

Frontiers of Medicine

Teacher's Student Activities

Objectives

Completion of the suggested explorations will enable students to address the following questions:

- What are the latest discoveries in AIDS research and genetic engineering?
- What medical breakthroughs have occurred in our understanding of infectious disease processes?
- How has the development of genetic engineering enhanced our ability to manipulate life?
- What are the potential applications of recent medical breakthroughs?
- What is the connection between the mind and the body, in relation to health and illness?
- Might the use of these emerging technologies somehow change the natural course of human evolution?
- What are the ethical responsibilities of science and scientists? Are there applications that should not be pursued, regardless of the ability to do so?
- Who should decide which scientific applications are ethical pursuits?

Using the

[Pre-Program Explorations](#)

- Prior to viewing the program, students should define any of the content-related terms that are unfamiliar, so as to improve their subsequent understanding of the presented issues.
- Research of the suggested topics will provide students with the background information necessary to discuss the program content effectively. Depending upon your time constraints and access to research materials, you may want to divide the questions amongst different student groups; findings can then be shared with the entire class. The Web sites listed in the "Reference Materials" section may be good starting points for student research efforts.
- The "Issues to Consider" provide thought-provoking questions that can be used as the basis for classroom discussions or can be answered through individual written

responses. You may want to revisit these issues after the students have viewed the program, to see if their thoughts and opinions have been modified in any way.

Using the

[Post-Program Explorations](#)

- The explorations are divided into curriculum areas; however, you will find that some of the lessons are actually interdisciplinary in scope and could easily be placed in more than one area. We have categorized these multidisciplinary studies based upon the dominant theme of each.
- Included in this section is a "Current Event Exploration", which is a Web lesson designed around a timely issue, related to the program content. The suggested Web sites will aid students in the information gathering process. The synthesis of their research efforts can be documented via written response, oral presentation, or using multimedia (e.g. PowerPoint, HyperStudio, Web page creation).
- The suggested lesson ideas can be approached in numerous ways. Many are well suited to cooperative learning methods, where members of individual student groups address different aspects of an issue, and the group then synthesizes that information to formulate an answer.
- Individual or group completion of all of the explorations provides an interdisciplinary approach to the program theme. As a result, students are able to analyze the issues from multiple perspectives. If, however, time is limited, you may choose to confine student explorations to those that directly relate to your discipline. Students, for independent study, could then investigate additional topics.
- Possible assessment methods for these explorations are varied. You may want to have students demonstrate their understanding through individual written essays, through group projects, or through classroom discussions and debates. The method(s) you choose can be tailored to learner strengths or curriculum considerations.
- The "Reference Materials" can aid in the completion of these explorations and will probably foster your own ideas for lessons. Giving students reading assignments from the print materials, or portions thereof, will enhance their knowledge base and provide them the opportunity to examine original sources, thus decreasing reliance upon textbook accounts. These resources vary in terms of their

reading level; these differences may be a consideration as you assign student readings.

Pre-Program Explorations

Terms to Define

- AIDS
- alternative medicine
- antibiotic
- bacteria
- chromosome
- clone
- diseases of lifestyle
- DNA
- embryologist
- gene
- HIV
- host factors
- immune system
- mutation
- placebo
- RNA
- somatic cell
- stem cell
- ulcer
- vaccine

Topics to Research

- Trace the evolution of the fight against AIDS, from its emergence in the early 1980's to the present. How have incidence rates, treatments, survival and death rates, understanding of the disease, and education efforts changed over this period? What advances are forecast for the future?
- Distinguish between HIV, ARC, and AIDS. How is the virus contracted and what are its effects on the immune system?
- Outline the procedure by which a mammalian clone, such as Dolly, can be produced.
- What is the purpose of the Human Genome Project? What methodologies are being used to meet the goals of the project?
- Explain the roles of genes, chromosomes, and DNA in the replication of cells and organisms.

Issues to Consider

ISSUES TO CONSIDER

- What should be the goals of medicine and medical research?
- Should medicine and/or science do all of the things of which it is capable?
- What are the potential risks and benefits associated with genetic engineering?
- Although many diseases have well-documented, effective treatments, all segments of the world's population do not have equal access to health care. What are the ethical implications of these inequities?
- Is there a mind-body connection that affects one's health or one's ability to fend off disease?
- What should be the role of private industry in medical research and the applications thereof?
- How should society determine its priorities for expenditures and commitments? Should genetic engineering be one of those priorities, and if so, what benefits does it bring us?
- The featured guests are described as achievers. Does achievement differ from success, and in what ways? How would you define achievement?

Post-Program Explorations

ACHIEVEMENT EXPLORATIONS

- Achievement Television has defined six components of achievement: vision, preparation, integrity, courage, passion, and perseverance. Choose one of the featured guests and give examples of ways in which he embodies these traits.
- Choose one of the individuals listed in the first science exploration, and analyze his/her contributions, in light of our definition for achievement. Can he/she be described as an achiever?

SCIENCE EXPLORATIONS

- Examine the contribution that each person has made to our current understanding of life and the way in which it functions.
 - Fred Sanger
 - George W. Beadle and Edward L. Tatum
 - Paul Berg

- Erwin Chargaff
- Harriet B. Creighton and Barbara McClintock
- Francis H. C. Crick and James D. Watson
- Walther Fleming
- Archibald Garrod
- Alfred Hershey and Martha Chase
- Arthur Kornberg
- Gregor Johann Mendel
- Friedrich Miescher
- Hermann J. Muller
- Kary B. Mullis
- Marshall Nirenberg and H. Gobind Khorana
- Hamilton Smith and Kent Wilcox
- Nettie Stevens and Edmund Wilson
- Walter Stanborough Sutton
- Edouard van Beneden
- August Weismann
- Maurice Wilkins and Rosalind Franklin

- Read *Race for the Double Helix*, the account of the discovery of DNA's structure. How did the understanding of DNA's structure evolve, after the substance was first discovered? What did you learn about the nature of scientific endeavors? Who do you believe should have been awarded the Nobel Prize for the discovery?
- Pretend that you are a member of the National Bioethics Advisory Committee, which is convening to reevaluate its stand on human cloning. What criteria would you use to decide if efforts to clone humans should be pursued? What conditions would have to be met in order for you to grant approval for scientific cloning efforts?
- Conduct research to determine the cause(s), risk factors, symptoms, incidence, treatment and/or cure, prognosis, and fatality rate for the following genetic diseases: cystic fibrosis, Down's syndrome, hemophilia, muscular dystrophy, sickle cell anemia, Tay-Sachs disease.
- Drs. Marshall and Weil did not agree on whether technology has harmed or aided the cause of medicine. What is your opinion of its role? Support your position with specific examples.
- Conduct research to determine the five leading causes of death in the United States. Which of these can be categorized as "diseases of lifestyle"? What lifestyle changes decrease the likelihood, or delay the onset, of these diseases? Are you willing to make lifestyle changes now, for the sake of disease prevention later in life? Why or why not?

- Each society has many responsibilities to its members, yet money is a finite resource. Assuming that there is not enough money to explore any and all issues, provide a list of the ten most important areas for medical research, in ranked order. Indicate the reasons that an item is included on the list, as well as the rationale for its ranking.
- Explore the history of women in the field of medicine. What contributions have been made, what obstacles exist (or existed), and how can their role be expanded?

HISTORY/SOCIAL STUDIES/ETHICS EXPLORATIONS

- Trace the development of medicine over the course of history, from a discipline that was steeped in superstition and misunderstanding, to one that relies upon the scientific method to test hypotheses and determine validity of ideas.
- The twentieth century is often referred to as the age of physics, whereas the focus of the twenty-first century is expected to be biology or biotechnology. Discuss the appropriateness of these labels for each epoch. How did the age of physics impact society, and do you think that the age of biology will have similar effects upon humankind?
- As researchers work at the frontiers of medicine, who should ultimately decide which scientific applications should be pursued? And on what criteria should such decisions be based?
- Genetic engineering could give one the ability to alter the genes of one's offspring. For what reasons would such tinkering be ethical?
- Dr. Collins cited a quote from Albert Schweitzer, in which he said that technology must not exceed humanity. Explain this statement, and discuss the implications, for society, if technology were to exceed humanity. Has this already happened?

ENGLISH/LANGUAGE ARTS EXPLORATIONS

- The manner in which an HIV infection progresses has been likened to the episode of the Trojan War that involved the Trojan horse, as recounted in Homer's *Iliad*. Read this segment of Homer's epic and write an essay that evaluates the aptness of this analogy to describe HIV.
- Read Aldous Huxley's *Brave New World*. Evaluate the accuracy of his vision of genetic engineering and its effects.

CURRENT EVENT EXPLORATION

(Web lesson)

The Future of Cloning

First there was Dolly. Then there was Polly. Two sheep that have opened our eyes to the possibilities that medical research has uncovered. The ability to clone cells, organisms, and large mammals, already exists. How might these technologies be used in the future, and what are the potential risks and benefits?

In this lesson, you will explore the Web to find out more about the current status of cloning technologies and possible future applications.

Question for Exploration

How might the ability to clone organisms impact future generations?

PROCEDURE

1. Collect background information. In order to formulate an answer to the "Question for Exploration", you'll need to conduct some research to gather pertinent information and data about the topics. Some suggested areas for research are listed below, but you may find that you need to answer additional questions to make an informed response. A list of Web sites is provided, at the end of the procedure section, to help jump-start your search. If you need to gather information from additional resources, be sure to evaluate their validity. Government and university sites generally have more reliable information than personal or commercial sites. Keep a record of the information you've collected, as well as the source of that material. Include both the Web site name and URL address.

- What is a clone?
- What is the procedure by which large mammals can be cloned?
- What are the problems inherent to this procedure? Will scientific advances diminish these problems?
- Are there any negative effects upon cloned offspring? Do they differ from offspring produced "naturally"?
- How will changes to the genetic makeup of members of a population impact evolutionary processes and future generations?
- Does the cloning process increase the likelihood of

- Does the cloning process increase the likelihood or severity of genetic mutations in a population?
- What has been accomplished in the field of cloning to date, and what research avenues are being explored?
- What are the benefits of cloning, on any scale (cells, tissues, organs, organisms), for medicine and the ability to treat and/or prevent disease?
- Currently, could a human be cloned?
- Why would the ability to clone humans be beneficial? When would it be acceptable?
- Is there potential for abuse of these technologies?
- How would such technologies be regulated? Who would benefit from these technologies?

2. Synthesize the information that you've collected to develop a response to the "Question for Exploration". The format for that response, (written, oral, Web-based, etc.) will be decided upon by your teacher.

Suggested Web sites:

[Cloned: News Updates and Information Resources](#)

[Slouching Towards Creation: Peering into the Face of Cloning](#)

[Cloning: A Special Report](#)

[Human Cloning Plans](#)

[The Church of Scotland: Science, Religion, and Technology Project](#)

[Human Cloning Foundation](#)

[Ethical Aspects of Human Cloning](#)