

# Biology 101 Laboratory Exercise: Bioethics Debate

See also: [Biology 101 Syllabus](#) | [Ground Rules for Effective Groups](#)

## Biology 101 Laboratory Exercise 8: Bioethics Debate and Class Discussion

### Pre-lab Assignment:

Read this lab exercise and the textbook reading assignment, for introductory information about making ethical decisions in the biological sciences. Your TA has explained the pre-lab assignment and the ground-rules for this week's discussion during your last lab meeting.

Choose a topic (your own idea, or from one of the following areas) that you feel presents important ethical questions, one that you have strong feelings about, and that will provide controversial information suitable for debate. During the previous meeting, your TA will lead a class discussion about the choice of ethical questions, from which 3 will be assigned. In order to maximize your exposure to the topic, you will be asked to research your topic in the library and prepare notes for in-class debate. Your TA may require that you use the format described in the Methods section to define the elements of your problem. (Record your references accurately, including at least one journal article). **Be prepared to debate both the pros and cons on the subject.** Your position will be assigned at the start of the bioethics lab meeting. The quality of your presentation will depend on the amount of time and effort you put into this pre-lab assignment, so read the information introduced in this exercise concerning each of the following areas to help you choose a subject that you can invest in.

- [Transgenic organisms](#)
- Human genetic engineering, gene therapy, and genetic screening
- Health and limited medical resources
- Environmental ethics

### Objectives:

At the conclusion of this exercise, you will have gained skill and experience in

- reflecting upon and identifying your own ethical position related to questions in bioethics
- applying your understanding of cell biology in discussions regarding ethical issues in biotechnology
- applying your understanding of ecology in discussions related to environmental ethics
- applying your understanding of human biology in discussions related to health care and human gene technologies
- the application of the basic concepts in bioethics, to enable you to make use of these concepts in your daily life

### Introduction:

The miracles of modern medicine and advanced technology are still not sufficient to deal with all of the physical, mental, nutritional and other problems that plague our species and threaten the biosphere. Yet, increasing numbers of people depend either directly or indirectly on science and technology for their continued daily existence. Science and industry appear to be caught-up in an extremely strenuous and costly variation on the "scavenger hunt"; to be the first to obtain and disseminate practical knowledge and services meant to improve our condition on earth. At the same time, we are expected to make ethical decisions concerning the methods employed by these very researchers and the rewards they are entitled to. And to complicate matters further, as the conditions of life change, so does our perceptual and practical views of normal, productive, environmentally responsible, and healthful living.

Just as your experience has shown you when choosing one course of action over another, your decision is often different from someone else's because "it all depends on how you look at it"! The alternative choices in ethical decisions are broadly based on different ethical theories or positions. The following three ethical positions contrast each other sharply, and you may find that your position on a particular problem falls somewhere in between, as a kind of balance among extremes. However, each of these descriptions reflects the very powerful motives we weigh when asked to make an ethical decision.

### Conceptual Ethical Frameworks or Positions

#### *Formalist or Principle-based Ethics*

The person applies moral principles uniformly, no matter what the specific consequences. The motivation is to guarantee that decision-maker will act "correctly", according to "rules". All similar situations will be acted upon in the same way. Precedence is followed.

### ***Utilitarian Ethics***

Decisions are neither right nor wrong, but serve a particular purpose. The motivation is to achieve the greatest possible benefit (or the least amount of harm) by the decision. The consequences are most important in the decision making process.

### ***"Ego" Ethics***

The decision is based on the consequences to the decision-maker. Generally, the motivation is to act in a way that achieves the greatest possible benefit (or least amount of harm) for the decision-maker.

The following problems are real and timely. They provide examples the kinds of ethical struggles fought everyday, whether in the public eye or in research labs. These problems also serve to illustrate the new reality that some things we thought impossible only a few years ago have become not only possible, but in many instances, are almost commonplace. In the future, you may be asked to contribute to these decisions, as a voting member of society and as a consumer of the technologies that are at the root of these issues. Please consider these problems carefully.

#### **Methods:**

Students should work in groups of at least 4 people.

Once a topic or question has been chosen, you must then construct a concept map with which to navigate through the information provided in the problem, combined with an assessment of your own views and the views of others in your discussion group. (See p.78 of this manual for a review of concept map construction.) Then, conduct **library research** on your assigned topic to gather evidence in support of the possible actions a person may take, and bring at least one of these **references** to the debate. You are welcome to bring as many sources of information as you think are necessary to inform the discussion (or that have the potential to misinform), but you must provide full citations for each reference.

The following list of 4 major elements involved in the ethical decision process will help you define the elements of your problem. Read the brief descriptions for each, and provide a list of at least some of the information you will use to debate the solutions to the particular problem.

#### **Major elements involved in the ethical decision process:**

- **Database:** Who is affected? What is at stake? What are the alternatives? What are the implications?
- **Decision:** Who should decide & why? What are the criteria (social, legal, psychological, economic, etc.)? What is the ethical position?
- **Time:** How much time do you have to make the decision? How long do you expect the decision to remain relevant or appropriate?
- **Value:** Who or what is valued? How important is this decision?

ethical decision process



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### ***Transgenic organisms***

Transgenic organisms contain DNA from different species. It is likely that you will be making choices in the near future (if you haven't already) about whether to eat genetically modified foods and use drugs made by transgenic organisms.

### **History of Transgenics and Genetic Engineering**

#### ***3.5 Billions years ago to present***

DNA sequencing of prokaryotic genomes has strongly suggested that lateral DNA transfer between species is taking place today and appears to have occurred fairly often in the history of life, particularly in the prokaryotic lineage. Shown below is a reticulated "Tree of Life" that represents this idea. (From: Campbell, Reece. Biology. 6 th ed.)

primitive cells



### **An overview of the more recent history of transgenic organisms**

#### **1970's...**

- first transgenic bacteria made by humans, used for:
  - basic research;
  - *insulin* producing bacteria to treat diabetes (motivated by projected shortage of pig sources);
  - *human growth hormone* producing bacteria to treat pituitary dwarfism (motivated by viral contamination of human pituitary glands)

#### **1980's and 1990's...**

- transgenic fruit flies, mice, worms, sheep, goats, cows, salmon, insects, used for:
  - *basic research* (flies, mice, worms);
  - *disease-model systems* (mice - Alzheimer's, AIDS, muscular dystrophy, etc.);
  - *drug production* (sheep, goats, cows);
  - *fish farming* (growth hormone -salmon);
  - *public health* (malaria-resistant mosquitoes)
- transgenic plants, used for:
  - *basic research*;
  - *agriculture*:
    - reduction of spoilage -*Flavr-Savr Tomato* - (some call this a truly tasteless tomato)
    - pesticide resistance *Roundup®-resistant Soybeans*
    - pesticide production-*BT- corn* (produces a natural pesticide that specifically kills butterflies and moths)
    - virus-resistance- *viral-resistant squash* (which has a close relative that is a weed)

#### **Problems:**

- A. There are two types of pesticide-resistant soybeans available to consumers, one that has been genetically-engineered and another type which was created through breeding projects and artificial selection.
1. Is one better for the environment than the other? Why?

2. Which one(s) should be labeled? What information would such a label provide to the consumer?
- B. A genetically-modified crop has been created that will enable more cost-efficient *organic farming*, by inserting a type of pest-resistance gene.
1. What should determine whether or not this plant is environmentally safe?
  2. Is genetic engineering a simple extension of the human manipulation of nature since the dawn of agriculture, or is it a new situation altogether? Explain.
  3. Many people do not currently buy "organic" foods because of their high cost. Would genetically modified crops be an acceptable alternative for organic farming, in order to encourage more consumers to purchase "environmentally-friendly" products by keeping the costs low?

### **Human genetic engineering, gene therapy, and genetic screening**

There is a significant genetic component to many human disease processes, as varied as insulin-dependent diabetes and the predisposition to develop certain forms of cancer. Each of us carries an estimated 1-5 genetic faults which may be passed on to our offspring. When is it a moral obligation to submit to genetic testing? How should the results of such testing be used? (Note: Denmark prohibits marriage between certain couples after genetic screening unless they volunteer to sterilization procedures!) To what extent are you willing to let genetic intervention and reproductive technologies affect your future? For this exercise, assume that there is a genetic possibility that your child will have the condition described below. For which of these conditions would you:

- decide not to marry a prospective mate
- decide not to have children
- conceive a pregnancy, and then have an amniocentesis (or a comparable test) and abort the fetus if it is affected
- decide to keep the offspring from all pregnancies, despite the risk

### **Problems:**

- A. The child will grow normally for 6 months, after which time the child's nervous system degenerates and he/she becomes blind, deaf, and paralyzed, dying before age 4. This is caused by a lipid metabolism disorder, called Tay-Sachs Disease.
- B. The child can expect to live about 19-25 years, with a relatively normal existence except for time-consuming and expensive treatment and some reduction in activity level. This inherited disease process is caused by excessive and abnormally thick mucus secretions that block respiratory passages and impair the digestion and absorption of nutrients. It is called Cystic Fibrosis.
- C. The child will have a normal life until about 35-40 years of age, and then begin a period of rapid mental and physical decline, most of it confined to bed, and usually fatal within 5 years. People who develop this disease, Huntington's Chorea, have often had children themselves and passed on the gene.
- D. Normal life expectancy, but with severe mental deficiency requiring life-long guardianship at home or in an institution.
- E. Normal life expectancy and normal mentality, but paraplegic and unable to control bowel or bladder movements; confined to a wheelchair for life. (Some individuals WILL BE mentally retarded, blind and/or deaf, in addition.) This condition is caused by failure of the neural tube to close completely during early development of the embryo. It affects approximately 1/2000 births in the U.S. and is called Spina Bifida.
- F. Normal life expectancy, normal mentality, but of a gender unwanted by the family.

Which of these factors did you consider in your decision, and how did you balance them in making your ethical decision?

- the child's right to live?
- the child's anticipated quality of life?
- the potential effects on your family?
- your responsibility to society?
- your responsibility to future generations (i.e. the gene pool)?

Society supports many mentally or physically disabled people requiring a lifetime of institutionalization. Do you approve of this? Would you feel differently if you knew that the parents were aware of the possibility of having a child seriously affected by a genetic disease, but chose to have children anyway?

### **Health and limited medical resources**

A few centuries ago the pattern of disease and its treatment was much different than it is today. During the Middle Ages, a relatively simple infection associated with a tooth ache, broken bone, or appendicitis almost invariably resulted in death for the patient. Some diseases (e.g. yellow fever, typhoid, small pox) have since been almost completely eradicated because of better medical and

sanitary practices. Today, the same "everyday" ailments are no longer life threatening, but merely inconvenient.

However, society in the 21st century must be concerned with diseases borne by polluted water and soil (e.g. exposure to mutagens), a seemingly endless variety of emerging allergic and other toxic substances (e.g. as in multi-chemical sensitivity), new forms of malnutrition (e.g. hypercholesterolemia), and disease processes associated with our highly mechanized lifestyle (e.g. obesity, hypertension). A growing problem (literally!) is the rapid increase in the number of people who require medical intervention, and the ethical question of how limited healthcare resources are to be distributed.

### **Problems:**

- A. An 80-year old widow is hospitalized with pneumonia and a high fever; she also has diabetes and progressive circulatory problems, which has led to an ulcer on her leg. Prior to this hospitalization she was living independently, and taking good care of herself. While hospitalized, she develops gangrene in the leg ulcer. Her doctor decides that the entire leg must be amputated. However, after the surgery she will be unable to live independently. She refused to agree to the amputation, saying she would rather die "whole".
  1. How do you think this patient defines health? Is it different from your definition, and if so, how? How similar are the definitions of health among the people in your group?
  2. Is allowing to die (as a result of non-treatment) an action? In other words, is the cause of death non-treatment or the patient's illness?
  3. Should the hospital convince her only relative to sign the consent for the surgery?
- B. A 35-year old man is involved in a car accident which leaves him in a coma with no discernable brain activity. His brainstem is intact, however, so he is breathing normally and his heart is strong. According to the hospital, there is a less than 1% chance that he will regain consciousness. Hospital bills will run into the hundreds of thousands of dollars per year for his wife, who is left with 4 young children.
  1. Should this man be fed through a feeding tube to keep him alive?
  2. Is your decision based more on a philosophical distinction between life and death (e.g. happiness, ability to reason, contribution to society), or perhaps more on a physiological distinction (heart beat, brain activity, breathing)?
  3. How would it affect your decision if society, rather than the family, bore the financial and emotional burden of maintaining this patient's life?
- C. Parkinson's disease is a relentless disease of the nervous system caused by the progressive loss of cells that manufacture the neurotransmitter dopamine. Parkinson's patients become progressively immobile while their higher cognitive functions are not harmed. Dopamine replacement therapy is successful only for a limited time for each patient. However, experiments with rodent and dog models in artificially inducing Parkinson's disease and the reversal of the disease using transplanted fetal brain tissue have led to a testable hypothesis for Parkinson's disease, and to the development of what has been a successful treatment in humans. (This treatment is also being considered for Alzheimer's disease.)
  1. Do you believe that animals have inherent rights? If so, are they more than the right to a life free of pain and discomfort?
  2. Should the potential benefit to an individual or society be fundamental to the decision as to whether an animal model is required in a specific line of biomedical experimentation?
  3. How does transplanting fetal tissue differ from transplanting organs from an accident victim?
  4. Should pregnant women donating fetal tissue, or the clinician who performs abortions with the intent of donating fetal tissue, receive payment? Why?

### ***Environmental ethics***

To some people, each individual of each and every species on earth not only possesses an inherent right to exist - or at least to struggle to exist - but also has the right to exist without human interference. Is it possible for one species to avoid influencing the ability of another species to survive, while attempting to make a living itself? Will individual responsibility and accountability be enough to safeguard the earth's physical, chemical and biological resources? Which approach will best serve to protect these resources: species protection, ecosystem protection, or protection at some other level?

### **Problems:**

- A. A coastal area particularly suited to industrial port development is also one of the last breeding areas for one species of herring, an important commercial fish and food source for endangered salmon. Zoning for the area dictates that development can occur if danger to wildlife is mitigated in some way. However, artificial herring breeding areas have only a small chance of being successful in protecting the fish population if development does occur. Unemployed people living in the area who don't wish to move away are pressing for the

development in the hope of finding new jobs. The potential for new jobs from the development outweighs the number of jobs endangered by the loss of the herring fishery.

1. Should zoning be further liberalized to allow the development?
  2. What mitigation measures would be appropriate within the current zoning restrictions to allow development?
  3. If development of the port is allowed and the herring fishery collapses, what is the responsibility to the herring fishers?
- B. A pesticide used to improve the growth of peas and raspberries is banned due to evidence that it causes severe birth defects and cancer in laboratory rats. The pesticide is the only effective product on the market for pea and raspberry farmers. Its use makes the difference between profitability and bankruptcy for most of the farmers.
1. Should the ban be rescinded if the farmers agree not to employ pregnant women on their farms?
  2. Should the ban be rescinded if farmers agree to have each of their employees sign a consent form to prove that they have been informed of the potential danger of exposure to the pesticide?
  3. The maker of the banned pesticide is now marketing a pea plant into which a gene for pesticide production has been inserted. The pea plant now makes its own pesticide, and it is no longer a health threat to farm workers. Should this alternative crop be made available to pea farmers?