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# Human Cloning- Is Human Cloning going to make history?

## 1.1 What is our motivation on the topic we chose?

Human Cloning is a very interesting but also a controversial topic.

The opinions about Human Cloning are cleft. Some believe that Human Cloning will be profitable and others believe that it will be bad for the humanity, if it is possible.

The development of the researches and the proceedings raised many questions about Human Cloning. How does the Cloning Technology work? What are the advantages? Is this clone going to be a normal person? What are the consequences of Cloning?

The most interesting subject of Human Cloning is that scientists have found out how to clone animals like mice, cows and dogs through cloning the embryonic stem cells. But it is not possible to use these methods on Humans. The biggest problems are the abnormalities that occur and that can prevent embryo implantation in a uterus, cause the fetus to spontaneously abort, or the baby to die shortly after birth. So the next step would be to create a method, which prevents these kind of problems.

In Switzerland it is illegal, which makes it even more interesting to us. We want to learn more about the exact process, the impacts and the pros and cons of Human Cloning to precise our knowledge in this topic, because Swiss schools do not specialize in this subject.

## 1.2 Explanation of the applied technique

Cloning is defined as the producing of similar populations of genetically identical individuals such as bacteria, insects or plants which reproduce asexually. Human Cloning is the creation of a genetically identical copy of a human. It does not refer to the natural conception and delivery of identical twins.

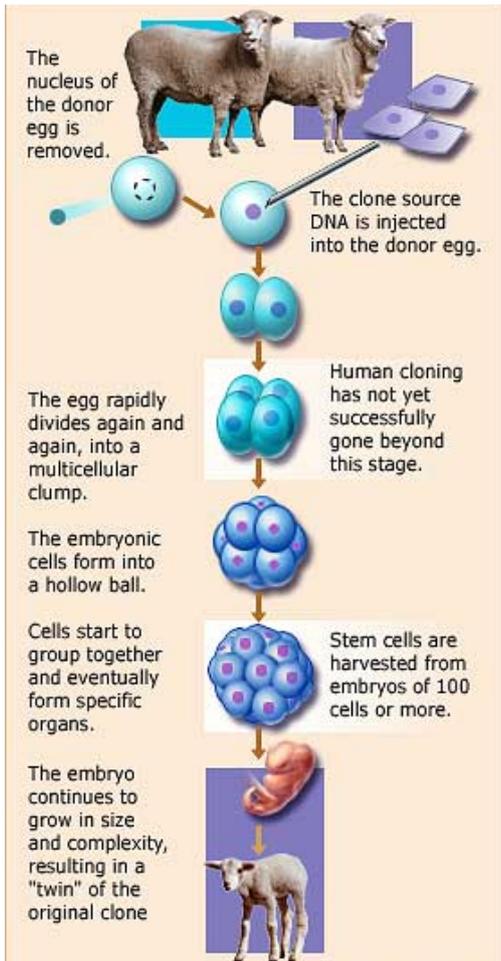
The Cloning of a human is similar to the cloning process of an animal. There are two types of Human Cloning. Namely therapeutic cloning and reproductive cloning. The therapeutic cloning is still an active area of research. Therapeutic cloning is be used for the purpose of medical treatment. It can be used for the replacement of an organ or a damaged body part, which might be possible through the somatic cell nuclear transfer. Thus stem cells are produced, which can grow into a variety of different cells.

Reproductive cloning (see *Pic 1*) is the production of an exact duplicate of a human. It is also performed by the somatic cell nuclear transfer, but in contrast to the therapeutic cloning the stem cells are not cultured in a chemical. That means the embryo is not destroyed and it begins to grow into a baby. The scientists are not completely successful yet with the cloning technology, because there are still abnormalities like kidney or brain malformation, huge organs or shorter life spans.

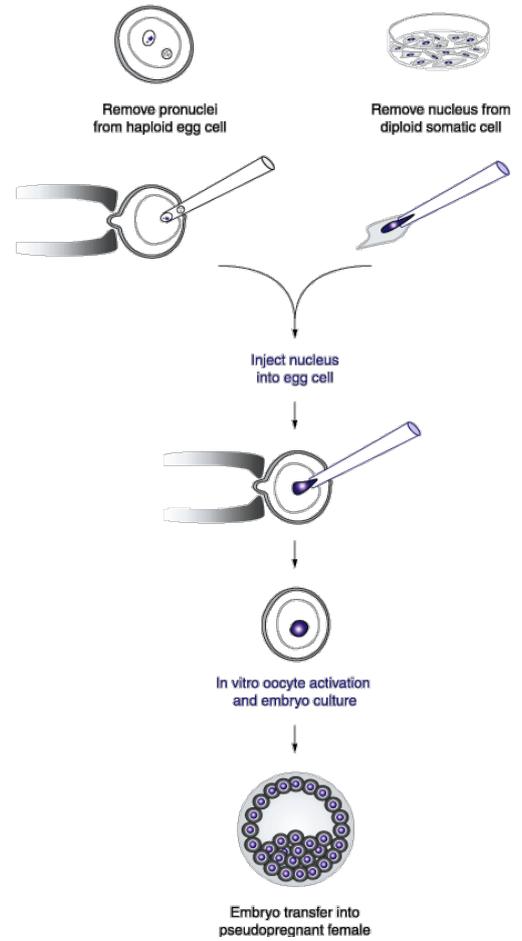
Different techniques have been examined in experiments to achieve major advances.

The first technique is called the embryo splitting (see *Pic 2*), which is the process of an artificial division of a single embryo. An embryo is an organism in the early stages of development. The produced embryos can advance like nothing happened. They are all completely identical.

The second technique is the "somatic cell nuclear transfer" (see *Pic 3*), which was also called the "Roslin Technique". This technique became famous through the first successfully cloned sheep Dolly. It was a success for the research in reproductive cloning, but also a proof for the realism of the method. The technique consists of taking a human egg cell and implanting a donor nucleus from a body cell. During the process the nucleus of the donor egg cell is removed. It is left deprogrammed, which leads to the implantation of the somatic nucleus in the empty ovum. The ovum is stimulated with a shock and will begin to divide. The egg develops and produces an adult organism. After many mitotic divisions, the single cell forms a blastocyst with the same DNA like the original organism. Another method would be "The Honolulu Cloning Technique", which was developed by Ryuzo Yanagimachi and Teruhiko Wakayama. This technique has a more successful cloning rate than the Roslin technique. It helps scientists to do further research on egg reprogramming in a nucleus. This technique uses adult cells and nuclei for cloning. The cell's nucleus is removed and a donor nucleus is injected into an egg. The new cell is chemically cultured to jumpstart cell growth. This will create embryos, which are placed into the surrogate mothers to be carried. In 1998 the method was used to create 2nd and 3rd generations of identical mice.

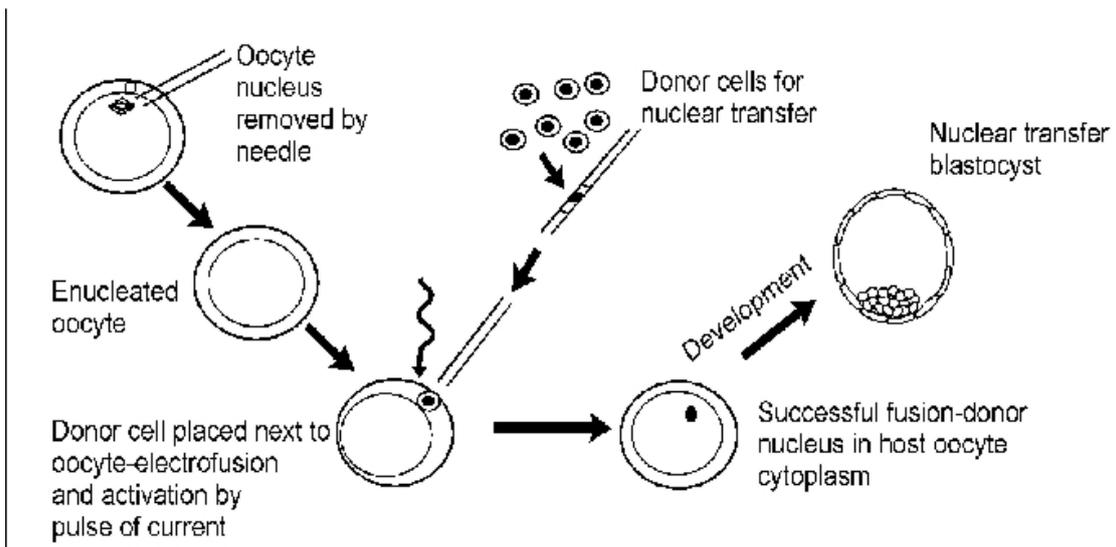


Pic 1: Reproductive Cloning



Pic 2: Embryo Splitting

Figure 4. Nuclear transfer via electrofusion in mammals



Pic 3: Somatic Cell Nuclear Transfer

### 1.3 What are some recent events?

The general idea of human cloning became a hot debate topic in 1996. The successfully cloned sheep Dolly has brought a marked revolution in the genetic engineering technology.

Dolly was cloned from a dead adult sheep using frozen cells. Scientists are not sure whether Dolly's latest problems were linked to the cloning technique, which commonly causes abnormalities. Possibly the world's most famous animal was put to sleep on 14th February 2003 after developing progressive lung disease. The big worry is whether teams trying to clone human babies will accidentally create very sick children.

Many nations including Denmark, France, Norway, Spain, Germany and Canada were against the idea of cloning production and outlawed it. Most ethicists agreed that human cloning would be reckless, unjustified and that it would undermine the human meaning of identity and parenthood. Even though the cloning reproduction is partially allowed, efforts are made to pass a world-wide ban on human cloning to clearly stop the researches at the United Nations and other international organizations.

Either way the first hybrid human clone was created by the somatic cell nuclear transfer, by an American biotechnology company in Massachusetts. The scientists took a nucleus from Dr. Jose Cibelli's leg cell and inserted it into a cow's egg from which the nucleus had been removed. The hybrid cell was cultured and developed into an embryo, which survived 12 days.

The American-based human cloning organization Clonaid was founded and registered as a company in the Bahamas in 1997. The organization has philosophical ties with the UFO religion Raëlism, which sees cloning as the first step in achieving immortality. It claims birth of first human clone called Eve on the 26th December in 2002. Eve was born outside the US to an American woman. Dr. Boisselier, the head of Clonaid, did not present the mother or child or DNA samples that would allow for confirmation of her claim at the press conference. She announced the birth of Eve, before it was evaluated whether the child in question is actually a clone. Michael Guillen, a former ABC News science editor, made an agreement with Boisselier for him to choose independent experts to test for a DNA match. Clonaid refused to identify the independent experts, because others could track the baby from the testing place into the mother's house. The Clonaid project was dismissed.

In 2004 and 2005 Hwang Woo-Suk advertised that he had cloned embryonic stem cells with the somatic cell nuclear transfer. In 2006 he confuted his statements.

In 2011 scientists at the New York Stem Cell Foundation announced that they had succeeded in generating embryonic stem cell lines. The process resulted in triploid cells, which are not be useful for cloning.

The researchers at Oregon Health and Science University worked more than 10 years and figured out what Hwang Woo-Suk did not. In 2013, they tried to fuse a genetically sick skin cell from a baby with donated human eggs to create human embryos in a nutrient fluid. The embryo grew to 150

cells. The experiment was not discontinued after seven days and the embryo died. These results showed that they were able to get a cloned human embryo to survive for the stem cell extraction with the identical genetic information like the somatic cells from another human. The scientists emphasized that they have done this experiment to precise the therapeutic cloning.

In April 2014 scientists in the United States advanced in therapeutic Cloning. They are making advances in the production of stem cells which match perfectly to a patient's DNA in order to treat diseases. They created stem cells out of the skin cells of two adult men through the embryonic development. They proved that it is possible to produce a cloned stem cell regardless of the patient's age.

## 1.4 Pros and Cons

The opinions whether human cloning has more advantages than disadvantages are controversial. Some people believe that infertility may be cured or that diseases could be healed through this technology, while others believe cloning is unethical and destroying to one's identity. Human Cloning might present a medical breakthrough, which could help people to survive diseases. But how does this idea of immortality influence the humanity?

### 1.4.1 Advantages of Human Cloning

Essentially it means that the human cloning technology might help people in different methods to live longer. On one side human cloning could be a medical breakthrough. If cloning leads to a better understanding of cell differentiation, the people may be able to cure cancer or heart attacks. Many people suffered accidental medical tragedies during their lifetimes. Tragedies like a burn victim, a girl who was born with cosmetic deformities, a man who needs a liver, a woman who is infertile because of cancer and a father, who lost his only son. A revolution cosmetic surgery or the production of organs for organ transplantation could present the solution. With the new technology, instead of using materials foreign to the body for such procedures, doctors will be able to manufacture bone, fat, connective tissue, which matches the patient's tissues exactly. That would give the patients satisfaction without the leaking of silicone gel into their bodies.

This technology could create genetically related children for people who cannot be helped by other fertility treatments. The current options for infertile couples are painful and expensive. And additionally men are made to feel like they are not real man, women as if they are useless. There is so much controversy, when homosexual couples decide to be ready for a baby. Human Cloning might be a possibility to create a baby with the DNA of both homosexual partners. They would not have to use donor sperms or eggs to have a child.

Numerous people think of satisfying themselves through cloning because they have suffered some terrible physical or mental handicap and feel robbed of the opportunities they should have had in life. They decide to produce clones of themselves, who would be enriched.

If it would be possible to clone people like Albert Einstein or some other above average people, we would have advances in science and technology at an ever faster rate and more people would be healthier than nowadays. Scientists claimed that Human Cloning could even be a step towards a fountain of youth. A human being's DNA could be reversed back to the age we prefer. The human lives would be prolonged, which would lead to immortality.

### 1.4.2 Disadvantages of Human Cloning

The most said disadvantage is that cloning is unnatural, that it could potentially violate the religious beliefs and that it would also destroy the uniqueness of a living being. If the same DNA is transferred over and over again, the genetic variation decreases. This would have far reaching consequences on the human race. The earth would be overpopulated with clones, which would lead to a lack of resources and many environmental problems.

It is not clear yet how safe this technology is, because human cloning is still in its early stage of development. An example for that would be the process of cloning Dolly. Nearly 300 of her eggs were used, 30 started to divide, 9 actually started to induce pregnancy, but only one cloned sheep was born. This suggests that scientists still have a lot of learning to do before they can clone humans. The production increases the risk of harm to embryos and to the adult cloned people. The gene variety decreases through the massive production of the same genetic structure. Natural gene mutations, which help a species to survive new viruses are lost. Therefore their immune systems do not work properly and a new virus could kill a large amount of clones.

Another disadvantage would be, that if a clone could survive, many criminals could use human cloning to get away with crimes. The criminals could make money by using cloned humans as slaves, organ donors or to exploit them as criminals on their behalf. That would lead to impacts on the society and to the death of thousands of people, which would eventually concern all of us.

## 1.5 Why and where would we use Human Cloning?

Work on cloning techniques has advanced our basic understanding of developmental biology in humans. Observing human pluripotent stem cells grown in culture provides great insight into human embryo development, which otherwise cannot be seen. Studying signal transduction along with genetic manipulation within the early human embryo has the potential to provide answers to many developmental diseases and defects.

Human Cloning could be used in many fields, but the acceptance for Human Cloning is not everywhere present. On the chart below you can see, how the ban against Human Cloning is spread all over the world.

	<b>National ban on reproductive cloning</b>	<b>National ban on genetic engineering</b>
<b>Australia</b>	Yes	Yes
<b>Austria</b>	Yes	Yes
<b>Argentina</b>	Yes	No
<b>Brazil</b>	Yes	Yes
<b>Canada</b>	Yes	Yes
<b>Croatia</b>	No	No
<b>Denmark</b>	Yes	Yes
<b>France</b>	Yes	Yes
<b>Germany</b>	Yes	Yes
<b>Greece</b>	No	No
<b>Hungary</b>	No	Yes
<b>Italy</b>	Yes	-
<b>Japan</b>	Yes	Yes
<b>Luxembourg</b>	No	No
<b>Moldova</b>	No	No
<b>Norway</b>	Yes	Yes
<b>Poland</b>	No	-
<b>Portugal</b>	No	No
<b>Russian Federation</b>	Yes	No
<b>Spain</b>	Yes	Yes
<b>Sweden</b>	Yes	Yes
<b>Switzerland</b>	Yes	Yes
<b>Turkey</b>	Yes	No
<b>United Kingdom</b>	Yes	Yes

## 1.6 Interview with Prof. Dr. Christian de Geyter on the 25<sup>th</sup> of January 2015



Prof. Dr. med. Christian De Geyter is the chief physician and the manager of gynecological endocrinology. He works at the “Universitätsspital” in Basel since 1996. He has experience in the reproduction medicine. Even though he is not specialized in Human Cloning itself, he has a lot of knowledge about it. He is working with his team on other methods like the induced pluripotent stem cell technology to find a solution for the treatment of diseases instead of using the techniques of Human Cloning.

*Pic 4: Prof. Dr. med.  
Christian De Geyter;  
Universitätsspital Basel*

1. How does Human Cloning, especially the somatic nuclear cell transfer, work?

*“Human Cloning does not exist. But the classical way is that you have a human egg and a cell from another individual. You remove the nucleus of the egg and you visualize that with special light. Afterwards you implant the nucleus of a somatic cell into the egg. The yolk of the egg will reprogram the nucleus of the somatic cell. But in Human it has never been done. There was one person in South Korea, who claimed that he has done it, but it was convicted of scientific fraud.”*

2. Why is it possible to clone a sheep rather than a human?

*“This is because of ethical reasons. The scientific community has agreed that human cloning should not be done. There are some discussions, that cloning cells of a tissue formation may be useful. Some similar techniques to cloning might be suitable for that, but nobody has ever done this yet.”*

3. Why was it possible to clone somatic cells from adults?

*“There are discussions, that there is a similar technique to cloning. Cloning is to produce a copy of an individual...a whole person. An adult person gives a somatic cell, which is put into an enucleated egg. So the older genetic material from one person can be transferred to an egg and be rejuvenated. That has been done with a sheep. It is a common technology in the bovine, but in the human for the moment it should not be done for ethical reasons. In Switzerland, the situation is easy, because cloning is completely banned by law. There are discussions where the similar technology should perhaps be done, to produce tissues for transplantation purposes. Not to produce the whole individual.*

*I am not involved, we are from the reproductive medicine community, we do not want to be*

*involved in that discussion. We have our regular clinical reproductive medicine.”*

4. Why should it be illegal if it can help people to treat diseases?

*“Whether cloning is needed for that, it is discussed. There is this other technology called iPS, the induced pluripotent stem cell technology, which is probably more prone to help instead of cloning. So the whole issue of cloning tissues is related to the compatibility of tissues for transplantation purposes. So if you want to transplant a heart from one individual to another and you want to avoid that this person needs to receive medication for the rest of his life to prevent rejection of the transplanted organ, you might produce a heart with the same tissue properties of the treated person. Cloning could help with that, I agree, but perhaps it is easier to produce a stem cell line from this person and to produce an organ with stem cells. For example, not the whole heart, only one part of the heart, myocardial cells, with which you can repair the defect. Stem cells produced from somatic cells of that individual are called iPS. This technology is not ready yet but it is very close to get there. A stem cell line, which has the property of everything. So you can take cells from the skin for the production of stem cells and from those you can produce myocardial tissue. And that tissue would have the same properties as the cloned tissue.”*

5. Is it possible to clone a disease during the cloning process?

*“If you have to treat a disease you may someday use iPS. And if you are not sure whether this is a genetic disease or not you take cells from one Individual and you reprogram them into stem cells. So on the top of the genes are epigenetic modifications. And by turning these cells into stem cells you erase the epigenetic coding, so that only the genetic coding remains. Then you turn the stem cell again to the tissue that is diseased, for example adipocytes (fat cells). We have done that with fat cells and then you can see whether the disease is still there. If the disease is still there you know that it is a genetic disease and if the disease does not occur any more we know that it is an epigenetic disease. For example some pharmaceutical companies are taking cells from Alzheimer patients, from people with Parkinson or people with neural diseases. Then they turn these cells into stem cells with this iPS technology. Then they produce cell lines, with which they can screen for drugs. So they make whole cell lines and then they screen for compounds, which in the future may become drugs. So this also an Application. But this is not human cloning technology, it is stem cell technology. For one of the things we are doing we use stem cells either genuine embryonic stem cells or iPS stem cells and we develop them into neural tissue as the embryo would do. Then we add medication of which we know they would cause disease for example neural tube defect. So we can see whether those differentiated cells also develop these defects. Afterwards we know what concentration the drug may cause the disease, in this case neural tube defects. We test other drugs too, of which we*

*not know yet they cause malformation in the embryo. If we still see that this compound at any concentration given to those differentiated stem cells, do not cause neural tube defect then we know this drug is safe for this particular disease. And this is called neurodevelopmental toxicology. This technology may someday help to avoid animal research. Now, thousands of rats must be treated during pregnancy. Then their pups are checked whether they were born with defects. We try to avoid this by developing this new technology based on stem cells.”*

6. What are some abnormalities, which could occur?

*“Now we have to focus on neural tube defect. For example a child may be born with a hole in his back. This occurs when women take medication before they even know they are pregnant. Some drugs are known to cause this. For example drugs that are given for the treatment of epilepsy may cause neural tube defect in a child if the mother takes this medicine during early pregnancy. But other drugs may be responsible for that as well. Now we are trying to develop a test to check those other compounds. But this is not cloning technology. This is stem cell technology. This is similar to cloning but the purpose is the same.”*

7. This is a hypothetical question. If we have a cloned human, would the clone act like us and behave like us?

*“We have natural clones, which are monozygotic twins. They have similarities in their character and in their behavior. So even if they are grown up in different places there might be many similarities. If we would produce identical clones, they will be similar to the monozygotic twins. They share their emotions and they are able to have their own children. This is not possible with the human cell technology. The possibility to produce gem cells is not there yet.”*

8. How was it proved that the Korean Hwang Woo-Suk lied about his cloning reproduction experiment?

*“They have been cheating the data. So they have been forcing their collaborators to produce eggs. There was a lot of fraud in there. They had a lab and female collaborators had to donate eggs for such purposes. And then the data was falsified. The head of the institution got fired. To my knowledge I have not seen him any more since then. Religious groups have claimed that they have cloned but they actually did not. Human cloning has not been done and nobody wants to do it.”*

9. But many people are trying to do it illegally?

*“There are not many labs, which are theoretically able to do so. And if one lab is able to clone we would experience that because this community is small. I do not think anybody has cloned a human yet. And if someone would claim to have done that, I would not believe it.”*

10. What is important to know about human cloning?

*“Human cloning is not needed for the moment. Stem cell technology could replace this. The ethical debate about cloning has vanished from the scientific community. Especially since the iPS technology has emerged.*

*There are two reasons why cloning should not be used. One of the technical reasons is, that it takes much too long. So if you have a person, which is adult and has a myocardial infection and he wants the tissues to be cloned, it would at least take a decade. It is a much too slow technology. And the second reason is, that we have other technologies, which are similar but faster.”*

## 1.7 Summary

In our opinion Human Cloning is an interesting topic, but not theoretically proved. We are against reproductive cloning but we support the idea of therapeutic cloning. In reproductive cloning the actual cloned human would be abused because he would not have life experiences to know what is right and what is not. That would lead to a world full of crimes. On the other side therapeutic cloning would save the lives of many sick people. For example the cure of cancer or the replacement of an organ would be a successful breakthrough in history.

Even though there has not been any success until now, they should continue to attend to therapeutic cloning.

Many scientists claim that in the future the somatic cell nuclear transfer will not be the technique that is used to produce a human clone. But they say the therapeutic cloning method might be effective and that it could help to prevent diseases and to prevent the risk of extinct species. Even though this problem with the reproductive techniques seems to be small, it will not be easy to figure out a new method. Additionally some people will not connect with cloning because of ethical aspects, which is comprehensible.

## 1.8 Sources

### Web:

Rettner, Rachael. "Could Humans Be Cloned?" *LiveScience*. TechMedia Network, 16 May 2013. Web. 15 Jan. 2015.  
<http://www.livescience.com/32083-cloning-people-biology.html>

Bailey, Regina. "The Different Types of Cloning Techniques." N.p., n.d. Web. 02 Jan. 2015.  
<http://biology.about.com/od/biotechnologycloning/a/aa062306a.htm>

"Human Cloning." *Wikipedia*. Wikimedia Foundation, n.d. Web. 15 Jan. 2015.  
[http://en.wikipedia.org/wiki/Human\\_cloning](http://en.wikipedia.org/wiki/Human_cloning)

"Medizinisch-Naturwissenschaftliche Aspekte." — *DRZE*. N.p., n.d. Web. 14 Jan. 2015.  
<http://www.drze.de/im-blickpunkt/forschungsklonen>

"Scientists Make First Embryo Clones From Adults." *WSJ*. N.p., n.d. Web. 14 Jan. 2015.  
<http://www.wsj.com/articles/SB10001424052702303626804579507593658361428>

Human Cloning Foundation Home Page." *Human Cloning Foundation Home Page*. N.p., n.d. Web. 15 Jan. 2015.  
<http://www.humancloning.org/index.html>

"Human Cloning: Latest News." *Human Cloning: Latest News*. N.p., n.d. Web. 15 Jan. 2015.  
<http://www.globalchange.com/clonenews.htm>

"Truth about Clonaid Claims: First Human Clone - Eve - plus Four More?" *Truth about Clonaid Claims: First Human Clone - Eve - plus Four More?* N.p., n.d. Web. 15 Jan. 2015.  
<http://www.globalchange.com/clonaid.htm>

"Clonaid." *Wikipedia*. Wikimedia Foundation, n.d. Web. 02 Feb. 2015  
<http://en.wikipedia.org/wiki/Clonaid>

"A Human-cow Hybrid Clone Was Created in 1998 by Advanced Cell Technologies!" *OMG Facts*. N.p., n.d. Web. 15 Jan. 2015.  
<http://www.omgfacts.com/lists/13644/A-human-cow-hybrid-clone-was-created-in-1998-by-Advanced-Cell-Technologies>

"Honolulu Cloning Technique." *Honolulu Cloning Technique*. N.p., n.d. Web. 15 Jan. 2015.  
<http://de.slideshare.net/14boggas/honolulu-cloning-technique>

### Pictures:

Pic 1:

<http://www.coviet.vn/diendan/showthread.php?t=16324&s=660e41874e5f16f379c79104801164ee>

Pic 2: <http://www.biochem.arizona.edu/classes/bioc471/pages/Lecture20/Lecture20.html>

Pic 3: [http://earthops.org/cloning\\_report.html](http://earthops.org/cloning_report.html)

Pic 4: <http://www.sgrm.org/wb/pages/de/sgrm/who-is-who.php>

### Book:

Alan Damon, Randy McGonegal, Patricia Tosto, William Ward: *Biology SL*. Pearson, 2007

### List:

" *Countries with Bans on Human Cloning And/or Genetic Engineering* | *Public Agenda*. N.p., 15 Jan. 2015.

<http://www.publicagendaarchives.org/charts/countries-bans-human-cloning-andor-genetic-engineering>

**Pictures on the cover:**

Picture 1: <http://oldsite.english.ucsb.edu/faculty/rraley/images/Newsweek77.gif>

Picture 2: <http://www.layman.org/wp-content/uploads/2013/05/clone1.jpg>

Picture 3: <http://catholiclane.com/wp-content/uploads/tiny-humans.jpg>

Picture 4: <http://www.lifenews.com/wp-content/uploads/2011/05/picturecloning9.jpg>

Picture 5: [http://img.timeinc.net/time/magazine/archive/covers/2001/1101010219\\_400.jpg](http://img.timeinc.net/time/magazine/archive/covers/2001/1101010219_400.jpg)

Picture 6: <https://popcornaday.files.wordpress.com/2012/05/human-cloning3.jpg>

Picture 7: <http://gallery.future-i.com/comedy/pic:cloned/full/cloned.jpg>

Picture 8: <http://www.thegospelcoalition.org/blogs/tgc/files/2013/05/clone.jpg>