The Government and Science: An Interrelationship

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INTRODUCTION

This unit is designed for a United States History class that is offered in the eleventh grade. It may be used in two ways: as an end of the semester review or as a unit on the interaction of the federal government and the scientific community. With adjustments for the reading, the unit can be used in either regular or honors classes in eleventh or ninth grades. The school is on an accelerated block schedule with five 90-minute classes weekly. The school population is predominantly minority and low income; many students are recent immigrants or refugees.

RATIONALE

The interrelationship between government and the scientific community is a long and complicated story. Current United States history books touch briefly on major inventions and technology. They contain some material on organizations concerned with physics – specifically the Manhattan project and NASA, but they provide very little information about biological concerns, apart from brief citations of Margaret Sanger and birth control, Walter Read and the Panama Canal, and Jonas Salk and polio. Much is omitted, including any reference to the 1918 flu pandemic.

The purpose of this unit is to show the development of government agencies that deal with biological matters and to discuss some of the current problems that these agencies face in organizing research, in supervising scientific investigations, and, most importantly, in dealing with ethical problems.

REASONS FOR GOVERNMENT INVOLVEMENT

In 1776, the second year of the Revolutionary War, the Second Continental Congress passed a pension act that provided for assistance to wounded veterans of the Revolution. (1) Later, in 1798, the Marine Hospital Service, a forerunner of the U.S. Public Health Service, was established to provide medical care for merchant seamen. (2) From these two rather modest beginnings came the development of the huge institutes and bureaus that sponsor and control much contemporary scientific research. In establishing these precedents, the government was trying to address both military and economic concerns. The care of military personnel and the support and encouragement of business and trade have continued to affect government policies from the eighteenth century to the present. Research and technology eventually required the administrative support of agencies and commissions. As the federal bureaucracy grew, not only in the Great Depression but also

in the eras of the Civil War and World Wars I and II, the size of the agencies that oversaw scientific areas also increased.

The Constitutional authority for governmental involvement in these actions is found in Article I, section 8 of the Constitution. Here Congress is given the power to raise armies, maintain a navy, provide for the common defense, regulate commerce, promote the progress of science, and establish a uniform rule of naturalization. The elastic clause, which allows Congress to pass whatever laws are needed to carry out its constitutional powers, permitted the "progress of science" to expand beyond the narrow limits of the Patent Office to institutions such as the Smithsonian, the National Institutes of Health, the Center for Disease Control, and the National Science Foundation. Similarly, naturalization laws were expanded to include health examinations of immigrants. Each of these expansions widened the government's power and required organizations that are more complex.

Wars force governments to invest more resources in research and development of weapons and associated war materiel. The relationship between government and the scientific community can be traced to Archimedes (287-212 B.C.), whose inventions and applications of physics were used for the military defense of Syracuse. Similarly, the Duke of Milan hired Leonardo da Vinci (1452-1519) to help with military preparedness. During the American Civil War, there were several developments that would involve the government in research. The National Academy of Sciences (1863) was supposed to be an organization that would advise the government on scientific issues and was organized so that there would be some centralized control over American science. The Department of Agriculture (1863) established the precedent that taxes could be used to support research conducted in the national interest. (3) Abundant food crops are a necessity for any war effort. The Homestead Act (1862), which encouraged new farms in the west, and the Morrill Land Grant Act (1863), which enabled states to establish state colleges, were other innovations of the period. Many of the land grant colleges would develop into today's research universities.

The need to take care of American military personnel required a medical service under the jurisdiction of the Surgeon General, whose original sphere of influence was much smaller than the modern one. As the title implies, the emphasis on medical work in the military was originally on the care of battlefield wounds and injuries. Although the federal government established a small hospital for veterans in 1811 (4), it did not expand its role in providing services for veterans until after the Civil War. Abraham Lincoln, in his Second Inaugural Address, cited the need "to care for him who shall have borne the battle, and for his widow, and his orphan." This hope was finally realized by setting up facilities to care for veterans.

The large percentage of the population that had seen active service in the Union army in the Civil War ensured that there would be a powerful voting bloc to press for veterans' concerns, especially pensions. Gratitude for the veterans' services and political pressure

from these same veterans caused Congress to enact several pension laws from 1862 to 1890. The pension laws' significance for historians was that a veteran was required to have a physical examination to determine eligibility. Although there was not a consistent standard of thoroughness, the government did keep records on the health of Civil War soldiers from the time of their enlistment through the years they received pensions. The compilation of these records began shortly after the Civil War. These data were re-evaluated in the late twentieth century and are now known as the Union Army Study; they are housed at the University of Chicago. These records provide data not only for massive longitudinal studies of veterans' health, but also have shown interesting results in other areas. For instance, they establish migration patterns to and from the west by using the changing addresses of veterans. Differences in immunity developed by residents of urban and rural areas can be inferred by comparing health records of recruits from cities and farms; the former were generally less prone to sickness in the army than were the latter.

The need to care for these Civil War veterans was the primary force behind the establishment of veterans' hospitals. The 1890 pension act widened pension eligibility to include non-service related problems. This increased eligibility, combined with the aging of the veteran population, forced the government to widen the scope of its medical care. Government medical services would be responsible for treating both a basically healthy young male population who were in the active military service and older veterans who would be presenting problems typical of the general population. Later wars, in which United States forces fought in tropical climates, introduced unfamiliar illnesses and led to the study of tropical diseases in military installations. The Veterans Administration, established in 1930, assumed control of hospitals for veterans. Veterans from the Indian wars, the Spanish American War and, most significantly, World War I were the initial patients. The World War II veteran population provided the most demand for services in the second half of the twentieth century. As the older veteran population declines, there has been increasing pressure to close these hospitals.

In addition to the demand for increased services to veterans, the hope for increased trade in Asian markets, increased European immigration, and the beginning of the Progressive movement caused other government organizations to become involved in health matters. A laboratory in the Marine Hospital (Stapleton, Staten Island, NY) was set up in 1887 because of the danger of infectious diseases, including yellow fever and cholera, being brought in by seamen and immigrants. This hospital, the Hygienic Laboratory, was moved to Washington in 1891 and was funded by Congress in 1901 with a mandate to investigate "infectious and contagious diseases and matters pertaining to the public health."(5) Interest in public health and welfare was a characteristic of the Progressive movement and resulted in the passage of the Meat Inspection Act (1906), the Pure Food and Drug Act (1906), the Biologics Control Act (1902) and the newly reorganized and renamed Public Health and Marine Hospital Service (1902). The Biologics Control Act was passed in reaction to the deaths of thirteen children who received contaminated diphtheria antitoxin. The new agency started government research

in immunology and regulated the manufacture of vaccines until 1972 when supervision was given to the Food and Drug Administration. Another widening of the government's role in research occurred with the Public Health Service Act (1912), which allowed research into non-contagious diseases and pollution in streams and rivers.

Two developments in the 1930s had particular importance for the government's support of scientific research. In 1930, the Hygienic Laboratory was renamed the National Institute of Health (note the singular) by the Ransdell Act. This act provided fellowships for research into basic biological problems. This is significant for two reasons. First, its impetus came from the desire to apply the knowledge of chemistry that had been gained in World War I to biological problems. Second, the failure to find private funding because of the Great Depression forced the scientific community to turn toward the government. The second innovation in 1937 was the creation of the National Cancer Institute. This was the first time an institute would be established to focus on what was thought to be a single disease. Organization by type of disease has become common in the NIH.

The fight against poliomyelitis also changed the government's role in scientific research. In the early 1950s, the National Foundation for Infantile Paralysis (NFIP) spent ten times as much money on polio research as did the National Institutes of Health and, in the days before health insurance, paid for the care of polio patients. (6) The NFIP had managed the national field trials for the Salk vaccine, but when it was time to administer the vaccine nationally, the NFIP could not undertake the job because its financial resources had been exhausted. Government help posed political problems for President Dwight Eisenhower who had taken a stand against socialized medicine in his campaign and had opposed active government help. The Department of Health, Education and Welfare (Oveta Culp Hobby, Secretary) was not prepared to administer the distribution of the vaccine, believing that this was a job best left to the states because polio did not affect the national interest of the United States. (7)

Testing the quality of the vaccine became the responsibility of the Bureau of Biologics (formerly the Laboratory of Biologics Control) in July, 1955. In December of the same year it separated from the National Institute of Microbiology and became a separate division within the National Institutes of Health. This reorganization occurred after an improperly prepared batch of polio vaccine that had been made by Cutter laboratories caused outbreaks of polio. The administering of the vaccine and keeping records became the responsibility of the Public Health Service's Communicable Disease Center. The work done by this group during the administration of the Salk vaccine established protocols for testing that would be followed in later outbreaks. (8)

In the second half of the twentieth century, the most important factor in determining the relationship between the federal government and the support of scientific research was the desire to maintain an organization or bureau similar to the Office of Scientific Research and Development (OSRD). The purpose of this World War II department was

to coordinate research, set priorities, and support research, both basic and applied, that would help in the war effort. Vannevar Bush, the head of OSRD, was asked by Franklin D. Roosevelt to write a report that would answer four questions: 1. What could be done to disseminate the results of war research? 2. What could be done to continue the "war of science" against disease? 3. How can the government aid research done by public and private institutions? 4. Is it possible to set up a program that could develop scientific talent? The answers to these questions were found in the landmark report, *Science- the Endless Frontier*. (9)

Sen. Harley Kilgore (Democrat, West Virginia), a proponent of the New Deal, had proposed as early as 1942 that the government establish a central agency to co-ordinate scientific research. (10) The legislative battles to establish the National Science Foundation lasted from 1945 until 1950 when Harry Truman finally signed the NSF bill. Many significant problems had to be overcome. First, Kilgore wanted all patents that resulted from government-sponsored research to be available to all; privately owned companies that might conduct research on a government contract and the National Association of Manufacturers opposed this threat to profits. Second, the president had the power to appoint the director of the NSF; many scientists believed that the director should be appointed by a committee of scientists. The argument in favor of presidential appointment was that there would be no political accountability if this power were to be delegated to a non-governmental and non-elected authority. Third, scientific grants should be awarded to institutions in various sections of the country and to both private universities and land-grant institutions. This aspect was very controversial in the scientific community. During World War II government research grants had been awarded to a relatively small number of institutions. As a result, there had been a "brain drain" from smaller institutions to the larger laboratories. If grants were awarded to only a few institutions, scientific programs in many universities might wither. This question split people along geographical area and type of institution (land grant vs. private). Fourth, how much control should the government have? New Dealers and proponents of big government agencies generally supported a large agency; conservative Republicans wanted a smaller one. (11) Finally, the fear of world Communism caused some people to see an evil Communist influence in increasing government control. Even the National Infantile Paralysis Foundation thought that the provision of one bill to include a special section on poliomyelitis was "part of a 'Communistic' scheme." (12)

The five-year delay in setting up the National Science Foundation contributed to the fragmented organization of contemporary science research. Other organizations were set up to investigate specific areas or problems. The Office of Naval Research (1945) supported basic research in physical and biological sciences. The Atomic Energy Commission (1946), which had its roots in the World War II Manhattan Project, supported research in atomic energy and radiation. The Research and Development Board (1947) coordinated research and development in defense-related projects. The most important new agency was probably the National Institutes of Health (1948), which was

re-organized because of the addition of new institutes devoted to specific problems, such as the National Heart Institute (1948). (13)

The energy crises of the early 1970s helped spur the Energy Reorganization Act (1974). This act abolished the Atomic Energy Commission and substituted two new agencies, the Nuclear Regulatory Commission and the Energy Research and Development Administration. The Department of Energy, which has become a major supporter of research, was established in 1977.

INDIVIDUAL CASE STUDIES

Three topics have particular importance and interest to historians: smallpox, polio, and the problems concerned with the cloning of stem cells. The first, smallpox, is found in some of the earliest events in United States history and is still of concern today with the danger of biological attacks. The second, polio, struck Franklin D. Roosevelt and crippled thousands in the mid-twentieth century. Polio provides an example of an important government official being active in attempts to find a cure for the disease at the same time that he was trying to hide the damage it had done to him. Finally, the questions concerning stem cell research show another effect of the Vietnam War. The lack of trust and belief in government statements and positions that arose in the Vietnam era of the 1960s and 1970s fostered a general distrust of many government claims. Reports about the Tuskegee experiments on syphilis and soldiers in World War II being exposed to excessive doses of radiation increased public skepticism about the government's ethical standards. In these experiments, researchers used subjects who were not fully informed about dangers and possible harm of the procedures; these inappropriate and unethical methods led to demands that the government fully explain and justify its actions. In the last several decades of the twentieth century bioethicists have raised questions about the propriety of pursuing potential areas of research. It is very difficult to imagine that questions of this type would have been asked in the mid-twentieth century at the time of the Manhattan Project. In 1973, the National Science Foundation established a program, Ethical and Human Value Implications in Science and Technology. (14)

Smallpox

Smallpox is a virus and is a member of the largest viral genome, the poxvirus (genus *orthopoxvirus*, family *Poxviridae*). Viruses of this genus are unusual because they replicate in the cytoplasm of a cell, not its nucleus. The virus is easily spread from person to person via droplets that are inhaled or ingested. The incubation period can be as long as two weeks; a person may be contagious, even though no symptoms are obvious, late in the second week. The virus moves from the respiratory tract to the lymph nodes and then to the liver, spleen and into the bloodstream. The infected person will develop a rash with pistules (the "pox") first on the face, then on the arms, trunk and legs. After eight or nine days, a crust forms on the pustules. As these scabs separate, there appears a pitted

scarring. Other symptoms may be fever, headache, fatigue and nausea. In severe cases of hemorrhagic smallpox, the mortality rate in unvaccinated people is 99%.

Smallpox is particularly dangerous because its incubation period is relatively long and a person may be highly contagious before any symptoms appear. As the disease moves through various organs, the genome produces proteins that affect the body at the cell and the organ level. Because it is so contagious, it can spread rapidly when there are concentrations of people living in close quarters, such as in the military. Therefore, the natural occurrence of smallpox and the use of smallpox as an offensive weapon have been threats to armies and the general population.

In early American history there are examples smallpox spreading naturally and by design. In 1763, at the conclusion of the French and Indian Wars, the British commander, Sir Jeffrey Amherst, suggested that blankets be infected with smallpox and given to the Native American tribes that were still causing trouble for the British. Amherst, bitter from his struggles in Canada wanted to "extirpate this execrable race." On June 24 of the same year, Captain Ecuyer wrote in his journal that two chiefs were given "two blankets and a handkerchief out of the smallpox hospital. During the American Revolution there was a severe epidemic introduced, perhaps, by the British soldiers who arrived in Boston. There is speculation that the British, by forcing some Bostonians to leave the city and cross American lines, were trying to spread small pox among the American army. (15) It is interesting to see the parallel concerns of Amherst and the twenty-first century NIH in that each are concerned that the person dealing with the disease not be infected. In contrast, the efficacy of inoculation against the pox was known. Jonathan Edwards died (1758) as a result of experiments in inoculation and on July 12, 1776, Abigail Adams reassured her husband that she and their children had been inoculated and could avoid the danger of the outbreak of the disease in Boston.

Smallpox was introduced into the native American tribes by European settlers. It spread rapidly; there are reports of outbreaks recorded in the annual reports of the Bureau of Indian affairs in the first half of the nineteenth century. Smallpox, along with cholera, was recognized as a communicable disease. The latter disease was the reason the Hygenic Hospital was established on Staten Island.

The eighteenth century use of infected blankets against the enemy is a type of germ warfare and raises the same problems, both logistical and ethical, as does the twenty-first century use of smallpox as a weapon of biological terrorism. How can you be sure the released virus is going to affect the enemy population without harming those who launch it? Ethically, is it moral to target everyone and not only regular military forces? Amherst considered the Indians to be members of a group that should be eliminated – a type of ethnic cleansing.

In the late 1960s, Donald A. Henderson was sent by the Center for Disease Control to the World Health Organization to direct the campaign to eradicate small pox, a goal that

was attained in the late 1970s. Today, the World Health Organization claims that smallpox has been eliminated. There are, however, two places, the Center for Disease Control in Atlanta and the Russian State Research Center at Koltsovo in the Novosibirsk Region of Siberian Russia that maintain samples of the smallpox virus, although there is probably no way to be sure that there are not other places that have samples. The Russian samples had been moved from the Research Institute for Viral Preparations in Moscow to the more secure Siberian location. The WHO had hoped to destroy the remaining samples in 2002, but opposition to this plan has postponed the destruction. There are several arguments against destruction. First, should an outbreak occur, additional vaccines could be more easily made. Second, the virus in a new outbreak could be compared to the samples. Third, there has never been a previous instance of humans consciously destroying a species. Is it right to destroy a species, even if it does harm? Fourth, In a worst case scenario, the virus could be developed as a biological weapon.

The date for destruction of smallpox samples has been postponed several times. Arguments for destruction of the samples stress that the DNA for the virus has been sequenced, a development that makes maintaining the virus superfluous. Second, the samples could be the source of another outbreak, either caused by accident or by deliberate terrorist activity. In either case, the impact on the general population would be disastrous because few people have immunity. Because of the threat of terrorist activity, the United States government is developing a stockpile of smallpox vaccine. A plan of "ring vaccination" has been adopted. In ring vaccination, the people who have contact with the infected person are vaccinated. This is similar to the approach Henderson used in his campaign to eradicate smallpox.

Poliomyelitis

Poliomyelitis, or polio—also called infantile paralysis—is caused by a virus that enters the central nervous system and inflames the gray matter in the spiral cord. Exactly how it is spread and how it enters the nervous system are questions that are not completely understood, although it is possible its spread is a result of contact with fecal matter. There is evidence of a connection between injections, such as DPT shots, and polio. The increase in cases of polio, which begins in the late nineteenth century, coincides with the beginning of improved sanitary conditions in cities. It is possible that in earlier times people would have developed an immunity through childhood exposure to a mild case. A safer and cleaner water supply and improved sewers decreased the opportunities of being infected. In the mid-twentieth century, epidemics of polio increased dramatically after World War II, possibly because the disease was brought back by veterans who had served in areas where it was endemic. Polio is highly contagious, although paralysis occurs in only about one percent of cases. (16)

The polio virus was identified in 1908 by Austrians, Karl Landsteiner and Erwin Popper, and different strains of polio were identified in the 1930s. In the same decade two Americans, Maurice Brodie and John Kollmer, attempted to develop polio vaccines, the former developing a vaccine based on a deactivated virus and the latter a vaccine that used a live virus. Neither attempt was successful. Kollmer tested his vaccine on humans and many developed cases of polio, a result that caused researchers to be extremely cautious in using human trials at the time of the development of the Salk and Sabin vaccines. Governmental sponsored research helped indirectly in finding a cure for polio because Jonas Salk gained experience in developing vaccines during World War II when he worked on influenza vaccines. In 1952 Salk, like Kollmer, developed a vaccine based on an inactive virus. The 1958 Sabin oral vaccine was based on a live virus. (17) By 2002 the use of vaccines has become so successful in eliminating polio that there is a strong possibility that this disease, like smallpox, will be eliminated within the next few years.

The fight against polio was helped by the publicity it received during the Presidency of Franklin D. Roosevelt (1933-1945). FDR had been stricken by the disease in 1921 when he was 39 and in the early stages of his political career. In 1910 he had been elected to the New York State Senate and in 1920 had run as the unsuccessful Democratic candidate for Vice-President. Polio could have destroyed his career, but by clever public relations that stressed his physical vigor, he managed to return to public life. In 1924 at the Democratic Convention in New York City, he nominated Al Smith for the presidency. Four years later, at the Democratic Convention in Houston's newly built Convention Center, Roosevelt again nominated Smith. Although Smith's 1928 campaign was unsuccessful, Roosevelt bucked the Republican tide and was elected Governor of New York. Four years later he became President. The visibility of Roosevelt also gave more publicity to polio. The Warm Springs Foundation, which later became the National Foundation for Infantile Paralysis was founded in 1924 and was supported by FDR's leadership and money. During his Presidency, Warm Springs, Georgia became his favorite retreat and was the vacation White House. Roosevelt was frequently photographed there, while exercising in the water – an activity that stressed strength and physical fitness, but didn't require the use of legs. He died of a cerebral hemorrhage in his home in Warm Springs in April, 1945.

Roosevelt's publicity emphasized that he had survived polio and led the public to believe that he had recovered from it. This was a half-truth. He had survived, but he would never recover the use of his legs. For the rest of his life he would need a wheelchair and heavy leg braces. Nevertheless, he gave an impression of robust good health. He was shown swimming or seated with one leg casually crossed over the other. No pictures could be shown of his actually crossing his legs, because he couldn't. He managed to stand for prolonged periods by locking his braces and holding on to the arm of someone next to him. He could walk a short distance by using a cane, holding onto someone's arm, and by swinging each leg forward. During campaigns he would sit in the back seat of a convertible or appear on the rear platform of a train. The result was that the general public knew that he had had polio, but did not know the extent of the damage the

disease had inflicted. In those pre-Watergate days, there was no demand to see reports of the health of the President, and news photographers acquiesced to Roosevelt's requests that he not be photographed in a wheelchair or in situations where his disability was obvious.

The National Foundation for Infantile Paralysis, which had been supported by Roosevelt money, organized research efforts to find a cure for polio. This foundation set several precedents for future research. First, it focused on a single disease. Second, it used innovative marketing methods to raise money. The effects of the disease were personalized and there was a definite appeal to emotion. Cute children on crutches or with leg braces posed for March of Dimes posters; the models were crippled, but were not ravaged by the disease.

Stem-Cell Research

Research into smallpox and polio was largely centered in individual university or foundation laboratories. As the need increased for larger, more complex and more expensive laboratory equipment, larger organizations were necessary and government financial support became critical. Government money comes in tandem with government supervision and requirements. Frequently, this is combined with pressure from events or political interest groups. For instance, if efforts to combat terrorism were to lead to the exclusion of non-United States citizens from government funded research in universities, there would be a considerable loss in effectiveness in research.

The ethical debate on stem cell research is intertwined with the one on somatic cell nuclear transfer, frequently referred to as "cloning" and the manipulation of genes. The main government agencies involved in this research are the Department of Agriculture and the National Institutes of Health. Agriculture is interested in improving production by developing new varieties in staple crops and in improving livestock by finding ways to replicate desired qualities in animals. For example, the dairy industry would benefit if cows could produce more pounds of milk or higher percentages of butter fat in the milk. In other words, could there be an animal combining the characteristics of a Holstein and a Jersey? The ethical debate becomes more complicated as the focus changes from plant cloning, to animal cloning to transgenic alterations and finally to human cloning. There is little concern about developing a new variety of wheat or a new breed of cattle. This is close to what occurs naturally through hybridization. However, when genetically altered produce is used in commercial products, the public has a right to be informed and to be warned of possible side effects. If sheep are genetically altered so that their milk contains proteins that are present in spider silk, what problems might there be in the lamb or mutton sold to the public?

The genetically altered sheep is typical of the ramifications that may develop. The Army wanted to produce bulletproof vests that were lighter in weight and stronger that the ones that were currently used. It was thought that spider silk would be the perfect

material to use in vests because spider silk is exceptionally strong in relation to its weight. Spiders, however, can't be farmed because they tend to cannibalize each other. Therefore another host, sheep, must be used. Questions must be answered regarding the safety of the milk and meat for human consumption.

When the sheep Dolly was cloned in 1996, the possibility of human cloning accelerated the discussion of ethics. Biologists, philosophers and religious leaders have been participants. The National Bioethics Advisory Commission (NBAC) held hearings on cloning. There were three major categories of arguments about cloning humans. First, the act of cloning is neither good nor bad, but the motive of the person doing the cloning will determine whether it is ethical. Second, cloning is bad because it violates natural law by removing the physical sexual relationship; the moral repugnance arguments of Leon Kass are in this group. Third, the effects on the child who is cloned or on the person who provides the cloning material might be harmful. (18) The NBAC made several recommendations. First, there should be a moratorium on federal funding for research that uses somatic cell nuclear transfer to create a human. Second, there should be legislation, subject to review after three to five years, which prohibits this type of research. Third, research on human DNA and animal cloning should be allowed to continue. Fourth, future human cloning experiments should be carefully regulated to ensure that ethical standards are maintained. Finally, the federal government should continue investigations into the moral implications of cloning experiments and the public should be educated in these developments. (19)

There are arguments in favor of using somatic cell nuclear transfer to produce humans. One argument stresses that this process does not produce true clones, because the mitochrondrial material in the cell is from a different source. Furthermore, differences in environment and historical era will affect the person differently. Another argument is that this method should be considered as just another way to assist couples who want to have children; psychological dangers associated with cloning are exaggerated. For instance a person who wants to reproduce a great musician is similar to a parent who forces a child to study music. A third argument is that a cloned child's problems are similar to those of an adopted child. All of these arguments supporting cloning are based on the condition that cloning will become a safe method of producing children.

The National Institutes of Health implemented new guidelines for research using embryonic stem cells (Feb. 28, 2002). These guidelines follow the policy announced by President George W. Bush (August 9, 2001). Stem cells from destroyed embryos will not be used; human embryos will not be created and human embryos will not be cloned. The President created a President's Council on Bioethics, which will be chaired by Leon Kass. The debate on stem cell research is an ongoing one. In June 2002, the United States Senate was still debating a bill regulating cloning. There is a great danger that the stem cell debate will degenerate into a simplistic round of political statements made to appeal to narrow ill-informed constituencies. One of the aims of this unit is to help students form reasoned opinions on these matters.

(1). Department of Veterans Affairs: A brief History http://www.va.gov/vafhis.htm.
(2) Stetten, DeWitt, Jr., *A Short History of the National Institutes of Health*, http://www.nih.gov.od/museum/exhibits/history/full-text.html, p.1.
(3) Kleinman, *Politics on the Endless Frontier*, p. 47.
(4) Department of Veterans Affairs, *op. cit.*
(5) Stettin, *op.cit.*, p.2.
(6) Smith, *Patenting the Sun*, p. 64.
(7) Smith, *ibid.*, pp 350, 354.
(8) Smith, *ibid.*, pp365-369.
(9) The questions are in the letter from F.D.Roosevelt to V. Bush and are repeated in the transmittal letter from Bush to Roosevelt.
(10) Kleinman, *op. cit.*, p.6.
(11) Kleinman, *op. cit.*,see chapter 6 for an extended discussion.
(12) the quotation is given in England, *A Patron for Pure Science*, p. 91.
(13) Kleinman, *op. cit.*, p.152.
(14) Appel, *Shaping Biology*, p.245.
(15) Modern History Sourcebook, http://www.fordham.edu/halsall/mod/smallpox1.html
Indians and smallpox H-Net, http://www2.h-net.msu.edu/~west/threads/disc-smallpox.htm;
Jeffrey Amherst and Smallpox Blankets.
For the 1776 outbreak, see Thompson, "More to dread…than from the Sword of the Enemy"
http://www.nativeweb.org/pages/legal/amherst/lord_jeff.html.
(16)Sass, Edmund J., Polio Definition,
http://www.cloudnet.com/~edrbsass/poliodefinition.htm.
(17) Sass, Edmund J., Polio History,
http://www.cloudnet.com/~edrbsass/poliohistory.htm.
(18). R. Alta Charo "Cloning and the Ethics of Public Policy," pp.107-113, *Human Cloning, Science, Ethics and Public Policy*, Barbara MacKinnon, ed.
(19). "Cloning Human Beings. Report of the National Bioethics Advisory Commission," pp. 183-187, *Ethical Issues in Human Cloning, Cross-Disciplinary Perspectives*, Michael C. Brannigan, ed.

LESSON PLANS

Constitutional Authority

Have students read Article 1, Section 8, which lists the powers of Congress. Have them place the powers in categories: military, financial, judicial. How might each of these be used to encourage scientific research? Possible answers follow.

To establish a uniform Rule of Naturalization.

Naturalization follows immigration. Immigrants must be checked for disease.

To…fix the standard of Weights and Measures.

The National Institute of Standards and Technology.

To promote the Progress of Science and the useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.

This is the rationale for the patents and copyrights. The patent office has to judge the scientific originality of submitted inventions.

To provide and maintain a Navy.

Accurate astronomical observations are necessary for ship location. The Naval Observatory supplies these.

To make all Laws which shall be necessary and proper for carrying into Execution the foregoing powers.

This "elastic" clause enables the Constitutional powers to be broadly interpreted.

Topics for students' reports:

Use the Internet to give brief reports on the following:

The Department of Agriculture, the National Institute of Standards and Technology, the Patent Office, the Naval Observatory, the Veterans Authority, the National Institutes of Health, the Public Health Service, the Centers for Disease Control, the Department of Energy. The Department of Energy web site has histories of each of the 35 DOE supported facilities.

To show government influence on science in other eras, do reports on Archimedes and Leonardo. Use the Rorres and the National Museum of Science and Technology (Milan, Italy) web sites.

Smallpox in United States History

Have students work in groups to answer the following questions

Lord Jeffrey Amherst: Use web sites *Jeffrey Amherst and the Smallpox Blankets* and *Indians and Smallpox* to explain the situation and to answer the following questions.

1. What is Amherst alleged to have done? What evidence is there for this allegation?
2. Why did Amherst want to kill these Indians?
3. Where did these events occur?
4. Do you think that Amherst was guilty of ethnic cleansing or genocide?
5. How had Amherst become one of the most famous military men of his day?

George Washington: Use the Mount Vernon (Thompson) website.

1. Where had Washington contracted smallpox? What might have caused him to go there?
2. Why was inoculation banned in Virginia?
3. What caused the increase in smallpox cases in 1776?
4. What steps did Washington take to protect the army from smallpox?
5. How did smallpox interfere with American attempts to capture Quebec?

Jonathan Edwards and Abigail Adams: Use the Jonathan Edwards web site and Abigail Adams letters in *Early American Writing*, pp. 502-505 (Letters March 31, April 5 and July 13, 1776).

1. What was Edwards' relationship to the Great Awakening?
2. How do you think that Edwards' assignment to the Massachusetts frontier helped him to see the beauty of nature?
3. How is Edwards' attitude toward inoculation consistent with principles of the Enlightenment?
4. How did Edwards die?
5. At the time Abigail Adams wrote these letters, where was John Adams?
6. What evidence of the smallpox epidemic does Abigail Adams report?

Smallpox and Bioterrorism

Use the Bardi, O'Toole, Henderson, and WHO websites and the Goldberg article. Have all students read the O'Toole scenario. The Bardi site and the Goldberg article are more difficult and could be used as additional activities for more advanced students.

The O'Toole scenario for a terrorist attack that used the smallpox virus shows the conflicting interests and overlapping jurisdictions of the national, state, county and local municipal level.

1. What are the characteristics of smallpox? What types of smallpox are there?
2. As you read the article, list the government agencies that are involved. Are these agencies part of the federal, state or local government?
3. How could better co-operation and communication between the FBI and other intelligence gathering organizations, such as the CIA, have provided better intelligence on the proposed attack?
4. Why was smallpox difficult to diagnose? How long after the visit did the first case appear?
5. What could each of the following people contribute to solving the emergency? The chairman of the department of medicine, the hospital's epidemiologist, president, vice-president for public relations, and general legal counsel.

6. Was the FBI within its rights in keeping everyone in the hospital? How did this action cause panic?
7. How did news services increase the panic?
8. If vaccine is in short supply, who should get it? Everyone, all who came in contact with an infected person, people who attended the speech, health care providers, law enforcement personnel, city office holders, people most vulnerable to disease? (This question can be illustrated by the use of anthrax vaccine in the attacks of 2001-2002. All members of the U.S. Senate and their staffs got the vaccine; postal workers who handled mail did not.) Answers to this question should consider both medical and ethical concerns.
9. What are the further stages of the outbreak?
10. As the epidemic expands, how does the city increase medical care?
11. How was the social fabric of the city destroyed? What happened to schools? What was the economic effect? How was the judicial system adversely affected? Why was there civil unrest?
12. Why were smallpox victims abandoned to die? Why were recovering victims denied food?
13. What is the legal precedent for compulsory vaccination? (1905 Massachusetts case says requiring vaccinations is not a violation of due process.)
14. Is quarantine legal? (This depends on the state. Decisions have varied because of HIV cases.)
15. If there were warnings about a possible attack, should the president have gone and delivered a speech? What balance should be made between public safety, national security and presidential visibility?

Summary activity:

Divide the class in half. Have one group provide arguments for more government intervention and have the other group provide arguments for leaving the treatment of the sick to the medical community. Each group must consider the size of the threat to the country and the possible loss of constitutionally guaranteed rights.

For advanced students:

Read the Goldberg article which describes a poison gas attack in Iraq.

1. How did the smallpox attack and the poison gas attack cause panic?
2. In each attack, why did people feel helpless?
3. What were the long-term effects of a large decrease in the size of the population?

Long term projects:

Look in current newspapers for information on the following:

What groups might be interested in using smallpox for terrorist activity?
Where are the remaining smallpox samples? Are there plans to destroy them?
What is the status of the U.S. smallpox vaccines?

Poliomyelitis: The Disease

Use the Polio Information Center and the Sass websites and Smith's *Patenting the Sun* to answer these questions.

1. What is the meaning of "poliomyelitis"? Why is the disease also called "infantile paralysis"?
2. How many strains of the polio virus are there?
3. How does the polio virus affect victims?
4. What was an iron lung?
5. Who was Elizabeth Kenny and how was her treatment of polio unusual?
6. What was the original purpose of the March of Dimes? What does it do today?
7. What is the difference between the Salk vaccine and the Sabin vaccine?
8. How did Salk's work on influenza vaccine help him in his research on a polio vaccine?
9. In some countries, polio is endemic. How would this explain why there were polio epidemics in the United States in the late 1940s and early 1950s?

Poliomyelitis and F.D. Roosevelt

Use Gallagher's *FDR: The Splendid Deception* and the Sass, the FDR cartoon, the FDR library, and the naval pictures websites to answer these questions.

1. When and where did FDR develop polio?
2. What political offices had he held before he became sick?
3. How did FDR help support the National Foundation for Infantile Paralysis?
4. At what political event did FDR re-enter politics?
5. How did FDR's support of Al Smith help FDR become governor of New York?
6. Why did FDR think that polio might keep him from being president?
7. Do you think that FDR could have hidden his paralysis if he were President today?

Use the picture of FDR and Churchill at the Atlantic Charter Conference
(August 10-12, 1941)

1. Who is supporting FDR?
2. How is this support being given?

Use FDR library picture (5/14/1943) Churchill and FDR in Louisiana.

1. What is FDR holding?
2. Where are they sitting?
3. How does this give the impression that FDR is vigorous?

The FDR Cartoon Website has many cartoons that show a vigorous and athletic FDR. Students should notice what actions FDR is performing, whether he is shown seated or standing, whether his legs are shown. Some sample cartoons, questions and answers are:

November 1932 to March 1933

Elderman. "Seeking Advice on Bronco Busting." In *Washington Post*. (5 Jan 1933)

1. What is FDR doing? Climbing over fence rails to get into arena. He is wearing boots.
2. How does this refer to New Deal? FDR is not yet in office; he is eager to get into action and to try to fix the economy.
3. How is this typically American? The cowboy is an American icon.

Morris. "Sweeping Changes expected After March 4th." In *Hoboken Observer*. (21 Feb 1933)

1. What is FDR doing? He is holding a broom.
2. What activity is implied? He will vigorously sweep and clean the house.
3. What is the significance of the date, March 4th? It is the last March Inauguration.

Hulton. "The First Job for the New Engineer." In *Marshall* (TX) *Messenger*. (6 Mar 1933)

1. What is FDR doing? He is swinging down from the cab of a steam locomotive; he is holding a wrench and is about to dislodge a bull from the cow-catcher.
2. What does the bull represent? Opposition to New Deal measures.
3. How does FDR identify with Americans? This cartoon shows him as a working man in a situation that is both industrial (the train) and rural (the bull).

Byck. "Keeping His Nose to the Grindstone." In *Brooklyn Observer*. (6 Mar 1933)

1. What is FDR doing? He is operating a rotary grindstone by pedaling.
2. What occupations use grindstones?

The First Hundred Days

Seibel, Fred O. "That's Riding Him, Cowboy." In *Richmond Times Dispatch*. (10 Mar 1933)

1. How is this similar to the Elderman cartoon? Same cowboy theme.
2. What were the "First Hundred Days"?

The Supreme Court Controversy

Hungerford. "The Kickoff." In *Pittsburgh Post Gazette*. (6 Jan 1937)

1. What is FDR doing? He is punting the football.
2. How is the Republican Party depicted? As an elephant in a wheelchair.
   If FDR had been associated with wheelchairs, this cartoon would not be effective. This cartoon also associates disability with weakness and incompetence. This was an accepted view of people with disabilities. It was because of this attitude that FDR had to minimize his paralysis

World War II

Alexander. "Keep the Home Fires Burning." In *Philadelphia Bulletin*. (24 Feb 1942)

1. What is FDR doing? He is striding toward the fireplace, carrying logs.
2. What is the significance of the fireplace? This alludes to the "fireside chats."

Other Projects

1. Look through history books to find other pictures of FDR.
2. Look through newspapers from the early 1950s to find reports of polio outbreaks.
3. Why was there controversy about including a wheelchair in the Roosevelt Memorial in Washington, D.C.. Do you think FDR would have wanted a wheelchair in the exhibit?

Stem Cell Research

Use the NIH website. Because the discussion of stem cell research is continuing, there are many references in current newspapers and magazines.

Vocabulary building exercise:

soma	(Greek root, *soma* = body)	of the body
-potent	(Latin root, *posse* = to be able)	capable

toti-	(Latin root, *totus* = all)	all, completely
plur-	(Latin root, *plur*- = more)	most
multi-	(Latin root, *multus* = many)	many

somatic cell = body cell that is not of an egg or a sperm
totipotent = capable of producing all tissues in an organism
pluripotent = capable of producing most tissues in an organism
multipotent = capable of producing many tissues in an organism

Define other words that contain these roots:

chromosome	group of coiled strands of DNA containing genes
psychosomatic	combining mind and body
potential	capable of future action
potent	powerful
impotent	not effective
potentate	a powerful person
omnipotent	all-powerful
plenipotentiary	with full diplomatic powers
posse	a group that has been deputized and has legal authority
total	complete (adj.), add up (verb)
totality	entirety
plural	more than one
plurality	the largest number in a group of numbers
multi-	prefix = many, multiplex, multifaceted, multicolored, multiply

Other definitions:

Cloning: The early splitting of an embryo, which produces an exact copy. This happens naturally in the case of identical twins.

Somatic cell nuclear transfer: moving the nucleus of a donor cell into the nucleus of the egg of a recipient. The recipient will be the mother. In this process, the DNA in the nucleus is that of the donor. The DNA surrounding the nucleus is that of the recipient. In current discussions of stem cell research, somatic cell nuclear transfer is called cloning.

Stem cell: a cell that is totipotent and that can be the source of all types of tissues. In normal development, stem cells are totipotent for only a very few days after fertilization.

Adult stem cells: cells that are present in particular tissues, such as bone marrow. Some of these might be multipotent.

Give students copies of the Bush policy statement on Embryonic Stem Cell Research. In groups have them answer the following questions.

1. What stem cell research will the federal government sponsor? What is the source of the stem cells that are used?
2. What research will the government not sponsor?
3. Who will be the chairman of the Council on Bioethics?
4. What is the difference between embryonic and adult stem cells?
5. What are the potential benefits of stem cell research?
6. How are embryonic stem cells created?

Class discussion topics for the previous questions:

1. a. How is this position consistent with that of the Right to Life movement? An embryo is a potential human being and should be protected.
   b. What ethical question is avoided? Is it right to use anything derived from a destroyed embryo?
   c. Why is it important that donors be informed and not be paid? Informed consent is a right. Payment to egg or sperm donors puts pressure on people who are in financial difficulty to undergo medical procedures that might be harmful to them.

2. a. What ethical and/or legal arguments oppose research on human embryos? If an embryo is a potential human, how can it be protected? Is there informed consent? How can the risks be evaluated?
   b. Could the process to create a human embryo be patented? Could the embryos be patented? In addition to ethical questions, there are legal ramifications arising from the Thirteenth Amendment, which abolished slavery.

3. a. What is the background of Leon Kass?
   b. What are some of his arguments against cloning in "The Wisdom of Repugnance"? (Consult the AEI Book Summary.) They include an excess of human manipulation, the confusing of family relationships of "mother" and "father," the danger of replicating dictators, the intrusion of government.
   c. What are some of James Wilson's arguments against Kass? Cloning is a logical and not immoral extension of solutions to infertility problems. There is no reason to think that parents of a 'clones" child will be any less responsible than parents of adopted children.

   For further discussion, see articles in McGee's *Human Cloning Debate*, especially "A Model for Regulating Cloning," Glenn McGee and John Harris, "Human Cloning and Child Welfare," Justine Burley and John Harris and "The Question of Human Cloning," John Robertson.

4. How does the White House view of the potential of adult stem cells differ from that of the NIH? The White House view gives the impression that adult stem cells have been found for all types of human tissue. The NIH recognizes the potential of using adult stem cells, but stresses the difficulties.

5. and 6. How could stem cell research improve medical treatment of problems in human organs? If stem cells could be used, problems caused by organ rejection would be avoided.

See the website, Time.com, for more applications and for visual materials on cloning.

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Internet Resources

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Smallpox

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World Health Organization
Historical significance, forms of the disease, transmission, treatment, vaccines

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World Health Organization
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Polio
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