# Bioethics in Human Biology: Proposed Strategies for Quebec Secondary III Level Curriculum

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## Dedication

With love to my dear:

(Parents and Anil)

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"Mankind is urgently in need of new wisdom that will provide the knowledge of how to use knowledge for man's survival and for improvement in the quality of life".

(Potter,1971)

In recent years the overwhelming revolutionary biological discoveries and techniques have introduced an awareness of moral,ethical,and philosophical concepts in the social consciousness.As such we are faced with difficult dilemmas,for example,if a defective unborn child should be aborted or if persons on life supporting machines should die according to their own or their physician's will. These conflicting issues are receiving an increased attention of mankind.Questions involving the ethics of human experimentation,behavior control,genetic engineering,cloning,amniocentesis,abortion,etc.,have caused the human population,biologists,and medical practitioners to pause and consider the ethical implications of biotechnological advances and the future directions of human beings.

As a result,there has been an emergence of "bioethics" as a new field of study due to the technological advances in the area of science,biology,

and medicine.Hence bioethics covers the discussion of these life related issues that need carefully thought out decisions for the present and the future generations.Bioethics not only attempts to confront such questions and clarify the value issues underlying a particular choice,but it also explores ways of making value judgments.

Consequently,a broad spectrum of professional educators in the field of biosciences are increasingly being confronted with ethical problems created by conflict between new biological knowledge, biotechnological applications and contemporary pluralistic value stances.To make intelligent choices, the educated citizens need to be aware of the alternative consequences of bioethical decisions in today's world. Furthermore,these citizens need to be aware of the value stances they hold and how these values influence their decisions.Therefore,biologists and educators in the developed countries have established that a strong need exists for a more humanistic and realistic high school science curriculum.This type of curriculum will not only respond to the personal and societal needs of the students but will also allow them to explore their values and make informed decisions when confronted

with bioethical issues.

The programs at the Hasting centers in (New York),the Kennedy centre at Washington (DC),the Westminister Institute for Ethics and Human Values in London(Ontario),the center for Bioethics of the Clinical Research Institute in Montreal(Quebec) are a few examples of the centers to educate a small population of mankind.Also,the multiplicity of courses in bioethics appearing in colleges and universities provide training in the technique of ethical reasoning for a certain sector of the society only. However,a greater portion of the western society, which constitutes the younger generation,are unaware of the confronting bioethical issues at the secondary school level in many states of North America.One such example is the province of Quebec in Canada.Although students at the secondary level are taught about Human biology,yet they are not exposed to current bioethical issues in this subject.

Keeping in view this condition in the existing curriculum for Human biology,the present proposed curriculum will try to investigate appropriate issues for inclusion in the above discipline.This curriculum should offer the kind of opportunity that will ensure awareness of current controversial issues among students at the secondary level.Hence implementation of bioethics in the

present Quebec Human biology curriculum is intended to make a contribution in this area.

Almost more than fifty percent of all secondary level students never have a chance to go to college. Although the college student may be exposed to bioethical issues,the fifty percent who do not attend college may be unprepared to confront the issues raised by new developments in the biotechnological sciences that are sure to affect their lives.

The purpose of this study is to reformulate the Quebec Human biology curriculum by incorporating various bioethical issues.This will make the curriculum more relevant and up-to-date for the students and society as well.Therefore,the aim of this curriculum will be to develop student sensitivity toward the prevalent bioethical issues which will in turn lead to scientific literacy in the context of bioethics. Also,bioethical awareness in life-related issues will assist students at the secondary level to understand the issues,to experience making rational value judgments,and develop decision making skills.

The study is organized into five chapters. Chapter one presents the literature review and has four objectives:

1.To present an introduction about 'bioethics' and bioethical issues.

2.To show interrelationships between science,society, and technology.Also the importance of societal issues in science curriculum is discussed.

3.To present a brief review of the trends in science education with special reference to science education in the U.S.A. This section further concludes with a definition of scientific literacy.

4.To state the goals of biology education keeping in view the modern trends in science education,and the rationale for the bioethics curriculum in human biology.

To present bioethical issues in human biology, we need to know something about the pedagogical techniques that are available. Two approaches, therefore,have been considered for the purpose of this monograph.These are the moral development approach and the value education approach. As bioethical issues require value judgments,the biology teacher must have a thorough knowledge of values,value education,and moral development.In bioethics,students are confronted with problems where they need a higher level of moral reasoning,and the clarification of their values.Hence chapters two and three present the moral development and value education approaches respectively.

Chapter four reviews the various bioethics curricula designed and implemented in biology

or general science curriculum in the U.S.A., Canada, and other countries.The purpose of this chapter is to present various examples and ways illustrating how bioethical issues can be dealt with in school science curricula.The main purpose is to focus the attention of Quebec human biology teachers to develop a more relevant curriculum by incorporating important bioethical issues in human biology.The chapter concludes with a description of Macdonald's Circular-Consensus model to facilitate organization of the bioethical issues in the school curriculum.

Chapter five deals with the implementation of bioethics in human biology which is also facilitated by using various strategies for effective methods of instruction.Hence a few important strategies used by professional educators will serve as examples. This will help the teachers to use many strategies for a superflous understanding of the bioethical issues by students. Finally,the chapter ends with the conclusion and recommendations for the development of science curricula including contemporary bioethical issues.

# CHAPTER 1

## REVIEW OF THE LITERATURE

### 1.1 Introduction

Bioethics offers an intellectual and moral challenge as it involves the reexamination of moral values. Bioethics is multidisciplinary in character and is related to various fields such as medicine, law, biology, psychology, philosophy, religious studies, and social sciences. Both academic and nonacademic scholars, writers, journalists, health professionals, social workers, lawyers, and counsellors are all showing interest in this area. Thus several disciplines and professions need to cooperate with their expertise, skills, and resources to analyze and evaluate the political, social, economic, and value issues inherent in this area.

### (a) Definition

Literally speaking 'bioethics' means the ethics of life (Shanon and Digiacomo, 1979, p. 1). The function of bioethics is to explicate questions of moral rights. Ethical principles are related to specific problematic situations. As such bioethics is an attempt to determine the fundamental values

by which we live. In a social context it attempts to evaluate the actions of persons based on certain values (p. 2).

Broadly speaking, bioethics is a composite term derived from the Greek words bios (life) and ethike (ethics). Thus bioethics is the "systematic study of human conduct in the area of life sciences and health care, in so far as this conduct is examined in the light of moral values and principles" (Reich, 1978, p. xix). This indicates that we must take the discipline and the implications of scientific knowledge seriously in order to understand the issues, and learn to evaluate possible consequences of various discoveries and their applications.

In other words, bioethics demands the critical examination of the moral dimensions of decision making in health-related biological sciences. It is, therefore, the application of traditional ethical theory to specific areas of science, medicine, and health in general. This idea is equally supported by Clouser (1978, p. 127) who maintains that bioethics is the response of traditional ethics to particular stresses and urgencies that have emerged by virtue of new discovery and technology. In a democratic life we have to know how far individuals are able to

change the direction of human affairs. As such we need intelligent solutions to problems. Human biology has raised so many questions that are urgent that we are left with a little choice of what is desirable or undesirable in a human being. For example, the question as to who should live, reproduce and who should not remains to be unsolved. Therefore, bioethics deals with broad range of problems that arise from science in general and medicine in particular.

Bioethics is everybody's business as it makes us attend to problems that all of us will and must eventually face (Shanon and Digiacomo, 1979, p. 4). It is an area of interdisciplinary studies whose focus depends on the kinds of issues it examines and the nature of ethical inquiry. As one special area of learning, bioethics tries to uncover and clarify the value dilemmas characteristic of this century.

(b) Bioethics- The Science of Survival

The knowledge of how to use knowledge for the social good is the science of survival that serves as a prerequisite to improve the quality of life. In this respect, this science of survival

must be built on the science of biology and enlarged beyond the traditional boundaries to include the most essential elements of the social sciences and humanities with emphasis on wisdom. This emphasis on wisdom is further elaborated by Potter (1971, p. 1) who believes that "biological knowledge and human values are the two main ingredients of new wisdom that are needed desperately by an individual". This means that bioethics should help us to survive in the present world.

To understand man's nature and his relation to the environment, biology is the ideal subject that could include both the reductionist and holistic views. As man's survival depends on ethics based on biological knowledge the teaching of bioethics becomes essential. This would provide models of life styles for people who can communicate with each other and propose and explain the new public policies that according to Potter (1971, p. 2) could provide a "bridge to the future". Therefore, as a science of survival, bioethics will help to solve today's crisis problems that have a direct or indirect effect on human beings.

Bioethics can easily fit in the human biology discipline which includes the science of human genetics,

heredity,physiology,and reproduction,etc.essential for the survival of the human beings.As such,man has a right to know about his body and a right to make decisions.With the help of bioethics he can question the experimenting with genes and the right to determine the criteria of selectivity and diversity of future human beings(Edwards and Sharpe,1971,p90). In this respect,an effort should be made to get the necessary knowledge that will help us to improve the quality of life.

(c) Bioethical decision making.

To examine a bioethical issue,a student needs to have an understanding of the relevant scientific-technological background to the question, he also needs to have developed skills in outlining an issue and making decisions.Furthermore,he needs to understand the relationship of values while making ethical decisions.Thus bioethical issues demand an intelligent and effective response of our students. According to Hurd(1977,p16) "decision making is the intellectual process by which knowledge is brought into action or applied". Hence decision making involves reasoning which forms the basis of ethical methodology.

The above statement is further supported by Kieffer, (1979,p177) who believes that ethical methodology is the procedure that one follows to arrive at a decision based on the weighing of different values. In this way the procedure would allow an individual to improve his or her ability to make bioethical decisions with practice provided a rational methodology is used rather than taking a haphazard approach to making value judgments.

In bioethical decision making four major stages are involved.These are:

1.Confrontation with the need for choice- an occasion for decision.
----define the issue.
2.Determination of important values or goals affecting the decision.
----determine why the issue?
----identify the goals to be achieved and resulting consequences.
----examine beliefs in the good,the right, the valuable or the important.
----list higher references
----what results we want from our decisions?
3.Identification of a range of alternative courses of action.
----ask what actions can be taken to solve the problem?
----ask which actions best reflect the values and goals set out?
4.Gauging of the positive and negative

> consequences of these various courses of action.
> ----identify the plus and minus effects of various choices in terms of trade-offs or costs.
> ----choose the option that gives the greatest award for the least cost (Manitoba Pilot Guide,1984,p6).

As a result,through developing decision making skills, students are more strongly motivated if and when they make decisions.They learn to consider and analyze alternatives,make wiser choices through practice and unwise decisions.In addition,they learn to identify and make adjustments for individual strengths and weaknesses.They recognize that there are more ways than one to satisfy an objective set.

Bioethical decision making differs from scientific inquiry in many ways.As decisions are based on reliable and relevant knowledge,they also include a value dimension.In other words,both qualitative and quantitative sides are involved.Also, identitical facts considered by two or more people or at different times can lead to contrasting conclusions.Or,the same person might find meaningful relations among data;the choice is the one found to be the most satisfying.Thirdly,decision making is action oriented,it implies what to do next.Decision making is therefore,one form of human adaptive behavior,a

necessity brought about by the biological advancements(Barman and Rusch,1978a,p107).

Through discussions of bioethical issues,a sort of ethical development takes place that human beings come to accept right or good and reject wrong or bad.Students while discussing various bioethical issues develop their ethics based on experience through effective discussions.In this way they choose between right and wrong in conflicting situations.Wise decision making requires accurate data,a conceptual basis for understanding the data,and clarified values.As such the questions raised in our minds may ask:

> 1.Do the value systems we hold permit us to make wise decisions?
> 2.What are our value stances? what fundamental motives and beliefs guide us in attaining clarified ethical values? (Mertens and Hendrix 1978,p7).

In this respect,an individual knows how to use effectively what he has learned.He learns how to cope with stresses arising from the adverse life conditions.

Though ethical decision making is not an easy task,it will enable students and teachers to think intelligently about the new biotechnological changes affecting human lives.The current and

future issues will demand decision making within the next several decades.Therefore,it is the responsibility of teachers to equip students with decision making skills for making personal value judgments.This idea is further supported by Aikenhead (1980,p39) who maintains that decision making skills and understanding the interrelationships between science and society are necessary in order for citizens and key decision makers to deal effectively and constructively with the problems of scientific and technological society.

To conclude,bioethical issues are complex and as such cannot be resolved out of ignorance.They need effective and long term resolutions.These issues require analysis and a change in our attitudes.Thus the realization of self responsibility and relating to the needs of others is what a bioethical decision demands.Decision making is an art and science of using knowledge and information to resolve these bioethical issues.To ask students to resolve complex problems before they have any substantive background is to create feelings of futility and frustration (Glen and Richard,1979,p39).

(d) Bioethical issues

With the passage of time new problems arise. However,present-day problems are mostly related to

the advances in biotechnology.Such conflicting issues as euthanasia,genetic engineering,artificial insemination,etc., are going to stay with us for at least upto the year 2000.This means that our present and future generations need to be scientifically and biologically literate to understand these issues in order to make intelligent decisions.Therefore,it is important "to connect this literacy to the issues of our times"( Flint,1982,p719).

This indicates that the area of bioethics is a wide area.Due to the modern biomedical technology a human being is almost completely influenced from conception to death.For example,issues like birth control,fetal research,abortion,and amniocentesis can be studied under conception.Similarly,issues like quality of life,care of the critically ill,death with dignity,organ transplanting,suicide,and informed consent can be analyzed under death.Since all these issues need to be included in a human biology curriculum,a brief summary of some of these issues is presented here.

(i) Amniocentesis

The process of amniocentesis is a fairly common technique used to assess the condition of the unborn.A syringe is inserted in to the prospective

mother's uterus and a quantity of amniotic fluid surrounding the fetus is withdrawn.This fluid contains the same cells as the fetus.These cells are examined for chromosomal disorders and grown in the lab to test for specific biochemical abnormalities.

Although,amniocentesis would seem to provide great benefit to our society,there are serious implications that have developed as a result of this technique. Fletcher(1972,p.457) conducted a study of 25 couples who requested amniocentesis.After interviewing these people,Fletcher found they had serious guilt feelings relative to the idea of aborting the fetus as well as the possibility of carrying a defective gene.This indicates that people are in a dilemma about the consequences of amniocentesis.

(ii) Fetal Research

People are mostly concerned about the fetal research.Should we permit biomedical research on living fetuses presents another dilemma to modern society.Experiments on the fetuses have created a great ethical confusion.On the one hand we have those who believe that we must protect one of the helpless creatures in our society.On the other hand there are some who believe that experimentation on the fetuses can give a great deal of information so that future

fetuses can be given a better chance to develop into normal infants.

(iii) Euthanasia

The euthanasia issue is presenting yet another dilemma to society.Due to modern technology,medical practitioners have become confused if or not a right exists to prolong or terminate the life of critically ill patients. Ethical and moral arguments for and against active or passive euthanasia are conflicting and confusing.Thus the euthanasia issue is both controversial and emotional(Kieffer,1977,p84).

(iv) Behavior modification

The use of electrode stimulation,drug therapy,psychosurgery,and psychoanalysis is creating ethical conflicts.Also problems of consent, predictability of side effects,and societal definitions of male-female normalcy have arisen(Shanon and Digiacomo,1971,p121). One is often confronted with the questions:

1. Is informed consent necessary and possible?
2. What is normal and abnormal,who decides?
3. What happens to personal freedom?

(v) Population control

It is another example of ethical conflict.The world population is expected to reach 6-billion by the year 2000(Kieffer,1977,p82). This increase in

population has resulted in increase in hunger and starvation.The population issue has become political and there seems little hope that a resolution to this problem is imminent.As such the "world is facing a moral dilemma as excessive population threatens existing or desired human values"(Kieffer, 1977,p83).

(vi) Abortion

This hot issue is presenting a great conflict in the modern society.The question of personhood, and sanctity of life are the critical elements in the abortion debate.The questions involved are:

1. Is, a fetus a person?
2. When is a fetus a person?
3. Who has the right to survive? The mother or the child? (Shanon and Digiacomo,1976,p42).

In addition to these questions,different views of abortion are held by the social community. Various members hold the liberal,conservative,and the moderate positions about the abortion as,whether it should be performed and under what conditions.In this respect,students must be able to decide if and when to abort a fetus without being influenced by their community members.

Similarly,other controversial bioethical issues need to be incorporated in the human biology curriculum . For example,issues like:

## 1.2 Science,Technology and Society

Science is the force that shapes our society,affects our lives and determines the destiny of humanity.Conversely,science is influenced by the ways members of society structure their feelings,choose to behave,and come to value themselves (Casteel et al,1974,p186). In the modern culture science is regarded as a means by which all problems such as disease or starvation can be resolved and thereby improve the quality of life.However,when one studies the interaction of science and society via technology, one becomes disillusioned when seeing the societal and personal problems it creates.The conflict between scientific advances and humanistic values raises ethical issues that affect everyone in the present society.

Technology represents another dimension in the science-society interface.The products of technology together with their accompanying social and environmental implications are essential features of daily life.In other words,"the more common conception of technology is applied sciences, as process or activity, modern technology is a kind of action,one whose fundamental characteristics is the rational pursuit of efficiency"(Edel,1978,p1538). The new technologies,for example,nuclear powered

satellites,high speed computers,automated systems, new medicines,energy production,and new methods of transportation are a few examples in the modern society.

Although science and technology have advanced, it has resulted in a situation in which the human race is endangered.A few decades ago it would have been unthinkable that expanding technology could be a source of human problems.Since the nature of technology itself has changed,it is forcing each of us to adapt faster and faster to remain current with contemporary developments.Further,as technology serves as a bridge between science and society,many of the major social,political,economic,scientific, and personal decisions of the present world depend upon a clear understanding of technology,its potential, and its direction(Hurd,1975,p28).Hurd's view is further substantiated by Cliford Grobstein(1977,p1) who states:

> ---Science,of course,is crucially consequential to society,precisely because it is an intensifying source of both benefits and risks.For example,research with recombinant DNA may provide major new social benefits of uncertain magnitude, ---are ensured in best scenarios for the future applications of recombinant DNA technology.Worst case scenarios can also

> be conceived,world wide epidemics caused by newly created pathogens,is just one example.Both the best case and worst case scenarios are largely speculative.The gap between them symbolizes the large degree of uncertainity that surrounds this major step forward in molecular genetics.

This clearly indicates that technology must be a very complex activity of decision making,much more akin to the logical decisions of science.

Marshall(1979,p9) considers tne following objectives should be served by technology:

1. Develop an understanding of the relationship between values and decision making,
2. Investigate the problems of contemporary social issues which exist because of the extensive use of technological products, and,
3. Explore possibilities for future development of technology and its potential effects in the society.

In this respect,technology should serve the needs of society and human desires.Since values are more related to technology than science,technology is thus directly involved in problem resolution.In this sense,technology should enable us to make wise decisions in the present world,being dominated by technology itself.

Technology,however powerful,does not create affluence independent of intelligent human applications.In fact the history of technology indicates that new developments can easily generate more problems than they serve.This is further supported by Palm Ann, (1974,p657) who states:

> Technology is a good servant but poor master.Scientific researches have not yet only caused social ripples but also have set off pervasive shock waves through society,as scientific work often touches on important moral and ethical issues affecting the health of citizens,the nation,and the world.

This indicates that technology as applied science is the channel through which the greatest scientific influences have been brought to bear on contemporary life,and so in turn the ethical problems faced by mankind.Hence before making choices about the use of technology one must understand what it is,and realize that social,economic,political forces determine its use.The forces are confronted by people and reflect human values.As citizens in a democratic society it is our responsibility to become informed about technological issues,clarify our values,and after careful analysis involve ourselves in the process of influencing decisions that affect the quality of life(Switzer et al,1982,p457).

Societal forces have always caused change in the school curriculum.However,as science,technology and society both change at increasing rates,the time required for such forces to accumulate has decreased considerably.At present the change is so swift that many yearn to return to the old days where goals and curricula were most stable and less volatile.For example,twenty years ago it was common to separate science from technology in a school curriculum.But today technology has become an essential feature in the science curriculum.The science programmes stress that "schools today must prepare children for a rapidly changing society" (Searles,1977,p1).The changes brought about by technological innovations and biological research demand the development of rational thinking skills.

At present science is seen as an applied knowledge and its concepts are used to attack the present-day problems of society.Thus science is no more discipline oriented.According to Herron(1977,p 30) "the major difference between the old and new in science education is not content,but in the affective domain—that is in the area of attitudes and values".This means that the present school science curriculum should have a balanced coverage of conceptual schemes,science concepts,and science

processes including rational thought processes,the social aspects of science and technology,and the values derived from science and technology(Ost,1974, p585;Watson,1980,p6).

Modern society holds two major attitudes about science and technology.On the one hand science and technology are seen to solve all the problems of mankind.But on the other hand,the disillusionment caused by science and technology,example,nuclear war,environmental pollution,is growing rapidly with a host of ethical doubts generated by biomedical research demands an urgent need for the science educators to upgrade the quality of science teaching in the present-day schools. Indeed,the major goal of science education is to develop scientifically literate and personally concerned individuals with a high competence for rational thought and actions (NSTA,1971,p47).Therefore,science education must understand and appraise the impact of science and technology on society(Hurd,1975,p27).

The interrelationship between science, technology and society is further supported by the National Council for the Social Studies(NCSS,1983,p 258).Their position statement is:

> ---The impact of science and technology upon society,be it the environmental

> study,the energy problem,or other timely occuring issues,indicates a need for societal studies and science educators alike to develop guidelines for teaching about science related social issues.--- The examination of scientific issues offers an excellent opportunity for helping students develop a synthesized perspective on science related social issues,a synthesis of the technical data coupled with social,political,economic, ethical,and philosophical information.

In this respect,it becomes essential that every student should understand science and technology as a human enterprise.This will allow them to understand and explore the moral and ethical issues that science and technology create.Hence science teaching must provide critical thinking,moral/ethical reasoning, value clarification,and decision making skills.

In conclusion,science,society,and technology are so interrelated that it is impossible to consider the one without the other.It then becomes the responsibility of science educators to include science and scientific issues in the school science curricula.The discussion of impact of science and technology on society will help our students to reconsider the scientific discoveries and their applications.Also,societal issues can help as monitoring factors to make science more relevant to the needs of students and society.

### 1.2.1 Social issues in the Science curriculum

Many issues in today's society are directly related to science and technology. Because of this relation between the present persisting societal problems and science and technology, it becomes essential to study today's society and the forces acting upon it. It also involves the consideration of the scientific basis for the problems which otherwise would be antiintellectual, irresponsible and unfortunate (Hofstein and Yager, 1982, p 543).

Science and technology have progressed to the point that value dilemmas must be faced today which did not exist a decade ago. At both personal and societal level, developments of science and technology have caused human beings to search for new values, values which frequently clash with those of the past. For example, DNA research has caused the present world to consider both the old and new values. Similarly, at one time the primary function of marriage and sexual intercourse was to have babies, but at present with the birth control techniques, what was done for

procreation is now done for recreation.Yet this recreational sexual life has raised serious moral, religious,and ethical questions and thus has brought new values into direct confrontation with the old values(Switzer et al,1981,p453).

This new impact of science and technology on our personal and collective values brings one to the important justification of integrating social issues in the school science curriculum.According to Palm Ann(1974,p658)"science curricula need to be revised keeping in view the human values and the social issues". In this respect,it becomes important that all present-day students gain an understanding of various societal issues.Further,dealing with social issues and approaching science with a broad awareness of relationships between science and society might help to bridge the gap between socially abstracted scientific knowledge and the personal and societal needs of students(Hurd,1975,p28).

At present science is experienced in a social context.Hence we need people who can adapt to the social changes and can make rational decisions for themselves and society.To support it further Etzioni and Nunn(1974,p194) maintain that:

> "For a society to make rational decisions relative to science and its applications, the members of that society must be aware of the relationship between the science, society and technology and must have the understanding of the basic scientific facts".

This awareness would lead to the assessment of the potentials and limitations of science and its applications for resolving serious problems of mankind.

Students at present are not like those of the late sixties.Today's younger generation struggle to find sources of knowledge that are meaningful for generating new insights into the relation of human beings with the realities of nature. Therefore,the task educators face is to align the teaching of science with social realities.To do so educators need to reconsider the recent shifts in our culture and the changing responsibilities of science within the culture(Hurd,1972,p766).A survey by National Assessment of Educational Progress(NAEP 1975,p41) indicates that in many cases students are aware of what they should do about science related problems.However,their behavior does not reflect this awareness.Hence science teachers can function as important role models for individual action regarding social problems.With the help of teachers students should be able to develop rational inquiry

skills and should understand the basic nature of the social issues.

The emphasis on values,decision making,and reasoning in science curriculum will make a future orientation to science teaching a reasonable venture. Alvin Toffler(1972,p3) contends that educators are playing a dirty trick on students when they are subjected to an educational process which consists of hour after hour of instructing the students in the glories of the past,giving them perhaps a flash of what is occuring at present,but remaining silent about the future.He also contends that,although it is true that we do not change the future,we shall be compelled to endure it.Hence science teachers have an obligation to help young people plan for themselves the world yet to be.To substantiate it further, Bybee,et al(1980,p393) recommend that science educators must understand the trends and issues associated with the public's perceptions of science.They urge that people need to be aware of science related societal problems and should realize that their personal decisions help make up larger social decisions that can either perpetuate or alleviate social problems.In this respect,public awareness of scientific methods and values is essential in our society.

Since the technological advances are expected to have a major impact on society, the future is predicted to be greatly molded by the laser and solid state physics as is the present by computers (Kuhn, 1979, p 64). In addition, the dramatic changes in the life styles due to biomedical technology, education should be oriented strongly around the students that a typical student will develop a strong sense of identity, and will attain a high degree of self-esteem. According to Baez (1969, p 17) "the world of tomorrow can be taught in a way that helps to cope with the demands of the 21st century". This indicates that science education of the future must develop individuals whose approach to life as a whole is that of a person who thinks and acts in accordance with the spirit of rational inquiry.

To communicate the spirit of science and to develop a sense of social responsibility in the application of science, must be among the principal goals of science education. A student of science, in this sense, will be suspicious of any claim of certainity. To him no concept, proposition, or belief is immune to examination and possible rejection. As such he will be willing to see even his conclusions being challenged once he becomes aware

of the value stances of his fellow students.Through science education every one should become appraised of the stake each individual has in problem resolution.Also,inquiry into problems,rather than indoctrination,could be an effective approach to education(Jacobson,1982,p703). Hence science education should allow the consideration of important social issues in the modern schools.

Science education at present must be based on the premise that successful solutions to the persisting societal problems have to be found.The complexity of the issues is increasing and thus the ethical dilemmas are bewildering.Now more than ever, present and future generations must be provided with adequate intellectual and moral foundations to deal with these issues wisely.In this sense,science education should focus on students' comprehending scientific knowledge,value clarification and decision making.This is further supported by Thomas Sills, (1985,p31) who states:

> "Today science teachers must become aware of the importance of giving equal time to scientific discovery and to the limitations of scientific knowledge--- knowing science facts is important,but understanding science limitations is essential.Students have a right to know

> that science is not as clear cut and well defined as we might like it to be. It is not a pool of answers from which we can drink. It is more like a bubbling fountain of questions.

It seems more desirable that our students examine the consequences of modern science and technology. Rather than allowing them to be mesmerized by contemporary advancements, it would be essential to make them aware of the ethical implications of the outcomes of science and technology.

The art of living well in a technological society is not to confront it directly with our meager power, but rather to use the power within the system for our own ends. It is an art that yields the most satisfying results when guided by the educated mind (Broudy, 1976, p292). Therefore, we need a curriculum where emphasis will be on fostering a spirit of inquiry rather than the memorization of facts and concepts. As such, social responsibility must be the major goals of present day science education (Brown, 1979, p9). The ethical problems raised by the population explosion, genetics and neurophysiology, and by social and mental science, are at least as great as those arising from atomic energy and the hydrogen bomb. Hence to make the educational process effective in a technological culture, the layman must understand

in some depth the relationships existing among social sciences,the humanities and the natural sciences.The schools must shoulder substantial responsibility in assuming that the majority of citizens will be so enlightened(Snow,1963,p90).

Clearly,the role of schools should be to provide the opportunity to explore value-based social problems. Modern science and technology cannot be separated from the critical realities of contemporary life.In this respect,science education must be relevant to personal life and societal needs of students.Science education can no longer stress knowledge for the sake of knowledge.The most important task is to direct it toward the improvement of the lot of humanity.According to Glenn, et al(1985, p174) "as citizens of a science/technology-based society we serve our interests by helping our students and all people to be more scientifically literate and thus better able to make informed decisions".

Social issues make us aware of some real needs of our students and society.For example,problems of drug abuse,old age cancer,venereal diseases, alcohol abuse,etc.are the problems confronting our students several times a day.Therefore,it is important that they examine these issues and apply the scientific processes to these problems.

## 1.3. Trends in Science Education

A brief review of science education in the immediate past may help assess the current need for change and a direction for it.

1930--1940: The emphasis in this era was on social reconstruction through schooling. Problems were to be studied through collective decision making. Also, achieving consensus was an end in itself. Disciplines and conformity were the school's primary concerns. The primary goal of education was that the school curriculum should help young children adjust to the demands of an industralized society(Saber,1979,p257). For example, Dewey(1943,p29) in his 'School and Society' stressed that subject matter should be related to the society and school should be responsible to bring the two together.

1940--1950: The science programs were organized according to the structure of the science disciplines. The basic pattern was not changed until the 60's, although emphasis upon the structure was more important and apparent. More time and effort was devoted to identify the central themes, the conceptual schemes, the unifying ideas and the patterns of thinking of each of the science disciplines(Yager et al,1982,p377). Programs were designed to meet the goals of past times. Schools seldom have been

major forces for change so curricula were centered around subject matter.School science focussed mainly on the accumulation of knowledge.

In 1957,when the Soviets won the space race by launching Sputnik,further questions were posed about the quality of science and mathematics in N. American schools.This propelling of the satellite into outer space caused a widespread alarm among U.S.citizens.There was a great public demand that more rigorous curricula in science be provided in an effort to produce more scientists and engineers to solve perceived problems and atone for the national pride.

More and more scientists and educators became interested in the improvement of school science curricula for various reasons.Improvement of science education became a major national concern.Large amounts of funds were allocated.Educators concerned with the principles of curriculum development were expressing their views.For example,Tyler's(1949) basic book on curriculum development and later Taba's (1962) book on curriculum theory had a great impact. However,the major effort was in the field of science education and schools began to teach science with the purpose of advancing knowledge for its own sake.Emphasis was on logical thinking and

scientific inquiry skills.

1960: During the post-Sputnik years science teaching aimed at producing more scientists and engineers. The nature of science was considered to be value free.The goals of science teaching were internal to the various disciplines of science(Bybee et al,1980, p378).These goals were achieved by changing the curricula of elementary and secondary schools.Further emphasis on teacher training and laboratory facilities was laid.More accurate text books were introduced to improve knowledge in the biological sciences,physics,chemistry,and earth science.

With increased federal money, many new curriculum centers for developing programs appeared. These new programs were:

BSCS-------Biological Science Curriculum Study
CHEM------Chemical Education Materials Study
PSSC-----Physical Science Study Committee
CBA-----Chemical Bond Approach
ESCP----Earth Sciences Curriculum Project
HPP----Harvard Project Physics
IPS----Introductory Physical Sciences
PS-----Physical Sciences
SSSP---Secondary School Science Project
(Falk,1971,p5).

However,the public in many of the developed countries soon became disillusioned with science as young people considered the curriculum to be

irrelevant.Interest in school science began to decline and support for the curriculum development began to decrease(NSF,1963,p355).For example,the Vietnam tragedy,environmental degradation,the population explosion,concerns for civil,human,and individual rights led to the notion that science curricula were not resolving new societal problems.

1970: Science educators began to turn their attention away from the development of future scientists. Despite new and unquestionably improved text books, students' enrollment and interest in science began to decrease.Many considered these educational changes as directly related to the broader shifts in relationship between science and society.In this respect,an international committee composed of concerned scientists, and philosophers of science explored new challenges to human existence generated by the interaction of science,technology and society. Various associations recommended the teaching of science as a social enterprise(National Association of Biology Teachers,1970;National Science Board,1974; American Association for the Advancement of Science, 1975;National Science Foundation,1975).Therefore, social implications of science disciplines as an

instructional goal was proposed(Hurd,1970,p14).

In addition to these scholarly indications that education needed to be re-examined and perhaps re-considered,teachers themselves began to feel new concerns and needs(Bybee,1979,p250).Teachers and curriculum developers scrambled to make science education more relevant.Integrating the science disciplines at the junior secondary level was also stressed.This integrated science education was later also supported by UNESCO(1981).It was felt that all basic science disciplines must include societal issues.The purpose of science education was to prepare the students to meet the expected changes in the society.As Hurd(1972,p769) strongly recommended,a more holistic view of the entire school curriculum is needed.Hurd further advocated that the curriculum of the future will be societal rather than discipline-based(Hurd, 1973, p 18).

To study the interrelationships of science and social activities means that science education must provide the opportunity of analyzing the positive and negative effects of science on society. To determine the status of science across the United States in the late 1970s the National Science Foundation(NSF) supported three concurrent studies: a literature review(Helgeson et al,1977),a national

survey(Weiss,1977),and a series of case studies (Stake and Easley,1978).Nine professional organizations were invited to review the studies and make the necessary recomendations(NSF,1980). All these reports stressed the need for a 'back to basics' movement and its effect on science education.It also noted that secondary school science education lacked a sense of direction.

This lack of direction is further evident from the survey by NAEP(National Assessment of Educational Progress,1978). From their survey Yager (1932,p42) concluded that "four years of schooling result in the change of attitude of many students that conflict with the goals of science education".That despite the efforts of competent science teachers and well-planned science programs, students increasingly show a lack of interest in science.These findings of the NAEP survey provide a "valuable measuring rod against which science educators can gauge their own attempts to improve science programs and teaching strategies"(Yager,1982, p42).

In his final report of Project Synthesis, N.Harms(1981) made the following statement to improve science teaching in schools:

> Not only is there an increased need to understand large national issues,there is also an increasing need to understand the way science and technology affect us as individuals.Thus,a new challenge for science education emerges.The question is this: Can we shift our goals,programs and practices from the current,to an overwhelming emphasis on preparing all students to grapple successfully with science and technology in their own everyday lives,as well as to prepare to participate knowledgeably in the important science related decisions our country will have to make in the future? (Yager,1984,p197).

This indicates that educators must seriously search for new approaches to improve school science teaching.Science education must focus on decision making social issues.

1980: In this era a number of recommendations were made to direct science courses towards personal and societal problems.To resolve the crisis in science education,a new direction with a clear purpose and perspective was proposed.That students should be provided with a better understanding of science and technologically based issues.The crisis in science was presented briefly by Yager, et al( 1982,p387) and included the following problems:

1. Organizing problems:limited budgets and facilities, lack of vision and leadership in schools and lack of programs to meet varied needs of students.
2. Conceptual problems:confusion and uncertainity in goals and objectives.
3. Teacher related problems: poor quality teaching and counselling,lack of motivation and continuing growth.
4. Student related problems: declining enrollment, poor attitudes and motivation.
5. University centered problems:poor quality and low standards of teacher education programs,limited scholarly dialogue between researchers and practitioners.
6. Societal problems: public and parental apathy towards science and science education,school board and government controls.

To resolve these problems new policies for developing science education were suggested. It was felt that the system of science education in the United States should effectively participate in a modern scientific, technological,and industralized culture(McConnell, 1982,p9).

Concern that the teaching of issues created by science and technology must be reflected in science curricula

is evident from the recommendations made by (Bybee et al,1980,p393).They state:

1. A major redefinition and reformulation of goals of science,a new rationale,a new focus,a new statement of purpose is needed.These new goals must take into account that students today will soon be operating as adults in a society which is highly dominated by technology.
2. A new conceptualization of science curriculum to meet new goals,redesign of courses,course sequence and discipline alliances are needed.The new curriculum should include components of science not currently defined and or used in schools.Direct student experiences,technology,personal,and societal concerns should be the focus.

As a result,science is viewed as a form of knowledge, and also for its societal role in future interests of human beings.An issue-centered curriculum is highly recommended for the 21st century that will allow students to explore their values and make rational judgments.

Science education for the 80's and beyond must have a dual thrust:to prepare students for college work and careers in science and technology,and to prepare students to be scientifically literate citizens to make effective decisions(Bybee,1982,p378).

At present science for scientists only is not the attitude any more.The layman should and does express his opinion in more and more issues that stem from science and technology and have long-term effects on social welfare and human needs.One such example is the controversial issue concerning human engineering and recombinant DNA research,where lay people have joined scientists in so called "think tank" committees at Harvard,Princeton,and other communities of other major scientifc research(Eddy, 1983,p56).

Science educators have a double responsibility of explaining science in its broadest sense to the public,and also interpreting society's influence on science to the scientific and layman communities.Science educators must interpret science in the broadest sense for the citizenry.They must interpret society as it influences science for scientists and the public.Science education needs of the 80's are related to current social problems rooted in science and technology.These problems are serious and demand for more immediate solutions (Hofstein and Yager,1982,p541).

The proposed major goal of science education for many years has been to develop students as rational beings capable of making valid

judgments. Also, the idea that science education should consider the moral and ethical issues is not new. In fact, the notion can be found in American education as early as 1910 in Dewey's progressivism:

> Science has remained a servant of ends imposed from alien tradition.---Science must have something to say, what to do, and not merely about how we may do it most easily and economically.--When our schools truly become laboratories of knowledge--making not mills filled out with information hoppers, there will no longer be the need to discuss the place of science education (Dewey, 1974, p 192).

Dewey's contention was that science is often presented as ready made knowledge of fact and law rather than as a method of thinking or a method of inquiry into any subject matter. Hence it is necessary that science education be incorporated into the progressive educational view. That is to expose students to assess and evaluate their beliefs, attitudes, and ethical positions in the science subjects.

Current educators are thinking science not as an isolated subject, rather science in its relation to other areas of life (Lewis, 1978, p 341; Kahle and Yager, 1981, p 26, and Champagne and Klopfer, 1982, p 504). They believe, that science for citizens

would be concerned with all those issues of essential importance on which citizens in a democratic society would have to make decisions-political,social,and economic,most of which have a scientific component. Further,to achieve a working definition of scientific literacy it is important to include ethical components in the science curriculum.To the extent that a major aim of responsible science teaching is for the student to become aware of the multiple consequences that may arise from the decisions made on a social issue,the pursuit of ethical issues becomes legitimized(Zeidler,1984,p413).

In this sense,scientific literacy includes preparing informed citizens who can apply the scientific process to social problems(James,Schmidt and Conley,1974,p346).This idea is equally shared by Barman and Rusch(1978b,p5)., Bybee (1979, p246), & Stahl(1979, p183) who support the notion of scientifically literate citizens as effective problem solvers and whose judgments are cognizant of future impacts.As a result,students must be able to determine which facts of a given situation are relevant,and be sensitive to the repercussions that may follow their decisions.

In issue-centered science curricula students are given the experience of policy making.For this to occur they must be engaged in a process of reflective thinking(Kieffer,1977,p82).In countries like Japan and the Soviet Union,scientific knowledge is prized as a national resource,essential for understanding and living in a modern society.Science programs are seen as essential courses to resolve societal problems(R.Sigda,1983,p625).In this respect,the serious challenge facing science education in N. American schools has to be met by recognizing the realities of modern society.In their proposal, Yager,et al(1981,p13) strongly recommend that science taught in the schools twenty years hence must be oriented to the future because of its potential in resolving serious societal problems.

The goals for the eighties,emerging from the current revolution,may help provide better understanding of the need for the change.They are:

1.Science teaching at present has become a more central societal concern for scientific enlightenment.

2. Knowledge considered to be important is that which supposedly will be useful and relevant to the solution of societal problems.

3.Science and technology are now considered to be a

means for improving society.

4.Science for the 80's must be oriented to the future, a future in terms of its potential impact in helping to resolve serious societal problems.

5.Science of the 80's must be focussed not only on cognitive skills,but upon affective,ethical and aesthetic understanding as well.

6.Today's science is more accurately portrayed as value-laden science in which there are ethical and moral dimensions.Therefore,science for the 80's must be concerned with systematic thinking,and emphasize decision making skills.

7.The goals for the 80's are derived from the interaction of science,technology,and society(Hofstein and Yager,1982,p542). From these goals one could assume that there is a strong need for cultural and scientific validity to school science.

In summation ,an issue-centered science curriculum could foster students' involvement , enabling them to feel that they have a stake in potential solutions and possible future actions.Such a curriculum,including moral and ethical dimensions , would accentuate the importance of studying science. It would build upon the students' own experiences.The kind of science curriculum related directly to

societal issues could provide direct teaching and learning resources.Many issues in science areas have personal significance for students and merit discussion in school programs.For example,students must be aware of the issues like abortion,birth control,prevention and cure of ill-health, nutrition and health,energy and resources,and so on.This approach in science,which involves problem solving and decision making skills,can effectively make science more valuable and interesting to present-day students.

1.3.1.Scientific literacy

The term 'scientific literacy' first became public when the curriculum committee of National Science Teachers Association(NSTA,1964,p 8) stated,"the major goal of science education is to develop scientifically literate and personally concerned individuals with high competence for rational thought and action".This choice of goals is based on the belief that to achieve scientific literacy,we need the development of attitudes, process skills,and concepts necessary to meet the more general goals of all education.These goals are:

1.Using rational processes.
2.Building competence in basic skills.

3. Developing intellectual and vocational competence.
4. Exploring values in new experiences.
5. Understanding concepts and generalizations.
6. Learning to live harmoniously within the biosphere(NSTA,1971,p48).

However,keeping in view the impact of modern science and technology on the society,educators have tried a better definition of the term scientific literacy. After an extensive study of the literature dealing with science in contemporary society, Pella , O'Hearn, and Gale(1966,p206) published the results of their study.According to them,a scientifically literate individual is presently characterized as one who has the understanding of:

1. The basic concepts in science,
2. The nature of science,
3. Ethics that control the scientists in their work,
4. Interrelationship of science and society,
5. Interrelationship of science and the humanities,and
6. Difference between science and technology.

Evidence from an analysis of the literature reveals that knowledge of the interrelationship of science and society,ethics of science,and the nature of science are most important in attainment of scientific literacy.

Gatewood(1968,p18) maintains that in a society that is scientifically and technologically oriented,all students should be broadly educated in science,in its process,its products,its philosophy,and its impact on society.In this sense,the most important goal of school science must be to prepare scientifically literate citizens for the future. Since the 60's,various other educators have proposed different definitions for scientific literacy(Daugs, 1970,p10;Agin,1974,p403;George O'Hearn,1976,p103,and Miller,1983,p29).From these definitions one could describe a scientifically literate person as one who perceives science as a product,a process,and a human enterprise(Evans,1970,p80).

Scientific literacy is both a challenge and as a goal to be sought. One can view this challenge and goal as the ability to:

> -----understand the material that confronts us and add it to our own store of scientific knowledge,
> -----verify,and
> -----evaluate and to apply the learning materials to our society(Smith,1974,p34).

This indicates that science should be concerned with systematic,intellectual thinking and decision making skills.Fine discussions and good exercises in scientific literacy can be built around many

current issues.For example,should we support further research in genetic engineering or not? It then becomes essential for a scientifically literate person to understand the code of values by which scientists and science operate.

Stedman describes a scientifically literate person as one who is aware of the reciprocal relationship of science and society with each other. Thus an individual should comprehend science as:

1. A body of knowledge(conceptual schemes).
2. A way of knowing(nature of scientific truth).
3. A way of discovering truth(process and inquiry).
4. An integral part of society(social enterprise).
5. A foundation of technology(a practical enterprise).
6. A humanistic and moral influence(values and ethics) (Stedman,1976,p30).

All the above concepts form the nucleus of scientific literacy.Through creative realistic inquiry-oriented activities,awareness of knowledge and limitations of science can be understood.As future citizens, problem solvers,and analysts,students need practical tools(critical analysis,inductive and deductive reasoning).In addition,students need to comprehend science as a human enterprise.

Science should reflect an emphasis on science as a human endeavor is further supported by the NSTA curriculum committee.According to them a scientifically/technologically literate person is one who:

---uses science concepts,process skills and values in making responsible everyday decisions as he interacts with other people and with the environment,

---understands that the generation of scientific knowledge depends upon the inquiry process and upon conceptual theories,

----distinguishes between scientific evidence and personal opinion,

----understands how society influences science and technology and vice versa,

----recognizes the limitations as well as the usefulness of science and technology in advancing human welfare,

---- knows the major concepts,hypotheses,and theories of science and is able to use them,

---- understands the application of technology and the decisions entailed in the use of technology,

-----has sufficient knowledge and experience to appreciate the worthiness of research and technological development,

---- has a richer and more exciting view of the world as the result of science education,and

---- knows reliable sources of scientific

> and technological information and uses these sources in the process of decision making. (Yager,1984,p195).

The development of scientific literacy is a purpose of science teaching for every student as a future citizen.This literacy is nurtured by teachers(Moyer, 1981,p380).In the same way,by imparting scientific methods and biological knowledge to the students,a kind of biological literacy is achieved when nurtured by teachers( Hurd,1978,p.4 ;Mertens and Hendrix,1982,p148).

The current situation requires that we must broaden the scope of what is taught,and also expand the market of students.This can be achieved by the development of new relevant courses in science education.Future oriented teaching materials will ask students to project new applications of existing scientific knowledge and assess the consequences for the public(Browne,1978,p207). Since our society is becoming more and more involved in technological pursuits,more and more people are becoming engaged in making decisions that require a scientific and technological background.

Science education must provide a more comprehensive view of science and the world for the present-day students.It should provide a mechanism for developing scientific literacy which will

compliment science and meet the future needs.In this sense,a scientifically literate citizen will have faith in values,logical reasoning,and decision making(Yager,1981,p154).

1.4. Goals in biology education

The goals of biological education have not yet received major attention,possibly due to the recent advances in biological sciences.These advances have sparked the debate concerning the impact of the knowledge on humans.Public awareness that this application of knowledge have ramifications at the human level is increasing.As a result,one is horrified by these scientific advances and the ensuing bioethical debates that one has to face.In this respect,the relation of biological research and the bioethical problems,and their implications for biology education are important and need to be discussed (Harms et al,1979,p211).

By now we are familiar with the catalog of bioethical issues.At certain levels these issues affect the day-to-day life of every person.However, most individuals feel that the current bioethical problems are due to man's continuous influence on the evolutionary processes(Ladd,1978,p400;Newman, 1978,p879).To overcome such problems,students of

biology need to be familiar with biological knowledge and the issues associated with it.Hence professional biology educators have set various goals for the kind of biology education that will focus on personal and societal issues.Such goals have been set to ensure that the methods of instruction and the curriculum will be directed to the present-day needs of students.

In view of the above fact,Harms and Yager reformulated the goals of biology teaching.The desired goals according to them are:

1. Goals: Human adaptation and alternative futures will be emphasized.
2. Biosocial problems and issues as goals.
3. Inquiry processes will be unique to biological disciplines.
4. Decision making involving biological knowledge in biosocial problems.
5. Career awareness will be an integral part of learning.
6. Values,ethical,and moral considerations of biosocial issues and problems.
7. Curriculum:Curriculum will be problem centered, flexible,and ultimately be culturally and biologically valid.
8. Humankind will be central.
9. Multifaceted,including local and community relevance.
10. Use of natural environment,community

resources, issues.

11. Biological information will be in the context of student as a biological organism in a cultural/social environment.

12. Instruction: Individualized and personalized, recognizing student diversity.

13. Cooperative work on problems or issues, including school and the community.

14. Methodology based on current information and research in developmental psychology involving cognitive, affective, experimental, and maturational studies with special attention to adolescents.

15. Evaluation: Testing and evaluation will stress the use of biological knowledge to interpret personal and social issues.

16. Student evaluation will be based on growth in rational decision making.

17. Teachers: The future philosophical orientation of biology teaching will include a commitment to human welfare and progress.

18. Professional growth will be continuous in order to maintain a valid curriculum and related teaching practices.

19. Teachers will use a variety of techniques in the classroom.

20. Teachers will base their programs on theoretical, social, bioethical, and biological grounds (Harms and Yager, 1981, p332).

From these goals it is obvious that to teach bioethical issues, the curriculum must be flexible and centered

around human adaptation and human welfare. The fundamental feature of the biology program will be to improve the quality of life by implementing decision making skills. In this respect, with a new focus and rationale for biology instruction, new and relevant topics emerge as central. This indicates that secondary school teachers will have to rekindle their interest and emphasize teaching of bioethical issues in the human biology curriculum.

According to Hurd (1978, p 6) human biology is not characterized by a precise body of subject matter but is rather an attempt to relate what is known in biology to the human condition and cultural values. It is holistic in its approach, encompassing a wider perspective than the interest of the researcher. Therefore, our students should be exposed to various bioethical issues inherent in this discipline.

Consequently, the biology curriculum needs a dimension that not only makes it possible for the students to receive new and relevant information but should help them to adjust to maximum change. It should provide them with the intellectual resources to make choices among alternative futures.

## 1.5 Rationale

Contemporary advancements in the biological sciences have agitated the modern society.As such the moral and ethical dilemmas confronting us are exponentially increasing.For example,the development of a birth control pill;the manipulation of genetic material of humans,behavior control mechanisms,and the use of life support systems on comatose patients are among the issues that have aroused public awareness.

In the present society everybody must share the responsibility of solving these problems. To achieve this goal we need to train our younger generation in the schools who as future citizens can intelligently participate in society's affairs. These future citizens will be faced with a formidable number of bioethical issues throughout their lives (Kieffer,1981,p110).It appears that unless biology instruction allows them to examine some of these problems,they will be confronted with a more severe case of 'future-shock' than predicted by Alvin Toffler(1970,p402). In this sense,forward looking individuals will be needed to cope with the future.

When today's high school students become adults they will have to decide how long they wish to live, what sex and physical characteristics of their child should be ,if or not they should prolong the lives

of their parents ,and so on.Such issues are real , and belong to personal matters of life and death. Hence these students must be aware of these personal issues.Some students in present-day schools are drug addicts and homosexuals.In this sense,it becomes the responsibility of human biology teacher to bring into discussion the pros and cons of such topics.However,teachers should not influence the students with their personal opinions.Educators like Kieffer(1975,p11,1977,p80,1979,p176);Creagor(1979, p. 495); Hurd (1982,p358)strongly recommend that schools must be highly enthusiastic to teach bioethical issues as they have a sense of urgency about them.These bioethical issues have long-range societal implications as they are related to life.

Teaching bioethics involves exposing students' thoughts and feelings that would lead to individual conclusions.In solving bioethical issues an atmosphere of disagreement is formed , where at least two sides of an argument are discussed (Andrew,1970,p30;Ladd,1982,p18;Hofstein and Yager, 1982,p543;Rosenthal,1984,p819).In this respect, these issues present unresolved problems that provide an intellectual challenge and exploratory atmosphere to the learners concerned.This division

of opinion,ethical disagreement,clashes of ideas and beliefs will lead to the moral and ethical development of students(Kieffer,1980,112).Hence each student must be given a chance to defend his or her opinion on ethical grounds against alternative views.That is,their positions should be clearly articulated.Students' interaction with others can provide valauble insights that can be useful.

Although being in command of the correct facts is absolutely necessary for the effective decision making,the scientific facts alone cannot allow for wise decisions.Unless decision makers understand their own values and make a concerted effort to analyze how values of their own affect their lives and choices,the solution reached will not be an effective or valid one(Hendrix,1977,p85). By exploring the values,alternative solutions can be implemented.This view is further supported by Kieffer(1979,p177) who maintains that in ethical decision making different values are compared.Kieffer gives the following characteristics of values:

1. Values indicate what is judged to be "the good".
2. Values imply preferences.
3. Values are supported by rational justification.

4. Values countenance strong feelings or intense attitudes.
5. Values specify a course of action.

To qualify as a value, a statement must satisfy all these criteria. In bioethical decision making these values help us to make a right choice after weighing different values. For example, should genetically related six month old fetus be deliberately sacrificed so that its organs can be transplanted to an adult whose death due to say kidney failure is imminent? This issue involves a set of values and would thus require rational decision making.

Biology and human society have never been separate enterprises, and they will never be. As such, exploration of biological, societal problems, and ethical dilemmas becomes essential. These issues could influence society's survival (Alan McCormack, 1983, p15). Biology teachers need to refocus their teaching to emphasize the interface between the science of biology and society. In this respect, Jennings (1982, p39) recommends that:

1. Biology teachers should make an effort to go beyond the text books in providing interesting supplemental socio-scientific dilemmas to the students and to encourage the solution for the controversial value laden issues.
2. Science courses should develop students'

skills in identifying science based societal problems and in making decisions about their resolutions.

3. Science education should emphasize not the past but the future.

This indicates that in order to play constructive roles in the society,both moral and ethical reasoning must take place.Human biology will provide students with an excellent opportunity to deal with a number of ethical issues.As self-starting and self-initiating learners,they can learn to solve any bioethical issues concerned with their lives(Mertens,1983,p630).

Seeking answers to the bioethical questions provides a basis for library work and subsequently stimulates both classroom and out of class discussions.Students practice decision making skills which consists of maximizing the meaning or the use of information largely on qualitative basis. Thus the process of thinking is critical,disciplined, and rational(Piburn,1976,p20).Students learn how to clarify their own values and develop techniques for reaching decisions on conflicting problems that are personally satisfying and can be justified by them. Operating under the assumption that students will learn what they find personally meaningful,the teachers' task is to set biology education related with bioethical decision making skills(Gotleib,1976, p,148;Mertens et al,1982,p149).

At present,educators are urging that such courses be developed that will focus mainly on solving issues related to human beings(Hurd,et al,1980,p 404;Hickman,1982,p358;Mertens and Hendrix,1982,p148). They recommend that a variety of bioethical issues must be discussed in present biology classrooms.Hence the need for the necessary relevant text books, and supplementary materials is being greatly felt(Dede et al,1973,p486;Glenn and Gennaro,1975,p85;Boshman et al,1978,p14;Levin and Lindbeck,1979,p203).These authors feel that the newer more controversial issues related to mankind,for example,abortion,family planning, recombinant DNA research,and so on,represent more complex questions and should be dealt with in modern text books in a high school curriculum.This means that biology teachers should make a conscientious effort to expand the study of bioethical issues in a human biology curriculum.

Human biology has either the competence or the opportunity to deal with bioethical issues. It is here we are considering man,his welfare,and the future.Therefore,it becomes essential to encourage our students to study and discuss the impact of modern biotechnology on human beings. Solving problems of human living requires not only appropriate knowledge but an interpretation in the

context of human values(Hurd,1971,p400 ;Dean,1979,p 179).For example,students in human biology need to know about such questions as:

1. If we should allow surrogate motherhood in an already overpopulated world?
2. Should we develop the technology to control our own evolution(Mertens et al,1979, p164).

Such pertinent questions can be only dealt with effectively in a human biology curriculum.This brings one to the important justification of integrating bioethical issues in human biology.Discussion of such issues will eventually lead to value analysis,policy making, and fostering a spirit of inquiry(Sweat,1974,p156). It is here that students can be challenged to examine their deepest beliefs and search for answers to bioethical questions (Penick and Kyle, 1982, p 303). This will offer a more productive and insightful experience in the study of human biology.

At present,human biology is regarded as a means to explore and attain the fullest potential of an individual both at the personal and societal level.As a human service curriculum,it will provide the means by which the results of biological research are brought to bear on decisive problems of human concern.Such a curriculum organized around problems and issues of human endeavor overlaps disciplinary

boundaries and promotes unifying concepts in the process of learning(James,Schimdt and Conley, 1974, p 346).Therefore,this wider and holistic perspective for teaching of bioethical issues in human biology provides a means for effectively integrating the cognitive and affective phases of human experience. It is here students will develop social responsibility and sensitivity toward various bioethical issues. This emphasis on improving the quality of life is further evident from Hurd's statement.He states:

> Biology becomes significant to students when they have the opportunity to think rationally about such questions as genetic engineering,human organ transplants ---students seek a biology course that says something about their growth and development,---shows to enhance their own well-being (Hurd,1971,p399)

This indicates that we should not remain aloof from the biosocial problems that impinge on man.In human biology,students will not only understand DNA and RNA,but will also learn how to improve the quality of life.In this sense,the curriculum will be value based and future directed.

As a result,practically all content of human biology,and every major concept we teach becomes a part of personal and societal value

systems.One cannot imagine a human biology classroom that would not include a discussion of amniocentesis, human genetics,and more serious genetic diseases. Similarly,when Down's syndrome(characterised due to trisomy for chromosome 21,that is the affected person's cells each has 47 chromosomes,including 3 rather than the normal 2 chromosome number 21)(Mertens,1980a, p119),is discovered by amniocentesis,the topic of abortion must be confronted.We cannot consider human biology without placing a value judgement on human experimentation and various other issues involved here.

Keeping in view various genetic disorders, educators are recommending that students need to be taught the basic biomedical facts about genetic disorders and the ethical dilemmas created by it(Stine, 1977,p29;Mcinerney,1979,p6;Mertens,1980b,p24;Blank, 1981,p208;Mertens,Hendrix and Sutton,1982,p89;Mertens, 1983,p629).The need for giving high priority to the bioethical issues is further supported by the fact that at present an average person is totally unaware of the relationships of one's genetic constitution to matters of health and disease (BSCS,1978,p19).The authors stress the need for developing an informed citizenry capable of making enlightened decisions concerning reproduction and genetic health in the light of human experiences.

Teaching about bioethical issues at secondary level has been strongly urged by Mertens (1980b,p18),who in his report states"that with respect to some of the more recent and significant areas of development where human genetics and human welfare interface, most students claim that they had received virtually no secondary school instruction".For example,in his survey of freshman college students he states:

> --only 7 of 117 recalled studying about genetic counselling.
> --only 9 of 117 had learned of genetic screening.
> --only 9.4% remembered about studying genetic engineering.
> --only 11.7% had learned of practical diagnosis of genetic disease.
> --only 22.2% recalled being taught the role of heredity in producing mental retardation(Mertens,1980b,p19).

This survey indicates that secondary schools are doing an inadequate job by placing more emphasis on the traditional discipline rather than on those areas where the discipline affects human well-being.Students have been found to know very little about their own issues. They cannot take a stand on the issues unless they are informed and trained to do so.Further, teacher education programs in biology and life sciences have been deficient in problem solving that employ decision making skills(Hendrix and Mertens,1984,

p20).These authors further advocate that secondary school teachers need the developmental psychology techniques that will help students to clarify their ethical beliefs,values,and help them to comprehend bioethical issues by thinking and reasoning.

Students at present hear these confronting issues on radio,T.V.,and from the news media almost daily.In this respect,schools must provide the necessary knowledge to solve them.For this reason, content acquisition must be enhanced and societal issues can serve as excellent motivation for content acquisition.In this sense,students can be motivated to solve problems and to learn content when they can see personal relevance in bioethical problems in human biology.

The increasing need to teach bioethical issues is evident from the fact that"15 million people in United States alone suffer from some of the genetic diseases or defects,that 75 to 100 new human inherited traits are described each year" (Sachs,1974,p119).It is clear that these defective genes will raise ethical,legal,and many social issues.For example,there is no cure for Down's syndrome,which is generally characterized by physical abnormality and mental retardation.Although through amniocentesis prenatal detection is

possible, the only way to eliminate Down's syndrome is to eliminate the affected fetus(Mertens, 1980a,p121).The associated moral and ethical issues with the elimination of fetus are obvious in the modern society,and the fact that controversy surrounds the use of amniocentesis is not surprising.

Human biology in secondary schools must explain questions associated with genetic diseases.For example,the molecular basis of sickle cell anemia (defect in β-polypeptide of the hemoglobin molecule,the defective hemoglobin causes red blood cells to assume a crescent(sickle) shape under low oxygen conditions),the new methods of prenatal detection of various genetic diseases,and so on (Francoer,1974,p16;Hudock,1974,p24;Vinson,1975,p 29;BSCS,1981,p3;Haddow,1982,p94).These questions and the issues associated with them need to be discussed in a human biology curriculum.

To conclude,a well developed human biology curriculum,sensitive to the personal lives of the students,can add an important component to the decision making skills.Students need to be guided by their teachers to discuss these issues. Who knows our students might select tomorrow the embryos of their choice neatly frozen and on display in supermarkets.Bioethical literacy can help them to decide what to choose.

# CHAPTER 2

## MORAL DEVELOPMENT

An analysis of moral development is crucial for understanding the implication of bioethics in the human biology curriculum. It is important to realize that the first reflective thoughts of maturing youth deal with value problems. Such problems provide the developing individual with opportunities for reflective decisions. Also, youngsters are concerned with intellectual development and as such seek individuals and ideals with which to identify. For this reason, the general development in bioethics curriculum seems to be equally important to human biology students. According to Dewey:

> --- The aim of education is growth or development, both intellectual and moral. Ethical and psychological principles can aid the school in the greatest of all constructions-- the building of a free and powerful character---education is the work of supplying the conditions which will enable the psychological functions to mature in the freest and fullest manner ( Dewey, 1964, p29).

Dewey believed that education is not simply teaching information skills and attitudes, but its ultimate purpose is development, both moral and intellectual ( Dewey, 1908, p 10). In addition, Dewey stressed the

need for open education,active learning,problem solving,and reflective thinking in the school of education.In this manner,Dewey postulated three levels of moral development:

1.The premoral or preconventional,
2.The conventional, and
3.The autonomous level (Dewey,1908,p10).

In the premoral level the biological and social impulses motivate the behavior.In the conventional level the individual accepts the standards of his group with little critical reflection.In the autonomous level the conduct is guided by the individual thinking and judging for himself if a purpose is good,and does not accept the standards of his group without reflection.

Although Dewey's ideas about moral stages were theoretical,he described a method for teaching ethics in public schools.For this reason,he encouraged teachers to engage students in discussions of controversial issues(Boydston,1971,p56).Unlike Kohlberg(1972,p16) Dewey insisted that students consider actual scenes of human interaction,and disapproved of students arguing at a level of moral abstraction.

Dewey tempered the cognitivism of his moral approach to education.In his 'Reconstruction in Philosophy' Dewey emphasized on interest,

satisfaction,and the "ever enduring process of perfecting,maturing,refining" which he believed ought to be the aim of human life(Dewey,1948,p177). He further suggested that by analyzing specific situations,a general idea which becomes the principle is derived.This is evident from his 'Golden Rule' which helps one to clarify and illuminate the situations requiring intelligent deliberations (Dewey,1932,p142).In this sense,moral education is a matter of making behavior into conduct.It is a matter of freeing each individual to take charge of himself.

Dewey did not favor any special classes in moral education.He believed that the moral concern ought to permeate all aspects of the school.In this respect,he spoke of 'moral trinity'---"social intelligence,social power,and social interest"(Dewey 1909,p43).For this reason,moral education is a process of involving human beings,living consciously in association with one another,in thinking purposively and intelligently about the subject matter provided by their common,intertwined lives(Dewey1909,p43).

Dewey's aim of moral education is very much similar to the aims of democratic education. The young persons are required to think intelligently with others.Emphasis is on shared undertakings,

conjoint activities in the classroom and the use of literature work to broaden the horizon of students (Maxine,1976,p26).Dewey stressed that ethics should be intimately linked to all educational experiences. His advice to teachers is to use instrumental methods that could foster active participation, interaction,and cooperation among students.Similarly, Dewey condemns the use of imposing uniform standards of behavior instead of allowing for a social division of labor among pupils(Dewey,1909,p21, 26).This indicates that teachers must use methods that provide the chance of reciprocity and positive personal achievement among students(Lugenbiehl,1983, p216).

In a bioethics curriculum,there is no authority imposed by the teacher.Students would discuss openly and freely various bioethical issues with each other.They will be exposed to the same standards of moral judgment that adults face in society.In a democratic society children need to develop an interest in social control,they need to acquire habits of mind that will secure social change.Children must be trained for self direction and directing others,trained both for leadership and obedience(Dewey,1916,p87).

Dewey's advice to teachers is to treat topics under discussion as a practical problem to be solved,and not reside on the issue as a moral one.He stresses the study of this complex world of which we are the members(Rucker,1970,p4).Dewey's suggestions are aimed at helping students put aside all ready made moral judgments so that they might appreciate how moral choices result in certain consequences in actual human relations.

The analysis of moral judgment of children is of major interest to Jean Piaget who conducted research on moral development in the early 1930s. Piaget's theory of moral development was centered on children's practice of rules and consciousness of rules.He made different observations regarding how children of different ages applied and perceived rules,and defined four stages in the development of intelligence,each roughly correlated with a certain age group(Piaget,1965,p13).

Piaget's stages of development are:

1 Sensory-Motor stage (premoral stage,age below 2). For Piaget they had no sense of rules.The children use purely motor activity without consciousness of a rule.

2. Preoperational stage (age 2 to 6 years).It is marked by dominance of perception.Rules are

followed through immitation.These children have sense of rules,but the practice of following the rules is egocentric.Piaget calls this heteronomous obedience as rules come from others in the authority.

3.Concrete operational stage(age 7 to 10 years).

Children recognize rules as important regulatory mechanism in social interactions.Although the child can solve problems involving concrete objects, he cannot yet cope with hypothetical situations.In other words,the awareness of rules is still heteronomous.

4.Formal operational(age 11 to 12 years).This stage is characterized by freedom from concrete reality. Autonomy emerges over heteronomy.Both cognitive development and cooperative play contribute to this action.An example of this type of autonomy is seen in preadolescent age.Here the purpose and consequences of following rules are considered,and obligations are based on reciprocity and exchange(Piaget,1965,p13).

In Piaget's theory of development,the rules are understood from heteronomous to autonomous stage.The latter stage develops through cooperative interactions among children.The stage of formal operations constitutes the highest level of development.The key to the moral development is due to the cooperation among peers(Piaget,1966,p148).In

this respect,as the child gains experience in interacting with his peers,his understanding of rules change.By involving themselves in joint pursuits, peers more easily communicate their intentions to one another.They see one another as people who make decisions.

For Piaget cognitive factors are crucial ingredients of morality.Moral judgments decide and guide personal actions,and through moral judgments one can evaluate one's own and other's decisions and behaviors.In other words,both cognitive factors and morality are inseparable aspects of unified human development(Hennesy,1979,p173).

Piaget defines the general goal of moral education as the formation of an individual(Piaget, 1973,p44).He believes that social factors are especially important in the matter of learning rules, customs,and behavior patterns.The individual develops through multiple and differentiated social interactions.It is through the social interactions that the growing person constructs his own logic and ethics,learns how to communicate the values. (Piaget,1973,p45,46).

The key elements in Piaget's learning are spontaneity,collaboration,and investigation. Both

spontaneous, collaborative investigation by interaction and experimentation with the environment is the definition of learning for Piaget. He states:

> Knowledge achieved through free investigation and spontaneous effort will be retained by the learner throughout his life and he is curious to learn more.Also free collaboration among students themselves, teacher and students, is important. This collective living is essential to full development of personality (Piaget, 1973, p 109).

Piaget is against the authoritarian and purely individualistic pedagogy. He cautions teachers that they should not indoctrinate, as only a social life among students themselves will lead to the full development of personality. Piaget believes in active and collective thinking. Arguing against the authoritarian methods, he states:

> It is absurd and even immoral to wish to impose upon child a fully worked out discipline when the social life of the children themselves is sufficiently developed to give rise to a discipline infinitely nearer to that inner submission which is the mark of adult morality (Piaget, 1965, p 404).

This indicates that, to ensure a normal intellectual

development,no external force should be employed by the teacher to transform the child's mind.In this respect,the teacher must be a collaborator,not a master.He must be rational and moral.Hence educational methods should involve cooperation and group work. Moral development is basically the growth of a child in a social environment.

Piaget holds the view that the role of the educator is to provide a certain social milieu and to determine by which methods this social milieu will achieve the best formative results(Piaget,1973, p54).In addition,school is the center of real life activities carried out in common,so that logical intelligence may be elaborated through action and social exchange.Further the learner has a right to find out all that is necessary to the building of a questioning mind and a dynamic moral conscience(Piaget, 1973,p47,48,92).Piaget's findings give us an appropriate atmosphere for moral growth to take place in a social milieu.In this type of social interaction students in human biology should develop their personality by discussing current bioethical issues collectively.

Like Piaget,Lawrence Kohlberg's finding that people progress through stages of moral reasoning is very useful in understanding the moral development

of children.Kohlberg used a wide range of subjects with different ages and interviewed them beyond adolescence.In order to define moral development in a better way,he carried a number of studies in different countries.In 1958,he started his longitudinal study of boys from 10 to 16 years of age and followed their value evolvement past the ages of 24 to 30 years.

Kohlberg further substantiated Piaget's belief that moral development is hierarchical in nature(Kohlberg,1973,p14).That an individual passes progressively from a rather egocentric view to universal ideas.His approach to moral education is best described as the 'moral reasoning approach'.For Kohlberg the aim of moral education is "the attainment of higher levels or stages of moral development" (Kohlberg,1981,p19).His goal is to stimulate the development of more complex patterns of thinking in pupils by helping them progress through the moral stages in a step by step fashion.In this respect,the moral development is what unfolds and blossoms in an individual as he learns to direct and choose his behavior and his actions.This one acquires through a sequence of stages(Kohlberg,1973,p14/1981,p19).

Kohlberg's stages of development consist of three levels.

These levels are:

1.Premoral or preconventional
2.Conventional or conforming
3.Post conventional or self accepting
(Kohlberg,1973,p14).

At the preconventional level a child responds to good or bad,right or wrong and interprets these in purely physical terms.In other words,he is punished if he is bad and rewarded if he is good(age 7 to 10). This level has two stages:

Stage 1.Punishment, avoidance,and obedience orientation: The individual is mainly motivated to act in certain ways to avoid punishment by some superior power.Moral decisions are based on the basis of aversive consequences.Behavior is simply obedience to authority.For example,I will do what you say to avoid punishment,characterizes moral judgment at this stage.

Stage 2. Seeking rewards:The individual concerns are based on the desire to satisfy his own needs and occasionally those of others.The child accepts the rules because they benefit him.Elements of fairness,reciprocity and equal sharing are present. For example,you scratch my back and I will scratch yours becomes the rule.No loyality or gratitude is involved.

At the conventional level expectations of

individuals' family group are perceived as valuable. The attitude involves conformity to the social order and loyality to it.Maintenance of social and legal order,justifying the order becomes the principle(age 10 to 13 years).This level consists of two stages:

Stage 3. Social orientation:Good behavior is what pleases others and is approved by them.Behavior is frequently judged by intention.It is learned that conformity to parents and authorities will get approval.Be good and play nice just sounds right. Moral decisions and actions are based on what pleases others.

Stage 4.Law and order orientation: Authority-fixed rules and the maintenance of the social order are valued.One must show respect for authority.Right behavior is doing one's job. A large social orientation is the basis of deciding right from wrong.To maintain social order,authorities like teacher, principal,and president must be obeyed.

At the post conventional level a clear effort is made to teach others a personal definition of moral values.Decisions are based on values shared by others rather than on self centered interest(age 13 to adults). This level comprises of following stages:

Stage 5. Social contract,legalistic orientation: The individual is sensitive about

infringing on the rights of others or violating the rules made by peers.Right action tends to be defined in terms of individual rights and the standards that have been agreed upon by the whole society.One becomes aware of importance of personal rules and opinions,and corresponding emphasis on procedural rules for resolving conflicts become clear.Through cooperative negotiation laws can be changed.

Stage 6.Universal ethical orientation: While respecting the values and attitudes of others,the individual mostly depends on his own intellect and values for making personal decisions. Self-chosen principles based on logical comprehensiveness, consistency,and universality become the ethical and abstract principles (Kohlberg,1981,p19).

A basic feature of Kohlberg's program of moral development is the discussion of moral issues. He used moral dilemmas to evaluate individual levels of moral development.In this respect,dilemmas are selected, "because they generate cognitive conflict-uncertainity about what is right, about the adequacy of the current moral beliefs the student holds or because they generate disagreement between students" (Kohlberg,1972,p16). For this reason,the classroom teacher should focus student's attention on a moral education curriculum based on elicit discussions

of moral dilemmas between students at adjacent stages of moral development. This will in turn help students to think about the reasoning they use to solve moral conflicts(Dispoto,1977,p279).

Kohlberg maintains that development is invariant.That a student must develop reasoning skills at say,stage 3,before attaining stage 4.He further maintains that individuals can comprehend one stage higher than their present level of development(Kohlberg,1972,p16). To achieve this,the teacher has to know a child's level of thought and match his level by communicating directly at a higher level,focussing on reasoning.This will help the child experience the type of conflict that will lead to an awareness of greater adequacy of the next stage,higher levels of reasoning.

Kohlberg claims that although certain virtues and morals may vary from culture to culture, his moral stages are universal(Kohlberg,1971,p154). Studies carried in U.S.,Mexico,Israel, Turkey, Taiwan, and Malaysia have confirmed this fact.However,he maintains that percentage difference among cultures does occur. Also,children from higher socio-economic levels are ethically more advanced than children from below average families.This difference is essentially due to the opportunities some children get

by participating in family discussions of moral conflicts.

Kohlberg strongly urges that peer interaction is equally important for moral development.Although home is important, its positive effects upon development are primarily due to the provision of role taking opportunities also provided by the peer group,the school and the society(Kohlberg,1972,p16). Therefore,schools must provide this peer interaction and logical reasoning.He believes that classroom discussions of moral issues are valuable as students become actively involved in moral discussions and decisions.He stresses that schools must engage students to solve contemporary social problems.

Kohlberg's view is further substantiated by Zeidler and Schafer(1984,p1) who maintain that science education,moral reasoning and past experiences mediate the formation of moral judgment in the student by working on environmental dilemmas. They conducted their study in two phases using environmental science majors and non-science majors of college age.They concluded that"moral reasoning is influenced by the context(setting) of a moral dilemma"(p10).They also noted that students with higher stages of moral development did strongly influence those working on lower levels.In this

respect,resolving science-oriented moral dilemmas requires general reasoning ability,positive attitude, commitment and comprehension.That "content knowledge and reasoning methods require the catalyst of proper attitudes and past experiences before interaction occurs in the formation of moral judgments"(Zeidler and Schafer,1984,p1).

To help our students to respond to the ethical issues of science,they need proper training in moral reasoning. Such effort must be made to explore the factors that facilitate moral reasoning in science related areas.To develop scientifically literate citizens,educators need to incorporate moral/ethical issues in science curriculum.This idea is equally shared by Dewey(1960,p145) who recommends that "the great need of the present time is to break down the traditional barriers between scientific and moral knowledge,so that there will be organized and consecutive endeavor to use all scientific knowledge for humane and social ends". In this sense,discussion of moral/ethical issues of science would facilitate moral reasoning in our students.

Moral reasoning takes place only through the active involvement with moral issues.Individuals need to engage in a discussion or interaction to

promote moral growth.This interaction allows them to confront with situations that modify their reasoning and progress to a higher level of moral thought. Students see that some of their peers have a different solution to the problems.They feel that their logic is not consistent.These discoveries according to Kohlberg(1972,p14) lead to moral development.His advice to teachers is that they must listen carefully to children's moral judgments because children like teachers are moral philosophers (p14).

The progressive educational position holds the view that there must be a "just environment" in the classroom for the value attainment to occur.Here students are confronted with situations interfering with learning(Dewey,1909,p10-11).It is the students who should be asked to resolve value conflicts instead of teachers using authority to correct them. Students cannot be expected to learn to interact with others humanely or to resolve value conflicts unless they have opportunities to do so and are treated justly(Bybee and Sund,1982,p173).Through non-dogmatic methods,students learn in a democratic atmosphere.In this respect,a teacher should remain neutral,assuming the role of a moral guide and mediator(Kohlberg,1972,p42,43).This democratic atmosphere stimulates moral development.

Educators who use Kohlberg's theory will hopefully increase the awareness of their students and their skills confronting the moral dilemmas.Kohlberg tends to increase the awareness of moral reasoning in self and in others.He favors value clarification as it promotes student-teacher interaction as a way of moral reasoning.Teachers can help the development of moral reasoning by facilitating clarification and resolution of moral issues by students themselves.Decision on moral judgments is what Kohlberg calls morality(Kohlberg,1972,p15).

According to William Kay,the precondition for morality is that a person needs a mature and informed conscience,which provides him or her with the inward validation of such judgments,followed by success and achievement.Thus as a person attains moral maturity,five moral traits emerge.These are:

1.Moral judgment,
2.Deferred gratification and future orientation,
3.Moral personalism,
4. Moral flexibility,and
5. Moral dynamism(William Kay,1975,p14).

Kay stresses that these moral principles should be creatively applied to everyday life.He calls a morally mature person being "autonomous,rational, altruistic,and responsible"(p15).In this sense,any thing done under compulsion is no longer considered

as moral unless an autonomous decision is made. Through autonomy valid moral judgment can be assured.To modify a rational decision,altruism is needed.This policy and decision making involves both students and teachers.

Kay calls the school a familial organization where value clarification and sound decision making skills can be achieved(Kay,1975,p191). Since the aim of education is to produce good citizens and not just scholars,the school should provide the democratic environment where decision making process would take place(Kohlberg et al,1974, p10). This view is further substantiated by Hersh et al(1983,p18) who believe that schools should:

1. Help persons acquire the appropriate knowledge and skills needed for citizen participation in a democratic society.
2. Assist students learn to respect our pluralistic heritage and to value individual and group differences.
3. Help them to learn how to cope constructively with change.
4. Transmit knowledge,skills and values necessary for survival.

This indicates that familial schools would form the preconditions for an autonomous,altruistic,and socially responsible person.Teachers are instruments in the transmission of values.By using value

clarification strategies based on reason and inquiry, the teacher can encourage students to form valid judgments(Dewey,1968,p69).Therefore,a careful approach to theory helps the teacher generate more effective and creative learning experiences for their students.The teacher should create a cognitive conflict and stimulate a social perspective taking attitude in students to facilitate moral development (Barman,1982,p177).

Through intellectual efforts,reflection and inquiry,learning takes place(Bloom et al,1964,p 164).Hence consideration of values and conflicts within a pluralistic society will assist students in the development of a moral code.The best place to create this cognitive conflict is the classroom.The various kinds of interaction that may stimulate cognitive conflict according to Hersh et al(1983, p155)are:

1. Student dialogue with self.Thinking about the solution of a problem and weighing the conflicting reasons inside their heads,eventually results in a stage change.
2. Dialogue with other students. Interaction among students will expose them to a higher stage of reasoning.
3. Dialogue with the teacher.Interaction with the teacher can stimulate

their thinking beyond their present level of thinking.

4. Teacher dialogue with self. To stimulate effective interaction, the teacher thinks carefully the necessary conditions.
   For example, what is the best moral issue to focus on?
   Am I asking effective questions that will stimulate cognitive conflict for the particular group?

To stimulate the cognitive conflict, the curriculum should be built around the great issues, principles, and values that a society deems worthy of the continual concern of its members (Bruner, 1962, p59). This has been further supported by Kay who maintains that "in a technological society our students must decide what is right or wrong. Cybernetics will create more aesthetic and moral hunger, not less" (Kay 1975, p343).

From the experience of various educators, it is believed that adolescents are much interested in moral discussions (Mosher, 1980, p4; Hersh et al, 1983, p19). These adolescents being at the conventional level of moral reasoning are able to think abstractly and ready to take any perspective in solving a moral issue. In addition, they are at the transition to postconventional reasoning, hence take a realistic stand on moral issues. In this respect, adolescence is the special time for deciding on a set of values

by which to order and live one's life(Mosher,1980, p4).They need to be trained to make personal difficult decisions in conflicting situations.

To promote moral development in adolescents, an issue-centered curriculum should be implemented in the present-day schools. At the ages of 14 to 16, students need to be assisted to explore the value laden issues.These students have different value positions,as such policy making serves as a powerful tool in resolving controversy.In this sense,they arrive at decisions in which optimal competing claims and values are satisfied in a policy decision. Kohlberg believes that development of moral reasoning involves effective discussions and more critical thinking.The focus on reasoning adds the important notions to elaborate,clarify,modify,and differentiate one's thinking.Being challenged and by challenging, students become effective decision makers(Kohlberg, 1972,p15).

The moral components of the behavior involve cooperation,empathy,shared responsibility, and concern for others.Therefore,exposure to social interaction is necessary for active cognitive growth(Dewey,1930,p4;Hennessey,1979,p18).Students must take the perspective of others,a necessary condition for moral development.For this reason,

at the time of adolescence,students must be given the opportunity to inquire systematically into values(Mosher,1980,p87).This is in accordance with the goals of progressive education.

In summation,the need for moral development is so important that we need to revise the current curricula of schools to prepare students to reach their own moral decisions on the basis of valid criteria.The success of a moral decision also depends on a trusting classroom atmosphere.Free and open discussions,cooperative atmosphere in the classroom will lead to creativity and innovation in assessing and diagnosing problems and their solutions(Baker and Doran,1975,p540;Beyer,1976,p194; Galbraith and Jones, 1976,p10).

Teachers should play a major role to induce moral maturity among students.Students estranged from parents would finally come to teachers.Hence teachers should foster insight in students by involving them in various discussions that are based on current moral/ethical issues.Teachers must accept the responsibility for the moral welfare and the future of their students.By creating cognitive conflicts, alternative realities,and more adequate moral reasoning,an effective moral development can be facilitated.

# CHAPTER 3

## Value Education in Science

The importance of value education in science is clear from the statement made by Young,when he states:

> It is the value judgments that ultimately bring the disciplines of science to life and make them more meaningful in liberating those who study them (Young, 1974,p111).

As one looks at the various problems confronting science and society today,it becomes difficult to avoid the discussion of value questions in science. For example,topics like genetic therapy,cloning, fetal experimentation,and so on are all potential areas of value conflict for the individual student and society as a whole.Hence science could be a vital ingredient in the process of value clarification(Ost,1976,p279).

Science has its origin in human values and is itself a value system.It offers the individual a systematic mechanism for objective analysis of physical reality and the reality of the individual.Moreover,science shares a set of values with several areas of society which involves rational inquiry.In this respect,to resolve a societal problem,a person uses this rational inquiry and is observed to be aware of his values.In this

sense,value clarification becomes important in science instruction to solve the current societal problems.This idea is further substantiated by Glenn and Gennaro(1975,p86) who strongly urge that "if science is to be relevant to life today and life in the future,science teachers have no other alternative but to consider the relationship between science and values".In making ethical decisions,different values are compared and in weighing these values, an ethical judgment is reached.

Teaching science with a value focus provides students with a means for interpreting what they have learned within their own experiences.This kind of learning makes it possible for students to become self-adaptive as science-related issues often involve tough choices between conflicting values. Hence making a decision in a conflict between economic,ecological,and bioethical problems that are value-laden,requires a careful consideration of alternative factual and ethical claims(Patrick et al, 1982,p346).To solve bioethical problems,we need action,choice,plan,judgment,and wise decisions.

## 3.1 Definition of value

The term 'value' has been defined variously by educators(Raths et al,1966,p27;Rogers,1969,p241;

Guralnik, 1970, p869; Newman, 1978, p877; Sullivan, 1978, p1083). From their definitions one can briefly summarize and state that value is a conception of the desirable, of what ought to be desired that influences the selection of behavior. This view is further supported by Inlow (1972, p2) who describes value as determiners in man that influence his choices in life and what thus decides his behavior. Hence the value system of an individual plays a major role in his attitude toward social issues and other problems. These value systems are important to every human being that act as decision making tools.

## 3.2. Nature of values

Values are viewed differently. For example, an analysis of science curricula reveals a fundamental set of implicit values that teaches students a mechanistic view of nature. The scientific view places a high value on cause and effect reasoning, reductionism, and linear thinking (Kilbourn, 1980, p 19). On the other hand, the Project Synthesis (Volk, 1984, p23) inquiry group describes values as open-mindedness, skepticism, criticalness, commitment to accuracy, and reliance upon verifiable facts for conclusion. However, values are also seen as the

spectacles through which a society interprets the world around it (National Education Association, 1976, p 9). These values arise as expression of basic needs or from cultural preferences. In this sense, values provide the basis for the human beings for better or worse.

Since values are important for the maintenance of social order, a diversity of personal and cultural values is important for social change and development. These cultural norms provide experience and moral wisdom that influence one's decisions (Dobzhansky, 1956, p 19). Our actions as adults, as decision makers, as human beings, are thus mediated by values. This view is further supported by Bronowski, who states:

> Individuals do not make ethical choices in the vacuum. Lack of values in a community makes life festering and souring (Bronowski, 1978,p 26).

This means that we must look at this world as a whole and from a single perspective, one which involves all human values and activities based on science. These values could assist science to interact harmoniously and thoughtfully with the society (Mendelsohn, 1976, p 23).

Values according to Herron are:

1. longing to know and understand,

2. questioning of all things,
3. search for data,
4. demand for verification,
5. respect for logic,
6. consideration of premises, and
7. consideration of consequences (Herron, 1977, p 30) .

Values are important to human beings and education. Longing to know and to understand implies curiosity that leads a person to think rationally.

## 3.3. Role of the teacher

The important factor in value education is the classroom behavior of the teacher. An open minded teacher will understand the feelings of his students, encourage their actions, and criticize or justify his authority. This type of behavior will have an important bearing on the potential of value education. On the other hand, if the teacher does not accept a student's feelings, or if he is critical, the student will be reluctent to explore his values. Hence, the teacher can be a real person with a value system which he exposes in the classroom (Rogers, 1969, p 106). As a real person he can be either enthusiastic or boring.

Thelen is completely against the imposing of values by the teacher.

> He calls: "curriculum to be destructive when the teacher adopts an authoritative attitude toward students, utilizes methods that do not engage the critical questioning facilities and brings about in students a state of mindless acceptance of conventional knowledge, belief, and attitudes (Thelen, 1983, p191).

This process would lead to the inhibition of life's most useful and important learnings. In this respect, teachers should refrain from expressing their values until the students have expressed their value orientation. The non-directive teacher can lessen teacher talk in lieu of productive student talk and thus increase the potential for value exploration (Kuhn, 1974, p 583).

Science teachers need to make a serious commitment to the preparation of students for value exploration. We cannot implant our values in the young. Their own inquiry and rational judgment will assist them to decide what to accept or reject. In addition, the teacher is a person to his students, not a faceless embodiment of a curricular requirement, nor a sterile tube through which knowledge is passed from one generation to the next (Rogers, 1969, p 106). Hence, a pedagogical check up is as essential for the science teacher as a medical examination is

for an astronaunt (Kuhn, 1973, p 347).

Value education in science demands critical thinking, value analysis, interpretation, and communication on the part of students. To prepare our students for the future, teachers should focus on these skills which would be productively employed in decision making regardless of what the future might be. Further, the teacher must understand how the student's attitudes and value systems can be formulated. He must realize how these values affect or influence their behavior or judgment. He must provide an atmosphere to develop, modify, and apply students' value systems through a structured interaction with other students. Therefore, the teacher must be less dogmatic and more open while discussing any value issue in the classroom.

### 3.4. Importance of value education in science curriculum

In the past science courses have generally served as poor models for the exploration of values. Recently, it has been felt that school courses have ignored the moral, political, economic, theological, and intellectual consequences of industrial advances in science and technology (Jenkins, 1972, p 405; Samples, 1972, p 279 and Ost, 1974, p 585).

They maintain that man's technology and his morality have come face to face where he can scarcely treat fact and value separately. This view has been further supported by Hurd who states:

> Science has long been taught in a value free context. No longer can we tolerate a science curriculum devoid of idealism and without commitment to human ends. The greatest deprivation in American life today is a paucity of values which can serve to guide responsible decision making along lines deemed worthwhile (Hurd, 1976, p 6).

It is the students' right to expect the best preparation possible in view of increasing scientific development through value exploration and decision making. Further, sensitizing students to the problems that modern biotechnological advances have created requires more than a cognitive approach. Therefore, an alternate direction for the teacher might be to explore the attitudinal basis for these problems with students (Kuhn, 1974, p 586; Yager, 1983, p 27).

Current educators recommend that science should not be only taught as 'process' and 'product', but value issues related to a particular science topic should be emphasized (Schumacher, 1975, p 82; Fox, 1976, p 23; Glenn and Gennaro, 1978, p 19 and

Aikenhead, 1979, p 23). To fail to do so would produce scientifically illiterate students (Harms and Yager, 1981, p 115).

Science is value laden, perhaps the best we can hope for is a balanced class where a number of opinions are considered. Problems which are social, scientific, and technological cannot be solved by knowledge alone. To support this idea Piburn (1976, p 20) maintains that "to ignore value questions means that they will be dealt with elsewhere in a setting where science's input is absent" . Science must consider values as there are enormous opportunities for value activities in the science classroom. Hence it is essential that teachers emphasize the valuing process (involving choosing, prizing, and acting) and provide students with an opportunity to formulate their value structures in relation to the social implications of life sciences (Hodgkinson, 1976, p 271; Carter, 1982, p 428).

The use of exploration of values as a test task in schools must then be the fundamental goal of science education (Bronowski, 1956, p29; Seaborg, 1966, p6). Science education should nurture a healthy and natural interaction by the students with their developing and changing society and their environment which is being modified by science and

technology.This view is also supported by Broudy who states:

> The goal of science education in general is not the production of scientific workers at the applicational or routine investigational, important no doubt that, as it is--- the target is, rather exploration of value including its scientific components (Broudy, 1969, p 28).

It is so important that our citizens will require the sort of thinking, deliberating, and choosing that will allow them to live in the humane and democratic world. Science teachers should find it useful to have a single approach to developing subject matter related materials that evaluate comprehension of science content and simultaneously helping students to acquire and practice decision making skills (Stahl, 1979, p 183).In this sense, if students are to rationally consider, clarify and comprehend, and use values and moral beliefs, they should have a sufficient objective information and situations available to study and understand.

Harmin and his colleagues divide any science curriculum into three levels: the first is the facts level, the second level includes the concepts, and the most important level is the value level. It is the level three (value level) where subject matter becomes relevant to students (Harmin, et al, 1970, p18).

The value level requires the use of information available from the first level to the second level. It often demands additional information that students can find from various journals, magazines, daily newspapers, and special publications. This will allow students to examine their scientific issues at the value level. In this sense, the process of valuing and decision making must include:

1. Identification of values in conflict.
2. Recognition of groups that would benefit or make sacrifices.
3. Selection of alternatives emphasizing general welfare.
4. Application of reliable sources for actual claims, and prediction of results from the implementation of an alternative (Baker and Doran, 1975, p. 540).

To stimulate the examination and formation of values, teachers need to ask higher order questions. These questions would include analysis, synthesis, and evaluation. Hence, an essential method of value education is to integrate valuing into our day to day teaching. Harmin, et al(1970, p 17) state:

> That value issues must become a part of science teaching, so much part of it that no topic in any science class will be taught without some opportunity to consider the value implications of that

> content. Just the facts, "Ma'am", must be banished from science teaching. Today with the nuclear holocaust just outside the window---, we cannot afford to train a generation of students who know(how) and (why) of scientific phenonmenon but do not have a process for inquiry into value issues raised by the topics they study.

To make science instruction more relevant to the needs of students and society, the role of the school must be to promote an understanding of the values on which science is everywhere based. School is thus the logical place where students can gain insight into attitudes and values. To substantiate it further, Brodbelt (1971, p 77) states:

> The school is the nuclear institution for the reflection upon political, social, and economic values because it possesses the instruments necessary to engage in value analysis-namely teachers, and curriculum. Moreover, the process of schooling by definition includes the guiding of an individual in becoming a reflective thinking citizen. Decision making with decisions based upon intellect and value core are integral parts of reflective process.

Since values are not separate from knowledge, it is essential that there should be an intensified and

directed effort to expose our students to value exploration skills. To restrict thinking and discussion on value issues is to restrict knowledge and growth (Baur,1970,p111). As such we need a curriculum especially arranged to guide the formulation and continuation of values. In this respect, emphasis on values and social aspect of science and technology must be an integral part of a science curriculum. The values of science are the most complete expression of human values, the belief of human dignity. Hence science curricula need to be organized in a context of human values and social dilemmas (Creamer and Creamer, 1978, p110).

The importance of teaching values in a science curriculum is further noticed by the following statement:

> The goal of instruction is to develop a humane rationality growing out of biologic concepts. Solving problems of human living requires not only appropriate knowledge but an interpretation in the context of human values and relationship (Hurd,1971, p 400).

In a human biology curriculum, students should have enough opportunity to clarify their values, attitudes, and beliefs about the current bioethical issues. Since our most basic values and the human life itself are

being changed, it is the responsibility of educators to bring the events happening in the world of biotechnology into line with human values. It is these human values by which we manipulate the biological revolution today, that will determine the dignity and destiny of persons in the future. This emphasis on facts and human values becomes sharply focussed as we gain more control over the evolution of life, with technical abilities such as recombinant DNA, tetra-parental embryos and the separation of procreation from sex and vice-versa. Hence if we can clarify our values, we can take charge of our life (Simon et al, 1972, p19).

The important goals in value education should be:

1. Every student is a reflective decision maker. The student should be able to analyze a problem in his own setting. He should generate enough alternatives to allow himself and others an educated choice, and then make a choice based on recognized values and probable consequences.
2. Every student can think and work toward consensus with others whose self-interest and values may differ from his own. This involves sensitive behavior of individuals, recognizing differences in perception, values, and life styles. He is able to use these differences to create solutions

> which include skills and active cooperative effort by everyone.
>
> 3. Every student will work actively in our society to resolve social issues that will move us toward a society of maximum freedom and maximum equality (Baur, 1970, p112).

Valuing provides direction and a framework for decision making. Students must be willing to share the responsibility of discussing these value issues created by scientific knowledge. Hence the ability involved in obtaining, interpreting, and applying knowledge within an ethical framework becomes essential.

To teach values in the science classroom, a number of strategies are used. These can be role-playing, simulation, value clarification, etc. Therefore, proper planning of teaching values must be considered. In addition, subject matter is to be lifted beyond facts and concepts to the value level. According to educators:

> History must not record that science teachers ignored the value issues and stick to their facts and concepts, to do so would be to remain crudely prescientific and prevent our students from having any future at all(Harmin et al, 1970, p20).

In this sense, it is important that students do not become science sophisticated without a deep awareness of the value issues underlying their abundant knowledge.

3.5. Value education approaches

Various approaches have been used by educators to assist students in evaluating their own beliefs, feelings, and attitudes toward various value issues. The more common approaches are:moral development, value clarification, action learning, analysis, value continuum and rank-order. These approaches are being used freely in science teaching and social studies classes. The main goal is to help students develop decision making, and critical thinking skills.

(a) Moral development

Lawrence Kohlberg,(1973) is the leading advocate of using this approach. His approach focusses on the reasons a child uses to support his position. The main objective is to develop moral reasoning by using moral dilemmas. Kohlberg's theory contends that all people develop moral reasoning in a series of stages. With the help of moral dilemmas, Kohlberg has been able to raise moral reasoning of his students by one level.

In his approach, the student uses his own stage of moral reasoning and the teacher supplies reasoning at stages that children do not mention. The teacher fills this role by asking probe questions. For example, the teacher might ask, 'you have considered the consequences for yourself, but what about the society if

everyone did this'. Thus probe questions either ask students to think more deeply about a particular consideration, or to think about relevant considerations which have not yet been included in their deliberations.

Kohlberg's moral dilemmas can be applied to any bioethical issue. For example, in a genetics class where students have known the basic Mendelian Principles, a hypothetical case study can be used to introduce students to the conflicting issues raised by genetic counselling and genetic screening. Hence by providing a brief story and appropriate questions at the end, students can be engaged in discussions giving reasons to justify their statements. However, Kohlberg's approach does not focus upon consideration of alternative choices.

(b) Value clarification

This approach began with Raths, et al, (1966, p27) who devised their strategies based on theory of valuation(Bloom et al,1964,p164). The purpose of value clarification is to aid students in developing processes used to determine their values. The teacher's role is non-dogmatic, open, and to help students to clarify their attitudes and beliefs. The teacher has to make sure that this attitude also prevails among students. The teacher should also

know that value is formed in a hierarchical fashion. The steps involved are:

a. being cherished,
b. publicly affirmed,
c. freely chosen,
d. chosen from alternatives,
e. choosing knowing the consequences,
f. linked consistently with other values, and
g. being acted upon (Raths et al, 1966, p 27).

Proponents of the value clarification approach urge that students exposed to this approach must be able to critically analyze the problems and make effective decisions( Casteel and Stahl, 1975, p24). This has also been proven by other educators. For example, an increase in achievement of high school students has been found by incorporating a value clarification approach in the classroom (Barman, 1975, p152). In this respect, a value clarification approach can be a valuable and useful strategy for discussing controversial bioethical issues.

Through value clarification activities, Simon et al (1972,p22) have devoted considerable energy to translate ethical theories into action. They believe, morality cannot be taught directly, it needs active involvement, social interaction, and use of minds by the students.

The value clarification approach has been

applied to study a number of bioethical issues. For example, Barman, Rusch, and Cooney (1979, p16) have used this activity in a unit dealing with 'families and life styles' . Their objective is to help students to clarify their(students') personal views about family size. It also allows students to determine if their present values about life styles were consistent with future goals. In addition, the aim of this activity is to help students identify some of the reasons why there has been a general shift in attitude in U.S.A. toward family size.

The unit is divided into three parts:

Part I : The teacher asks students to respond to the questions: e.g.,

> How many children were in your mother's and father's family?
> How many children are in your present family?
> How many children do you think you should like to have?

The teacher then tallies and records the responses in a table so that they are visible to the whole class.

Part II: Students are asked to offer possible explanations for the type of data compiled in the table.

Part III: Students are then asked to write

answers on the paper for the following questions

1. What type of vocation do you plan to pursue?
2. What are the major components of the type of life styles you would cherish for most of your life?
3. Do you feel your vocation and life style are compatible with the number of children you feel you would like to have? Explain your answer (Barman et al,1979, p 16).

The authors feel that decision making value clarification strategy is extremely useful to discuss bioethical issues. Students realize their personal status and solve a conflicting problem according to their mental capability. Through the active participation, students try to resolve the issues presented to them.

(c) Action learning

Action learning and value clarification use many similar teaching strategies. For example, role playing, simulations, and hypothetical value laden situations that require group discussions are used. However, action learning stresses the activity of students outside the classroom and provides students with the opportunity to act on their values. In this sense, action learning activities involve solving community problems.

Action learning approach has been found to be very useful in solving some problems related to biology (Barman, 1980, p154). Here students are organized into groups of three to four. They are asked to make a list of problems in their community. Students then rank order the problems from the most important to the least important. After identifying each problem on the list, students are asked to follow the action which includes:

a. developing the plan to investigate the possible cause for number one problem,
b. developing the ways to solve this problem, and
c. organizing and presenting the findings of their investigation to their classmates including any recommendations for possible solutions (Barman, 1980, p155).

Students present the data with possible recommendations. Time is allowed for discussion after every presentation. Sometimes local people are also invited to participate in discussions. Thus students try to modify their investigations by making possible recommendations. They also present various limitations of their investigations to the class.

(d) Analysis approach

The objective of this approach is to provide students with learning experiences. This

allows them to analyze various bioethical issues rationally. Barman and his colleagues use this approach to teach the topic " Definition of death " (Barman et al 1979, p 17 ). After the concept of life and death has been introduced, students are allowed to examine some of the problems created by modern technology in relation to defining human death.

Through the analysis of this topic, students come to understand that the traditional biological definition of death is no longer adequate for the technological society. In this respect, students are given three different statutes defining death:

Statute I: Death can be defined by the inability to breath and by heart cessation. Or, a person is considered dead if an EEG(Electro-encephalograph) reading indicates a lack of brain waves.

Statute II: Death is defined on the traditional heart-lung concept. If both organs have stopped, the person is considered dead. However, if a life support system is applied, death can be declared if the attending physicians are convinced that the patient has suffered irreversible brain cessation.

Statute III: Based on the proposal of the law and medical committee of the American Bar Association, a human body is dead if irreversible brain

cessation occurs as indicated by an EEG (Barman, 1980, p156).

Students are then asked to discuss the above statutes and analyze in groups of three or four. Their discussion must focus on the following factors:

1. Which statute do you feel you want your state legislature to adopt? Explain the rationale for your answer?
2. If you feel that none of the statutes are completely adequate, attempt to devise one that you feel would be more appropriate (Barman,1980, p156).

In this sense, students become actively involved to examine and analyze the issues presented to them.

(e) Value continuum

This technique is used to aid students in identifying and displaying their values. An issue is chosen and discussed briefly to make sure that students have enough background information. A value continuum is placed on the black-board and students are asked to select a spot regarding their position on the value continuum. Students thus make their ideas publicly known and give reasons also. This is followed by a discussion with the teacher as the discussion leader.

The value continuum can be used to teach any bioethical issue. For example, Barman, (1975,p151) uses this technique to define students' positions

about genetic counselling. Students are asked to give choices from 1 to 7 ranging from complete agreement, partial agreement, to incomplete agreement.

Value continuum

1 ——————————————— 7

complete partial incomplete

The aim of value continuum like value clarification is to provide students the means to evaluate their beliefs about various bioethical issues.

(f) Rank-order technique

This technique is also used for value clarification. Students are given 3 or 4 alternative choices according to their own choices. They rank the issues, and these rankings are then compared by teachers and students followed by a discussion. This type of activity allows students to express their values, explore the issues, and make valid judgments.

Rank-order technique, like other value approaches can be applied to bioethical issues as well. For example, students can be asked to rank the issues based on the spending of more money. Thus, the choices might be :

a. genetic engineering,
b. poverty,
c. defence, and
d. space exploration.

In this sense, the teacher might know the reasons and willingness of students to utilize the money on a certain issue they like more. This will lead to further discussion of the issues at hand, helping students to clarify their values.

Value clarification approaches provide an efficient means of encouraging students to take a position on any issue and the values they hold. As such, these strategies follow the sequence of knowledge, values, and action (Rowe, 1982, p12). Through knowledge and action, students come to realize their values.

To conclude, the important factors in value education are:

1. The value level of science teaching that gives students an opportunity to evaluate their value structures.
2. Emphasis is placed on student opinions and judgments. That is fostering in the students the valuing process.
3. Emphasis is on the acquiring of skills of valuing process and decision making.
4. Values cannot be imposed. Students have a right to decide what is good or bad.
5. Active participation, social interaction, and cooperation among students in the valuing process must receive more attention.

Value education can be enhanced by using appropriate

teaching materials and strategies. Hence all scientific materials may be used in value education as they have a value component. In this respect, value education in science requires a complete metamorphosis. It has a very important place in science education. It has implications for curriculum development, material selection, teaching styles, and many other aspects of science teaching. To prepare our students for the 21st century, we must involve them in discussions that will help them to explore and clarify their values. In human biology, students should develop decision making skills by value clarification techniques.

The next chapter presents the various curricula implementing bioethical issues. These will serve as examples to see how students are involved to discuss current bioethical issues at various places.

# CHAPTER 4

## PROJECTS IN BIOETHICS

A number of various bioethical projects have been incorporated in school curricula by various educators. For example, in the U.S.A., Canada, and other countries, these projects have been successfully implemented. The objective of these projects is to foster an understanding of bioethical issues among students of secondary and college level. In this respect, curricula like biology, general science, and human biology include discussion of current issues.

The purpose of presenting these projects is to inspire biology teachers to include bioethical issues in their existing curriculum. By reformulating their curriculum and methods of instruction, an effective teaching of these issues can be equally facilitated. Also, the curriculum can be designed in a way as to meet the personal needs of the students.

The use of societal issues as organizers of the science curriculum has many advantages. One of which is that it helps to delineate content that can be useful for improving the quality of life. As the issues change, the society also changes. In this sense, a science curriculum must eventually change to be relevant to student needs and

society. As such, a curriculum has to be developed that will include current issues and that should allow students to experience value exploration and decision making skills.

4.1. Manitoba project

The department of education has implemented a pilot programme guide for biology 200--300 levels. This involves teaching of Genetics as an 'issue-approach'. The course is being taught with the rationale:

> The thrust of genetic engineering and much genetic research is currently directed toward genetic screening that is, the identification of those individuals with genetic defects or who may pass deleterious genes on to their offspring. Genetic screening is a relatively recent phenonmenon, analysis of chromosome defects date to the 1950s, and screening for biomedical defects such as galactosemia and phenylketonuria to date the same period. The fact that scientists can now detect genetically defective fetuses in-utero and have developed procedures to detect heterozygous carriers of genetic diseases raises moral, ethical, and political problems (Manitoba Pilot Guide, 1984, p271).

The unit is designed to focus on some of the recent advances in genetics and molecular biology. Students are encouraged to discuss the issues that these

areas raise. For example, issues like DNA research, euthanasia, genetic engineering, population control, and cryogenics are discussed. A decision making model is used to discuss these issues. The outline of the model is based on Mertens and Hendrix model (1982, p 148).

The course involves a number of reference materials both for students and teachers. For example, 'Dilemmas in bioethics' by Iozzi et al(1980) serves the purpose of references. A number of films and slides related to the topics are also shown to students. In addition, public information sheets are available on the genetic defects: Tay-sachs, Spina-bifida, Sickle cell anemia, Down's syndrome, and so on.

Following are the objectives and suggested activities for the project:

| Objectives | Suggested activities |
|---|---|
| The student should: | |
| 1. Define "inborn error of metabolism". | Investigate the work of Garrod, Beadle and Tatum. |
| 2.Explain how mutations affect the genetic code to the synthesis of defective enzymes and | Identify diseases resulting from faulty enzymes or other proteins, e.g. sickle- |

| Objectives | Suggested activities |
| --- | --- |
| other proteins. | cell anemia, galactosemia, phenylketonuria. Investigate the effect of single base pair changes on amino acid sequence of hemoglobin. |
| 3.Give examples of the ways genetic diseases can be detected. | Discuss the various techniques used to detect genetic diseases pre-and post-natally. (amniocentesis, fetoscopy, ultrasound, biochemical tests on blood, urine and other body products). |
| 4.Relate how deviations from the normal number and pattern of human chromosomes give rise to genetic abnormalities. | Make karyotypes of normal and abnormal human chromosome complements. |
| 5.Recognize the causes of chromosomal-anomalies e.g., non-disjunction, translocation, inversion, deletion and duplication. | Examine karyotypes of Down's syndrome, Turner's syndrome. |

| Objectives | Suggested activities |
| --- | --- |
| 6. Differentiate between genetic and nongenetic fetal abnormalities | Discuss the effects of infections, drugs, medication, and x-rays on fetal development. Discuss the effects of education and public health programs in reducing the incidence of non-genetic defects. |
| 7. List various corrective and preventive measures which can reduce the incidence of genetic diseases. | Discuss genetic counselling, prenatal care, dietary regulation, hormone therapy, corrective surgery, prosthesis, and rehabilitative training. |
| 8. Identify ethical and social issues involved in screening for genetic diseases. | Apply the decision making model to such questions as: identification and compulsory sterilization of individuals with undesirable genotypes, selective breeding of individuals with desirable genotypes, choice of the |

| Objectives | Suggested activities |
| --- | --- |
| | sex of a child, termination of pregnancy when the fetus is known to be genetically defective, the costs of maintaining these individuals. |

The basic principle of this unit is that through school projects, students should develop decision making skills. Decisions, that are based on a personal value system which recognize both the priorities of the students' society and the integrity of the individual. In this respect, students should be provided with learning experiences in the selection and organization of information. This information would include alternative points of view which are appropriate, relate the needs, ability, and level of maturity of students to the expectations outlined in the curriculum guide. Students in Manitoba classrooms are not embarassed for positions they hold on any issue. Further they are entitled to sensitivity on the part of teachers and other participants concerned with the discussion of issues.

The pilot guide recommends that local school division boards must establish local

policies for identification and treatment of various controversial issues in the classrooms.

4. 2. Bioethics at the University of Delaware at Secondary Level

An interdisciplinary bioethics workshop has been organized by Singleton and Brock (1982, p280). The authors believe that "the interdisciplinary method may be the best theoretical way to deal with bioethical issues"(p280). The approach is based on the following assumptions:

1. There is a matter of scientific fact and scientific fiction, a subject best addressed by the methods of the scientist,
2. One must consider the perspective from which we view the human situation, a perspective best understood through the methods of historian, the writer, or, the literary critic, and
3. One must be concerned with rights and values, concerns to which the methods of the philosopher or theologian apply with most authority (p 280).

The implication of this trilogy is that no discipline has sufficient basic scope to deal with the complete range of bioethical problems. Each of these disciplines must rely upon the others for essential information and insights to produce a rational and well-substantiated judgment.

The courses dealing with bioethical issues are taught by a team of scientists, literacy critics, historians, and philosophers. The utilization of these persons is based on the fact that each member of the team is able to approach a given issue from the particular perspective of his own discipline. In addition, he is able to see facets of an issue not readily apparent to other members of the team (Singleton and Brock, 1982, p 281). Hence each acts as a check upon the others, and each is free to point out the need for further clarification or expansion of the appropriate issues.

The workshop is organized into three sessions. The first session deals with the introduction to the subject of bioethics, to interdisciplinary teaching, and to the reading materials. The topics chosen are abortion controversy, genetic diseases, truth telling among physicians, fetal research, human experimentation, mental illness, and euthanasia.

During the initial session, the topic of euthanasia, as a paradigm of authors' approach to bioethics is focussed. A number of reference materials and a series of films are included. For example, "The Death of Ivan Ilych" by Tolstoy is used to demonstrate how human beings react to dying and death. Films, like "Please Let Me Die" and "Who Shall Survive " are used. The

authors believe that these topics concerned with euthanasia raise arguments about the new technological advancements in medical treatment and surgical techniques. Both raise important questions regarding the quality of life and individual's right to make life affecting decisions.

The second session of the workshop is held two months later. This consists of over 40 hours of intensive classroom study of the topic. For example:

Day 1- - - - - - Introduction to ethical theory.
Abortion: Film session:
Rappaccini's daughter:
Dr. Heidegger's experiment.
Technology and values.
The new Genetics.

Day 2- - - - - - Literature: Fetal research (birth defects). Discussion of case studies.

Day 3- - - - - - Literature: Introduction to genetic diseases(joint session): Genetic diseases
Discussion of case studies.

Day 4- - - - - - Human experimentation:
Literature: Discussion of case studies.

Day 5- - - - - - Introduction to the recombinant DNA debate(joint)
Recombinant DNA: Discussion of case studies. Ecology issue(joint session) and

discussion of case studies.

Day 6------ Pedagogy and implementation of bioethical concepts, summary (Singleton and Brock, 1982, p282).

The session begins with a talk by a practising bioethicist. Most classroom sessions are seminar discussions of specific reading assignments. Occasionally, a lecture format is used. A variety of readings are selected to cover specific issues. Classroom work involves a critical examination by the participants. Case studies also form a major part of the workshop activity. Participants are asked to write a brief essay in which they agree or disagree with an ethical problem raised by a given case study. As a result, each participant is able to pursue at least one issue in more depth.

Workshop topics proceed from the narrow personal ethical decisions to broader ones with societal consequences. After a discussion of ethical theory, for example, 'Mill and Kant's ' theory, which is used as a model of ethical system and argumentation, the next step is to focus on the topics of bioethical concerns.

The final session consists of a one day session held four months after the intensive summer program. Its major purpose is to obtain more

detailed information about the values of the program to the participants and to exchange their own successes and failures. The overall goal of the workshop is to reduce the lack of knowledge, training, and confidence of science and humanities teachers to deal with bioethical issues by providing information, materials and methods for classroom use. In this respect, the communication between science and humanities teachers is established.

An evaluation of the workshop takes place through a questionaire to see if the objectives are met. The success of the workshop is observed by the positive attitude and response of the teachers and students. For example, many biology teachers have revised their courses to introduce units dealing with bioethical dimensions. Team teaching in the workshop also results in exchange of classes for brief periods by various teachers to make subject more feasible to students.

Students in the bioethics workshop feel highly encouraged. By taking part in discussions and literature research , the authors believe that this unit provides extrafamiliarity of bioethical issues to secondary students. Hence, the authors feel that an interdisciplinary approach to bioethics can make a significant statement about

how teachers view the structure of knowledge. In this sense, team teaching provides an excellent intellectual approach to analyze bioethical problems. After all, the real world in which all students must live and make judgments is not organized into discrete disciplines but the real world is inter-disciplinary( Singleton and Brock,1982, p285).

The authors recommend that this approach can prove useful at high school or secondary level. Since many issues receive wide coverage in news media, a number of students are superficially familiar with these issues. In this respect, they need more information and guidance. High school teachers are also becoming familiar with these issues (Kieffer,1980,p113). At present, traditional biology or general science curricula are poorly equipped to deal with these issues. Hence these issues need to be implemented in school science curricula.

## 4.3. Teaching Human Reproduction

Hiscoe and Ahl(1979, p 28) have developed a course about human reproduction at Michigan State University. The course 'Biological and Social Aspects of Human Reproduction',attempts to integrate thorough grounding in biological facts and technological capabilities in human reproduction with an extensive study of the social aspects.

The course is taught with the objective:

> Too often citizens, not biologists, are called upon to make value judgments without having an appropriate knowledge of biological facts on which to base them (Hiscoe and Ahl,1979, p28).

In analyzing the needs of these citizens for knowledge regarding human reproduction, the authors have made three assumptions:

1. Ethical and moral decisions should be made with as complete knowledge as possible of all pertinent facts.
2. Informed public opinion capable of influencing public policy and legislation is vitally necessary to the welfare of our society.
3. Students should have an opportunity to study science, technology, and human values as related to human reproduction as a single integrated experience(p.28).

Based on an extensive search of the literature on sex education and courses in human reproduction, the authors feel that teaching of ethical and social issues related to human reproduction should become a priority in present biology curricula.

Human reproduction course is based on the following broad goals:

1. To increase students' perception, knowledge, and understanding of:
   a. their own physical nature and

the nature of humanness and personhood;
b. the interaction of genetics and environment in human development, leading to an awareness of the partially deterministic and partially indeterministic nature of human beings;
c. technology and its capacity to modify human existence.

2. To help students use this knowledge as a basis for examining values and making decisions regarding
a. their personal health;
b. their reproductive behavior;
c. technology as it modifies and gives rise to new human values;
d. "permissible" scientific activities;
e. the application of their definitions of humanness and personhood in particular circumstances;
f. desirable social and political behavior(Hiscoe and Ahl,1979,p 28).

Various issues are explored by students in human reproduction course. No matter what the particular topic in reproduction, the same issues are explored throughout the course, viz., the benefits and risks of applying a particular knowledge or technology to the solution of a human problem, benefits of an individual versus benefits of society, and so on.

Each issue under human reproduction involves its scientific background, the technology involved, and the societal values. For example, the issue of 'Contraception and Sterilization' involves

these steps:

1. Scientific background. It includes anatomy and physiology of adult reproductive system.
2. Technology. Irreversible( involving vasectomy and tubal ligation) and Reversible( involving physical barriers and chemical barriers).
3. Social issues. Includes safety of contraceptive measures and nature of informed consent regarding sterilization (coercion of sterilization, legal and economic aspects of sterilization, and sterilizing the unfit:societal vs. individual rights)(Hiscoe and Ahl, 1979, p 30).

Procedure:

The course consists of two 1-hour lectures and two 1-hour discussion sessions each week. Discussions are limited to 25 students each. Each week of classes the focus is on a particular topic. During each unit relevant scientific information, related technological capabilities and social impact are discussed. For example, sterilization is the technology discussed in conjunction with the scientific information about anatomy of the reproductive system. The risks involved with tubal ligation, hysterectomy and vasectomy are considered and compared with those of childbearing.

Students thus become aware of the potential misuse of sterilization as they evaluate legal safe-gaurds against coercion of the poor, the retarded, and

minors. The course also addresses the opposite problem, viz, roadblocks sometimes placed in the path of those seeking sterilization. Students must decide the relative merits of these safeguards.

The format of the course is also illustrated by the week spent on hormonal control and modification of reproduction. The primary issue addressed is the safety of such intervention, i.e., what constitutes an acceptable risk and who regulates safety in these matters? Readings and discussions thus present a broad spectrum of viewpoints to promote an understanding of how a person's knowledge of scientific facts may modify his views. In this sense, students are encouraged to present their convictions, or to express their own uncertainities in an attempt to foster an atmosphere for thoughtful consideration of social issues based on knowledge of scientific facts and technologies.

Similarly, in the Human Reproduction course, the cause of birth defects (genetic and environmental) is considered. This leads to a consideration of individual and social responsibility for providing a safe environment for the gametes before conception. Students confront the very question of what constitutes responsible parenthood during these preliminary steps in establishing a family( Hiscoe and Ahl,1979,p 29).

Several texts are involved in teaching the scientific material. This provides a balanced presentation of the issues arising from the application of scientific knowledge and technology to the control of human reproduction. An anthology (Bioethical issues and human reproduction ) of pertinent readings is developed. The authors find this book very interesting to students (p, 32).

Students have evaluated the course by responding to a questionnaire designed to measure its success in reaching the goals, and on the personal impact of the course on students. According to authors, change in students' attitudes, actions, respect and responsibility toward human reproduction has been found. The course has been also found to encourage the exchange of diverse opinions concerning social and ethical issues (p,29).

Students are evaluated on their ability to present arguments both for and against such procedures as amniocentesis and abortion, genetic engineering, genetic screening, sterilization, and artificial inovulation. In this manner, students become used to weighing advantages and disadvantages in espousing any particular issue, solving the issue, and to consider the proposed solution from the viewpoints of other students and society as a whole.

Hiscoe and Ahl (1979, p29) believe that the course in human reproduction involves a discussion of a broad range of issues. In addition, the course is valuable to the needs of students not majoring in science, since it provides a basis for understanding how science, society and technology interact. Students will benefit from such a course if incorporated into the existing Quebec Human biology curriculum.

4.4. Teaching about'The Quality Of Life for the World's Population: A Unit On Bioethics'

Bloom and Constan (1976, p292) have developed a course " a unit on bioethics " , stemming from a desire to take biology out of classroom and laboratory and into the world. The unit provides experience in decision making and reasons based on students' values. Students are also required to understand how values can change. The objective of the course is to give an opportunity to students to analyze data, consider alternatives and consequences, hypothesize, formulate models,and make decisions. To achieve these objectives, the authors use role-playing and value clarification strategies.

An international conference of students is staged in which they participate as delegates. These delegates represent certain nationalities,

religions, and occupations(China, U.S.A., Africa, etc.). Two weeks before the conference, each delegate is given an associated packet of materials. Although the packets vary slightly, they all contain:

1. Population statistics on every nation to be represented at the conference.
2. A survey of religious views on population control.
3. A pamplet on genetic engineering.
4. A bibliography of related books and articles( p,292)

During these two weeks students familiarize themselves with the reading materials. An important facet of each students' research is to become aware of his country's natural resources. This would enable him to deal with the proposals presented at the conference. Students thus have a great deal of latitude in molding their specific characters as they are provided with broad background information.

Three conference sessions are held. Each session is followed by a discussion where students vote for their opinions. Each delegate presents the proposal based on moral, religious, practical, logical, economic, and political factors. A record is kept for each vote. After the voting tabulation is declared, delegates begin to persuade and bargain to influence other delegates. In this way delegates are called back to discuss, and a second vote is taken.

This gives an idea if any change has been achieved from the first vote. In this manner, a good deal of reassessment is found as some delegates who are persuaded during the discussion period change their positions on the strengths of other delegates' arguments and inducements.

The ' unit on bioethics' also involves value clarification strategy. Students are helped to take their positions on a particular issue, regardless of how much information they have obtained. The authors feel that by using this strategy, the success of the course is achieved. They recommend that such a unit on bioethics must be included in biology curriculum (p,294).

4.5. Change in Attitudes Toward Contraceptives

A course in ' cell physiology ' is offered at Alvan college of education, in Nigeria. In addition to the main objectives of the course, a subsidiary objective aimed at improving contraceptive attitude among participants is being persuaded (Owie, 1983, p571). This objective is achieved through the following learning activities:

1. Reading assignments.
   Students are given a list of suggested topical areas and requested to locate five relevant

> articles or briefs within the list for critique, subject to the lecturer's approval.
> 2. Group projects.
> The class is divided into interest groups. Each group chooses an area of interest in contraceptives on which it carries out further research. This is followed by a five-page group essay on the main issue. Group leader reads his group paper to the whole class and class members are encouraged to raise pertinent questions.
> 3. Group Discussions.
> Each group meets every week for thirty minutes to discuss the topics. Following the discussion, group leader presents the paper to the instructor for analysis and feedback. The analysis is evaluated as ten per cent of the final grade (p. 572).

Both male and female students are involved. They are given a sixteen item inventory to determine what attitudinal changes might have taken place with reference to the contraceptives. This is done by an evaluation at the beginning (pre-test) and at the end (post test) of the semester's learning activities. The change in attitude according to the author has been found to be statistically significant.

From these studies, Owie concludes that "important changes in attitudes were observed in all items concerning the use of contraceptives" (p. 574). As such the author recommends that programs of this

nature can help classroom science teacher to focus on pervasive social issues in the core of the school curriculum. In this sense by specifically identifying a social problem in developing countries, science teachers can contribute a lot to present-day students. Issues like abortion, population control, quality of life, and birth control are very common issues. Hence a significant portion of the instructional activities in science must be commited to resolution of human issues. With a little creativity, modification and adjustment, instructional activities can be brought to bear on contemporary social issues that our students must be made aware of (Owie, 1983, p 575).

4.6. Maryville College Project

David Young (1974, p. 111) organized a project for science and non-science majors. Students are given a chance to study three courses, namely:'science thought', 'science and technology', and 'biomedical ethics'. Science thought: The so called freshman sophomore required course is team taught by the faculty of biology, chemistry, physics and psychology. A small group of 10 to 12 students is formed. The course objective is to provide an opportunity for critical analysis of modern science and technology. Students are allowed to analyze their own viewpoints on the use of scientific knowledge and its

impact on human beings.

The topics included for a 2 week span are:

> 1.The game called science (how science operates).
> 2. Things my mother should have told me (the right to be born and the right to die with dignity).
> 3. A clockwork orange (behavior modification and control).
> 4. There is no such thing as a free lunch (ecology and population).
> 5. The future of the future is in the present (computers and beyond "startrek") (Young, 1974, p. 111).

A prerequisite for attending every class is a 'class ticket' (a written response to a specific question or discussion topic). Persons without class tickets are not allowed to attend the discussion. Students are asked to produce assignments in any form, as foot-noted papers, scenarios, and poetry. A brief description of three class tickets will illustrate their nature:

> 1. After the discussion of four general areas of behavior control (electrical stimulation of the brain, drugs, behaviorism, and self actualization), students are asked the questions like:
> "you are going to 'control' human behavior in some way in the future as you become teachers, lawyers, doctors, ministers, business persons, and so on. Pick the future occupation you think

is most likely for you and describe how you might be using these methods of behavior control".

2. Students are asked to find and read two magazines or journal articles on abortion or euthanasia. This leads to the summary of the view points and reasons.
3. Students assume themselves as members of a committee which is responsible for choosing an individual to be placed on a kidney machine for blood purification. Students try to decide the most urgent person (out of three patients) to be placed on the machine. Students then answer questions like:
   (a) whom did you choose?
   (b) why did you not choose the other two?
   (Young, 1974, p. 111)

The Science and Technology course consists of a seminar style instruction for juniors and seniors. This seminar is based on topics like technological growth (communications, computers, transportation, war, privacy, and energy), and their impact on individuals and society. Discussion is stimulated around these areas. Key possibilities and issues in each area of technology that will require value decisions are identified. In this manner students explore their ideas and beliefs and are actively involved ( p. 111).

Similarly, Biomedical Ethics is designed to bring students with different measures together to consider how biomedical information should be used. A seminar is arranged and each seminar proceeds by a lecture given by the professor on scientific and ethical issues. Thus topics like clonal reproduction, genetic counselling, electrical stimulation of brain, and death and dying are discussed. Students prepare an individual paper followed by a group paper two weeks before the seminar. Often other guests are invited to join the seminar. These include doctors, church members, a specially educated teacher, and so on.

The author finds an increasing positive attitude developing among students taking this course. The course according to him is 'provocative, challenging, and mind bending' (Young, 1974, p. 112).

4.7. Social Enrichment in High School Biology

This project has been introduced at Cedar Falls (Iowa) High School. The main objective of the project is to make biology students aware of the impact biology has on society (James Meyer, 1976, p. 417).

Brief individualized exercises have been designed to give students an opportunity to discover the growing influence of biological sciences on world's cultural, economic, political, and social

systems. At least forty enrichment exercises have been developed around six controversial issues:

1. Development of modern Genetics
2. Human Experimentation
3. Human behavior control
4. Population control
5. Health care problems
6. Environmental issues (Meyer, 1976, p. 417)

Each activity in the project presents a specific issue to the student through one or more informational articles. After reading the materials, students are asked to react to the issue. Methods that have been used include in-depth library research resulting in written reports, or class presentations. Students also gather information about the issues by making a survey in the community. In this manner students record and present the value positions of the community people to the rest of the class. Further experts are also contacted to help students to understand the issues.

Of the six areas, 'modern genetics' has been found to be the most fruitful of the resource materials. This exercise includes discussion of topics like test tube babies, inheritance of human intelligence, cloning, genetic engineering, eugenics through sterilization, genetic screening, and the correction of genetic defects. For example, students are asked to get the concept of genetic screening from selective

readings as 'The politics of Genetic Engineering: Who Decides Who's Defective ?'(Ausubel, et al, 1974). Students are directed to find out if there are any mandatory genetic screening tests given in the state of Iowa. If such tests exist, students are asked to investigate further details of the tests and the purpose of administering them.

The information thus gathered is presented in a written report. However, if the entire biology class happens to be involved in the study of genetics, the material is presented orally and discussed with other members of the class. Similarly, correcting genetic defects involves deeper thought on the part of students. Here the booklet 'Genetic Counselling' is assigned to read. This is followed by a series of questions. For example,

> 1. What implications might the new intracellular engineering techniques have upon the field of genetic counselling in regard to certain genetic diseases?
> 2. What effects might intracellular engineering have upon the future incidences of the genetic diseases mentioned in the article?
> 3. Did you feel that such techniques should be continued and developed?
> (Meyer, 1976, p. 418)

Since this topic deals with rather complex biological information, the teacher and students discuss information gained and interpretations made on a one-to-one basis.

The article 'The Ethics of Human Experimentation' (Science News, 1975) gives students the concept of a human fetus in biological research. The article includes the use of aborted fetuses in research studies. Both sides of the issue are discussed. Students are then asked to design their own set of ethical guidelines for future research on live fetuses. After formulating the guidelines students are given articles that discuss the existing guidelines devised by the department of health, education, and welfare for comparison. Other exercises dealing with human experimentation have been developed around the use of retarded persons, felons, and mentally retarded as subjects for scientific experimentation.

Control of human behavior through the use of such techniques as psychosurgery and chemicals have furnished topics for a number of enrichment exercises. For example, in behavior modification-lobotomy, students are asked to read several case histories describing both favorable and unfavorable results of such technique. Finally, students are

asked to react to each case study and questions about behavior modification. The questions posed are:

> 1. Should the technique be regulated?
> 2. If so, how would you regulate this surgical technique? (Meyer, 1976, p. 418)

Students completing this exercise can present the information gathered along with their reactions to the entire class. This usually generates a discussion.

The method used in studying the issue of population control involves an initial presentation by a medical researcher. Students are thus given the concept of scientist's belief as to when life begins. This results in a survey of a sample of students by asking questions about the beginning of life. Various opinions are recorded and then compared with the opinion of the authority. In this way all the enrichment exercises generate discussion in the biology class. This results in a better understanding of the controversial issues.

James Meyer finds these exercises to be an inexpensive means of exploring the issues and exposing the biology students to the current issues. He recommends that these enrichment exercises can be further extended with the help of articles that form the nuclei of new enrichment exercises (p. 418).

In this manner every year new packets are included at this Iowa high school dealing with various issues of biology.

4.8. Science Forum

Cusimano and Halpern (1979, p. 234) are teaching bioethical issues through the science forum. The rationale to teach such a course is:

> Students must consider bioethical issues within the framework of their personal value systems; and to supplement value clarification and decision making skills in the existing biology curriculum (p. 234).

The organizers of the science forum include the following guidelines for the project:

> 1. Understanding the problem: students must understand the relevant facts about the bioethical issues. This will involve legal, scientific, economic, social, and political aspects of the problems. For example, to study the implications of recombinant DNA research, students should first understand the basic mechanism of breaking and rejoining of DNA molecules, the role of various enzymes in this process, and many other biochemical parameters pertinent to recombinant DNA technology. In addition, students must know the rules and regulations

regarding the laboratory costs, community involvement in decision making processes surrounding recombinant DNA research.

2. Research papers:

Students are provided with a list of seven bioethical issues. These include recombinant DNA research, ethics and organ transplantation, science and society, abortion, population control, euthanasia, and energy and living standards. These topics are introduced with a specific problem peculiar to the issue. Students choose a topic and prepare a written report after a thorough research. They are given one week to select one of the seven areas that interest them. Meanwhile, students get a chance to discuss each of these issues in their class with their teachers and other students.

3. Writing procedure:

After selecting the topic students are given guidelines as to how to write the paper. These guidelines emphasize problem identification, background information, objectivity, and a variety of viewpoints are presented. Students conclude the paper with their own opinions.

4. Submission of the paper:

No grades are given but questions by the teacher are written on the

> paper submitted by the students. These questions are intended to establish a personal dialogue with the students. This allows students to clarify or expand their positions when the teacher asks the phrased questions. This often results in informal discussions, and the authors believe that this kind of interaction among students and teachers is highly rewarding (p. 235).
> 5. Science forum:
> Two panels are formed. Students submit their abstracts of a particular bioethical issue. A number of community members are invited. These include teachers, parents, doctors, and scientists. At least 112 participants are present (p. 237).

After the brief presentation of the seven issues, the participants discuss their views with an already selected panel. In their discussion panel members and participants share their knowledge in their field of expertise. This helps students to clarify the specific issue and find possible solutions that are recommended. The guidelines for the panel include:

> 1. Meeting with the co-chairperson before the panel discussions and deciding on procedures for the panel.
> 2. Responsibility for calling on the participants to present their questions

> for discussion.
> 3. Allowing ample time for a thorough discussion of the question.
> 4. The outline for the panel should be:
> (a) What is the problem? This should be a thorough analysis of the problem. Technical information is also discussed to understand the problem.
> (b) Should society be involved with the scientists to help solve the problem? If so, what form should this involvement take.
> (c) What concrete suggestions or recommendations can this panel make to help solve the problem, or at least begin to deal with the problem? (Cusimano and Halpern, 1979, p. 237)

The evaluation of 'science forum' takes place by giving a questionnaire to all participants. All the participants in the forum agree that exchange of ideas and the depth of discussions lead toward an understanding of bioethical issues. Students are better informed and are willing to add and discuss more bioethical issues in biology curriculum.Students also recommend that science forums should be continued every year with other participants as well (p. 256).

The organizers of the science forum believe that students gain the most important learning experiences in their high school careers as they feel more enthusiastic, enlightened, and encouraged.

Hence the authors recommend a highly structured program of problem analysis, research techniques, and preparation of research papers to be implemented in the current high school biology curriculum.

The authors further recommend that teachers need to establish a personal dialogue between students, students and teachers, and help students to clarify their values. Students are able to explore their ideas with other community members and hence should be allowed to discuss such controversial issues. This will lead to the growth in the affective domain (p. 256).

To conclude, bioethical projects can provide the opportunity for value clarification, decision making, and intellectual development of present-day students. In this respect, biology teachers must design various activities to help students solve controversial bioethical issues. An active participation by students and guidance by teachers can encourage students to develope critical analysis skills.

## 4.9. Curriculum Developmental Model

In order to facilitate the organization of bioethics in the human biology curriculum, a curriculum model will have to be considered. This model will help to provide a meaningful framework which can be used to obtain information about the selection of content for

a particular science curriculum to be developed. For the purpose of this study, Macdonald's Circular Consensus model has been adopted since it is concerned with societal issues.

Curriculum development model: It is the special function of curriculum development to select and to organize the content in such a way that the desired aims, goals, and the objectives of the specific curriculum are met as effectively as possible (Zais, 1976, p. 322; Searles, 1982, p. 3). During this developmental process, curriculum developers are required to make judgments in the selection of content and as such, due to the values and perspective of the developer, varied curricular designs have originated. These curricular designs reflect the influences and beliefs of the developers themselves. Further, members of the curriculum development may conflict regarding the various components of the curriculum. These differences in beliefs and conceptualization have been noted by such curriculum theorists as Macdonald (1975), Eisner and Vallance (1975). Macdonald believes that the basic phenomenon that precedes and directs the activity of curriculum thinking and development is the phenomenon of human interest. To simplify the task of content selection and organization is to use the model that is suited to the kind of task at hand.

For developing the present curriculum, it means that the values inherent in the model would help match the curriculum with the personal and societal needs of the students. Macdonald used three basic cognitive human interests which influenced curriculum development models of: (1) Linear Expert, (2) Circular-Consensus, and (3) Dialogical (Macdonald, 1975, p. 283-294). An empirical research study has shown that these models "have different basic value positions and that they are responsible for the selection and organization of different content which results in a curriculum design according to the development model used" (Searles, 1982, p. 10). However, for the purpose of this monograph, only the Circular-Consensus model will be elaborated to utilize it in the development of bioethics in Quebec human biology curriculum at the secondary level.

The Circular-Consensus model is based on the human interests of consensus which occurs among teachers, school administrators and laymen representing the local community during the curriculum development process. According to Macdonald (1975), "this approach requires considerable faith in the use of group process and a conviction that unless teachers are centrally involved in the process of curriculum development, texts, documents, and materials will be misused or relatively meaningless" (p. 292). This model is also referred to

as the "grassroots" approach to curriculum development. In this approach the role of the discipline scholars is that of 'experts on call', rendering their services to the curriculum development team only when required to participate. This also holds the belief that teachers being in the field are more capable of helping in the selection of the learning materials that are relevant to the needs and interests of students and the society as well.

The propositions by Schwab (1973) and Walker (1971) support the Circular-Consensus model's emphasis. Schwab points that, although discipline scholars possess an essential ingredient for curriculum development, namely the knowledge of the discipline, they are "incompetent to translate scholarly material into curriculum" (p. 501). This is due to the lack of four other equally indispensable bodies of experience. These extra inputs of experience concern knowledge of (1) the student, (2) the social environment, (3) the teachers, and (4) the curriculum making process. All these areas of knowledge must be represented in any curriculum development exercise.

In addition, consensus is reached through effective collaboration based on the recognition of concerns, values, and other viewpoints. In this sense the role of the teacher would be to select the learning

material for the students because teachers are in direct contact with the students. Similarly, the community members will check if the curriculum is relevant to the needs of the students keeping in view their role as future citizens in the community. Also, the administrators will examine the curriculum with respect to the teacher's willingness and performance. Finally, the educator being the expert in the curriculum development will ensure the selection and organization of the curriculum material.

Decker Walker's naturalistic model (1971) for curriculum development lends further support to the Circular-Consensus model. The model consists of three essential elements, "the curriculum platform, its design, and the deliberations associated with it" (p. 52-53). The deliberation process is the major element here as it serves as a means to reach an agreement about what curriculum content is adopted. This is achieved by having the members of the curriculum development team give careful consideration to the merits and demerits of each curriculum alternative. It means that choices are made from the alternatives involved. In this manner these choices reflect a consensus of a variety of opinions of the team members. As such, Walker's model supports the Circular-Consensus model.

Macdonald's Circular-Consensus model is

appropriate for teaching bioethics in human biology curriculum. Here the value based social problems of human life will involve students, teachers, administrators, and community members to select and organize an issue-centered curriculum. This type of curriculum will allow students to make informed decisions and clarify their values when confronted with bioethical issues. Further, the issue-centered curriculum will actively involve other members of the community (church members, social welfare persons, lawyers, doctors, parents, and so on) to discuss these issues effectively based on their individual experience and viewpoints. In this sense students will gain a deeper understanding of the issues. In addition, with the help of these experts, students will learn the pros and cons of various bioethical issues.

With the help of administrators and community members, the teacher can develop a curriculum around bioethical issues. This type of curriculum should be better suited for the personal and societal needs of students. By making valid rational judgments students should be able to cope with the future challenges of biotechnology.

The next chapter presents the implementation of bioethics in Quebec's human biology curriculum. This is facilitated by using a variety of useful instructional strategies proposed by various educators.

# CHAPTER 5

## Proposed Curriculum : Strategies

From the contemporary goals of biology teaching, the proposed curriculum should focus on values, ethical, and moral considerations of bioethical issues (Yager, 1982, p. 332). Implementing bioethics in human biology is based on the following assumptions:

> 1. There is an important analogy between scientific and ethical patterns of judgment or problem solving.
> 2. There are overlapping rationales for intellectual and ethical education (Kohlberg, 1972, p. 475).
> 3. Solving moral and ethical dilemmas for individuals and society demands a critically thinking, scientifically literate citizens with high moral standards (Hendrix and Mertens, 1984, p. 23).

This chapter is divided into the following sections:

1. Various strategies
2. Outline of the existing Quebec human biology curriculum
3. General format for the proposed curriculum
4. Investigating various bioethical issues
5. Proposed strategy

## 5.1. Various Approaches to Teaching Bioethical Issues

There are numerous intellectual approaches that have been proposed and used by various educators depending on the great diversity of curricula taught at various levels in various institutions. All these approaches have been used to teach bioethical or social issues in science or biology.

Although there is no single best approach to teach bioethical issues, yet each of them has its own pedagogic advantages, its own characteristics, its rationale, and its own validity and limitations. Nevertheless, these strategies can serve as examples to human biology teachers who aim at teaching bioethics at secondary level. By using a variety of strategies , an effective decision making skill can be facilitated.

The approaches used are in the form of case studies, small group discussions, role playing, research papers, and so on.All these approaches employ value clarification and decision making skills which follow the concept of affective domain (Bloom, et al, 1964). The basic pattern followed by these approaches is:

1. Description of a particular bioethical issue
2. Response by the students which may involve research on the topic, active participation in small and large group discussions

3. Exploring the values of students and make them realize the values of others
4. An explanation of the values by students after attempting alternate positions (Griffths, 1982, p. 9).

(a) Decision making model

This model is devised by Barman and Hendrix (1983, p. 23) and Mertens and Hendrix (1982, p. 148), and involves the basic concept of the affective domain. The objective of the model is to merge bioethical decision making skills with human genetics content. The model is designed to enable students to clarify their values rather than have their teacher's values imposed upon them. The model also stresses examining alternate solutions to ethical problems and the consequences of these solutions.

A number of lecture series in bioethics are involved. For example, 'Bioethics-the interface of biology and society' is used. These lecture series act as stimuli for developing and teaching a course on bioethical decision making and for increasing the emphasis placed on social/ethical issues in human genetics course (Mertens and Hendrix, 1982, p. 150). These aim not only at stating bioethical problems but also at providing students with a mechanism for resolving these problems in a manner that is acceptable to them.

The model is as follows:

1. Students identify the problem.
   (a) Students write a short paragraph giving their reasons why they identify their problem as a value/ethical problem.
   (b) They list five personal values expressed in their problem.
   (c) Students rank these values from most important (1) to the least important (5).
2. They list alternative solutions to the problem (minimum of five).
3. They rank solutions by personal value preferences.
4. They list the reasons for choosing the #1 solution in terms of values and principles.
5. They repeat step 4 using the solution ranking last.
6. They list consequences of their number one solution to various systems (For example, family, school, medicine, law, and other professions).Thus their consequences are ranked according to society.
7. Students assess each consequence through their value screen (1c) as being good (+) or bad (-).
8. Students tally their assessment for step 7, and ask themselves if there is any 'bad'consequence that over-rules many 'good' consequences.
9. Students compare their number one choice to the personal ethical principles (1b). If both solution and principles agree, they continue to step 10; if conflict exists, they select alternate solution, i.e., number 2

or modify number 1, and repeat steps 3 to 9.

10. Students list reasons why others might not agree with their solution.

11. Students finally assess the solution in terms of 'conviction'. That is, if other fellow students will accept the solution stated.

| Confidence 1 2 3 4 5 No Confidence |
|---|

The authors have used this strategy to test its significance while teaching a human genetics/bioethics course. According to them, the decision making model is useful to students for exploring their personal values (Mertens and Hendrix, 1982, p. 150). The approach also uses case studies before the model is implemented.

The 'Decision making model' can be applied to a variety of bioethical issues. For example, issues like genetic counselling, recombinant DNA research, amniocentesis, organ transplants, and abortion can be discussed by using a number of case studies. In this respect students should be able to make decisions and give reasons to support their possible solutions regarding a particular issue.

(b) Small Group Discussions

Hendrix, Mertens and Smith (1983, p. 21) have used this strategy at Ball State University with 50 to

57 students, most of them are non-science majors. The bioethics component of the course is designed to help students clarify their values and formulate personal decisions on controversial issues that arise from the application of new genetics knowledge. The purpose of the small group discussions is to help students identify and clarify:

> 1. The data from several disciplines that pertain to a specific issue
> 2. Value stances held by the students' peers relative to the issue
> 3. Alternate solutions to the issue
> 4. The few solutions that society might find morally and ethically acceptable (Hendrix, et al, 1983, p. 21).

A packet is devised for a discussion topic. This particular packet concerning alphafetoprotein (AFP) screening for neural tube defects (NTDs) is divided into four components.

Component 1: This includes general instructional guidelines for the group leader. Introduction to leading discussions is developed to clarify the role of the discussion leader for the upper class students who assume this responsibility. The salient features of this component are:

> (a) The leader's role is to help keep task-oriented discussion in line with the issue

in hand, and thus progress toward a solution.

(b) He is the person seen by the group members whom he is helping to fulfill their needs.

Certain roles may develop among participants that will reduce the group's efficiency. For example,

> Blocker-- totally negative; prevents progress
> Agressor-- insults and criticizes
> Anecdoter-- tells irrevelant stories that waste time
> Dominator-- seeks to monopolize group interaction
> Recognition Seeker-- seeks attention and sympathy
> Confessor-- seeks counselling for personal problems
> Playboy-- distracts group with antics, jokes, and comments
> Special Interest Pleader-- seeks recognition for a non-relevant cause (Hendrix, et al, 1983, p. 22).

The group leader has to check the characters from time to time so that the discussion continues smoothly.

Component 2: This is three-fold;

(1) To provide cognitive data concerning NTDs and the AFP screening program.
(2) To raise value and ethical clashes that actually exist in society today.

> (3) To encourage students to take a stance on issues in a safe environment by role playing as panel members (p. 21).

This component also presents an informational packet on AFP screening for all participants in the discussion prior to the discussion. The packet also states the major problems to be addressed.

Hendrix, et al,(1983, p. 22) recommend that teachers should develop a single strategy that can be completed in a one hour class period. Further, they must provide a data sheet including current cognitive information, evident value clashes concerning the application of the information, and a method by which students can clarify their own values with respect to the issues. These data sheets can be given to students one day before the actual discussion. For example, the authors give information about NTDs to students in the data sheet. This concerns the NTDs affecting the continuous tube forming the spinal cord and the brain.

According to authors about two babies per thousand in the U.S. have NTDs. The occurence of NTDs is correlated with a high level of alphafetoprotein in the maternal blood during sixteen to nineteen weeks of gestation. A high concentration of AFP may indicate an open neural tube, twins or triplets, or a dead fetus. Pregnant women undergo a screening process or amniocentesis (p. 24).

After giving this information to the students they are asked to discuss and make decisions about the national program for the screening of NTDs. Students are given a few questions to give their personal choices, and this is followed by a group discussion, which leads to an attempt to reach a consensus on each question. The questions asked are:

> 1. Which pregnant woman should be screened for NTDs? All women or only those women who have had an affected child?
> 2. Ought the screening tests be mandatory or voluntary for all pregnant women?
> 3. Should society encourage the abortion of fetuses identified as having NTDs?
> 4. Should society pay the cost of an AFP screening program? (Hendrix, et al, 1983, p. 23).

Component 3: This includes specific questions for the group leader to keep the discussion on task. He provides additional information to the group and raises various aspects of value issues. The discussion leader does not enter the discussion but his job is to raise the questions and continue the discussion. The questions are related to the above specific questions.

Component 4: This involves students' evaluation where they are asked to respond to various questions

anonymously. The questions put to students are:

> 1. Do you feel the discussion moved satisfactorily toward a solution to the problem?
> 2. Did the discussion cause you to look at the problem from a viewpoint other than your own?
> 3. Were you permitted to express your views without hostility or ridicule from others?
> 4. On which women do you think AFP screening should be performed? All pregnant women/ no woman/ those pregnant women who have had an affected child/ those women who request the test?
> 5. Do you think Spina Bifida Association is unnecessarily slowing the drive to begin a national program of AFP screeening?
> 6. Did the discussion help you form an opinion on the issue?
> 7. In your opinion should a fetus with spina bifida be aborted?
> 8. Do you feel the discussion was a profitable use of your time?
> (Hendrix, et al, 1983, p. 24).

The authors believe that these components provide pertinent information on the discussion topics and clarify the role and responsibilities of the discussion leaders from component one to four. The authors are convinced that the use of their packet and its success is due to the component one.

Almost 99 per cent of the participants have felt that they were permitted to express their views without hostility or ridicule from other group members (p. 24).

Hendrix, et al,(1983, p. 25) recommend that teachers must follow the procedure of small group discussions with other topics of bioethics to achieve best results and success. In this respect small group discussions give students an excellent opportunity to exchange ideas and atmosphere of critical thinking through specific information on a conflicting issue. In addition, small group discussions are less intimidating for some students who may not ordinarily volunteer a response in front of the entire class. Methods such as value clarification, case study approach, and analysis activity are effective in initiating small group discussions.

Various bioethical issues like genetic screening, genetic counselling, genetic engineering, fetal research, and so on can be discussed in small groups in this way. Small group discussion is, therefore, a task oriented discussion, which is directed toward the solution of a particular bioethical issue that students must discuss.

(c) Concept Assessment Or Cognitive Biological Concept Assessment Instrument (CBCAI)

Hendrix, Mertens and Baumgartner (1981, p. 246) have developed this instrument keeping in view the students' needs and the educational objectives of the course. Their instrument is based on the cognitive domain concept. Therefore, CBCAI helps to measure various levels of understanding among students of biology.

The authors have used the cognitive domain philosophy which is divided into six levels (Bloom, et al, 1956, p.52). Each of these levels is conceptually more advanced than its predecessor. They are: knowledge, comprehension, application, analysis, synthesis, and evaluation. Developing and using such an assessment instrument should enable an instructor to determine, given a specific bioethical or biological term, if a student has any idea of what the term means, if he knows a simple definition of the term (knowledge), if he truly comprehends what the term means (comprehension), or if his conceptualization of the term shows that he uses abstractions (application, analysis, synthesis, or evaluation). (p. 247)

The authors of the CBCAI test use the instrument to assess the entry level of their students with respect to the concept objectives in three

courses:

1. Human Genetics and the Problems of Humankind ,
2. Bioethical Decision Making , and
3. Symposium in Human Genetics and Bioethical Decision Making (Hendrix ,et al, 1981, p 247).

The authors have used a list of fifty biological and bioethical terms from the popular magazines by matching concept terms with the concept terms used in the course objectives. The next step involves compiling of different definitions of each term taken from sources like books, biological dictionaries, and advanced text books. In this manner, three final composite definitions are created. Each definition is placed in a sequence from the lowest to the highest concept level.

The test is given to the individuals of different educational and experiential backgrounds with respect to human genetics and bioethics concepts. These include high school juniors, college students, and high school life-science teachers. Each population is assessed with the instrument prior to instruction in basic genetics, human genetics, and bioethics concepts. The authors already assume that teachers would be at a higher concept level than college students, and the response of college students would be higher than that of high school juniors (p. 248).

The results are reported in five major

groups:

(1) Mendelian Genetics
(2) Human Genetics
(3) Philosophy and Ethics
(4) Reproductive Physiology
(5) Human Behavioral Control (p. 251).

The percentage of individuals in three populations responding to human genetics terms is presented in the following sample:

| Term | Never Heard | Low Response | Medium Response | High Response |
|---|---|---|---|---|
| Amniocentesis | | | | |
| A | 92% | 5% | 3% | 0% |
| B | 50 | 0 | 25 | 25 |
| C | 5 | 11 | 55 | 29 |
| Gene Pool | | | | |
| A | 53 | 39 | 5 | 3 |
| B | 33 | 25 | 25 | 17 |
| C | 3 | 45 | 39 | 13 |
| Eugenics | | | | |
| A | 79 | 8 | 13 | 10 |
| B | 42 | 17 | 25 | 17 |
| C | 18 | 33 | 26 | 26 |

A(H.S. Juniors), B(College Freshmen), C(H.S. Science Teachers) (Hendrix, et al, 1981, p. 250)

The above results show that almost 80 to 90 per cent of high school juniors are unfamiliar with the terms used by the authors. This indicates that

students at present must be aware of these basic concepts of bioethics. Similarly, teachers also need to have a thorough understanding of the bioethical terms.

The authors have found the instrument very useful and valid. If administered properly and completed conscientiously, the CBCAI can be of use to an instructor in several different ways. Instructors can evaluate their success in raising the concept level of students after retesting with the CBCAI. This instrument can be applied to a number of bioethical terms. For example, such terms like eugenics, gene surgery, psychosurgery, behavior modification, tubal ligation, euthanasia, and so on, must be known to the students. This can be achieved by giving the CBCAI test before and after instruction. In this manner teachers can assess entry and exit concept levels of students.

(d) Case Studies

The method of case studies is most widely used for value clarification and decision making skills. Many educators have used this method in teaching bio-ethical issues (Barman, 1975, 1980; Kieffer, 1975, 1979; Fox, 1976; Barman and Rusch, 1978a,b; Rosenthal, 1979; Mertens and Hendrix, 1978; Yager, et al, 1981; Singleton and Brock, 1982; Mertens, 1983; Barman and Cooney, 1983; and Barman and Hendrix, 1983).

Case studies involve a story presentation

where a bioethical problem is stated or a socio-scientific dilemma is presented to the students. The format of case studies involves a presentation of the case to students, an evaluation of the case by students, discussion of the case by students and teachers, and testing of values. For example, a case study can be developed as follows:

> John and Judy have a child who seemed normal at birth but later proved to be a victim of serious birth defects. The child was physically handicapped and mentally retarded. The couple yearns for a healthy child. Being advised by friends to have a second child, they take a chance hoping the child will have a lesser probability of being handicapped. Judy is pregnant again.
>
> John is told by his doctor that through the process of amnio-centesis test he might be able to determine if the embryo will develop into a healthy, normal child. However, if the embryo has a serious defect the couple might consider terminating the pregnancy.

After presenting the case study a number of ways can be adopted to help students clarify the conflicting issues at hand. For example, Barman and Rusch (1978a, p. 88) use a question form with a scale from one to seven. Number one represents complete agreement, and number seven denotes complete disagreement. Number

four represents partial agreement.

| Complete Agreement | | | Partial Agreement | | | Complete Disagreement |
|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |

The numbers between one and four, and four and seven show students' feelings that represent neither complete agreement, nor partial agreement nor complete disagreement. For example, number six would mean that the student is almost in complete disagreement with the statement. Statement used for the above case study could be:

1. Mentally retarded and physically handicapped persons are seriously defective persons.
2. It will be right for Judy to undergo amniocentesis.
3. If, after the amniocentesis, the doctor finds that the embryo has a serious defect, Judy should terminate the pregnancy.
4. Judy should raise the child as she raised her first one.
5. The couple should not plan any more children.
6. A mentally retarded and physically handicapped child has a right to live in our society.
7. The process of amniocentesis is useful to our society.

After the evaluation of statements and questions, students discuss the case in groups of five or six. Group discussions allow the students to interact and exchange their ideas and beliefs. Barman and Hendrix (1983) and Mertens and Hendrix (1982) use

a variety of case studies merging bioethical decision making skills with human genetics content. Students' analysis follows the written format of value clarification.

Numerous case studies can be developed around such bioethical issues as organ transplant, euthanasia, genetic counselling, genetic screening, and behavior modification. In this manner, students can be engaged to discuss these issues in depth.

(e) Role-Playing or Scenarios

These strategies have been used by many professional educators (James, Schmidt, and Conley, 1974; Bloom and Constan, 1976;Bridger , 1977; and Rosenthal, 1979). James, et al,base their strategy on the following criteria:

> 1. The importance of the general understanding of biology
> 2. The ability to provide a laboratory experience that would enable students to gather quantitative and qualitative data
> 3. The existence of a social issue related to an understanding of the concept. (James, et al, 1974, p. 346)

The authors use the material called PAKs (fictitious name given to the material grouped in 16 units). Each of the PAKs is eleven days in length. The purpose of these units is to put students into a

normal situation that a citizen would find himself in, when confronted by a social issue.

The scenario used is related to a town hall meeting (New Bubbleton, MO). Students represent tax payers, and the teachers represent alderman. A variety of social issues such as use of pesticides, use of strip mining, abortions, drug usage, human population, venereal diseases, and peoples' rights are discussed. Students are given the opportunity to verify their ideas in the laboratory. For example, under the subject of pesticides, the students study the effect of DDT on other organisms. For abortion, cellular structure and diffusion is the main laboratory work.

The authors are satisfied with the results of their strategy as 97 per cent of the students are reported to be willing to study these social issues. This has encouraged the authors to continue and to help students develop a greater understanding of social issues, and to acquire skills to deal with them (James, et al, 1974, p. 347).

Bridger (1977, p. 242) uses a 'life-line ethics' scenario that includes various bioethical issues from conception, birth, and death. The conception theme includes issues like birth control, fetal research, abortion, and amniocentesis. The issues under the birth theme are genetic counselling and genetic

screening. Under the theme of death, issues like definition of death, euthanasia, transplant ethics, and care of the critically ill are studied. Between the themes of birth and death are issues like the quality of life, population control, allocation of medical resources, and informed consent.(p. 242)

Bridger uses any scenario which involves the presentation of a situation concerning one of the bioethical dilemmas, and allowing students to cast themselves in the roles indicated by the scenario. For example, in a scenario the students are asked to play the roles of an obstetrician, a registered nurse, and parents with a severely deformed child. Students are then asked to study the scenario, and to research the issue by using selected references. Next, they form groups, and create the scenarios for their classmates.

Role-playing thus facilitates real student involvement and active participation rather than a discussion merely on an intellectual level. It also allows for group interaction while ensuring that the several sides of each issue are explored (Bridger, 1977, p. 243).

Another technique that Bridger uses is the 'thumbs up/thumbs down' approach. Here, statements are read aloud by the teacher or the student, and after a short time for thought, each student is asked

to indicate his agreement or disagreement with the statement by making the appropriate thumb signal. In this way individual and group feelings are immediately apparent. This in turn leads to class discussion. For example, the following statements can be made:

> 1. Scientists should be regulated so that only beneficial discoveries are allowed.
> 2. An ailing person should be told whether he has a terminal illness. (Bridger, 1977, p. 243)

Rosenthal (1979, p. 336) teaches 'science and society' by using different strategies. The course is taught as an interdisciplinary course involving both science and social studies teachers. Students are given basic information about each major topic. This is followed by an examination of its social implications. A number of topics are selected to be covered in a twenty week period. Five major themes are selected. Various issues are studied under each theme. These are:

> 1. Interactions between science and society
> 2. Population
> 3. Food
> 4. Medicine and genetics
> 5. Who is responsible? (p. 337)

A number of reading materials are involved. These are: mini-texts, magazines, and articles from newspapers.

The course is also supplemented by useful films, slide sets, and film strips covering science and society. The issues studied under 'medicine and genetics' include world health problems, disease in underdeveloped countries, health care in the U.S., euthanasia, living wills, death with dignity,abortion, human experimentation, organ transplants, behavior modification, psychosurgery, cryonics, genetic counselling, genetic engineering, and eugenics (p. 338).

Rosenthal uses various strategies including lectures, small and large group discussions, class group projects, field trips, presentations by guest speakers, and role-playing activities. However, the two best activities used are in the form of games. Through such games, students get personally involved with the issues, as opposed to viewing them as abstract problems with no relevance to their lives.

The games are called 'Simulation Meal' (American Friends Service Committee) and 'Redwood Controversy' (Educational Research Council of America, 1971). In the Simulation Meal game, the class is divided into three groups:

1. First World representing the western bloc (technologically advanced countries)
2. Second World representing the Soviet bloc countries
3. Third World representing the developing countries (p.339).

The real situation in these groups is dramatized by students representing various countries. Students play money and meal game. In this respect the size of each group, the amount of food it can buy, and the amount of space it occupies are made proportional to the real situation existing in each group. Through this experience, students get profoundly involved in the emotion of the issues, and feel sympathetic toward the problems of less-fortunate people.

In the Redwood Controversy game, proposals for three different national parks to preserve the Redwoods of California are studied by a senate committee. Students play the roles of senators and the committee witnesses. The game usually takes one week to complete. As a result, students not only gain insight into the political, economic, and social complexities of the related issues, but also begin to question the responsibility of decision making by the government, the scientists, and the citizens.

Rosenthal also uses case histories of patients to help students understand the difficult decisions that health care professionals face. On her unit of medicine and genetics, students are given seven case histories of patients. They are asked to discuss and make decisions as to who has the right to

live and who should die in view of the hospital funds and conditions of the patients. In the follow-up discussions students examine the basis on which they make decisions. Strong differences of opinion usually exist within the class, and the teacher tries to clarify the guidelines that are generally agreed upon.

Rosenthal believes that teaching science and society with a focus on social issues is a great achievement (1979, p. 340).

(f) Club

Sister Regina Smith (1980,p. 10) applied the approach of using a science club for teaching bio-ethics. The club called BRIM (Biological Revolution and its Implications on Man) serves to stimulate and sensitize the students to biosocial issues. Students become actively involved and informed about the latest biological advances and their ethical and social implications.

The club meets weekly. It has a student leader who is responsible for the program outline. All the members involved select a dilemma to be resolved. The faculty moderator of the club guides the students as a process facilitator. His job is to stimulate students in searching, stretching, and helping them to explore their personal values. Since value questions are difficult to resolve, students are informed by the

moderator that no one answer is absolute or correct. Each position has its own merits and needs further probing. Students are also encouraged to listen to one another.

To trigger critical thinking, each student is given some background readings that serve as a basis for a bioethical dilemma. Students then read several research papers on the issues prior to the meeting. In the meeting students analyze 'why' and 'what' questions of each issue. This is followed by a discussion, proposed alternatives, and possible solutions of the issues. A summary of entire discussion is retained on the tape by the secretary for students to review their ideas. During the discussion period, the classroom atmosphere is open and conducive to a free exchange of ideas. Students feel at ease and able to express themselves without fear of being challenged (p.10).

The club has discussed a number of dilemmas like organ transplant, kidney dialysis patient selection, test tube babies, fetal research, human behavior control, and eugenics. A single dilemma is discussed in two consecutive meetings. This allows students to participate individually and take a stand on the dilemma.The author believes that this approach provides a useful and interesting

experience to students. In this manner, students develop ethical reasoning, critical thinking, and decision making skills (Smith, 1980, p 11).

The author's approach can be applied to a number of bioethical issues. A club can be organized in any school where students and teachers can tussle with bioethical issues. In this respect, students can be encouraged to discuss more recent biomedical topics and their ethical implications.

(g) Research Reports

Stephen Zipko(1983, p47) uses 'research-report format' as a successful technique to expose students to a diversity of issues in the biology curriculum. These reports require students to analyze controversial bioethical issues to ensure a more intelligent resolution of these issues. The reports are interdisciplinary in nature. This allows students to develop skills in library research, language arts, biological knowledge, history, sociology, mathematics, law, and politics.

Students are allowed one month to complete the reports which are composed of the following:

1. Introduction
2. Body
3. Conclusion
4. References (p.47)

The reports require a minimum of three and a maximum

of eight pages. The emphasis is on concise reporting of an issue, i.e., the style of the'CBS-TV show 60 minutes'. Students may use photos, maps, graphs, charts, and diagrams to complete the reports. Students either type or handwrite their reports. In this way they are encouraged to develop their cursive writing skills.

In the introduction part, students are requested to briefly touch upon those points to be discussed in detail later. They are required to include an historical background to the controversy, similar to that done by television ' news magazines' and current events magazines such as Time and Newsweek.

The body section is divided into several subsections to prevent students from rambling on one topic and to encourage them to develop their issues logically. The report must be supported by a number of illustrations that will enhance reader understanding. Zipko prefers interdisciplinary evidence such as archaeological, medical, sociological, and legal. In addition, students are required to consider both sides of a bioethical conflict. Students thus devote equal textual and pictorial evidence to both aspects. In other words, the body consists of an objective treatment of the controversy.

After summarizing the main concepts in the

body, students place their arguments(for and against) in the conclusion part. The ideas for resolution of an issue are labelled in two columns, ' pro and con'. Students thus form their own opinions only after careful scrutiny of all possible consequences. Such considerations force them to think futuristically. They must likewise ask open-ended questions about their controversies. These questions may come from references or be raised by the students (Zipko,1980, p 47).

Due to the nature of research topics offered for student selection, encyclopaedic references are discouraged while references to periodicals are encouraged. The periodicals include newspaper articles, general science magazines, and Scientific American journals. Students also view videotapes of certain science shows that explore the current state of their topics. The number of references ranges from five to eight, none of which may be more than ten years old (p, 48).

Zipko used this format with junior high students. He believes that this interdisciplinary approach would also work well at higher educational levels. The author uses a variety of topics of bioethical and social concern. All issues are thus relevant to the needs of students(Zipko,1980,p48). Some of the issues are:

1.Animal testing controversy
2.Occupational health: problems and solutions
3.Should heroin be legalized for medical use?
4.How did human beings originate?
5.Evolution versus creationism
6.Smoking versus non-smoking
7.Costs and benefits of genetic engineering
8.Controversy over pesticides and biological control of insects
9.The medical and legal problems in defining death
10.Should the genes of rare species be frozen for later mass production?
11.Should we colonize other worlds?
12.Is mental illness genetically based?
13.The benefits and problems of artificial devices for the human body
14.Do the medical benefits of food additives outweigh the risks?
15.How to deal with overpopulation and starvation
16.Do the benefits of space exploration outweigh the costs?
17.Cryonics and suspended animation in humans--an alternative to burial?
18.Laterile, interferon, and cancer research--The debate continues
19.Toxic waste and the Love Canal (Zipko, 1983, p. 48)

Bioethical research reports help students to recognize that a solution to one problem can create new problems. Students use information and values to make decisions and evaluate the consequences for others. They recognize that data can be interpreted differently by different people, depending on their values and experiences. Students also recognize the ways science and technology

have changed their lives in the past by changing the coping skills available to them. In addition, students assume a sense of collective responsibility for the environment over a period of time. They also understand that science does not always provide easy answers to problems, and that the use of hard work and the processes of science are required to 'resolve' many problems rather than to 'solve' them (Zipko, 1983, p. 48).

Bioethical research reports provide a useful end-of-year project which crystallizes many concepts. They also help students to analyse and reevaluate various aspects of bioethical issues. Hence, these reports can be built around a number of bioethical issues. In this respect students get an opportunity to do library research and get exposed to a variety of bioethical issues.

It is apparent that there are a number of modes of delivering information about bioethical issues. An attempt has to be made to assist students to examine personal solutions to value laden issues. To achieve success for an effective teaching of bioethical issues, open and free discussions by students become essential. In this manner bioethics in human biology can prove interesting if the teachers of human biology use a variety of strategies as mentioned above.

## 5.2. Outline of Quebec Human Biology Curriculum

The course of human biology is compulsory at secondary III level (age 14 to 15 years). The main objectives of the course are:

> 1. To develop an understanding that the physiological changes occuring within a human body are natural.
> 2. To discover students' responsibility to their bodies.
> 3. To bring students'personal contribution to the field of public health (Quebec Human Biology Curriculum, 1982, p. 4).

Although the purpose of the course is to study the major systems of human body, it does not include a discussion of various current issues that are associated with the human body. The content of the course gives priority to the functions of nutrition and reproduction with a special emphasis on physiology and hygiene. A brief representation of the course content is as follows:

Course Number: 535-314 (Pub. No. 16-3148-01)

A. Nutrition

1. Entry of food stuff.
   - (a) Digestion and absorption of food
   - (b) External respiration of oxygen
   - (c) Hygiene of the system
2. Transportation of selected intake
   - (a) Circulation of blood
   - (b) Hygiene

3. Metabolism of intake

(a) The cell

(b) The activities of the cell

4. Utilization of intake

(a) Growth and repair

5. Elimination of wastes

(a) Elimination of carbon dioxide by lungs

(b) Elimination of urea by kidneys

B. Communication

1. Sensory communication

(a) Sense organs

(b) Nervous system

(c) Hygiene

2. Movement

(a) The skeleton

(b) The muscles

(c) Hygiene

C. Reproduction

1. Physiology of the system

(a) Anatomy of the system

(b) Function of the system

(c) Hygiene

2. Physiology of reproduction

(Quebec Human Biology Curriculum, 1982, p. 10-12)

It is evident from the course content that nowhere are any

bioethical issues linked to the topic of reproduction, nutrition, or communication. Such issues like fetal research, abortion, birth control, amniocentesis, ultrasound prenatal treatment, and research on fetuses can be taught under the theme of reproduction. Similarly, other bioethical issues can be implemented in the content of nutrition and communication. Since these issues have a direct impact on the lives of students, it becomes essential to train the students at secondary level, to explore such issues and think of the alternatives.

## 5.3. General Format for the Proposed Curriculum

The proposed curriculum will have a format different from the existing Quebec human biology curriculum as proposed by the policy statement (Quebec School Curriculum, 1979, p. 29). The format for the proposed curriculum is based on the following tenets:

1. The curriculum will be centred around the kinds of bioethical issues that will need bioethical decision making by the students. Such issues like human experimentation, behavior modification, psychosurgery, genetic screening, genetic counselling, recombinant DNA research, genetic engineering, death and dying, and active and passive euthanasia need to be incorporated in the human biology curriculum. In this respect the curriculum will be directed toward an improvement

in the quality of life. Human biology students will be exposed to opportunities of reflective thinking, scientific inquiry, and value clarification.

2. The instructional materials and the strategies used in this curriculum will include:

(a) an educational method effective for dealing with bioethical issues (including a variety of strategies to make the subject matter more meaningful and interesting),

(b) use of external resources involving texts and extensive literature research based on current magazines, scientific journals, newspapers, and research papers,

(c) help from experts in various fields ( this will include seminars by doctors, lawyers, biologists, theologists, and community members), and

(d) use of audio visual materials on various issues followed by in-depth discussions ( materials such as films on specific issues, slides, and video tapes).

3. Active participation and social interaction among students will be stimulated by effective group discussions. In this sense, humankind will be central, and cooperative work on ethical issues will be essential. Students will be confronted with policy judgments on various bioethical issues. They will weigh positive

and negative aspects of an issue, thereby openly accepting or rejecting an idea. This will encourage them to take a strong stand on a particular issue.

4. Teaching bioethics needs a non-dogmatic teacher. As a guide he will watch students grappling with complex issues, predicting the future, and making value judgments. Serving as the discussion leader, the teacher will make use of probing questions to stimulate students to search for new ideas or alternatives. This will help students to review their values as well as those of other students. In this respect the teacher will help and encourage students to discuss the issues openly and frankly.

Various goals will be recognized as important and valid for assessing the course. Some of the important goals should be:

1. to understand the biological material involved (students will be sensitized to ethical concerns, for example),
2. to develop familiarity with bioethical literature,
3. to be able to analyze a given bioethical issue verbally or in writing, and
4. to demonstrate the ability of clarifying and assessing their own values and decisions ( leading to development of decision making and value exploration skills).

Students should identify and solve bioethical problems in a more realistic and humanistic way. This should lead to fostering of scientific literacy and informed decision making. This type of curriculum should be life centred or meaningful on both intellectual and emotional basis (Comb, 1981, p. 446).

5.4. Investigating Various Bioethical Issues

The desired goal is to implement bioethical issues in the human biology curriculum. The following section will investigate various bioethical issues that human biology students should be familiar with. The purpose is to develop moral/ethical reasoning, value exploration, and decision making skills. To achieve this, the students will compare different values and weighing these values should result in an ethical judgment. In this respect students should learn how bioethical decision making takes place by comparing different values.

Topic Abortion

Ethical Questions

1 Is it a justifiable act?

2. What is infanticide?

3. Is a fetus a person?

4. When is a fetus a person?

5. Does the fetus have the same right as a new born infant?

6. Should we encourage abortion?

7. Should we abort a fetus if it is genetically defective?

8. Can we afford to abort a fetus if preferred on the basis of sex?

9. Does a woman have the right to control her body in relation to the right of a fetus to be born?

10. At what stage of pregnancy abortion should be performed?

11. Does a woman have the right to abort the child?

12. Should society support abortion?

13. Should there be free clinics for abortion?

14. Should there be federal legislation banning abortion?

15. Should taxpayers pay for abortion?

Applied Strategy

1. Case studies (Barman and Rusch, 1978a, p. 88).

2. Small group discussions (Hendrix, et al, 1983, p. 21).

3. Decision making model (Mertens and Hendrix, 1982, p. 150).

4. CBCAI test (Hendrix, et al, 1981, p. 246).

5. Research formats (Zipko, 1983, p. 47).

6. Value continuum (Barman, 1975, p. 151).

Topic Amniocentesis

Ethical Questions

1. Should we use this technique to establish if a fetus is genetically defective?

2. Should we use it to establish the sex of a fetus?

3. Is it proper to allow pregnant women to undergo prenatal detection?

4. Should all families decide by themselves whether or not they must take the risk of amniocentesis?

5. Should selective abortion be allowed?

6. Is informed consent necessary?

7. Should a woman above forty be advised to undergo amniocentesis?

8. Whether or not citizens have the right to know about the availability of amniocentesis?

9. Who should be given preference for amniocentesis, an expectant mother over forty or one who has a history of genetic problems?

10. Should individuals be prevented from using amniocentesis for non-coercive breeding?

Applied Strategies

1. CBCAI test.

2. Case studies.

3. Small and large group discussions.

4. Research formats.

5. Role-playing (Bridger, 1977, p. 242).

Topic Artificial Insemination

Ethical Questions

1. Should we allow people access to 'sperm banks', and choose sperms with desired traits?

2. Who is the legal father if the child is produced by a donor semen?
3. Can such a child be regarded as legitimate?
4. Should we allow use of donor semen?
5. What about the sanctity of the family?

Applied Strategies

1. Group discussion.
2. Decision making model.
3. Case studies.
4. Role-playing.
5. Value continuum.
6. CBCAI test.

Topic Behavior Modification (psychosurgery)

Ethical Questions

1. Is it beneficial to the individual or the society?
2. Should we use drugs or surgery?
3. Is informed consent essential?
4. Who should decide what is normal and what is abnormal?
5. Should there be a choice between competing forms of therapy?
6. Is it right to subject a person to the control of others so that he may eventually be restored to self-control?
7. What happens to personal freedom?
8. Should expectant mothers undergo control by

coercion (shock treatment, drug therapy, or electrode treatment)?

9. What happens to the right to privacy?

10. Is it morally right?

11. Should we allow people to undergo drug therapy?

Applied Strategy

1. Case studies.

2. Role-playing.

3. Research reports.

4. Group discussions.

5. Value continuum.

Topic Euthanasia (Death with dignity, living will)

Ethical Questions

1. Whether or not right exists to kill a comatose person whose explicit consent is not obtainable?

2. Is it moral to kill a person in pain?

3. Who should decide when a life is over, or should be over?

4. What should be the definition of death (clinical or brain death)?

5. Should it be legal to help someone who does not want to live any more?

6. Should an ill person be told about his terminal illness?

7. Do families and physicians have the right to

prolong or terminate a life of pain and suffering?

8. Who should decide that time has come to commit active or passive euthanasia (the doctor, the patient, or the family)?

9. Should 'living wills' and 'death with dignity' be legalized?

10. Should we use a life-support system when a person is technically dead?

11. Should we take into account the age of the patient?

12. Can we postpone death?

13. Should we interfere in the patient's rights?

14. Should we get the consent of the patient?

15. Should we let critically-ill patients to die?

Applied Strategies

1. Case studies.
2. CBCAI test.
3. Group discussions.
4. Role-playing.
5. Decision making model.
6. Research reports.

Topic Family Planning (Birth control)

Ethical Questions

1. Who should assure the safety of contraceptives?
2. Should we prefer oral contraceptives to other devices?

3.Should we discourage use of contraceptives?

4. Is IUD an abortive agent?

5. Should we sterilize unfit individuals?

6. Who has the right to decide , the society or the individuals?

7. Should we get informed consent of the people to be sterilized?

8. Should preference be given to male contraceptives?

9. Whether or not there should be legal and economic aspects of sterilization?

10. Are there any religious or legal objections?

Applied Strategy

1. Role-playing.

2. Decision making model.

3. Case studies.

4. Research reports.

5. Group discussions.

Topic Fetal Research

Ethical Questions

1. Should biomedical research on living fetuses be permitted?

2. When should a fetal experimentation be done?

3. Is informed consent from parents necessary?

4. Ought fetal research be conducted on the basis of risks/benefits analysis?

5. Should we differentiate between a fetus to be aborted and a fetus going to full term?
6. Who will take responsibility for a fetus born alive but damaged by research procedures?
7. What about woman's rights?

Applied Strategy

1. Group discussion.
2. Decision making model.
3. Role-playing.
4. Case studies.
5. Research reports.

Topic Genetic counselling

Ethical Questions

1. Should we use the services of genetic counselling?
2. Whether or not government should pass laws so that people advised by genetic counsellors are bound to take the latter's advice?
3. Should the government be involved in educating the masses on genetic counselling?
4. Should genetic counselling be provided to parents when the fetus is found to be defective?
5. Whether or not society should bear the financial burden of caring for a child with a severe genetic defect, if the mother elects not to abort?
6. Will there be any benefits to mankind?

Applied Strategy

1. Case studies.
2. Group discussions.
3. CBCAI test.
4. Role playing.
5. Research reports.

Topic Genetic defects

Ethical Questions

1. Should we spend extra money to keep new borns with serious genetic defects alive?
2. Should the decision to abort be dependent on the seriousness of the defect?
3. Whether or not a couple should reproduce when one of them has a genetic defect?
4. Should we deny individuals with genetic defects the right to reproduce?
5. Whether or not people with serious genetic defects should be sterilized?
6. Should the government provide financial assistance to women wanting to abort defective fetuses?
7. Should abortion be resorted to when a fetus has Sickle-cell Anemia, Down's Syndrome, Phenylketonuria, and Spina Bifida?

Applied Strategies

1. Case studies.
2. Role-playing.

3. Decision making model.

4. CBCAI test.

5. Research reports.

Topic Genetic Engineering

Ethical Questions

1. What are the benefits and risks of applying this technology to solve human problems?

2. Who is responsible for the inherent risks?

3. Should genes of rare species be frozen for later mass production?

4. Should we support and encourage DNA research to produce humans with special traits?

5. Do only such individuals who have been developed with special inherited traits have the right to live?

6. Should genetic research be regulated by federal legislation?

7. Whether or not society should impose restrictions on all genetic research?

8. What would be the legal status of a human clone?

9. Do we have right to tamper with our heredity material?

Applied Strategies

1. Rank order technique.

2. Decision making model.

3. Group discussions.

4. Research reports.

5. Role-playing.

Topic Genetic Screening

Ethical Questions

1. Should society pay the cost of genetic screening program?
2. Who protects the privacy of those who are screened?
3. Should we perform screening on all pregnant women or those with an affected child, or those who request the test?
4. Should the screening tests be voluntary or mandatory?
5. Whether financial assistance must be provided to encourage participation in a voluntary program?
6. Is there a need for a national program for screening?
7. Should money be the sole factor in determining whether or not a screening program should be implemented?
8. Should informed consent be mandated by law?
9. Should screening be performed even if the mother is not willing to go ahead with abortion?
10. Is there a need to screen new borns for genetic defects?
11. Should genetic screening be banned in order to respect privacy?

Applied Strategies

1. Case studies.
2. Group discussions.
3. Role-playing.
4. Research reports.

Topic Gene Surgery

Ethical Questions

1. Should a person employ gene surgery to modify his genes (for example, preferring blue eyes to brown eyes)?
2. Should society support scientists who want to change human characteristics by adding or removing genes if and when possible?
3. Should there be religious or legal objections to gene surgery?
4. Ought we to correct hemophilia or subnormal intelligence by such a technique?

Applied Strategies

1. CBCAI test.
2. Group discussions.
3. Decision making model.
4. Rank order technique.
5. Research reports.
6. Role-playing.

Topic Human Experimentation

Ethical Questions

1. Should we get informed consent from the subjects of the experiment?
2. Who assures the safety and liability for undesirable results?
3. Who should look after the interests of a human embryo

when considered for experimentation?

4. Should there be a preference for a special group for experimentation?

5. Should human experiments be done if and only if there is consent?

6. What should be the principles and practices for informed consent?

7. Do we need to inform a subject about the consequences and the conditions of an experiment?

8. Is therapeutic or manipulative experimentation all right?

9. Should children be experimented upon based on their parents' decisions?

Applied Strategies

1. Group discussions.

2. Role-playing.

3. Research reports.

4. Decision making models.

Topic In vitro Fertilization

Ethical Questions

1. Should society support studies on in vitro fertilization?

2. Who should decide the legal status of natural mother vis-a-vis the child when a surrogate is used?

3. Should there be religious or legal objections?

4. Who assures the safety of embryo throughout the duration of the process?

5. Is there any concern for the sanctity of family?

Applied Strategies

1. Case studies.

2. Role-playing.

3. Group discussions.

4. Decision making models.

5. CBCAI tests.

6. Research reports.

Topic Nutrition

Ethical Questions

1. Can the overpopulated and starved countries be fed?

2. Should we question the nutritional value of the foods we intake?

3. Do benefits of food additives outweigh the risks?

4. Should human population be controlled in view of the food shortage?

5. Can the use of synthetic foods be permitted?

6. Is it beneficial to use medicines to achieve quick weight loss in a health conscious society?

7. Is there a need for action to purify polluted environment in order to assure our safety?

8. Should heroin be legalized for medical use?

9. Should expectant mothers smoke?

10. Should government regulate smoking , alcohol and drugs?

Applied Strategies

1. Role-playing,
2. Group discussion,
3. Decision making models,
4. Research reports.

Topic Organ Transplantation

Ethical Questions

1. Should citizens be encouraged to donate organs?
2. Who should and who shouldn't donate organs?
3. When should the donor and recipient be chosen?
4. Is organ transplantation beneficial to the society?
5. Should decisions regarding transplants be made on an individual basis?
6. Is informed consent necessary?
7. Who should decide whether or not to go ahead with a transplant?
8. Should there be a tax incentive for donors?
9. Whether or not we should support further research on the dynamics of organ rejection?

Applied Strategy

1. Case studies.
2. Role-playing.
3. Group discussions.

4. Decision making model.

5. Research reports.

Topic Population Control

Ethical Questions

1. Should we encourage surrogate motherhood in an already overpopulated world?

2. Should there be a limit on family size?

3. Should society finance a cure for infertility?

4. Should society respect religious stances on family planning?

5. Is there a need for strong measures to alleviate the problem of overpopulation?

6. Should abortion be legalized to facilitate population control?

Applied Strategies

1. Role-playing.

2. Group discussions.

3. Research reports.

4. Decision making models.

## 5.5 Proposed strategy

The proposed strategy has been developed to serve as an example of how to teach various bioethical issues in the human biology curriculum. This strategy comprises two phases:

Phase I: Lecture Method

Phase II: Written Assignments

The lecture method includes giving scientific background to the issues, followed by the technological terms and technology used. This in turn will lead to the ethical concerns of issues at hand. For example, if the issue is 'hormone use', the teacher will talk about hormones in females, menstrual cycle and hormones, and hormones in males. Students will be asked to read in advance the scientific information concerning the issue. This will help them understand the topic and its issues.

The teacher will also inform the students about the technology involved in hormonal uses. For example, oral contraceptives, prevention of miscarriage, palliation of menopausal systems, possibilities of male contraceptives will be discussed. This will be followed by a number of ethical issues related to the use of hormones. These issues will include risk of hormone use to alter normal physiology, definition of safety, responsibility of deciding, human experimentation, legal

responsibility, and delayed effects of hormone use.

With the help of films or slides and guest speakers (an expert), students will be able to understand the issue logically. This will lead to a class discussion where they will discuss the positive and negative aspects of the issue at hand. The teacher will guide the students to discuss the issues by asking 'why' and 'what' questions (Smith, 1980, p. 11). In this manner, by stimulating critical thinking students will be able to analyze the issue, give their reasons, and propose various alternatives for the solution of the issue.

Phase II is based on Zipko's format (1983, p. 48). Here students will be exposed to a diversity of issues, and will be asked to select any issue for the assignment. Students will bear in mind the ethical nature of the issues, and their long term effects on society.

Students will be given four weeks to complete the assignment individually or in groups of three or four. Potential issues for such an assignment include abortion, family planning, fetal research, human experimentation, behavior modification, amniocentesis, genetic screening, genetic counselling, cloning, recombinant DNA research, population control, and invitro fertilization. This will lead to an extensive library research by students. Relevant references from

current research papers and magazines will be encouraged.

The library research will culminate in a written paper and an oral presentation. The presentation will include background information, their position on the issues, and predicted consequences. In the oral presentation the student or the team will use audio visual aids, data on the issues, and appropriate discussion techniques. Thus effective communication will become as important as the issue itself. This will stimulate a lively discussion among the teams followed by resolution and a consensus on possible alternative solutions. The teacher will aid the students by creating simulation and role playing games. Finally the students will be evaluated by the teacher. The feedback from the teacher will help the students improve their understanding of the issues.

To conclude, bioethics in human biology is an action oriented course which will give students a relevant experience in making informed decisions. The course is important for all students regardless of their scholastic standing. Both science and non-science majors will benefit from this course. Students not only gain an understanding of the issues, but also learn to analyze them.

At the secondary level, a student being of adolescent age is faced with personal problems that need to be discussed. They need to know positive and

negative sides of an issue. That will help them find the solution to their problems. Also, the teacher's divergent knowledge and teaching skills will enable him to serve them in a novel and effective manner. Since the contemporary goal of modern biology education is to prepare citizens with responsible decision making skills, it is the responsibility of biology educators to develop skills necessary to achieve these goals (Yager, 1983b, p. 14). With the help of other colleagues, biology teachers can merge value clarification techniques and decision making skills with bioethical teaching. This will in turn foster development of decision making skills among our students. Hence bioethical issues cannot be separated from human biology as problems of life seldom occur outside the context of values, ethics or prefereneces. Human biology should therefore include the issues of decision making bioethics.

## 5.6 Conclusions and Recommendations

We live in an age of biological revolution. Most of the biological advances at present are in life sciences. This is going to be true in the future as well. These discoveries and developments are having a profound effect on our students. As such we need to train our students to think seriously and thus to prepare them for their future role in making public policy. This can be achieved by exposing students in schools to current

bioethical issues. Since these issues are concerned with human beings, it is essential that human biology students learn to understand and analyze them.

In human biology, students will not only learn about human physiology, but also will discuss life and death issues inherent in it.Such issues as abortion, use of contraceptives, artificial insemination, fetal research, amniocentesis, genetic screening, genetic engineering, recombinant DNA research,and human experimentation need to be discussed. All these issues have a great impact on human lives. It vividly emphasizes the special need for teaching these controversial issues in the human biology curriculum.

According to many educators, decision making in the broadest context is one of the most important aims of education (Castleman, 1974, p. 18; Hoskins, 1976, p. 533; Wilson, et al, 1979, p. 226; and Boone, 1984, p. 449). Hence it would seem reasonable to direct our instructional efforts toward the goal of ethical decision making in human biology. Priority must be given to preparing secondary school students for crucial bioethical decision making. It is valuable for science educators to place their students in a learning environment that would expose them to value exploration and decision making skills (Hoskins and Shanon, 1977, p. 149; Sell, 1982, p. 160). By using analytical thinking

and problem solving skills, students should develop both morally and intellectually. Moreover, by identifying the moral/ethical premises for their decision making, and the logical inconsistencies in their value patterns, students should become sensitive to difficulties of making moral/ethical decisions.

Students at secondary level need to be informed about the complex issues that can mold their lives if they are not prepared to make value judgments and effective decisions. These students should not fall victims to ignorance thereby allowing others to make decisions for them. Hence, to understand the implications of bioethical decision making we need bioethically literate citizens.

To increase the awareness of bioethical issues among students, teachers should prepare them to become well informed decision makers of tomorrow. In this sense, the teacher's role should be to: (1) develope analytical skills, practice of reasoning so that decisions are made skillfully; (2) create an atmosphere of student interaction and cooperation involving them in value exploration and higher moral reasoning; and (3) involve students in library research analyzing the issues to increase critical thinking and using relevant current teaching material. By meeting these goals, the human biology teacher can train his

students to improve the quality of life with a well educated background in bioethical decision making.

A number of recommendations can be suggested for implementing bioethics in the human biology curriculum. To begin with, bioethical issues should be added specifically in human biology and human genetics. Both students and teachers can expand various important issues based on their personal experiences. The curriculum needs to be reformulated and reorganized to facilitate the implementation of bioethical issues. As such, school administrators, teachers, community members, and the ministry of education should take the responsibility of making the curriculum relevant to the needs of the students.

Various seminars in bioethics could be set at the secondary school level. These seminars can be arranged by school officials. Both students and teachers must attend the special presentations made by resource persons such as lawyers, doctors, professional educators, social workers, and religious leaders who can be invited to address bioethical issues. This can help students understand each issue in depth. The seminar can lead the participants into lively discussions which in turn can encourage the students to take a stand on an issue.

Faculty and action oriented students can choose to publicize bioethical issues in schools. These publications will inform other students, citizens, government officials, and the public at large about biomedical technology and its impact on human lives. This awareness will prepare citizens in advance to meet future challenges. Human bodies will not meet the same fate as the environment due to the industrial revolution. This will arouse a sense of awareness and interest among other students and citizens to know about these issues. As such both science and non-science majors can get the opportunity of studying bioethical issues offered in the human biology curriculum.

Teaching bioethical issues would need the training of in-service and pre-service teachers. These teachers will have preparation in value clarification techniques, development of moral reasoning, and decision making skills. They will acquire an up-to-date knowledge of current issues and problems. This would need an extensive use of research materials by the teachers. In this respect a well informed teacher can communicate effectively with his students. In addition, teachers need to employ multiple methods of instruction to facilitate a more meaningful and interesting presentation. This will allow student interaction and a free

discussion of the issues.

Finally, topics in bioethics need to be reevaluated and revised periodically, since issues change with advances in technology and biomedicine. Curriculum developers must ensure that the course offered is relevant to the personal and societal needs of the students. This means that new bioethical issues must be added to the human biology curriculum from time to time.

# APPENDIX

Some key features of human genetic defects

Cystic Fibrosis

The most common lethal genetic disease occurring among U.S. Caucasians. Abnormal mucus secretions block respiratory tract and pancreatic ducts. Treatment includes administration of antibiotics and pancreatic enzymes, as well as physical therapy designed to promote clearing of mucus from respiratory tract.

Down's Syndrome

Characterized by the trisomy for chromosome 21 (i.e., the affected person's cells each has 47 chromosomes, including 3 rather than the normal 2 chromosomes number 21). Children with this disease have reduced viability, decreased life expectancy, high incidence of congenital heart defects, leukemia and respiratory illness. Most are mentally retarded and possess almost slanting eyes(hence, the name 'mongolism' for this syndrome).

Hemophilia

Also called 'bleeder's disease', exists in two forms, classical hemophilia A (due to absence of the clotting factor, antihemophilic globulin) and hemophilia B (due to absence of the clotting factor, plasma thromboplastin). Both forms are due to X-linked recessive genes. Classical hemophilia is sometimes known as the

'royal disease' because Queen Victoria of Great Britain was a heterozygous carrier of the gene.

Neural Tube Defects (NTDs)

It affects the continuous tube forming the spinal cord and brain. One form of the defect called 'anencephaly',affects the brain resulting in its being exposed and causing fetal or neonate death. The other form of the defect called ' spina bifida', affects the spinal cord. There are many forms of spina bifida, ranging widely in severity. At one extreme is an open spinal cord that is covered by skin. Surgery can repair the defect. At the other end, the spinal cord and nerves protrude through the skin. The damage is most likely to be extensive. Children usually are mentally retarded with no bowel or bladder control. An extensive surgical treatment is mostly recommended.

Phenylketonuria (PKU)

A condition caused by the absence of the liver-produced enzyme, phenylalanine hydroxylase. Affected persons cannot properly metabolize the amino acid, phenylalanine, which then accumulates and is converted to abnormal metabolites that apparently interfere with normal brain development. PKU results in severe mental retardation. New-borns can be screened via a blood test and affected individuals can be helped by a low phenylalanine diet.

Sickle-Cell Anemia (SCA)

A condition caused by a defect in the β-polypeptide of the hemoglobin molecule in which the amino acid valine replaces glutamic acid in one position. The defective hemoglobin causes the red blood cells to assume a cresent (sickle) shape under low oxygen conditions. Sickled red blood cells jam capillaries and reduce the oxygen supply to vital organs. SCA is especially common in the black population but occurs in other ethnic and racial groups.

Tay-Sachs Disease

A lethal condition occurring primarily in Jews of eastern European origin (due to the absence of the enzyme hexoseaminidase-A) which results in abnormal lipid metabolism. Affected children generally die before four years of age. Prenatal detection is possible using amniocentesis technique.

Turner's Syndrome

A condition evidenced by females whose cells possess 45 (rather than the normal 46) chromosomes. Affected individuals lack one X chromosome. Many Turner's fetuses abort spontaneously. Those that survive lack ovarian tissue and are sterile (the condition is sometimes called gonadal dysgenesis). Other features include broad flat chest, widely spaced nipples, short stature ,and so on. Mental retardation is generally minimal( Mertens, 1980a, p 120-121).

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