

LE Magazine March 2002

REPORT

DON'T Let The U.S. Government Ban Therapeutic Cloning By Saul Kent, Director • Life Extension Foundation

Page 1 of 2

If The Human Cloning Prohibition Act (S.790) is passed by the U.S. Senate, it will be a crime for scientists such as Dr. Michael West to conduct therapeutic cloning research. Dr. West would face up to 10 years in prison and a \$1 million fine for pursuing a technology that could lead to cures for heart disease, cancer and Alzheimer's disease as well as the ability to extend the healthy human life span.

The Human Cloning Prohibition Act bans all forms of human cloning as well as the importation of therapies developed from cloned human embryos. The bill is sponsored in the Senate by Kansas Republican Sam Brownback. It was sponsored in the House by Florida Republican Dave Weldon, where it passed on July 31, 2001 by a margin of 265-to-162, after only two hours of emotionally-charged debate.



Among the reasons given by legislators in The House for their desire to ban cloning were the following, as reported in the Washington Post.

"Anything other than a ban on human cloning would license the most ghoulish and dangerous enterprise in human history," said North Carolina Republican Sue Myrick.

"This House should not be giving the green light to mad scientists to tinker with the gift of life," said Oklahoma Republican J. C. Watts, Jr.

"Cloning is an unholy leap backwards because its intellectual lineage and justifications are evocative of some of the darkest hours of the 20th century," added House Majority Whip Tom DeLay of Texas.

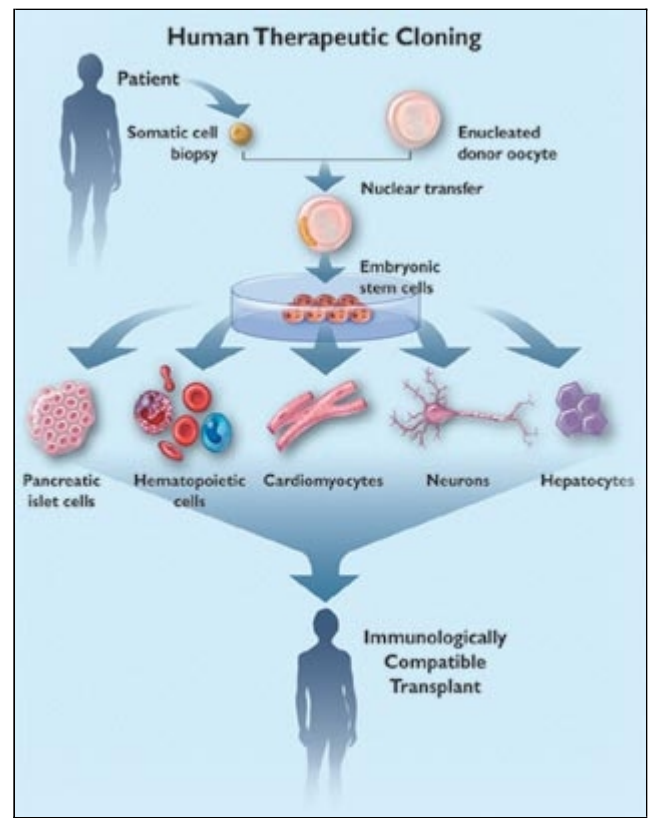
Therapeutic cloning vs. reproductive cloning

Almost all U.S. legislators are opposed to cloning genetic duplicates of human beings (reproductive cloning). This opposition is echoed by the public. A USA TODAY/CNN/ Gallup poll of 1,025 adults conducted Nov. 26 and 27 found that 88% disapproved of cloning humans, whereas 54% supported cloning human embryos to create stem cells for medical treatment (therapeutic cloning), with 41% opposed to the practice. The Weldon/Brownback bill bans both reproductive and therapeutic cloning. Debate on the issue in the Senate is expected to begin in February or March. President Bush has said he will sign the Human Cloning Prohibition Act if it is passed by the Senate.

While many in government want to ban therapeutic cloning, this new technology is supported by most scientists and organizations such as the National Academy of Sciences, as well as by a majority of the public, because of its potential for developing breakthrough treatments for today's "incurable" diseases.

Therapeutic cloning would work in the following manner. First would be the transfer of the nucleus of a somatic cell, such as a skin cell, into an egg cell whose nucleus had been removed. Then the egg would be induced to begin dividing into an embryo carrying the identity of the donor. When the embryo reached the blastocyst stage, a ball of about 100 cells, embryonic stem cells would be harvested from its inner layer. These cells would be grown in tissue culture and then transformed into young neurons, heart cells, liver cells, pancreatic cells-perhaps even into tissues and organs-for therapeutic transplantation into the donor. Since the transplanted cells would be the same tissue type as the donor's cells, they would not be rejected by the donor, which would eliminate the dangerous side effects and need for toxic drugs required in transplantation today.

Several of these steps have already been achieved in mice. Dr. West's company (Advanced Cell Technology) recently announced they had taken the first step towards therapeutic cloning by creating cloned human embryos.[1] Although these embryos stopped dividing at the 6-cell stage, the fact that they divided at all indicates that the company is moving towards the creation of larger embryos containing stem cells. Let's take a look at the arguments used by those who would criminalize therapeutic cloning.



Advanced Cell Technology, Inc.,
Worcester, Massachusetts.

Should human embryos be used for medicine?

At the core of the opposition to therapeutic cloning is the contention that early-stage embryos are human beings and that it is morally wrong to use them for research and medical purposes, even if doing so will eventually save millions of lives. This doctrine is an extension of the position held by the Catholic Church (and some others) that abortion is "murder of the innocent" and "against the will of God."

The fact that therapeutic cloning requires deliberate creation of embryos for research and medicine rather than for reproduction further upsets opponents of the practice. They believe this is immoral. It is a variation of the Catholic position that sex should always be engaged in for reproductive purposes not just for pleasure, and that birth control is immoral because it interferes with the reproductive process. Here are some quotes from some of the more vocal critics of therapeutic cloning.

Syndicated columnist Armstrong Williams in the Washington Post:

washingtonpost "With the ability to create life in a lab, man takes a place alongside God. Just one thing. We're not God. Plainly, exerting our will over the very creation of human life propels science well beyond our ability to reason, ethically and morally. Into this moral vacuum rushes human egotism, or the desire to exert our will over every aspect of our surroundings.

"We cannot allow such egotism to obscure the moral consequences of destroying human embryos. Scientific advancement alone is no justification for the destruction of human life. Murder is murder whether it occurs in a science lab or on the street.

"Such subtleties were lost on Nazi scientists, who routinely experimented with humans. . . In terms of moral consequences, their experiments formed this century's most frightful travesty of human dignity."

Attorney William Saunders, Jr. of the Family Research Council stated the following in testimony to Congress:

"Certainly, every cell in the human body is not a human being. . . . But once a single-cell embryo or zygote has been created, whether by sexual reproduction (the exclusive means until now) or by asexual reproduction (as with cloning), that embryo is a living, distinct, genetically complete human organism which, unless interrupted, will direct its own integral growth and development through all the stages of human life-from embryo to infant to teenager to senior."

Law Professor Robert P. George in The Wall Street Journal:

THE WALL STREET JOURNAL. "Modern science shows that human embryos. . .are whole, living members of the human species. . . It is not that a human embryo merely has the potential to 'become a life' or 'become a human being.' He or she. . . is already a living human being. . . . The being that is now you or me is the same being that was once an adolescent, and before that a toddler, and before that an infant, and before that a fetus, and before that an embryo. To have destroyed the being that is you or me at any of these stages would have been to destroy you or me."

What is a human being?

Opponents of therapeutic cloning insist that, once an egg has been fertilized, it should have all the rights of an adult person. That an early-stage embryo doesn't just have the potential to develop into a human being, but that it is a human being. They consider the use of a 100-cell blastocyst for medical purposes equivalent to the murder of an adult. That's why they're in favor of criminal penalties for anyone who conducts therapeutic cloning research. And that's why they would consider anyone who developed a cure for cancer with therapeutic cloning to be a criminal.

But what about their belief that a 100-cell blastocyst is a human being? Is that a valid definition of what it means to be human? The practice of abortion, where far more advanced embryos are destroyed in pregnant women, is legal in the United States. The legality of abortion is based upon the concept that the embryo/fetus doesn't have the rights of a person, even though many of them have a brain and other vital organs. With therapeutic cloning, on the other hand, we have microscopic embryos of about 100 undifferentiated cells, which haven't yet been implanted in a woman and which were not created for that purpose. Are these balls of cells human beings? Here is what some advocates of therapeutic cloning have to say about it.

Virginia Postrel, editor-at-large of Reason magazine in the Dec. 5, 2001 issue of The Wall Street Journal:

THE WALL STREET JOURNAL. "Most Americans don't believe we should sacrifice the lives and well being of actual people to save cells. Human identity must rest on something more compelling than the right string of proteins in a petri dish, detectable only with high-tech equipment. We will never get a moral consensus that a single cell, or a clump of 100 cells, is a human being. That definition defies moral sense, rational argument and several major religious traditions."

This view was supported by Nobel laureate David Baltimore, PhD, President of the California Institute of Technology in The New York Times:

The New York Times "Critics of stem-cell research allege that embryos... should be accorded all the protections available to a fully formed person. To me, a tiny mass of cells that has never been in a uterus is hardly a human being-even if it has the potential to become human."

Let's take a closer look at the blastocyst embryo (from which embryonic stem cells can be harvested) that opponents of therapeutic cloning consider to be a human being. None of the 100 cells in a blastocyst has yet been transformed into specialized cells. So the blastocyst embryo not only has no organs, it has none of the cells which make up organs. Its only link to a human being is the fact that it has (in its nuclear DNA) the blueprints for the development of a person. But this person can only develop if the blastocyst is implanted in the uterus of a woman.

Without a brain or any other organs, the blastocyst has clearly never been conscious or aware of its environment. It cannot feel pain or suffer in any way. Without any experience, the blastocyst has no memories or sense of self. It is merely a clump of blank cells containing a program for the development of a human being, not a human being itself. And a clump of blank cells cannot be an "innocent victim of murder."

Is therapeutic cloning against the will of God?

Most of those who proclaim that therapeutic cloning is immoral aren't content to base their claim on their own very human opinion, they also usually invoke God in the matter. Since therapeutic cloning is against the will of God, they assert, it is clearly immoral for anyone to pursue it.

But who determines the will of God? Or even if God exists? Should it be religious leaders? Should it be based upon the teachings of the Bible? The Talmud? The Koran? Or some other religious text? Or should it be based upon what the individual believes?

Thus far, the only religious body that has publicly opposed therapeutic cloning is the Catholic Church. None of the Protestant Churches have taken an official position on therapeutic cloning, nor have any Jewish, Muslim, Hindu or Buddhist organizations. Moreover, there are indications that some religious leaders are favorable to therapeutic cloning.

Rabbi Gerald Wolpe of the Jewish Theological Seminary in New York was quoted as saying (in USA Today, July 19, 2001) that he

had received hundreds of phone calls from retired people in Florida who wanted to know if he knew of any embryonic stem cell research that might help relatives with Alzheimer's disease and cancer. Here is what Rabbi Wolpe had to say about embryonic stem cell research and Judaism:

"In Jewish law, healing is a religious obligation. An embryo outside the womb has no legal status in Judaism. Of course, it has a moral component, so you can't use it without sensitivity, but in this case there is a question as to whether the element that would be used for research can even be called an embryo. It is at such a primitive state. As a result, for many people of the Jewish faith, human embryonic stem cells represent a genuine hope for treating devastating diseases."



Dr. Maher Hathout, a cardiologist and eminent Muslim, who serves as a spokesman for the Islamic Center of Southern California, has said that: "Muslims regard abortion as wrong, but they also hold that life does not begin until the fertilized egg attaches to the womb's wall, which would not preclude research on embryonic stem cells."

So it's quite possible that the leaders of some of the world's religions will endorse therapeutic cloning. But even if they don't, the position of a religion's leadership doesn't necessarily reflect the opinions or practices of its members. For example, the Catholic Church holds that contraception, abortion and sex outside of marriage are all immoral, but surveys have shown that millions of Catholics engage in all three practices.

The claim that therapeutic cloning is against the will of God is the invocation of the ultimate authority figure in an attempt to stop therapeutic cloning research in its tracks. It's the same tactic that's been used to oppose many human advances such as airplanes, automobiles, computers and, in medicine, heart transplants, artificial organs and in vitro fertilization. All these advances (and others) were eventually accepted by most members of society as innovations that have improved the quality and length of human life. What was once considered a challenge to God's will soon became part of God's plan.

Why therapeutic cloning is morally right

Which brings us to the realization that it is up to us to determine the ethics and morality of new practices such as therapeutic cloning. It is up to us to focus on the key issues involved in therapeutic cloning and how they're likely to affect us as individuals and society as a whole. It is up to us to decide who is likely to be hurt and helped by therapeutic cloning. And it is up to us to make the right choices in developing therapeutic cloning.

There are two sets of rights being debated here. Those who want to ban therapeutic cloning want to protect the rights of the blastocysts that scientists create to provide embryonic stem cells for the generation of young cells, tissues and organs for transplant. Life Extension, on the other hand, is seeking to protect the rights of patients suffering from heart failure, stroke, cancer, diabetes, Alzheimer's disease, arthritis, Parkinson's disease and other killers and cripples.

Self-proclaimed advocates of "morality" are arbitrarily defining rights for microscopic balls of 100 cells, while millions of people of all ages suffer and die from lethal diseases, and billions of people suffer from the ravages of aging.

The development of transplantable cells, tissues and organs is our brightest hope for the treatment of "incurable" diseases. It is also our best bet for the reversal of aging, either through the transplantation of young healthy cells into aging bodies, or as a new vehicle for anti-aging gene therapies.

There is no comparison between the alleged "rights" of microscopic balls of cells grown from patients who need treatment and the rights of those patients. We're talking about the real possibility of ending the suffering and saving the lives of millions. . . perhaps billions. . . of living, breathing people just like you and me. We're talking about young cells, tissues and organs that may be able to reverse the pathologies of disease and aging. We're talking about new therapies that could extend the healthy human life span for decades... perhaps for centuries.

That's why the pursuit of therapeutic cloning is morally right. That's why banning and criminalizing therapeutic cloning would be a crime against humanity. And that's why it is imperative for everyone who loves life to protest the bill to ban cloning that is working its way through Congress.

[Back to the Magazine Forum](#)

REPORT

Page 2 of 2

Adult stem cell research

Another argument used against therapeutic cloning research is that it is unnecessary. According to this view, the promise of stem cells for medicine can better be achieved via adult stem cell research, while the compatibility of cloned tissues can be achieved by other means. An organization called "DO NO HARM: The Coalition of Americans for Research Ethics" takes this position and issues reports on adult stem cell research to support it.

Recent advances in adult stem cell research have indeed been impressive. Until a couple of years ago, the prevailing dogma was that adult stem cells could only be used to develop the same type of tissue the stem cells were taken from. Thus, it was believed that you could only make blood cells from bone marrow stem cells, skin from skin stem cells and so on. It was also believed that adult stem cells could only be derived from a very limited number of sources and that adult stem cells are difficult to isolate and grow in tissue culture.

Today it is recognized that adult stem cells can be derived from multiple sources such as the central nervous system, the heart, skeletal muscle, the pancreas, even from fat. Moreover, scientists have been able to isolate and culture adult stem cells more easily than previously thought possible. In fact, Dr. Fred Gage and colleagues at The Salk Institute's Laboratory of Genetics in La Jolla, California have been able to derive and grow adult stem cells from various regions of human post-mortem brains taken from dead patients.[2]

Recent advances in adult stem cell research:

Recent studies have demonstrated that bone marrow stem cells can be transformed into other types of tissue than blood cells and that they have the potential for the treatment of a variety of conditions.

In one study, researchers at the Baylor College of Medicine transplanted purified bone marrow stem cells from adult donor mice into the bone marrow of lethally irradiated mice. The transplanted cells regenerated the hematopoietic system in the recipients and then migrated into cardiac myofibers, where they helped to regenerate the heart, which was suffering from ischemic damage caused by coronary artery occlusion and reperfusion.[3] In another study at New York Medical College, scientists injected bone marrow cells from donor mice into the contracting wall of the hearts of recipient mice, which had been damaged by ischemia. After nine days, they found newly-formed heart tissue in 68% of the infarcts.[4]

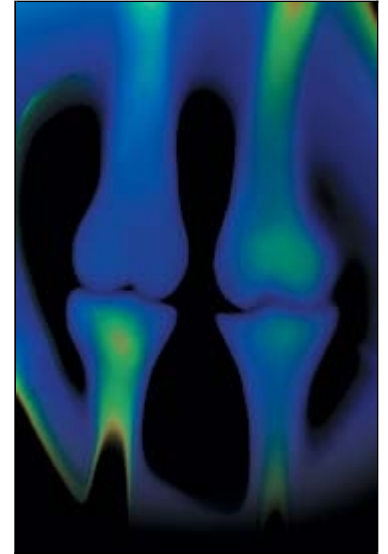
In France, doctors implanted skeletal muscle stem cells back into a patient from whom they were taken after he suffered a heart attack. They found encouraging improvement of the patient's condition after eight months' follow-up.[5] Clinical trials are underway in Europe and the U.S. to determine the value of this new type of therapy for heart disease.

At Humboldt University in Germany, scientists found that transplanted bone marrow cells in mice could generate fully developed, functional Purkinje neurons in the brain.[6] Purkinje cells are large neurons that secrete the neurotransmitter GABA in the cerebellum, an area of the brain involved in movement and coordination.

Scientists at the Yale University School of Medicine derived several types of mouse somatic cells from a single transplanted bone marrow stem cell. Among the types generated were cells of the GI tract, lung and skin. It was speculated that the derived cells may have been "summoned" to sites of injury by factors secreted from these sites.[7]

Adult vs. embryonic stem cells

The recent advances in stem cell research are very exciting. Further research in the field could lead to major advances in medicine. But there are still fundamental advantages that embryonic stem cells have over adult cells that have been recognized by most



Until a couple of years ago, it was believed that you could only make blood cells from bone marrow stem cells, skin from skin stem cells and so on. Today it is recognized that adult stem cells can be derived from multiple sources such as the central nervous system, the heart, skeletal muscle, the pancreas, even from fat. Moreover, scientists have been able to isolate and culture adult stem cells more easily than previously thought possible.

leading scientists in biology and medicine. Among the supporters of embryonic stem cell research (and cloning as a method of generating ESCs) are the National Institutes of Health (NIH), the National Academy of Sciences (NAS), the Federation of American Societies for Experimental Biology (FASEB) and many Nobel laureates.

Human embryonic stem cells are unique in the history of medical research. They are totipotent (or pluripotent), which means they stand near the base of the developmental tree and can branch out to form any type of cell needed in medicine. In contrast, adult stem cells are merely multipotent. They stand further out on the branches of the tree, which only enables them to form a limited number of cell types.

Nobel laureate David Baltimore summed it up as follows:

"It has been suggested that adult tissues might provide an alternative source of stem cells. This is simply false. Adult tissues are not known to have cells with the potential to become all parts of the body. In adults, certain tissues (e.g. skin, blood and brain) do contain specialized types of stem cells, but they are not generic stem cells with the same properties as those derived from embryos."

Another advantage of embryonic stem cells is that they can be modified more easily than adult cells. One type of modification is "gene targeting," which could enable these cells to "heal" mutations in genes that cause diseases and contribute to aging. Other potential applications of stem-cell-mediated gene therapy could be to provide resistance to chemo- and radiation therapy, enhance immune response to tumors, and induce tolerance to the transplantation of tissues and organs from other species.[8]

A third advantage of embryonic stem cells is that they multiply far more easily in tissue culture than adult cells. Dr. Ronald McKay of the National Institute of Neurological Disorders points out that, because of the proliferative power of embryonic cells, they will likely be used to produce large numbers of cells for use in clinical medicine. Dr. John Gearhart of Johns Hopkins Medical Center adds that the ability of embryonic cells to divide in the lab makes them a vital tool for learning how cells differentiate, [9] which is one of the major questions in biology. Insight into cell differentiation could provide us with clues about why we grow old and how we can reverse the process.



Embryonic stem cells derived from cloned embryos provide another important advantage over adult cells. Cells, tissues and organs generated from cloned stem cells will be almost identical immunologically to the cells of the donor from which the embryo was created. This should enable doctors to transplant them into donors without rejection problems.

Today's transplants usually require the lifelong administration of toxic, expensive drugs such as cyclosporine to stop the recipient from rejecting the tissue or organ being transplanted. Although it may become possible to grow tissues from adult stem cells derived from specific patients, which could then be transplanted into these patients without rejection, this is not likely to work as well as with cloned embryonic stem cells. Companies such as BioTransplant in Boston are working on methods of tricking the immune system into accepting "foreign" transplants, but success in this area may be years away. Moreover, using such tricks may never be as effective as transplanting tissues developed from cloned embryonic stem cells.

Revolutionary advances in medicine

Research with embryonic stem cells is about a decade behind adult stem cell research. The isolation of embryonic stem cells was first reported by Dr. James A. Thomson and colleagues at the University of Wisconsin in 1998,[10] and scientists at Advanced Cell Technology are only now beginning to close in on the isolation of stem cells from cloned human embryos. Yet, there have already been major breakthroughs in embryonic stem cell research, which promise revolutionary advances in medicine.

Mouse embryonic stem cells have been induced to develop into hematopoietic cells, heart cells, insulin-secreting pancreatic cells and neural progenitor cells, which have aided in brain development and recovery after spinal cord injury. Recently, scientists at Hadassah University in Jerusalem developed neural progenitors from human embryonic stem cells, which were then induced to develop (in vitro) into mature neurons, astrocytes and oligodendrocytes. When these cells were transplanted into the brains of newborn mice they migrated into various brain regions in response to normal developmental cues.[11]

When Thomson, et al at the University of Wisconsin transplanted neural precursors from human embryonic stem cells into the brains of 22 newborn mice, they found, one-to-four weeks later, that new mature neurons and glial cells had been incorporated into various brain regions in 19 of the mice. The new human cells were indistinguishable morphologically from the recipients' cells. They could only be detected through the use of human-specific markers. [12]



Scientists at the Hebrew University in Jerusalem found that retinoic acid (a vitamin A analog) and beta nerve growth factor both induced the growth of neurons in vitro from embryonic stem cells. They also showed that retinoic acid promoted the growth of mature neurons with receptors for the neurotransmitters dopamine and serotonin. The results of this study suggest new methods for the production of large numbers of neurons in culture for the possible replacement of neurons lost from trauma or degeneration to the central nervous system in humans.[13]

These advances represent the first wave of a revolution in medicine. The development of compatible cells, tissues and organs grown in the laboratory will eventually enable us to replace almost every diseased, injured or aging cell in our bodies with young, healthy cells.

The only cells that won't be replaceable are the brain cells that determine our identity, which will have to be rejuvenated rather than replaced. One possible method of rejuvenation for key brain cells, or for the organism as a whole, will be the use of stem cells for therapies to raise or lower the expression of genes involved in aging and degenerative disease.

In fact, new studies suggest that cloned embryonic stem cells, which are extremely young cells, may even be younger than their chronological age. After the cloning of Dolly, the sheep, it was reported that Dolly might have inherited the shortened telomeres of her nuclear donor (a six-year-old ewe), suggesting that she might be biologically older than she should be.[14] (Telomeres are DNA segments at the ends of chromosomes that become shorter when cells divide). More recent studies, however, have come to the opposite conclusion about cloned animals.

One study showed that the telomere lengths in 10 clones created from an aged, 13-year-old female dairy cow were similar to those found in the donor animal.[15] Another study produced similar findings in cloned cattle,[16] whereas two other studies, in cattle[17] and in mice,[18] found that telomere lengths were longer in the clones than in the donor animals.

Some researchers have warned that cloned animals tend to be abnormal but, as cloning research proceeds, the results have been improving. Scientists at Advanced Cell Technology recently reported, for example, that 24 of 30 cloned cows were alive and healthy, one-tofour years after they were cloned.[19] It has also been suggested that the high proliferative capacity of embryonic stem cells might create abnormal cells that might become cancerous. However, in two of the studies in which ES cells were transformed into neurons,[11,12] this did not occur.

Embryonic cell research about to explode

Embryonic stem cell research is on the verge of an explosion, which is likely to lead to unprecedented advances in medicine. Although research with adult cells shows promise, embryonic cell research could be the Rosetta Stone of 21st century medicine. By learning how these early-stage cells are transformed into skin, heart, brain and other organs, we will move closer to learning why we grow old and die while, at the same time, developing therapies to reverse the process.

Cloning is the best way of creating embryonic stem cells for medical purposes. It permits the transplantation of tissues created from these cells without rejection, and makes it unnecessary to use ES cells from any sources other than the patient who needs treatment. If the bill prohibiting therapeutic cloning passes the Senate, as it did the House, it will be a crime of unprecedented proportions.

At the end of this article, we present information about how to influence members of the Senate to vote against the bill to prohibit cloning (S.790) and include a sample letter to illustrate how that might be done.

Urge Senators To Oppose Bill To Ban Human Cloning

References

1. Cibelli JB, Kiessling AA, Cunniff K, et al. Somatic cell nuclear transfer in humans: pronuclear and early embryonic development. *E-Biomed: The Journal of Regenerative Medicine*, 2:25-31 (2001).
2. Palmer TD, Schwartz PH, Taupin P, et al. Progenitor cells from human brain after death. *Nature*, 411:42-43 May 3 (2001).
3. Jackson KA, Majka SM, Wang H, et al. Regeneration of ischemic cardiac muscle and vascular endothelium by adult stem cells. *Journal of Clinical Investigation*, 107:11:1395-1402, June (2001).
4. Orlic D, Kajstura J, Chimenti S, et al. Bone marrow cells regenerate infarcted myocardium. *Nature*, 410:701-705, Apr. 5 (2001).
5. El Oakley RM, et al. Myocyte transplantation for cardiac repair: a few good cells can mend a broken heart. *Annals of Thoracic Surgery*, 71:1724-1733 (2001).
6. Priller J, Persons DA, Klett FF, et al. Neogenesis of cerebellar purkinje neurons from gene-marked bone marrow cells in vivo. *Journal of Cell Biology*, 155:5:733-738, Nov. 26 (2001).
7. Krause DS, Thelse ND, Collector MI, et al. Multiorgan, multi-lineage engraftment by a single bone marrow-derived stem cell. *Cell*, 105:369-377, May 4 (2001).
8. Stanworth SJ and Newland AC, Stem cells: progress in research and edging towards the clinical setting. *Clinical Medicine*, 1:5:378-382, Sep/Oct (2001).
9. Vogel G, Can adult stem cells suffice? *Science*, 292:1820-1822, Jun 8 (2001).
10. Thomson JA, et al. Embryonic stem cell lines derived from human blastocysts. *Science* 282:1145-1147 (1998).
11. Reubinoff BE, Itsykson P, Turetsky T, et al. Neural progenitors from human embryonic stem cells. *Nat Biotechol*, 19:12:1134-1140, Dec (2001).
12. Zhang S-C, Wernig M, Duncan ID, et al. In vitro differentiation of transplantable neural precursors from human embryonic stem cells. *Nat Biotechol*, 19:12:1129-1133, Dec (2001).
13. Schuldiner M, Eiges R, Eden A, et al. Induced neuronal differentiation of human embryonic stem cells. *Brain Research*, 913:2:201-205, Sep. 21 (2001).
14. Shiels P, Kind AJ, Campbell KHS, et al. Analysis of telomere lengths in cloned sheep. *Nature*, 399:316-317 (1999).
15. Betts DH, Bordignon V, Hill JR, et al. Reprogramming of telomerase activity and rebuilding of telomere length in cloned cattle. *Proc. Natl. Acad Sci USA*, 98:1077-1082 (2001).
16. Tian X, Xu J and Yang X, Normal telomere lengths found in cloned cattle. *Nature Genetics*, 26:272-273 (2000).
17. Lanza RP, Cibelli JB, Blackwell C, et al. Extension of cell life span and telomere length in animals cloned from senescent somatic cells. *Science*, 288:665-669 (2000).
18. Wakayama T, Shinkai Y, Tamashiro K, et al. Cloning of mice to six generations. *Nature*, 407:318-319 (2000).
19. Lanza RP, Cibelli JB, Faber D, et al. Cloned cattle can be healthy and normal. *Science*, 294(5548):1893-1894, Nov. 30 (2001).

Urge Senators To Oppose Bill To Ban Human Cloning

These statements have not been evaluated by the FDA. These products are not intended to diagnose, treat, cure or prevent any disease. The information provided on this site is for informational purposes only and is not intended as a substitute for advice from your physician or other health care professional or any information contained on or in any product label or packaging. You should not use the information on this site for diagnosis or treatment of any health problem or for prescription of any medication or other treatment. You should consult with a healthcare professional before starting any diet, exercise or supplementation program, before taking any medication, or if you have or suspect you might have a health problem. You should not stop taking any medication without first consulting your physician.