

Cloning: How, why ... and why

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Human cloning claim adds to scientific, political controversy



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Whether or not “Eve” turns out to be the first living human clone, Friday’s announcement of her birth has added fuel to an already raging scientific and political controversy. Here are some of the top questions and answers about human cloning and what lies ahead.

What is cloning?

Cloning is the process of creating a new organism by copying genetic information from a single “parent” organism.

In a sense, identical twins could be considered clones of each other, but today the term is most commonly applied to a technique called “nuclear transfer.” In this process, the nucleus of an egg (which has half the chromosomes for a new individual) is removed and replaced with a nucleus from a donor cell (which has the full set of chromosomes). A chemical bath or electrical shock then sparks the cell to start dividing.

In “therapeutic cloning,” the cloned cells are harvested shortly after they begin dividing, when only a few new cells have been created. Many researchers believe the cells resulting from this technique could be used to grow new tissues for use in organ transplant and to treat diseases such as Parkinson’s and Alzheimer’s.

In “reproductive cloning,” the developing embryo is implanted into a woman’s womb and allowed to come to term. This is what scientists at a foundation called Clonaid claim to have done for the first time in history, using an egg as well as a nucleus donated by the mother to create a cloned baby, code-named “Eve.”

The distinction between therapeutic and reproductive cloning is crucial for understanding the debate over the science, ethics and politics of the procedure. Click through the interactive below to learn more about the process.

Is a clone a physical carbon copy of the original?

The cloned offspring shares the genetic blueprint of the original, contained within nuclear DNA, but scientists say other factors would make the clone different from its parent.

Mitochondrial DNA, which serves as the fuel factory for every living cell, would come from the donor egg rather than the implanted nucleus. Hormonal influences from the surrogate mother would cause differences in development. Also, some physical characteristics — such as your fingerprint pattern — are determined by random combinations during fetal development. (That’s why even identical twins have different fingerprints.)

Why are scientists so skeptical of the claims?

To begin with, cloning isn’t an easy feat, says Dr. Ian Smith, an NBC medical correspondent.

“It takes the right skill level, it takes the right technology, and many times it takes a lot of luck,” he said.

Clonaid’s researchers and backers don’t have a lot of credibility with the scientific community, in part because they have been linked to a space-alien sect known as the Raelians.

The company’s most visible scientist, Brigitte Boisselier, has very little background in the field and has kept virtually all the details of the project under wraps.

How will we know whether Eve is really a clone?

Clonaid appears willing to let an independent panel of experts verify that Eve is a clone, using genetic tests. Someone wanting to perpetrate a hoax would have to falsify the testing — for example, by providing two blood samples drawn from the mother and claiming that one of the samples was taken from the child.



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Anti-cloning activists demonstrate outside the headquarters of Advanced Cell Technology in Worcester, Massachusetts.

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Eve may also turn out to be the natural child of her mother and “infertile” father. In the past, supposed infertile couples going through the in-vitro fertilization process have been surprised to find out that their offspring were actually conceived the old-fashioned way.

Free-lance science journalist Michael Guillen is in charge of organizing the independent testing procedure to verify Eve’s genetic status.

“If Michael is in the room when the blood is drawn, and he oversees the delivery of that blood to the various scientific teams, I would have no question,” said Dr. Robert Lanza, a cloning researcher who is vice president of medical and scientific development at Advanced Cell Technology. “As long as Michael’s conditions are met, it would border on impossible for all the teams to independently reach the wrong conclusion.”

How did we get to this point?

Cloning was the stuff of science fiction until 1997, when British-based researchers produced a cloned sheep named Dolly.

In the years since then, cattle, cats, pigs and mice have been cloned through the nuclear transfer method, and a rhesus monkey has been “cloned” through a less complex process known as embryo-splitting.

Research into human embryo cloning has been driven primarily by the potential benefits of cloned tissue for treating disease, and the scientific mainstream has tried to discourage work in reproductive cloning. Only a few researchers on the fringe have been trying to produce babies.

Is human cloning dangerous?

In addition to the purely metaphysical and ethical questions, there are safety questions as well. In the experiment that led to Dolly, it took 277 attempts to come up with one successfully cloned sheep. Lanza said the chances of success look somewhat better if you look only at cloned animal embryos judged worthy of implanting in the uterus. Nevertheless, only about 50 percent of the implanted animal embryos resulted in pregnancies, he said, and only one or two out of every 10 embryos were successfully carried to term. The published research indicates that 25 to 30 percent of the animals that came to term suffered abnormalities, Lanza said.

What kinds of problems have cloned animals experienced?

Lanza said cloned offspring have evidenced dozens of health problems, including obesity, seizures, tumors, severe cardiovascular problems, thymus problems and joint problems.

Many of the problems are not apparent at birth, and there’s not enough of a track record to determine the full array of maladies that could arise during a clone’s life.

Scientists suspect that the problems are linked to abnormalities in gene expression that arise during the cloning process. Some researchers have reported that the cells of cloned animals appear to have shorter telomeres — snippets of DNA at the ends of chromosomes that have been linked to the cellular aging process. They suggest that the telomeres may play a key role in the cloned animals’ health problems, but other researchers aren’t so sure.

Why would anyone want a cloned baby?

Clonaid says Eve’s mother is a 31-year-old American woman who went through the cloning process because her husband is infertile. The organization says other clients are trying to have babies who will genetically match children they have lost. The Raelians, meanwhile, believe that humans could achieve a kind of immortality by cloning themselves, then somehow transferring their consciousness from one generation to the next.

Is the U.S. going to outlaw human cloning?

The House passed proposed legislation last year aimed at banning therapeutic as well as reproductive human cloning, but the measure was stalled in the Democratic-led Senate.

The Senate is now coming under Republican control, however, and the new majority leader is Bill Frist, a Tennessee physician opposed to both varieties of human cloning. Frist contends that researchers don’t need to resort to cloning to pursue research into embryonic stem cells.

The Bush administration’s bioethics advisory panel has recommended a ban on reproductive human cloning and a four-year moratorium on therapeutic cloning — which many researchers in the field say would effectively amount to a ban.

On Friday, the White House said it was “deeply troubled” by Clonaid’s announcement, and Frist was quoted as saying the announcement “should serve as a chilling reminder that individuals are still trying to clone human beings.”

Observers on both sides of the cloning issue expect a renewed political push for anti-cloning legislation during the next congressional session.

Is anyone else trying to clone humans?

Italian fertility doctor Severino Antinori predicts that his separate project will result in the birth of a cloned baby boy in January.

Advanced Cell Technology, the Massachusetts-based company where Lanza does his research, has been the only U.S. laboratory openly involved in therapeutic human cloning. Stanford University announced this month that it would conduct research into nuclear transfer technology, but it

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backed away from using the “cloning” label.

A number of laboratories outside the United States are involved in therapeutic human cloning research, sparking concerns among some scientists that U.S. research institutions could lose their edge in the biomedical field. Several countries, including Britain, have established laws that outlaw reproductive human cloning while allowing therapeutic cloning.

This article was updated to provide a better definition of telomeres and their role in cells.

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