

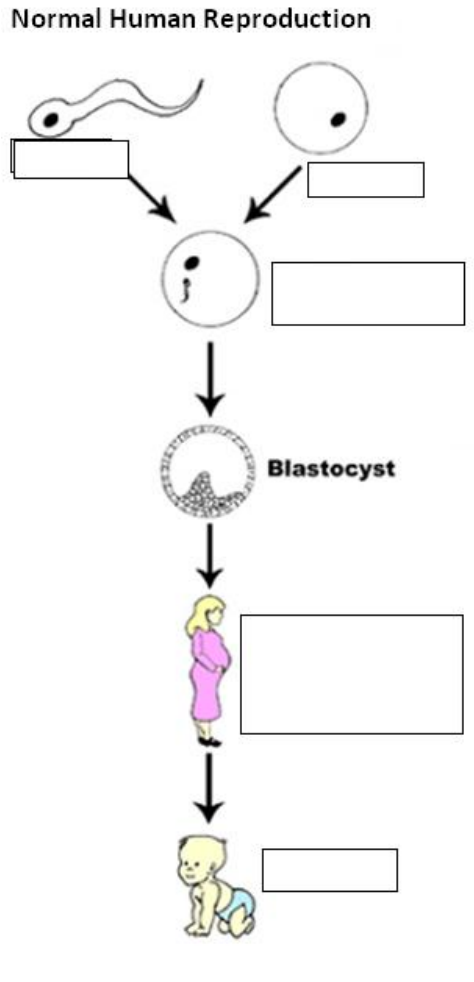
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TOC#

# CLONING AND THERAPEUTIC CLONING

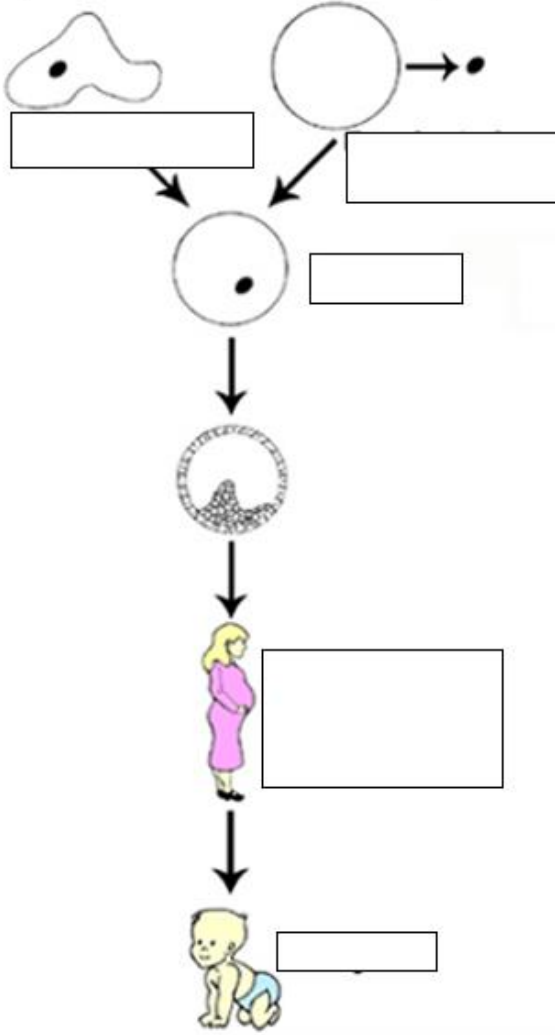
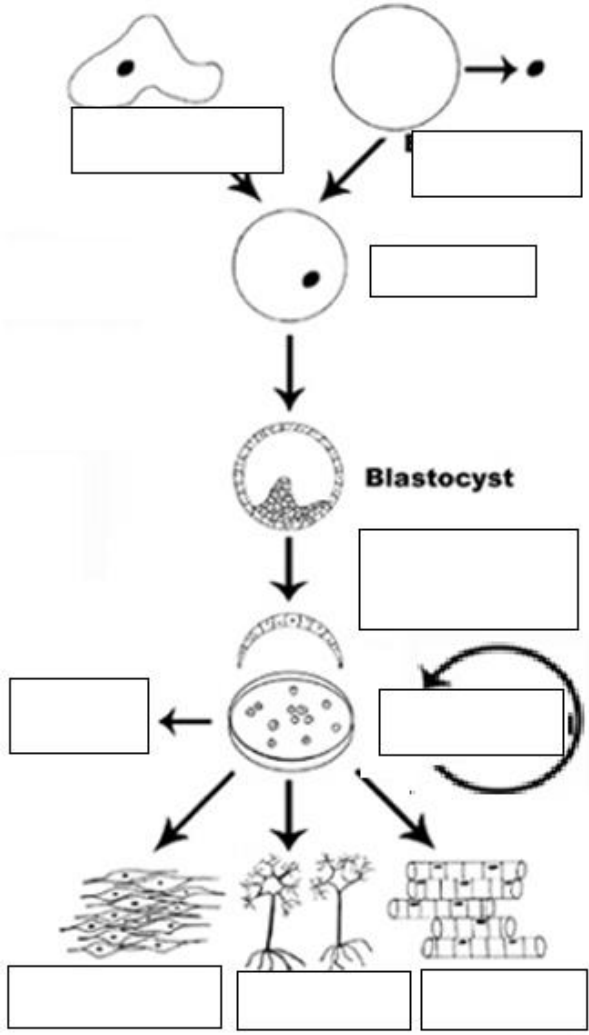
## 1. Brainstorming:

a. Label the diagram below with the steps of normal human reproduction:

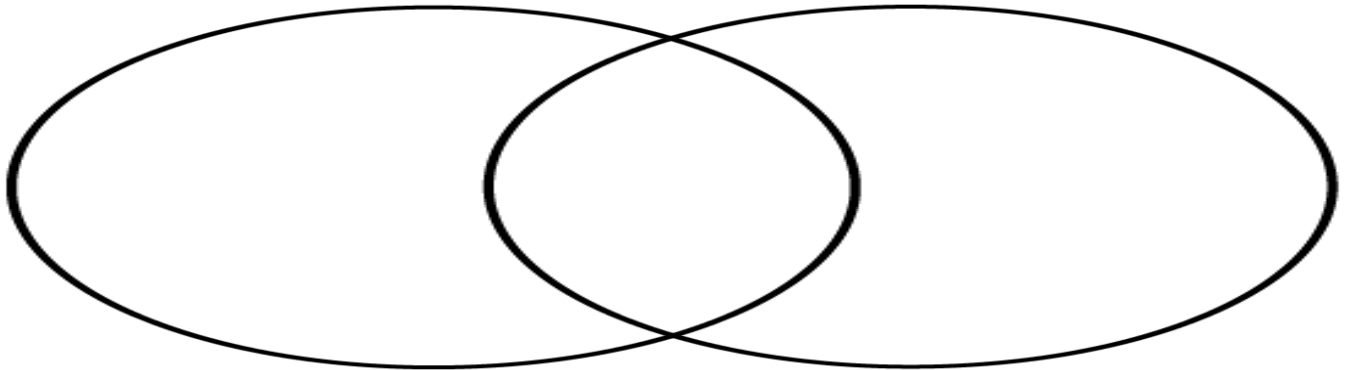


b. What do you already know about cloning? Include any details about the process, history, ethics, or personal opinions about cloning.

2. Notes – Label the diagrams in the space below and then summarize the processes of reproductive cloning and therapeutic cloning. Be sure to explain using your own words. Star or highlight any major differences between the two processes.

<p><b>a. Reproductive cloning</b> <b>Human Being Cloning</b></p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 10px;"></div>  <p>The diagram shows the process of reproductive cloning. It starts with two cells: a somatic cell (represented by a blob with a nucleus) and an egg cell (represented by a circle with a nucleus). Arrows from both cells point to a zygote (a circle with a nucleus). From the zygote, an arrow points to a blastocyst (a circle with a nucleus and a layer of cells). From the blastocyst, an arrow points to a pregnant woman (a woman in a pink dress). From the pregnant woman, an arrow points to a baby (a child in a blue diaper).</p> <p>Summary:</p>	<p><b>b. Therapeutic cloning</b> <b>Human Cellular Cloning</b></p> <div style="border: 1px solid black; width: 150px; height: 20px; margin-bottom: 10px;"></div>  <p>The diagram shows the process of therapeutic cloning. It starts with two cells: a somatic cell (represented by a blob with a nucleus) and an egg cell (represented by a circle with a nucleus). Arrows from both cells point to a zygote (a circle with a nucleus). From the zygote, an arrow points to a blastocyst (a circle with a nucleus and a layer of cells). From the blastocyst, an arrow points to a stage where the blastocyst is being cultured. From this stage, three arrows point to different types of cells: a skin cell (represented by a layer of cells), a neuron (represented by a tree-like structure), and a muscle cell (represented by a bundle of fibers). A circular arrow indicates that the blastocyst stage can be used to create more blastocysts.</p> <p>Summary:</p>
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3. Compare & Contrast – create a Venn diagram to illustrate the similarities and differences between reproductive cloning and therapeutic cloning.



**Pros & Cons –** On your own, create a list of pros and cons for both reproductive cloning and therapeutic cloning. These could include ethical, social, economic, or political reasons. Once your list is complete, share with a partner and discuss. Your team should reach a consensus about whether or not reproductive cloning and/or therapeutic cloning should be legal in the U.S.

**Reproductive Cloning**

PRO	CON	

**Therapeutic Cloning**

PRO	CON	

## Cloning Pros and Cons

As you read the following Pros/Cons/and Rebuttals, put a star next to the ones you agree with.

**Human Reproductive Cloning Arguments Pro and Con:** Cloning is a form of asexual reproduction. A child produced by cloning would be the genetic duplicate of an existing person. If you cloned yourself, the resulting child would be neither your son or daughter nor your twin brother or sister, but a new category of human being: your clone. The great majority of people have an intuitive sense that human beings should not be cloned. Arguments offered for and against reproductive cloning are given below. A summary comment follows at the end of the arguments.

### Cons

<b><u>Arguments AGAINST Reproductive Cloning</u></b>	<b><u>Rebuttals to Arguments AGAINST Reproductive Cloning</u></b>
<ol style="list-style-type: none"><li>1. Reproductive cloning would foster an understanding of children and of people in general, as objects that can be designed and manufactured to possess specific characteristics.</li><li>2. Reproductive cloning would diminish the sense of uniqueness of an individual. It would violate deeply and widely held convictions concerning human individuality and freedom, and could lead to a devaluation of clones in comparison with non-clones.</li><li>3. Cloned children would unavoidably be raised "in the shadow" of their nuclear donor, in a way that would strongly tend to constrain individual psychological and social development.</li><li>4. Reproductive cloning is inherently unsafe. At least 95% of mammalian cloning experiments have resulted in failures in the form of miscarriages, stillbirths, and life-threatening anomalies; some experts believe no clones are fully healthy. The technique could not be developed in humans without putting the physical safety of the clones and the women who bear them at grave risk.</li><li>5. If reproductive cloning is permitted and becomes accepted, it is difficult to see how any other dangerous applications of genetic engineering technology could be proscribed.</li></ol>	<ol style="list-style-type: none"><li>1. And 2. This will be true only if we allow it to be true. There is no reason that individuals and society can't learn to embrace human clones as just one more element of human diversity and creativity.</li><li>3. The problem of "expectations" is hardly unique to cloned children. Most parents learn to communicate their expectations about their children in a moderate and ultimately positive way.</li><li>4. Every medical technology carries with it a degree of risk. Cloning techniques will eventually be perfected in mammals and will then be suitable for human trials.</li><li>5. Human society can accept/reject proposed technology on its merits.</li></ol>

### Pros

<b><u>Arguments in Favor of Reproductive Cloning</u></b>	<b><u>Rebuttals to Arguments in Favor of Reproductive Cloning</u></b>
<ol style="list-style-type: none"><li>1. Reproductive cloning can provide genetically related children for people who cannot be helped by other fertility treatments (i.e., who do not produce eggs or sperm).</li><li>2. Reproductive cloning would allow lesbians to have a child without having to use donor sperm, and gay men to have a child that does not have genes derived from an egg donor (though, of course, a surrogate would have to carry the pregnancy).</li><li>3. Reproductive cloning could allow parents of a child who has died to seek redress for their loss.</li><li>4. Cloning is a reproductive right, and should be allowed once it is judged to be no less safe than natural reproduction.</li></ol>	<ol style="list-style-type: none"><li>1. The number of men and women who do not produce eggs or sperm at all is very small, and has been greatly reduced by modern assisted-reproduction techniques. If cloning could be perfected and used for this limited group, it would be all but impossible to prevent its use from spreading. Further, this argument appropriates the phrase "genetically related" to embrace a condition that has never before occurred in human history, one which abolishes the genetic variations that have always existed between parent and child.</li><li>2. Even if cloning were safe, it would be impossible to allow reproductive cloning for lesbians or gay men without making it generally available to all. Policy and social changes that protect lesbian and gay families are a much more pressing need.</li><li>3. Throughout history, parents who have lost children have grieved and sought consolation from family and community. "Replacing" the deceased child by cloning degrades and dehumanizes the child, its replacement, and all of us.</li><li>4. Rights are socially negotiated, and no "right" to clone oneself has ever been established. Furthermore, there is an immense difference between a woman's desire to terminate an unwanted pregnancy and the desire to create a genetic duplicate of another person. There is no inconsistency between supporting the former and opposing the latter.</li></ol>

## Therapeutic Reproductive Cloning Arguments Pro and Con

### Pros of therapeutic cloning

1. Therapeutic cloning can help create vital organs. This would be helpful for people suffering from kidney and other disorders, who are forced to wait years for a replacement organ.
2. When organs are made out of a patient's own cell, doctors do not have to worry about organ or tissue rejection by the immune system of the patient.
3. Stops the wait time for organs and patients then do not risk losing their life while waiting for an organ.
4. Therapeutic cloning may be helpful for preventing diseases; research in this area of therapeutic cloning is still being performed.
5. Organs would have an exact match of the patient's DNA.
6. No need for organ donors and no surgery required for the second party.
7. Allows for researchers to test cures for certain diseases, such as, Parkinson's and diabetes.
8. Researchers can study the regeneration of organs.

### Cons of therapeutic cloning

1. Adult cells are limiting, so therapeutic cloning relies on stem cells extracted from the embryos. Just a small portion of stem cells are usable.
2. Some cells mutate and cause tumors in patients.
3. In order to cure disease, millions of eggs are needed. We do not currently have this type of supply of eggs.
4. Many people believe it is ethically wrong and against "god's" wishes.
5. Extracting eggs from a female is costly and painful for the woman.
6. The cost of therapeutic cloning is very high.

### **After reading these, look back at your own pro and con list.**

1. Add any new opinions you have
2. In the blank box next to your pros and cons, try to write a rebuttal to at least one

### **Read the following article, as you read:**

- Highlight any information you find interesting or shocking.
- Underline any information you think is an argument against GMOs.
- Star any information you think is an argument for GMOs.

## **Scientists Create First Cloned Human Embryo**

**The process that created Dolly the sheep in 1996 has now been proven successful in humans.**

By [Francie Diep](#)

Posted 05.15.2013 at 3:27 pm

Scientists have made an embryonic clone of a person, using DNA from that person's skin cells. In the future, such a clone could be a source of stem cells, for super-personalized therapies made from people's own DNA.

It's unlikely that this clone could develop into a human, say the scientists, a team of biologists from the U.S. and Thailand. The team plans to publish a paper in the future detailing why not, [Nature reported](#). Previously,

the team conducted this entire process, including a technique called somatic cell nuclear transfer, in monkeys. Those monkey embryo clones always died before they could grow into adult monkeys.

"While nuclear transfer breakthroughs often lead to a public discussion about the ethics of human cloning, this is not our focus, nor do we believe our findings might be used by others to advance the possibility of human reproductive cloning," Shoukhrat Mitalipov, the clone research's lead scientist, [said in a statement](#). Mitalipov is a biologist who studies cells and development at the Oregon Health and Science University.

This is a feat that's been a long time coming. The world even got a bit of a tease of it nearly a decade ago, in 2004 and 2005, when Woo Suk Hwang of Seoul National University said he'd made human clones. It turned out Hwang was lying.

Now, Mitalipov and his team have made clones using the same basic technique that created Dolly the cloned sheep in 1996. The scientists took skin cells' nuclei—the centers of the cells, where the cells keep their DNA—and transplanted them into eggs that had their own genetic material removed. They then grew the eggs for a few days, harvested the daughter cells that appeared, and created a cell line, or a colony of cells that reproduces stably. The stem cells in the cell line could become several different types of adult cells, just like natural stem cells.

In the future, stem cells made in this way will compete with another method of creating personalized stem cells. Researchers previously showed they are able to transform adult skin cells directly into stem cells, with no stop for a transfer into an egg along the way. Such cells are called induced pluripotent stem cells, or iPSCs, and they don't require the creation of embryos.

### **Opinion/Reflection**

In the chart below, explain your opinion on each type of cloning based on the information you know have on each topic.

Animal Cloning	Human Cloning	Therapeutic Cloning

**HOMEWORK**  
**CLICK AND CLONE**

Go to the website: <http://learn.genetics.utah.edu/content/tech/cloning/clickandclone/>

1. What are the steps to clone Mimi?
  - a. Step 1:
  - b. Step 2:
  - c. Step 3:
  - d. Step 4:
  - e. Step 5:
  - f. Step 6:
2. What is a somatic cell?
3. What type of somatic cell are you using for Mimi and where does it come from?
4. What does the blunt pipette do?
5. What does the sharp pipette do?
6. What is enucleation?
7. After you transfer the nucleus of the somatic cell into the enucleated cell, you need to wait. Why?
8. What does the chemical do that you put onto the new cell?
9. How many cells are you trying to form? What is this ball of cells called?
10. What color is Mimi's clone?
11. Did this really happen?