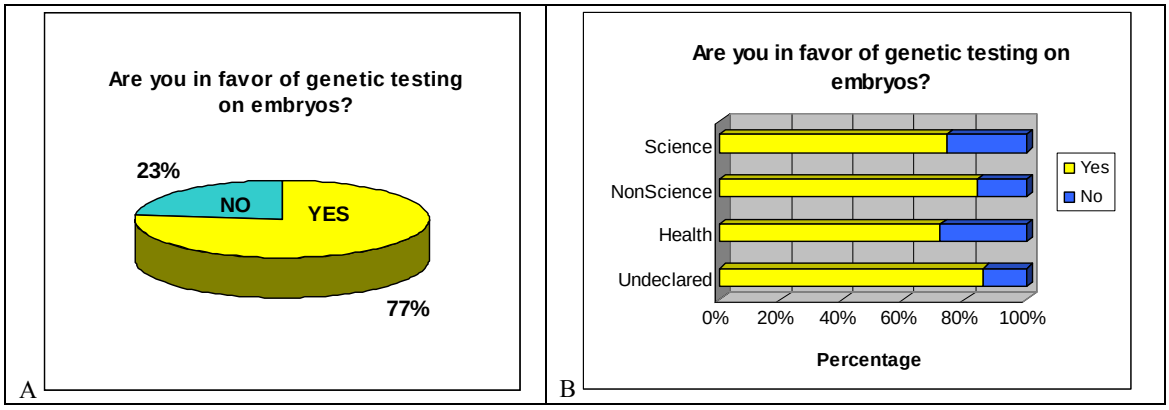

Figure 4. *Results of survey. A). Response of university students(n = 81) when surveyed concerning the question, "Are you in favor of genetic testing on embryos?" B} University students' response based on their background in the health and science fields.*

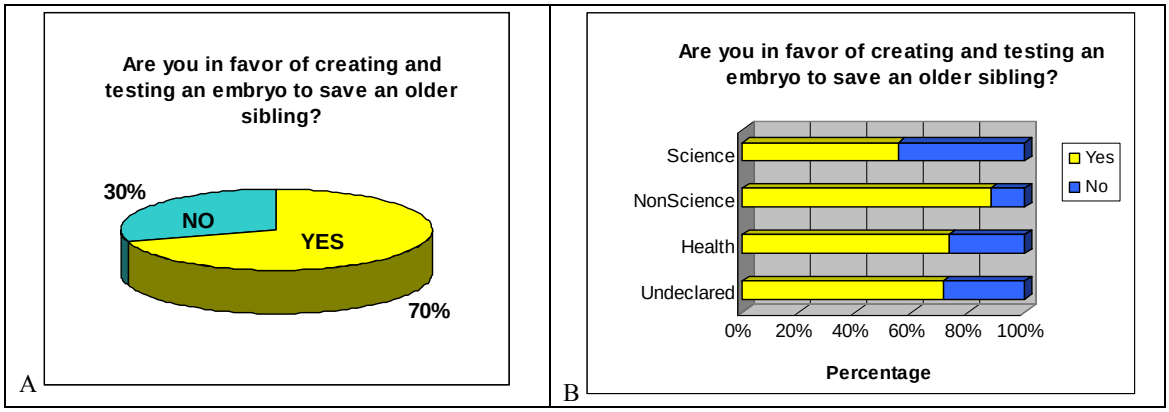

Figure 5. *A) Response of surveyed university students (n = 81) when surveyed concerning the question "Are you in favor of creating and testing an embryo to save an older sibling?" B) Response of university students by background in the health and science fields.*

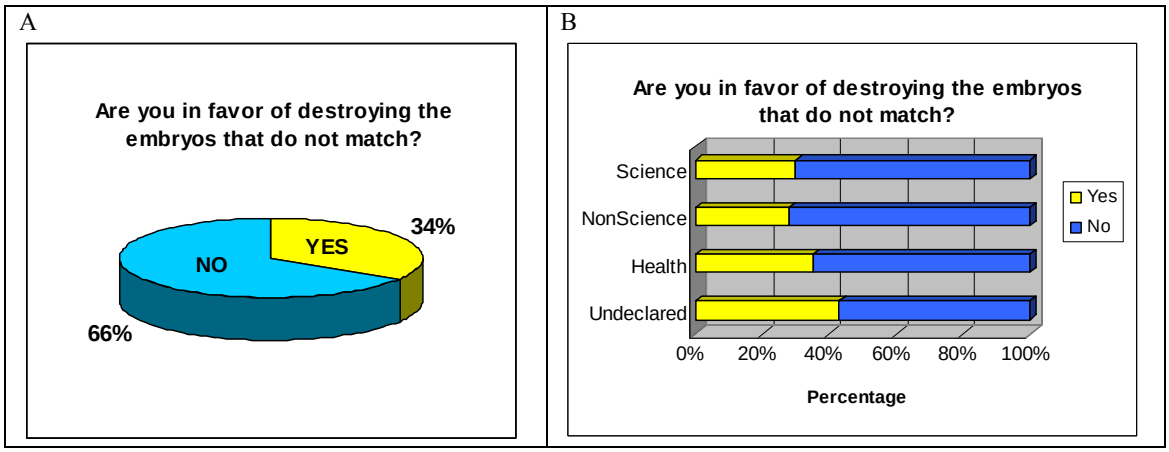

Figure 6. *A) Response of university students surveyed (81) concerning the question, "Are you in favor of destroying the embryos that do not match?" B) Response of university students by background in health or science fields.*

Activity 2

Divide the class into four groups for discussion. Each group will represent an individual interested in the issue of designer babies. Assign one of the following roles to each group: designer baby, sick older sibling, parents, or doctors/genetic counselors. Instruct the groups that they should approach the discussion from the perspective of the role assigned to them. Use the following questions as necessary to guide the discussion or formulate your own questions.

1. Why or why not would a couple with a child who had a fatal genetic illness use IVF or PGD?
2. From your assigned perspective how would you convince someone that IVF and PGD technology should or should not be used?
3. From your assigned perspective what are the advantages or disadvantages of creating a baby to cure a sick older sibling?
4. From your assigned perspective what are the ethical concerns with the use of IVF and PGD technology?

Activity 3

Divide the class into groups of four or five students. Allow each group to do outside research on the topics of IVF, PGD, and genetic engineering (see Table 2 for possible sources). Assign each group a pro or con position on one of the topics. The pro and con groups should debate the topic for five to fifteen minutes, with the rest of the class serving as evaluators and asking questions when necessary. At the end of the debate the rest of the class should assess the arguments made. Figure 7 provides a possible rubric.

Table 2. *Additional sources of information.*

Websites for Additional Research

Most comprehensive website on Designer Babies with additional links
http://www.tecsoc.org/biotech/focusbabies.htm

Good commentary UK Guardian on Baby Nash
http://www.guardian.co.uk/Archive/Article/0,4273,4072039,00.html

Washington Post on Baby Nash
http://www.washingtonpost.com/ac2/wp-dyn/A62318-2000Oct2

Cnn.com on Baby Nash
http://archives.cnn.com/2000/HEALTH/10/03/testube.brother/index.html

This article contains interesting arguments for and against designer babies
http://news.bbc.co.uk/1/hi/health/955644.stm

Website about IVF and Embryo selection
http://dir.salon.com/health/feature/2000/08/21/stem_cell/index.html

Two good articles on IVF and PGD in the UK
http://observer.guardian.co.uk/uk_news/story/0,6903,656109,00.html
http://www.guardian.co.uk/genes/article/0,2763,1266401,00.html

Recent and general article on 'Savior Siblings"
http://www.newscientist.com/news/news.jsp?id=ns99994965

Arguments against Human Embryonic Stem Cell research- contains alot of facts.
http://www.stemcellresearch.org/statement/statement.htm

Stem cell research explained
http://www.guardian.co.uk/genes/article/0,2763,535023,00.html

Comprehensive website about fanconi-anemia, with links
http://www.cancerindex.org/ccw/fanconi.htm#fa2

Henry - A boy living with Fanconi anemia, includes pictures
http://www.hsg.org/

User-friendly website on Bone Marrow Transplants with links
http://www.cancerindex.org/ccw/guide2bm.htm

Class Debate Evaluation

CATEGORY	POINT	TOTAL
Understanding of Topic		
-Team clearly understood topic and presented their information convincingly.	**5 points**	
-Team clearly understood topic and presented their information with ease.	**4 points**	
-The team seemed to understand the main points and presented those points with ease.	**3 points**	
-The team did not show an adequate understanding of the topic.	**2 points**	_____
-All information presented was accurate, clear, and thorough.	**5 points**	
-Most information presented was accurate, clear, and thorough.	**4 points**	
-Most information presented was clear but not thorough.	**3 points**	
-Information was not clear or completely accurate.	**2 points**	_____
-Every major point was well supported with relevant facts.	**5 points**	
-Every major point was adequately supported with relevant facts.	**4 points**	
-Most of the major points were supported with relevant facts.	**3 points**	
-Every point was not supported.	**2 points**	_____
-Team consistently used gestures, eye-contact and a level of enthusiasm that kept the audience's attention.	**5 points**	
-Team usually used gestures, eye-contact and a level of enthusiasm that kept the audience's attention.	**4 points**	
-Team sometimes used gestures, eye-contact and a level of enthusiasm that kept the audience's attention.	**3 points**	
-Team did not keep the audience's attention.	**2 points**	_____
-All arguments were tied to an idea and well organized.	**5 points**	
-Most arguments were tied to an idea and well organized.	**4 points**	
-All arguments were tied to an idea but not well organized.	**3 points**	
-Arguments were not tied to an idea or well organized.	**2 points**	_____
-All counter-arguments were accurate and relevant.	**5 points**	
-Most counter-arguments were accurate and relevant.	**4 points**	
-Some counter-arguments were accurate and relevant.	**3 points**	
- Counter-arguments were not accurate and/or relevant.	**2 points**	_____
		_____
Total Points		

Figure 7. *Suggested evaluation sheet for the classroom debate activity. Grades based upon point totals are entirely up to the classroom instructor*

Activity 4

Students should write a reflection paper on one or more of the following questions.

1. How do you think Gene's brother feels?
2. What if the embryo that eventually became Gene had not been selected? Discuss the ethical considerations of the embryos that were either frozen or discarded.
3. If you had Fanconi Anemia or a similar illness would you want your parents to create a sibling to be a donor?
4. If your child were ill, would you create another child to be a donor? Why or why not?

Activity 5

Divide the class into groups of four to ten students. Each group will present a skit about how Gene was told he was a "designer baby". Each group should create the characters and dialogue they find necessary for the scene. Each skit should be five to ten minutes in length.

CONCLUSIONS

The activities listed above were a challenge on two different fronts. First, it was a challenge for a non-majors bioethics class to accomplish the necessary research and complete the case study that was presented in this article. Second, it was a challenge for the freshmen, nursing students in the general biology course to engage in some of the listed activities. There were approximately 80 nursing students in the course. These students were divided into 4 different laboratory sections. Each laboratory section was assigned a different activity from those listed above.

It was interesting to see the diversity of the groups that were surveyed for Activity 1. They included health field professionals, family members, and even church members. Their findings varied depending on the group that was being surveyed.

The most revealing assignment was the students' responses to the questions listed in Activity 4, especially to question 1. "How do you think Gene's brother feels?" The students were not the least bit inhibited to share their feelings in answering this question. Their writings revealed a depth as well as a wide range of thought.

As an instructor, this case study was a great opportunity to expose non-majors to bioethics while also providing some valuable learning activities for the nursing majors. Hopefully both groups will have a better understanding of bioethics in their future endeavors.

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What Should Life-Science Students Acquire In Their BSc Studies? Faculty and Student Perspectives

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ABSTRACT: What should an undergraduate student in a specific discipline gain in the course of his/her studies? All too often, the answer to this question is not formally defined, and answers differ, sometimes largely, even between members of the same academic faculty. In our study we focused on the life sciences faculty and explored both undergraduate students' and faculty members' perspectives regarding this question. Eighty-two faculty members and 124 sophomores responded to a written questionnaire. In response to the question: "What do you think a graduated student should gain during his/her years of study?" they were asked to rate on a scale from 1 to 4 (1= not important at all…4=most important) eight factors: knowledge, lab experience, scientific writing, research skills, understanding the dynamic nature of science, science applicability to everyday life, historic viewpoint and motivation to continue in the field. Twenty-one faculty members of the 82 who responded to the written questionnaire were also individually interviewed. The findings show that there was a consensus, between both populations, on the importance of providing basic knowledge during undergraduate studies. Significant differences ($P<0.01$) existed regarding the importance of lab experience, research skills, scientific writing and understanding of the dynamic nature of science.

KEYWORDS: higher education, life sciences, undergraduate studies

INTRODUCTION

In the last decade there has been a general tendency to define the goals of university teaching from the point of the instructors. Trice and Dey (1997) described a longitudinal study, which examined changes in teaching goals over the past two decades. They reviewed data on trends in teaching goals obtained from national surveys of faculty conducted from 1968 to 1992, and they found that the goals that aim to *develop the ability to think clearly*, *prepare students for employment after college*, *prepare students for graduate studies*, and *provide for students' emotional development* were fairly stable over the 24 years covered by the surveys. Goals were also stable over time when compared by institutional type, although support for preparing students for employment after college grew at liberal arts and comprehensive institutions in the late 1980s and fell at research and two-year institutions. Interestingly, the results indicate a growing divergence between the relatively stable goals of faculty and the changing goals of students, who are placing more emphasis on practical training and job preparation.

Hativa (1995) surveyed 113 instructors from different disciplines (Humanities, Social sciences, Math/Natural sciences and Engineering) at an Ivy League university. She listed 21 teaching goals, grouped under two categories: (a) promoting the knowledge needed for functioning in the academic domain and in daily life, and (b) promoting students' motivation, aptitudes, and skills in the subject domain and for self-learning. The results demonstrated very high agreement among the respondents on 13 of the 21 goals. The goals perceived as important or very important by at least two thirds of the faculty belonged in the first category: *helping students gain the basic body of knowledge and tools of the domain*, and *promoting students' ability to apply methods and principles* and to *gain other working and thinking habits typical of the domain.* For the second category, the most highly agreed-upon goals were: *promoting students' independent, objective, critical, original, and creative thinking*; *advancing their interest and motivation to continue studying in the domain*; *enhancing skills for oral and written expression; fostering openness to different points of view; and facilitating the ability for self-study.* Thus, the main goals in teaching include the cognitive aspects of gaining knowledge and understanding, the affective aspects of promoting motivation, and the skills for learning and functioning in the workplace and in social life.

In a recent study, Stark (2000), surveying 2105 colleges' and universities' instructors of introductory courses, found that almost all teachers perceived *planning the promotion of students' effective thinking* as their most important goal. She found that the type of teachers' goals differed substantially by discipline. For example, biology teachers were most likely to emphasize knowledge acquisition, while teachers of English composition and literature emphasized personal and intellectual development. Stark also focused on teachers' views about their academic discipline and found that biology teachers "view the academic field concurrently as a group of individuals exploring common related interests and values, as a set of phenomena these individuals are trying to explain, and as a mode of inquiry" (Stark, 2000, p. 418). Other researchers (Angelo & Cross, 1993; Franklin & Theall, 1992; Hativa, 1993) also suggested that there are significant differences among disciplines concerning course goals and attitudes of faculty towards instruction, and that good teaching reflects the distinctive characteristics of a discipline.

In light of the suggestion that different fields of study operate according to different rules, which might in turn differentially affect instruction in these fields (Hativa, 1993), in our study we decided to focus on one discipline (biology). The major research question that we asked the life-science instructors and students, was: What should life-science undergraduates acquire during their studies? The in-depth interview (which took about an hour) with each instructor enabled us not only to view the instructors' declared goals, but also to understand the reasons behind their choices.

METHOD

The study was conducted at Tel-Aviv University's life-sciences facility. Tel-Aviv University, the largest university in Israel, is a public research university. It is a major center of teaching and research, comprising nine facilities, 106 departments, and 90 research institutes. The program for life-science undergraduates provides a thorough basic grounding in all fields of organismic and molecular biology. Students receive both theoretical and practical experience. Studies for the BSc include lectures, laboratory work, discussion sessions, and field trips. In 2002, there were 1100 undergraduates students (66% women), distributed over three years (ICBS, 2002).

The life-sciences faculty includes 141 members (18% women). Most of them (98) hold a professorial position, and have more then ten years of experience in teaching and research. The faculty members are grouped under seven departments: *Biochemistry* (19 members), *Molecular Microbiology and Biotechnology* (20 members), *Plant Sciences* (31 members), *Neurobiochemistry* (11 members), *Zoology* (36 members), *Cell Research and Immunology* (13 members) *and The Institute for Nature Conservation Research* (11 members).

In this study, we conducted in-depth personal interviews with 21 faculty members (between two and four instructors from each department). During the interviews, which lasted about an hour each, we asked participants the following question: What should life-science undergraduates acquire during their studies? We also urged them to elaborate on each aspect to which they referred, and to refer to issues such as their teaching approach, their attitude towards teaching and their course planning.

In addition, 82 faculty members (15% women) responded to a written questionnaire. In the written questionnaire the instructors were asked to rate, on a scale from 1 to 4 (1 = not important at all…4 = most important), eight factors answering to the question "What do you think an undergraduate student should gain during the years of his or her studies?" The eight factors were: knowledge, lab experience, scientific writing, research skills, understanding the dynamic nature of science, science applicability to everyday life, historic viewpoint and motivation to continue in the field. These factors had been suggested in the in-depth interviews, at an earlier stage of the study.

Since the learning process involves students as well, we also examined students' perspectives about the importance of these factors, and compared them to those of their teachers. Thus, we asked the sophomores to answer the same questionnaire, rating the eight

factors; 124 sophomores (72% women) answered the questionnaire.

The participants' responses to each of the eight factors were divided into two major categories: less important (Categories 1 and 2) and very important (Categories 3 and 4). We conducted $\chi 2$ tests to examine differences between instructors' and students' responses.

FINDINGS

Faculty Perspectives

Below we elaborate on faculty responses to the question: What should life-science students acquire in their BSc studies? Our discussion will be based on the eight factors that were mentioned above. Table 1 shows the percentages of faculty members who marked each factor as either important or very important

***Knowledge*:** Almost all the instructors believed that knowledge is one of the fundamental aspects that should be emphasized in the course of graduation. This aspect gained the highest rate of importance (Table 1). About 92% of the instructors chose to mark Categories 3 or 4 for this aspect. Interestingly, in the interviews the instructors raised the dilemma that while "knowledge" is necessary for any graduated student, independently of his/her future specialization, nowadays the available knowledge is so enormous, that it is difficult to agree what parts of it are necessary for a graduated student to master. Some of the instructors argued that it is more important for students to acquire the tools and skills to locate relevant knowledge rather than trying to cover all the subject matter during the course of study. They mentioned their conflict about the topics that should be included in their course syllabus. As one instructor explained:

> *In the past, I thought that I knew exactly what knowledge in ecology a graduated student should master. Then one day a student told me: "Listen, at the Hebrew University in Jerusalem they don't teach this topic and they are becoming as good biologists as at Tel-Aviv University." And then I realized that I couldn't define the body of knowledge that students should acquire during their undergraduate studies. I try to give them a broad picture of the subject, and basic concepts as much as I can, but I know that they are only at the beginning of their studies, and that they will have to do the rest by themselves. So I also try to give them the skills and the tools to learn.*

Only one instructor was very determined about the insignificance of providing a basic body of knowledge during first-degree studies:

> *The body of knowledge is changing from year to year so it is not important to teach facts or theories. We only need to equip the students with tools and skills that will enable them to get the information.*

***Table 1**: Percentages of students and faculty members that chose each of the eight factors as important or very important, while answering to the question: What should life science Students acquire in their BSc studies?*

FACTOR	Instructors N=82	Students N=124
Knowledge*	92%	99%
Lab experience*	67%	90%
Inquiry skills	81%	88%
Scientific writing	74%	63%
Dynamic nature of science*	89%	70%
Application of science to everyday life	70%	71%
Historical viewpoint	37%	37%
Motivation	84%	85%

*$P < .01$

Lab Experience: This aspect refers to the obligatory and optional lab courses in which students participate during their course of study. Two-thirds of the instructors thought that laboratory experience is very important for undergraduates to gain. Almost all the instructors emphasized this in their interviews. One instructor said, *It is very important that every life science undergraduate acquires manipulative skills, such as, how to hold a pipette, or how to prepare solutions*. Another instructor stated, *Biology is an experimental discipline, and so teaching biology without emphasis on the practical aspect is really a joke*. The opposite point of view was expressed, *Since lab techniques are changing and what is relevant today will not necessarily be relevant tomorrow*, and, *anyway, since not all graduating students will go into research, we shouldn't invest too much time in lab experience during the first degree*. In fact, in the last few years, there has been a major decline in obligatory laboratory courses required for the BSc. A main

reason for this decline is due to budget problems, especially due to the three-fold growth in student enrollment. Some instructors argued about the importance of acquiring lab skills during the first degree. They claimed that undergraduate studies tend to be more general these days, and that the specialization in life sciences should occur only at the graduate level. It might hence be important to expose undergraduate students to lab work, but lab skills acquisition should be moved to MSc studies.

Inquiry Skills: More than 80% of the instructors thought that acquiring research skills is very important to the undergraduate student. One instructor said: *The aim of teaching in a research university is not just to transmit knowledge, but to "produce" people who think creatively and are able to analyze observable facts and events, since at the end of the road, we want them to be researchers.* Other instructors thought that involving students in field research could be postponed to MA studies.

At Tel-Aviv University, students have the opportunity to actively experience field research in their last BSc year as part of a project under the supervision of one of the faculty members. Participation in this activity is not obligatory, but most of the students (about 85%) are involved in such projects.

Scientific Writing: During first-degree studies there is no specific scientific writing course, which trains students in writing the results of their research studies. Students gain limited experience in scientific writing through their lab reports or in seminar papers. Seventy-four percent of the instructors rated this as an important component of BSc studies. In the interviews, all the instructors complained about students' poor writing skills. One instructor said: *Israelis are good students, but they don't know how to complete one single sentence. They don't know how to organize paragraphs in a fluent and logical way*. But while most of the instructors mentioned the importance of this skill, they also claimed they did not know how to teach it. They mentioned that in the past there had been a special course dedicated to scientific writing, but it was cancelled due to budget considerations.

Understanding the Dynamic Nature of Science: Nearly ninety percent of the instructors believed it is very important for students to understand that science is not based on definite facts, and that scientific theories are changing and developing all the time. One of the instructors mentioned that, *It is important to give the student the sense that this field is dynamic, changing and adjusting all the time, generating more questions than answers*.

Emphasizing the Applicability of Science to Everyday Life: A majority of the instructors (70%) rated this aspect as very important. It should be noted that the instructors argued that, on one hand, it is important to relate science to everyday life in order to enhance its relevance and interest for the students; yet on the other hand students should also appreciate that pure scientific research is not necessarily applicable to everyday life.

Teaching science from an historic viewpoint: A relatively small proportion of instructors (37%) rated this aspect as very important. The interviews revealed that instructors' attitude toward teaching with an historical viewpoint depended a great deal on the specific topic that they taught. One instructor argued that teaching with an historical view greatly contributes to students' understanding of the dynamic nature of science, and that it is important that students who graduated in life science departments should recognize key characters in the history of science. In his words, *It is ridiculous that life science students do not know who Louis Pasteur was. Besides, I think that we owe them [scientists from the past] this recognition.*

***Motivation to continue in the field*:** Most of the instructors (84%) viewed this as a very important factor. One of the instructors mentioned that, *It is important to develop a positive attitude towards the field among the students; this will motivate them to specialize in life science later on*. Another instructor said, *Their [the students'] motivation to stay in the field greatly depends on our teaching, so it is our responsibility to make the subject interesting and appealing to students.*

Students' Perspectives

Table 1 shows that, with the exception of the historic viewpoint, students rated all the other factors as important components of the BSc program. We found significant difference ($p < .01$) between instructors' and students' perspectives only in the case of three aspects: knowledge, lab experience and the dynamic nature of science.

Our findings show that students rated knowledge and lab experience as more important than did the instructors. This might be because many students who choose life sciences believe, as a result of the way they were taught at high school, that this is an experimental discipline, mainly built on facts (knowledge) and hypotheses that are tested in the lab. Moreover, unlike the instructors, they are probably unaware of budget-related constraints.

Concerning the dynamic nature of science, 90% of the instructors, compared to 70% of the students, rated this aspect as very important. We assume that students, in the second year of their BSc studies, do not fully understand the meaning of the "dynamic nature of science", and even if they do, it may well be easier for them to be taught definite facts than to have to deal with uncertainty. For example: one instructor told us about one incident, during which a student became very upset and confused when the instructor tried to

explain that the theory that had been presented in class the previous day, was actually no longer valid. The student claimed that she had already put "yesterday's theory" in her notes and she felt the teacher ought to provide only one valid theory.

DISCUSSION AND CONCLUSION

Decisions about curriculum and teaching approaches are made by the faculty's academic staff. All too often, these decisions are not formally defined, and sometimes there are major differences among faculty members' beliefs regarding what an undergraduate student in a specific discipline should gain during his/her studies. In our study we focused on the life sciences faculty, and explored both undergraduate students' and faculty members' perspectives regarding the above question.

The findings show that there was a consensus between both populations on the importance of providing a basic body of knowledge during first-degree studies. Disagreement mainly concerned the importance of developing scientific skills, such as lab experience, research skills and scientific writing.

In the interviews, faculty members expressed a range of opinions concerning the importance of providing such skills during first-degree studies. Arguments against providing these skills mainly involved budget considerations (lab courses, for example, demand more faculty staff and require expensive materials and instruments), or ideological issues, as one faculty explained:

> *I believe that our responsibility in teaching for the first degree in life sciences is to provide the knowledge and tools that will enable students to go on acquiring knowledge independently… as for research skills, lab experience and scientific writing – these things are important, but could be postponed until advanced degrees, for students specializing in one of the biology fields. A life science undergraduate student could proceed to be, for example, a life-science expert in a law firm. He or she would not need lab skills…*

But, there was a considerable percentage of faculty members who believed in the importance of developing research skills during first-degree studies; as one professor said, *It is a sad fact that undergraduates lack the ability to write scientifically, not to mention that they demonstrate poor writing abilities in general…. These students might be the science teachers of our children*.

While the faculty members are those who determine the academic policies and teaching, we cannot ignore students' opinions. For example, even though faculty did not express definite opinions concerning lab experience, students were quite consistent regarding its importance, as a main feature to be acquired during their BSc studies, alongside formal knowledge. We believe that an awareness of both the faculty and student perspectives and the relations between them, will lead to better decision making concerning curriculum planning and teaching strategies, and will improve student satisfaction with their studies.

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Moral Principles and The Life Sciences: Choices About Moral Matters

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ABSTRACT: Today, more than at any other time in human history, biologists are or should be concerned about the morality of biological research and newly developed technologies. Two questions confront any scientist or science student concerned about morality and the life sciences. Is there some theoretical framework that might be used to assist in deciding about moral matters? And how should people go about deciding matters of morality? This paper considers four ways in which people make moral decisions. These decisions are based upon Authority, Intuition, Science, and Ethical Reasoning (Duty and Consequentialist views).

KEY WORDS: morality, decision-making, ethics, biology

INTRODUCTION

Today, more than at any other time in human history, biologists are or should be concerned about the morality of biological research and newly developed technologies. There was a period of time during which many scientists were of the belief that they were responsible for conducting "honest" research and there their responsibility ended. The development of the atomic bomb for World War II found well-known scientists in disagreement about their moral obligations not only in the development but the use of this "monster" (Atiyah, 1999). This initial concern was followed by a long list of scientists who wanted to outlaw the use of atomic energy for anything but the peaceful use of providing another source of energy for the world. The Asilomar Conference at Pacific Grove, California in 1975 was an effort by scientists to place restrictions on recombinant DNA research (Barinaga, 2000). Over 100 scientists met to discuss what they knew and didn't know about recombinant DNA. They drew up guidelines that would permit research to go on but without undue risk. This meeting was an important scientific landmark because it was, at that time, a rare instance of scientists independently questioning and regulating their own work. They agreed to suspend research of this nature until potential risks could be evaluated. This indicated they not only were aware that "good" intentions can go awry, but they also felt some responsibility for the possible results of their research. Today one can find numerous groups of individuals, many of them scientists, who have united to protect some aspect of human life. These aspects range from protecting the degradation of the environment to the cloning of human life.

Many biology teachers wish to include relevant social and ethical considerations in their teaching but lack the expertise to do so. This often results in either the omission of these considerations or a piece meal attempt to do so. This paper will help prepare biology teachers for the important task of letting students know that most aspects of biology do have social and ethical consequences, and there are ways to examine the morality of an act (Johnson, 1983-1992; MacDonald, 2002)

Two questions confront any science professor or science student concerned about morality and the life sciences. The first is the question of whether or not there exists some theoretical framework that might be used to assist in deciding about moral matters. In other words, how is a person to make decisions about what is morally right and what is morally wrong? An answer to this question can be obtained by observing how people make moral decisions. Do they rely upon some authority, such as a book: Bible, Koran, or Veda? Do they rely upon the teachings of a leader: Pope, Minister, or Imam? Or do they act instinctively because of a predisposition to favor some actions over or against others, in much the way one might choose ice cream over yogurt for dessert?

The second question will often be raised when answers to the first question are proposed. This question is, "How should people go about deciding matters of morality?" Answering this question is complicated by the fact that values change over time and in different societies. Early in human history and continuing through the 19th century, it was acceptable to reproduce with a girl as soon as she reached puberty. Today in the United States it is against the law to have intercourse with a girl below the age of 16. Here the value is determined not by the individual's anatomical and physiological ability to reproduce, but by an interpretation that emotionally and mentally a younger girl is not able to make "wise" decisions.

The concern of this article is with what we will call *Descriptive Ethics*. And that is to ask, "How do people go about determining whether something is morally right or morally wrong?" A simplified definition of moral is conducting oneself in a proper or right manner. Morals involve principles or habits with respect to right or wrong conduct. This seems simple enough until one attempts to answer what is "proper", "right" or "wrong." The use of embryonic stem cells illustrates the dilemma. It is right to attempt to save someone's life by providing her/him with stem cells that may correct a serious or life threatening problem from which she/he suffers. It is wrong to kill a potential human being by taking stem cells from the early embryo. So here is a single action that is both right and wrong. Another example, which recently attracted much discussion and controversy, was the case of a husband and wife who had another child to enable them to obtain tissue to treat an older child suffering from a fatal condition (Elwess, 2005; Sutton, 2002). Certainly, it is morally right for the parents to wish to help their child, but was the method they employed also morally right?

A descriptive study of moral decision-making requires some established boundaries, which come from a series of questions that need to be asked about moral values. For example, do people actually choose moral values? Or are moral values instinctual, a matter of biology? Some scientists respond "Yes" to this question; morality is as much a matter of biology as sexual preference or the desire to preserve one's own life is a matter of biology. These are matters that are genetically determined.

Other scientists insist that moral values are directly determined by the social controls of peer pressure and social conditioning. Everyone is a part of a larger society that shapes a person's behavior according to what the larger society determines to be the proper behavior. The moral choices any person makes are determined by the values that a society dictates; the laws of society make it morally wrong to steal, to batter a wife, or to bear false witness in a court of law.

On the other hand, most people endorse the view that values are a matter of choice; people do occasionally go against the instinctual drives for sex and self-preservation, e.g., some people take vows of celibacy, and some are known to have given up their lives on behalf of others. However significant genetic wiring might be and however significant social conditioning might be, all of us have a sense that we make decisions about moral matters. People make choices, but on what basis (Andrews, 2005)?

FOUR WAYS TO MAKE MORAL CHOICES

1. Moral Decisions Based Upon Authority

Some people make decisions about morality by resting their conscience upon what they consider to be supreme authority (Clayton, 2003; Jonas, 1995). Two notable groups who subscribe to authority-based morality are Protestant Fundamentalist Christians and Traditionalist Roman Catholic Christians. But we might include religious fundamentalists of any persuasion: Muslims, Hindus, even Buddhists.

Protestant Fundamentalists provide a clear instance of authority-based morality. Spelled out quite

clearly are the principles, which encourage members to look to authority for assistance. The first principle is the belief that God relates to people on a personal level. The second principle is that each, individual human life is important to God, and there exists a divine plan for each life. In class when we discuss genetic diseases, students often refer to this principle. Tay Sachs disease results in degeneration of the nervous system and the retina (Tay Sachs, 2005). The process of degeneration begins shortly after birth, and at 18 months the child is blind and deaf with death usually occurring before age five. A significant number of students indicate that they would not abort the child even if they knew he/she would be born with the disease. Their usual reason is that God intended them to have such a child, and thus it would be going against God's will to prevent its birth. A third basic principle is belief in the inerrancy of the Christian scripture. Fundamentalists believe that the Bible is a true and accurate description of things, and it provides the true record of events both in the past and in the future. While teaching a General Education course to a class of students at another university, I provided them with three short articles on Human-Animal Hybrids (Organic Consumer, 2005). They were asked to comment on each article. One article referred to research in which mice were to be created with brains made almost completely of human brain cells. A student indicated he was against this type of research because if God had wanted this type of thing done, He would have put it in the Bible. A fourth principle is the belief that human beings are weak, frail, even depraved. People are sinful and prone to make wrong decisions about how to live.

One consequence of commitment to these four principles is the additional belief that people need authoritative guidance for morality. That authoritative guidance is found in the Bible. For a Fundamentalist Christian, the Bible is an infallible guide for choosing how to live and how to behave.

Fundamentalist Roman Catholic Christians differ from Fundamentalist Protestant Christians in that their commitment is less to a book than to a Church. The authority for the Church is the Pope. He communicates with members of the Church in various ways including Encyclicals, which notify membership of God's messages. For example, Catholics are informed that birth control methods other than the rhythm method are wrong, and artificial methods of conception are wrong. These believers are suspicious of values in these matters, which they see as deriving from science. Science has made it possible for an infertile woman to produce a child with her own genetic material. She need not even bear the child; a surrogate mother can carry it. These and other topics, which conflict with some Authoritarian decisions, are often covered in a general education course in biology. Thus it is helpful for teachers and students to understand how individuals arrive at their decisions about what is right or wrong. Instructors should require students to be aware of the scientific information, but **should not** attempt to change students' method of deciding whether some idea or technique is right or wrong

In the process of helping students examine the morality of certain situations or actions, it is also important to teach them the concept of the *Slippery Slope* (Numberg, 2003). Understanding this concept may help them clarify their basis for moral decisions. The issue of whether or not to interfere with nature serves well for this lesson. Some students regard artificial or unnatural ways of bringing about pregnancy in infertile women as being against the laws of nature or God's will. They state, "If God had wanted the person to have a baby, He would have provided her with the ability to do so." At this point it is appropriate to ask them, "Should there be organ transplants? If God had wanted a person to have a good organ, wouldn't He have provided one?" These questions may be followed by similar questions about blood transfusions. More difficult for students is the question, "Do you believe in vaccination?" This may be followed by a discussion of the proposition, If God had wanted a person to have a different or better immune system, He would have provided it. Further down the slope is the issue of whether a person should take vitamin or mineral supplements. Usually the Slippery Slope discussion concludes with students opting for the individual deciding for God or another authority at some point on the slope where the individual takes over for God or another authority. This exercise should help the students to understand they are the ones making some of the decision for moral actions, although they may cite another authority for their decision.

2. Moral Values Based Upon Intuition

Some people insist that moral values are first learned at a mother's knee, that the rewards and punishments administered by parents instill moral values. After a few years of parental discipline, a child acquires a value system that is intuitive. Animal behaviorists would call this imprinting. The child begins spontaneously, without reflection, to respond to situations with approval or disapproval based upon her/his past experience with punishments and rewards. In a sense, the argument goes, moral values are intuitions that a person has, which are just as certain as her/his distinction between sweet and sour, loud and soft, and rough and smooth. A person knows directly what is right and what is wrong. In actuality, the phrase, "Honesty is good," really means, "I like honesty." Moral choices are choices of personal preference.

The Intuitionist must admit, however, that moral arguments, disagreements, and even discussions are fruitless. Just as one cannot convince another of the deliciousness of a favorite candy without the other tasting the candy, so a person cannot convince another

of the morality of an act unless the other person has had a similar experience. In summary, the Intuitionist view removes morality from discussion, debate, and disagreement. A scientific problem with this concept is that, as we are not all endowed with the same nervous system or receptors due to inheritable differences, we may not obtain the same input from identical stimuli.

3. Moral Values Based Upon Science

This approach to moral values is widely held by people who study one of the sciences, especially the social sciences. The general view is that scientists are solving problems of health, medicine, housing, and food; therefore, science should be used to determine morality, too. Because of the success of scientists in so many areas, it is appropriate to trust scientists in matters of morality as well.

They use a method of moral reasoning that is structured and objective. The first step is to gather all of the facts about a problem or situation. They think through the implications of any decision that might be made to solve a problem. Is the decision based upon the facts of the matter? What might be the consequences of this decision? A form of this method utilized by many physical and biological scientists is referred to as the "Scientific Method."

Suppose a woman becomes pregnant after being raped, and through no desire of hers a fetus exists within her. Is abortion a morally acceptable option for her to consider (Dreyer, 2004)? The first step is to gather the facts. Is the woman indeed pregnant? Is the pregnancy due to the crime of rape? How long has the woman been pregnant? These are questions that can be answered by analysis.

Then a person must consider the variables within the situation. Is the woman capable or incapable of carrying a child to fruition? What sort of life is the baby likely to have given the social and economic situation of the mother? Is it likely that the alleged father of the child will provide support for the child? Answers to these questions can be provided by analysis also.

Then one must find measurable data related to matters surrounding the aftermath of the decision about an abortion. In short, showing a decision to be morally right lies with the ability to provide the data upon which the decision rests.

The social sciences have adopted reasoning of this sort. Psychologists, sociologists, and anthropologists often find themselves making moral judgments based upon what they see to be clear-headed analyses of social facts. Recently, a field of study has appeared, which claims the title of "sociobiology," a mingling of sociology with biology. The argument for moral reasoning is as follows: nearly all, if not all, human behavior is biologically determined, that is, behavior is genetically determined; all behavior is directed toward the single goal of personal survival, which involves the necessities for life, such as food, shelter, and sex and is genetically built into people; even altruistic behavior such as kindness, courage, heroism, or devotion has the same aim of survival. Yet studies have indicated that environment plays a major role in one's personality; identical twins raised under different conditions not only don't respond the same to similar stimuli, but they might even have some physical differences.

The biological basis for behavior makes for trouble for some people, for example the inescapable urge for sex causes conflict. So people lay down some rules of conduct, rules, which will curtail conflict. And this is the origin of morality. Moral values are socially required and culturally reinforced. They have resulted in the development of techniques over thousands of years to keep as many people as possible alive and reproducing.

4. Moral Values Based Upon Ethical Reasoning

The formal study of Ethics is the study of how to acquire moral knowledge based on reason (Schroeder, 2002). The first question an ethicist asks is whether or not there actually is something called "moral knowledge." Is it possible to know what is right and what is wrong? But what is knowledge? Might intuition be knowledge? Might a conviction be knowledge? Might a preference be knowledge?

Ethicists and their philosophical colleagues define knowledge as "justified true belief." For an intuition, a conviction, or a preference to qualify as knowledge there are three requirements. First, there must be evidence, something to justify the claim of knowledge.

Second, it must be the case; it must be true. And third, it must be believed, not just by anyone, but by the person claiming to have knowledge. Ethicists want to make the claim that moral issues can be based upon knowledge of what is right or wrong, good or evil.

There are two general ways by which ethicists claim to gain knowledge about what is morally right and what is morally wrong. There are "refinements" of these two general ways, which have kept ethicists vigorously arguing for centuries. And, unfortunately, the two ways are not compatible with one another.

The ***Duty View*** of gaining moral knowledge rests its case upon what might be called a human sense of "unconditional obligation." Human beings possess within them a sense that they are obligated in some instances to perform some action or actions. In other words, people possess feelings of obligation; they feel obligated to eat properly, to practice good hygiene, and to get a proper amount of sleep. But in some instances, the sense of obligation is "unconditional," which means a person performs an action *for its own sake,* not in order to gain some result. For example, most people have a sense of obligation to their parents to behave in certain ways *for the sake of the behavior itself,* not for any reward. Such a feeling of obligation is rational because it occurs to a person that were it not for parents, he or she would not be alive. Every living person is unconditionally obligated to a mother and father for life itself. So, one can know moral obligation to a mother and a father.

The Duty View of morality is that people have a rational sense that they carry an obligation to do some things simply for the sake of doing them. And, it is maintained, the moral act is the act done for its own sake. Thus, moral knowledge is acquired through reason; a person knows that at some times and under some circumstances one is obligated to act on behalf of another. The feeling of obligation may occur as one of reciprocity; a person given a gift feels obligated to return the favor. This is illustrated very well in the case of transplantation. The recipient of a heart, lung, liver or kidney, feels an obligation to the donor, if still alive, or to the family of the donor. The obligation may be impossible to repay. Or the obligation may be based upon justice; people feel obligated toward fairness. Commiseration, a sense of sorrow at the misfortune of another, and respect, a sense that another is superior as a person, are two other conditions that may cause a person to feel obligated to act.

The ***Consequentialist View*** of gaining moral knowledge rests its case on the view that people should act in such a way to bring about consequences that are most beneficial to the greatest number of people involved. Edward Jenner, the discoverer of the small-pox vaccine, illustrates this view with his actions. He injected a young boy with the cowpox virus and then after a period of time injected the boy with the smallpox virus. This turned out to be the first vaccination. Entering unknown territory, Jenner could have given the boy a deadly case of smallpox; however, the potential for benefit to millions of people made the risk, in Jenner's mind, worthwhile. Attention must be given to the consequences of an action, not the motivation. The consequences determine whether an action is good or bad, right or wrong, in a moral sense. In the case of Jenner, the act was good. What is important is that it is possible to know what is right or wrong; the determining factor is the consequence, the result of the action. A person holding to the Consequentialist view of morality is convinced that the problem of moral knowledge is solved.

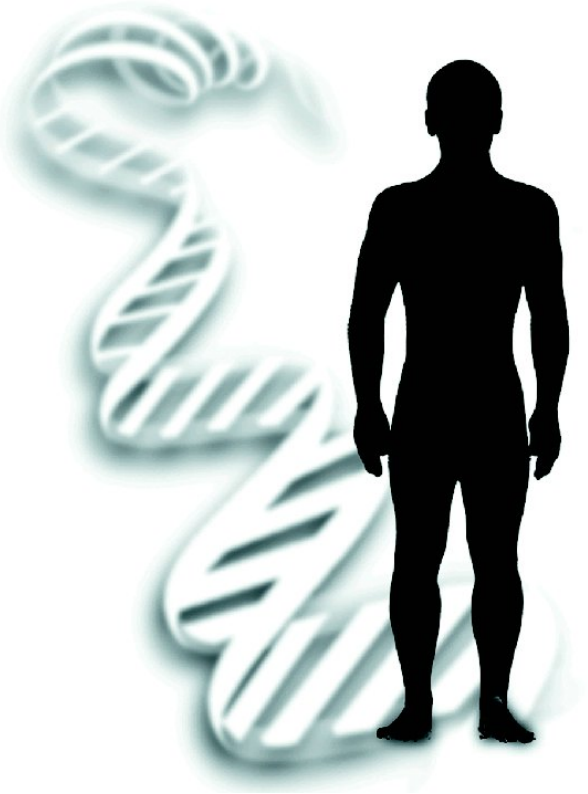
It is important to remember that there is no need to worry about motives, intentions, feelings of obligation, or duty. Although a person might have intended to do something evil, the act must be regarded as good if the consequences turn out to be beneficial. It is the consequence that determines the moral value of an action. One might be perfectly content to say that the end justifies the means. Hitler during World War I instituted a human breeding program in which he used the storm troopers as a sperm source for some German women (Hitler's Master Race, 1999). He wanted to create a superior race; as a result of this program, the next generation did show some increase in size. If an increase in size is the objective, then Hitler instigated a good act.

A crucial question, of course, is, "For whose benefit should a person be concerned?" There are three alternative answers to such a question. One alternative is called *Ethical Egoism;* a person should regard his or her own benefit when acting. A second alternative is *Ethical Groupism;* a person should regard the benefits for his or her group, family, community, organization, nation, or race and its benefits when acting. A third is *Ethical Universalism*; a person ought to act for the greatest benefit of all humanity. Promotions on television attempt to promote Ethical Universalism when they seek help for needy people in other parts of the world. The hope is that concern for these persons is universal; therefore, people will rally to their support.

It is easy to conclude that *Ethical Egoism* reflects selfishness and *Ethical Groupism* reflects chauvinism. *Ethical Universalism* is a compelling option to many Consequentialist thinkers. How should things be distributed fairly in specific situations e.g., the allocation of extraordinary medical technologies or access to kidney dialysis or distribution of organ transplants? Recent news reports on the ravages of AIDS in Africa have resulted in certain medication being made available from drug companies at a very reduced price. Bill Gates has donated millions of dollars to educate the people of India in an effort to prevent the rapid spread of AIDS in our second most populous nation. These are examples of Ethical Universalism. The point made is that what is morally

right can be known by the careful calculation of the consequences of the actions being contemplated. Should the life of a severely brain-damaged infant be saved, if saving the infant will be a hardship for the mother, father, and family that must care for the infant? For a physician in a hospital delivery room, the question is poignant; he or she knows that care for the brain-damaged infant often does not bring a family closer together, but instead results in unhappiness, separation, and divorce. Should a U.S. citizen be given a heart transplant at the cost of vaccination for thousands of children in a developing nation? If the person in need of the heart transplant is a close relative of yours, you might very well prefer the alternative, *Ethical Egoism*. An individual concerned with suffering children and having no relative needing a new heart could very well choose the alternative, *Ethical Universalism.* The Consequentialist does not escape difficult questions. He or she argues only that what is required is that some reasons be given for a moral decision. It is not enough, the Consequentialist maintains, that a person intuits, obeys some authority, or feels a sense of obligation; reasons for a moral decision are required.

The Consequentialist's position most closely resembles the Scientific approach to morality. In both cases, however, the question of consequences is problematic. When does a person know that the consequences have been realized? Is a person to judge an act by short-term consequences or long-term consequences (Berggren, 2005)? For example, the short-term consequence of the invention of atomic warfare was the end of World War II, when the Japanese surrendered. The long-term consequences include the whole world living under the threat of a nuclear holocaust and large numbers of Japanese living with serious mutations. Was the discovery and employment of nuclear technology morally good or morally bad? Consequentialism does not provide an easy answer to such a question. Time is an important factor in determining whether an action is morally good or morally bad in the Consequentialist view. The life saving potential of a lifeboat helps illustrate this point. A ship goes down, and the captain and 24 other passengers manage to board a lifeboat. The boat has a maximum capacity of 20 people and is already taking on water, when the captain is called upon to make a decision. Five people must be sacrificed for the boat to remain afloat. Throwing five people overboard to certain death does not appear to be a moral act; in the short term the act is morally bad. However, in the long term this will permit 20 people to live. A consideration of the consequences of the act would determine that killing five is the morally right thing to do. Other questions to address include which people should be "murdered," and which saved, and in which group should the captain be?



SUMMARY

All people make moral decisions. That is to say, every human being is faced with decisions about how to act in specific situations, and everyone should be aware that to choose not to choose is still to choose. In other words, everyone is faced daily with moral choices.

Scientists of our time are particularly challenged. Today, many areas of science are involved, not simply with the description of the way things are, but with the capability to change the way things are. The result is that scientists are faced with many moral dilemmas. Is it morally right to control population growth? Is abortion a morally proper procedure? Is it morally right to alter nature by genetic manipulation? Is it morally right to take the resources from one population group in order to benefit another population group (Hinrichsen, 1997)? Is it morally right to transplant an organ from one body to another?

It will benefit biology teachers, who often cover material of a controversial nature, as well as their students, to help the students determine the basis for some of their "moral" decisions. In addition, whether they base their decisions on Authority, Intuition, Science, or Ethical Reasoning, or a combination of these, they should be aware that once they have chosen a particular basis for their decision, they must take ownership of the decision. To say their God or mother indicates to them that something is morally good or morally bad means that they believe it is. Neither God nor a parent is present to defend the students'

decisions. In the end, they are accountable for their decisions.

This paper has considered the various ways in which people make moral decisions. Moral decisions are based upon *Authority*, *Intuition, Science,* and *Ethical Reasoning* including *Duty* and *Consequentialism Views.* Whereas, the Consequentialist's view for moral decision-making appeals to the methodology of many scientists, it is clear that the procedure does not promise easy solutions to moral problems in the life sciences. It does, however, encourage scientists to extend their analytic abilities to a consideration of the social consequences of scientific work.

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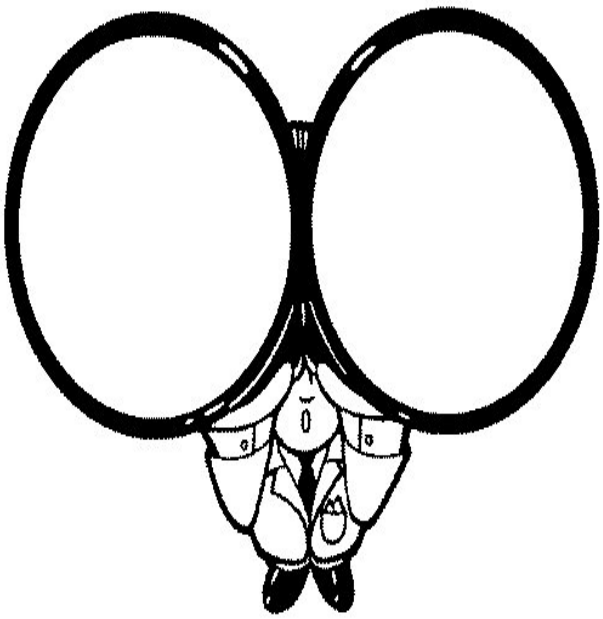
Call for Reviewers

We are looking for persons who are willing to review manuscripts for *Bioscene*. We need reviewers for a wide variety of subject areas. Reviewers should be willing to provide in depth reviews and detailed suggestions for authors concerning revisions necessary to improve their manuscript for possible publication. Reviewers should be willing to provide a rapid turn-around time for the manuscripts they review. If you are interested in reviewing for *Bioscene*, please send an email that includes your phone number, FAX number, and a list of the areas for which you are willing to review to: William Brett, Chair of the Editorial Board, at lsbrett@isugw.indstate.edu.

Rear View Mirror -- Looking Back

Edward Kos
ACUBE Historian



The 2005 Annual Meeting of ACUBE will be held in Cape Girardeau, MO at Southeast Missouri State University, October 13th – 15th. The General Theme for this meeting is "Interdisciplinary Explorations". Again I am struck by the fact that we have remained so true to our original goal, facilitating instruction in the classroom.

In 1965, the Annual Meeting was held in DeKalb, IL at Northern Illinois University on October 8th – 9th. The format followed that of our first meeting, namely to put together a group of Panels to discuss things going on in different areas. It was a slight deviation from showcasing latest advancements in different fields of biology. There were five Panels scheduled:

I. The Uses and Abuses of Secondary Teaching
II. Approaches to Undergraduate Research
III. Approaches to Programmed Audio-Tutorial Instruction
IV. Preparing the student for Medical School
V. Curricular Improvement. (This was an informal report on the CUEBS conference held at the University of Kansas in 1964.)

The featured speaker at this meeting was Dr. Mary A. McWhinnie, Professor at DePaul University, Chicago, IL. She spoke on the 'United States Antarctic Research Program' in which she had participated.

The 1975 meeting was held at Indiana State University, Terre Haute, IN, on October 17th – 18th. This meeting held with prior tradition in not having an overriding theme, but rather a series of Group Discussions, a panel discussing Curricular Developments, Field Trips, and the popular Film Festival featuring useful Biology education films. The main speaker was Dr. Richard Roblin of Harvard University who spoke on "Recombinant DNA Molecules: The Challenge of a Revolutionary Technique."

The Panel on Curricular Developments consisted of: Russell TePaske, Univ. of Northern Iowa, Austin Brooks, Wabash College, Orell Vandewater, Lincoln Land Community College, and George Gries, Oklahoma State University and AIBS Education Committee Chairman.

There were four different Group Discussions over the two day period which covered such topics as *Undergraduate Research; Labs That Work*; *Workshops in: Use of Millipore Filters*; *Electron Microscopy*; *Ecological Succession*; *Mammal Skin Preparation*; *Urban Ecology*; *Film Making and TV*. There were also discussions on: *Physical Science and Mathematics for Biology Majors*; *Status of Embryology in Undergraduate Programs*; *Cooperative Education Programs*; *Methods Courses*; and *Differing Background Levels in Students*.

The 29th Annual Meeting in 1985had a theme: "Biology: An Experimental Science." It was held at Augustana College, Rock Island, IL, September 27th – 28th. The featured speaker was Dr. Joseph R. Larsen, Professor of Entymology and Director of the Department of Rehabilitation Center, University of Illinois, Urbana, IL. The title of his talk was "The Importance of Laboratory Education in Life Sciences."

There was a Biology Film Festival which ran several times, along with a series of Demonstration Workshops covering Videotapes, Instrumentation and Software. There also was a Poster Session. There were five different Concurrent Session Topics: *Learning - Is It Possible*; *Bioethics and Perception*; *What's Going On in The Lab*; *Old, New & Different*; and *Writing Creative Thought - who need 'em*. These sessions were continued over 3 different time periods. There was a return of the former Discipline sessions which covered: *Biology of Cells*; *Biology of Animals*; *Biology of Plants*; *Biology of Populations*; and *Methods and Issues*.

1995 saw the AMCBT Meeting in Milwaukee, WI at Alverno College on September 28th – 30th. The central theme of the meeting was "Breaking Through Technological Barriers." There was an interweaving of both lab technology and computer technology/software throughout the sessions. A late night multi-hour introduction to the 'Internet' was given, a first for AMCBT. Other sessions dealt with *Multi-Media advances and New Lab Technologies*. Two speakers spoke about medical technology issues. One was Susan Amador, Department of Physics, Haverford College, PA, who gave a talk entitled, "Making Sense

of New Medical Technology." The second was Janis Ellis, Medical College of Wisconsin, Milwaukee, who talked on "Methanol Toxicity."

Interestingly, Dr. John Devereux, President of Genetics Computer Corporation, Madison, WI, was invited to give the keynote address. He declined, sending a letter outlining his reasons, but attended the meeting. I would refer readers, who have lasted this long in this article, to go to Volume 21 of "Bioscene" and read his letter, it's quite interesting.

There were two Workshops which dealt with Software/Laboratory Technology.

Session I:

1. Use of Macromedia Director
2. Protein/Nucleic Acid Analysis
3. Using Fyrite Brand Gas Analyzers.

Session II:

1. Teaching Human Biology
2. Jump-Starting Student Concept Maps
3. Powerpoint

There were three Paper Sessions:

Session I:

1. Fractal Geometry in Biology
2. Building 1 page Taxonomic Keys
3. PC Multimedia Tool for Field Biology
4. 'Inspiration' Concept-Mapping Software

Session II:

1. Does writing about biology enhance learning about biology?
2. Molecular Biology and On-Line Curricula
3. Virtual Research in a Virtual Library

Session III:

1. Data Acquisition in Physiology Lab
2. Darwin's Finches & Beyond: Evolution and Conservation in the Galapagos
3. Resources for SciEd Programs at NCSA
4. Sequential use of Case Studies to teach Investigative Skills and Interdisciplinary Views of Scientific Questioning

Note that we keep repeating those critical areas of concern: Interdisciplinary Studies, Hands-On Approaches, Up-Dates on Technology and Content, and, probably most important, our constant concern for Curricular Structure. I'm certain we will do this again at the Cape. Come on down and participate and bring a friend. Who knows, the fault may be 'rockin-and-rollin' with us.

Your friendly Archivist,
Edward Kos

Call for Applications – John Carlock Award

This Award was established to encourage biologists in the early stages of their professional careers to become involved with and excited by the profession of biology teaching. To this end, the Award provides partial support for ***upper division undergraduate and graduate students in the field of Biology*** to attend the Fall Meeting of ACUBE.

Guidelines: The applicant must be actively pursuing an ***undergraduate program or graduate work in Biology***. He/she must have the support of an active member of ACUBE. The Award will help defray the cost of attending the Fall meeting of ACUBE. The recipient of the Award will receive a certificate or plaque that will be presented at the annual banquet; and the Executive Secretary will provide the recipient with letters that might be useful in furthering her/his career in teaching. The recipient is expected to submit a brief report on how he/she benefited by attendance at the meeting. This report will be published in Bioscene.

Application: Applications, in the form of a letter, can be submitted anytime during the year. The application letter should include a statement indicating how attendance at the ACUBE meeting will further her/his professional growth and be accompanied by a letter of recommendation from an active member of ACUBE. Send application information or any questions about the Award to:

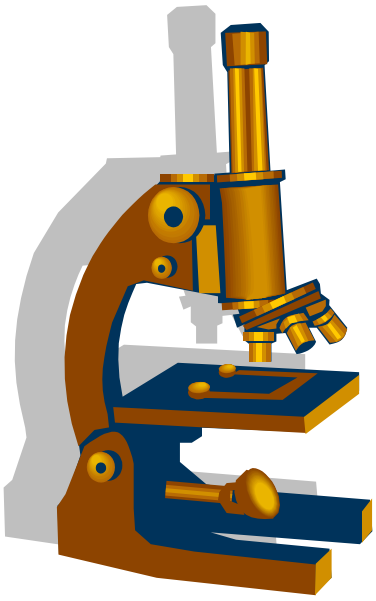
Dr. William J. Brett, Department of Life Sciences, Indiana State University, Terre Haute, IN 47809
Voice:)812) 237-2392; FAX (812) 237-4480; E-mail: lsbrett@isugw.indstate.edu

If you wish to contribute to the John Carlock Award fund, please send your check to:
Dr. Pres Martin, Executive Secretary, ACUBE,
Department of Biology, Hamline University,
1536 Hewitt Ave., St. Paul, MN 55104

Association of College and University Biology Educators
49th Annual Meeting

Southeast Missouri State University
Thursday October 13, 2005-Saturday October 15, 2005

Call for Presentations
Conference Theme: Interdisciplinary Exploration



Interdisciplinary can mean a lot of things. One sort of interdisciplinary exploration was the Lewis & Clark expedition in which many disciplines were used to complete a major project. In addition to scientific sampling, they created maps, described the geological features of the land and waterways, wrote, created images, lived in other cultures, did some politicking and diplomacy, evaded enemies, hunted, built lodging, and used orienteering and survival skills.

Another sort of interdisciplinary exploration is the way in which many biological problems are formulated and studied. For example, modern genomics, which uses statistics, engineering, molecular biology and computer science is an interdisciplinary approach to investigating problems as diverse as systematics and nutrition.

We invite you to submit a paper, poster or workshop on ways you incorporate interdisciplinary exploration or approaches in your biology teaching. Do you team-teach a class with someone from another discipline? Do you give students assignments that are overtly interdisciplinary? Have you designed a course centered on a project or theme that is interdisciplinary (e.g., land use for a particular plot of land, or field courses set in a different environment)? Are your nonmajors science classes becoming a combination of chemistry, physics, biology and earth science? Do your courses contain ethics, economics or global studies?

To submit a proposal for this meeting submit the following form by July 15, 2005 and email it as an attachment to Jill Kruper, Program Chairperson, ACUBE 49th meeting.

Email: jill.kruper@murraystate.edu

Note: At least one presenter for each poster, paper or workshop must be an ACUBE member. (Annual dues are $30.)

Proposed Title:_____

Presentation type (Circle one): Poster 45 minute Paper 90 minute workshop

Equipment/Facility needed
_____35 mm slide projector
_____Overhead projector
_____PC computer lab (Sorry, no MAC equipment available)
_____PC projection system
_____Other (Please explain)

Name of Presenter_____

Professional Address_____

Phone:_____ email_____

Name of co-Presenter _____

Professional Address _____

Phone _____ email _____

Abstract (200-250 words):

The 49th annual meeting of **ACUBE** will be held at Southeast Missouri State University in Cape Girardeau, MO. Join us for "Interdisciplinary Exploration."

Cape Girardeau is a bustling city of 37,000 people nestled on the banks of the Mississippi. Beginning as a trading post in the late 1700's, Cape Girardeau was an early stop on the Lewis and Clark expedition, was the site of a battle in the Civil War, and today retains much of its character and charm in the riverfront business district, a Missouri Main Street community known as "Old Town Cape." As a regional center (and the largest city between St. Louis and Memphis), Cape Girardeau offers excellent restaurants, shopping, and a wealth of antiquing possibilities. Known for its medical, educational and retail resources, over 90,000 people come to work daily in Cape.

Southeast Missouri State University sits on a hill above the Mississippi about 1 mile from Old Town Cape. Originally a teacher's college, Southeast today is a comprehensive regional university offering bachelor's and master's degrees to its 8500 students. Our meetings will be held in the University Center meeting rooms, with some sessions in the adjacent Kent Library. All meeting rooms are handicapped accessible. The campus is on rolling terrain, nice for a lunch time walk. See images at www.semo.edu

Nearby state parks in Missouri and Illinois include the Trail of Tears with its rugged terrain for hiking and Big Oak Tree State Park near New Madrid MO with its remnant swamp ecology in MO. Giant City State Park and Little Grand Canyon (Fern Cliff) are state parks in Illinois with interesting geological formations and plants. Horseshoe Lake recreation area near Olive Branch IL offers fishing and birding.

The Cape Girardeau Convention and Visitors Bureau website provides much information on activities and attractions in the Cape Girardeau region. Go to http://www.capegirardeaucvb.org/

Cape Girardeau's weather in October is likely to be warm, but visitors are advised to check the forecast before traveling (it has snowed in October recently). Dress for most all activities in Cape is casual and comfortable.

For more information on proposing a presentation or registering for this meeting, or for housing info and driving directions go to http://acube.org/ and click on the meetings button.

ACUBE 2005 Annual Meeting Registration Form

Southeast Missouri State University, Cape Girardeau, MO

October 13-15, 2005

NAME: _____ DATE: _____

TITLE: _____

DEPARTMENT:_____

INSTITUTION: _____

STREET ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

ADDRESS PREFERRED FOR MAILINGS: _____

_____

CITY: _____ STATE: _____ ZIP CODE: _____

WORK PHONE: _____ FAX NUMBER: _____

HOME PHONE: _____ EMAIL ADDRESS: _____

Registration Fee: Includes meals Friday-Sat noon, refreshments at breaks, and field trips.

Membership status	By 9/20/05	After 9/20/05
Regular Member	$ 85	$100
Regular member + 2006 dues	$115	$130
New Member (includes 2006 dues)	$115	$130
Non-Member	$115	$130
Non-Participating guest/spouse	$ 55	$ 55
Student (Grad or Undergrad)	$ 55	$ 55
K-12 teacher	$ 55	$ 55
Friday evening dinner only	$ 15	$ 15

TOTAL ENCLOSED (Please make checks payable to ACUBE) _____
Sorry, checks or money orders only.

Field Trips: Indicate the trip(s) you plan to attend. Space is limited, register early!

_____ Thursday afternoon: 1 pm- 5 pm: Little Grand Canyon geology and biology trip
_____ Friday morning: 7:00 - 10:00: Birding at Horseshoe Lake, IL
_____ Friday afternoon: 3:00 - 5:30: The Red House (Lewis and Clark interpretive center) & searching for references to biology in material goods (antiquing)

Special needs (food, facilities, etc.):

Please send registration form and payment to:

Dr. Margaret Waterman
ACUBE Local Arrangements Chair
Department of Biology, MS 6200
Southeast Missouri State University
Cape Girardeau, MO 63701

mwaterman@semo.edu

(573) 651-2381

ACUBE 49TH Annual Meeting

October 13-15, 2005

Southeast Missouri State University
Cape Girardeau, MO

Interdisciplinary Exploration

Tentative Program

Thursday, October 13th

2:00 - 5:00 PM	**Pre-Conference Field Trip:** Little Grand Canyon geology and biology trip
3:00 - 5:00 PM	**Steering Committee Meeting**
6:00 - 8:00 PM	**Registration and Reception**
8:00 - 9:00 PM	**Opening Session**
	OPENING ADDRESS (Public Welcome to Attend)
9:15 - 10:15 PM	**Steering Committee Meeting**

Friday, October 14th

7:00 AM - 5:00 PM	**Registration Continues**
7:00 - 8:00 AM	**Buffet Breakfast** (by Interest Group)
7:00 - 10:00 AM	**Field Trip:** Birding at Horseshoe Lake, IL
9:00 AM - Noon	**SUSTAINING MEMBER EXHIBITS** -- Refreshments provided
and 2:00 - 5:00 PM	
8:15-9:45 AM	**CONCURRENT WORKSHOP SESSIONS I**
9:50-10:20 AM	**POSTER SESSION I --** Refreshments provided
10:30 - 11:15 AM	**CONCURRENT PAPER SESSIONS I**
11:20 - 12:05 AM	**CONCURRENT PAPER SESSIONS II**
12:15 - 1:00 PM	**Luncheon and First Business Meeting**
1:00 - 1:45 PM	**Luncheon Program**
2:00–2:45 PM	**CONCURRENT PAPER SESSIONS III**
2:50 - 3:20 PM	**POSTER SESSION II --** Refreshments provided
3:00 - 5:00 PM	**Field Trip:** The Red House (Lewis and Clark interpretive center)
3:30 - 5:00 PM	**CONCURRENT WORKSHOP SESSIONS II**
5:05 - 5:45 PM	**Web Committee Meeting**
6:00 - 7:00 PM	**Social Hour**
7:00 - 9:00 PM	**Dinner and Second Business Meeting**
	Dinner Presentation

Saturday, October 15th

7:30 - 8:45 AM	**Buffet Breakfast** (by Interest Group)
7:45 - 8:45 AM	**Bioscene Editorial Board**
9:00 - 9:45 AM	**CONCURRENT PAPER SESSIONS IV**
10:00 - 10:45 AM	**CONCURRENT PAPER SESSIONS V**
11:00 - 12:15 PM	**Luncheon and Third Business Meeting**
12:30 - 3:00 PM	**Steering Committee Meeting** -- Includes newly elected Steering Committee members!

ACUBE Annual Meeting Housing Information.

Recommended Area Hotels/Motels. Watch for ACUBE discount coming soon.

All of the hotels below are off exit I-55 #96, near the mall and shopping and two miles from campus.

Drury Lodge
104 South Vantage Drive
573-334-7151
573-334-7151 (Fax)
AAA Rating: 2 Diamonds

Drury Suites
3303 Campster Drive
573-339-9500
800-DRURYINN (Toll Free)
AAA Rating: 3 Diamonds

Hampton Inn
103 Cape West Parkway
573-651-3000
573-651-0882
AAA Rating: 3 Diamonds

Pear Tree Inn
3248 William St.
573-334-3000
573-334-3000 (Fax)
AAA Rating: 2 Diamonds

Victorian Inn
3265 William Street
573-651-4486
573-651-3970 (Fax)
800-331-0445 (Toll Free)
AAA Rating: 3 Diamonds

Holiday Inn Express
Next to Victorian Inn
Coming Spring 2005

Off I-55 exit 99, near county park

Super 8 Motel
2011 North Kingshighway
573-339-0808
573-339-2060 (Fax)
AAA Rating: N/R

Bed & Breakfast Inns

Bellevue Bed and Breakfast
312 Bellevue
Cape Girardeau, MO 63701
800-768-6822 or 335-3302
www.bellevue-bb.com/

Near University (1 mile) and downtown (3 blocks)

Rose Bed Inn Bed & Breakfast
611 South Sprigg
Cape Girardeau, MO 63703
332-ROSE (7673)
866-ROSEBED (767-3233)
www.rosebedinn.com

2 miles south of University

Neumeyer's Bed and Breakfast
25 S. Lorimier St.
Cape Girardeau, MO 63703
335-0449 or 888-423-5184
www.capegirardeaucvb.org/neumeyers.html

Downtown, 1.5 miles from university

Campgrounds

Cape Camping and RV Park
(Now Open)
(573) 332-8888 or (800) 335-1178
1900 North Kingshighway
Cape Girardeau, MO 63701
- Full hook-ups with cable tv and wireless internet (107 total camping sites)
- Picnic tables and fire rings for grilling at every site
- Swimming pool with bathhouse
- www.capervpark.com

Suburban location, good for RV.

Trail of Tears State Park
573-334-1711
Highway 177
Jackson, MO 63755
Has full hook-up sites; basic tent sites; and electric only sites.

Note: this is lovely!! About 12 miles from University.

ACUBE

Association of College and University Biology Educators

NAME: _____ DATE: _____

TITLE: _____

DEPARTMENT: _____

INSTITUTION: _____

STREET ADDRESS: _____

CITY: _____ STATE: _____ ZIP CODE: _____

ADDRESS PREFERRED FOR MAILING: _____

_____

CITY: _____ STATE: _____ ZIP CODE: _____

WORK PHONE: _____ FAX NUMBER: _____

HOME PHONE: _____ EMAIL ADDRESS: _____

MAJOR INTERESTS

( ) 1. Biology
( ) 2. Botany
( ) 3. Zoology
( ) 4. Microbiology
( ) 5. Pre-professional
( ) 6. Teacher Education
( ) 7. Other _____

SUB DISCIPLINES: (Mark as many as apply)

( ) A. Ecology
( ) B. Evolution
( ) C. Physiology
( ) D. Anatomy
( ) E. History
( ) F. Philosophy
( ) G. Systematics
( ) H. Molecular
( ) I. Developmental
( ) J. Cellular
( ) K. Genetics
( ) L. Ethology
( ) M. Neuroscience
( ) N. Other _____

RESOURCE AREAS (Areas of teaching and training): _____

_____

RESEARCH AREAS: _____

_____

How did you find out about ACUBE? _____

Have you been a member before: _____ If so, when? _____

DUES (Jan-Dec 2006) Regular Membership $30 Student Membership $15 Retired Membership $5

Return to: Association of College and University Biology Educators, Attn: Pres Martin, Executive Secretary, Department of Biology, Hamline University, 1536 Hewitt Avenue, Saint Paul, MN 55104