

# CLONING

DEFINITION “It is the process of making a clone , a genetically identical copy of an organism by replacing the nucleus of an unfertilized ovum with the nucleus of a body cell from the organism”.

## HOW CLONING DIFFERS FROM NATURAL PRODUCTION

- Humans and most organisms result from sexual production. The female egg is fertilized by the male sperm and an embryo is formed.
- The embryo’s genetic structure is located in the chromosomes found in the nucleus of every embryonic cell.
- The new organism obtains one half of its genes from the mother’s egg and the other half from the father’s sperm.
- The egg nucleus is removed through a microscopic laboratory procedure and
- replaced with a donor’s nucleus, containing the unique genes of that individual.
- The egg which grows into an embryo , contains only the donor’s genes. The cloned organism is a near genetic copy of its “sole” parent rather than a random genetic combination of two parents.

## HISTORY

1894 : Hans Dreisch cloned a sea urchin by isolating blastomeres. Dreisch separated the urchin embryo when it was two cells large , and both cells matured into adult organisms.

1902 : The next successful experiment was conducted by German Dr.Hans Spemann on salamander embryos ,producing twins.

1958 :Steward obtained cells from the roots of a mature carrot root and was able to create a normal clone.

1984 : The Danish biologist Steen Willadsen cloned sheep using the DNA from early embryonic cells. Two years later. Willadsen cloned a cow from one week old embryo cells.

1996 :Dolly ( a sheep) was born using a cell from an adult cell by Wilmut and Campbell. The success of this experiment produced more ideas for cloning. A lot of scientists said that it could be used mass-produce genetically identical animals for research on human diseases.

After Wilmut’s success , a lot of cloned animals were created , such as a cat in 2001, rabbits in 2002 and dog in 2005 Rhesus monkey in 2007

## TYPES OF CLONING

1-DNA cloning/ Gene cloning

2- Reproductive cloning (Dolly)

3- Therapeutic Cloning

## DNA/GENE CLONING

- Practiced since 1970
- A term used to describe a collection of DNA fragments derived from the genome of an organism and cloned randomly into suitable cloning vectors (plasmids, phages).
- The term genomic DNA clone or chromosomal DNA clone then refers to an individual cell carrying a cloning vector with one of the cellular DNA fragments or to a phage isolate with a specific DNA insert.
- Reproductive cloning
- Reproductive cloning is the production of a genetic duplicate of an existing organism. A human clone would be a genetic copy of an

existing person.

- Some oppose reproductive cloning because of safety considerations. Animal cloning is seldom successful, and many scientists believe that reproductive cloning can never be made safe. Human reproductive cloning would also threaten the psychological well-being of cloned children, open the door to more powerful genetic manipulation technologies, and raise other social and ethical concerns.
- Dolly defied scientific convention. With her birth on 5th July 1996, her makers had done the impossible - cloned an animal from a cell taken from an adult mammal. When Dolly was announced to the world on 22nd February 1997 she became global front page news. Press and public flocked to her home at the Roslin Institute outside Edinburgh to catch a glimpse of the world's most famous sheep.

#### HOW TO GENERATE A DOLLY?

STEP 1: Udder cells were taken from a donor sheep. cells were then cultured to switch off their genes and become dormant.

STEP 2: Unfertilized egg cell was taken from another sheep. the nucleus was removed leaving an egg empty.

STEP3: THE egg cell without nucleus was fused with the donor cell using a pulse of electricity. A second pulse started the cell division.

STEP 4: After 6 days the resulting embryo was implanted into another sheep (surrogate mother).

STEP 5: After gestation the surrogate mother gave birth to dolly which was identical to the udder cell donor.

Reproductive cloning

Benefits

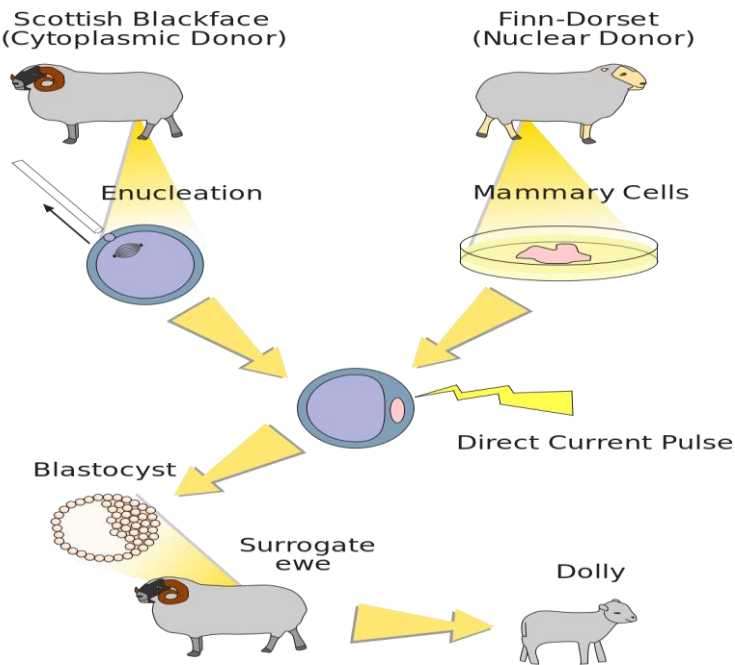
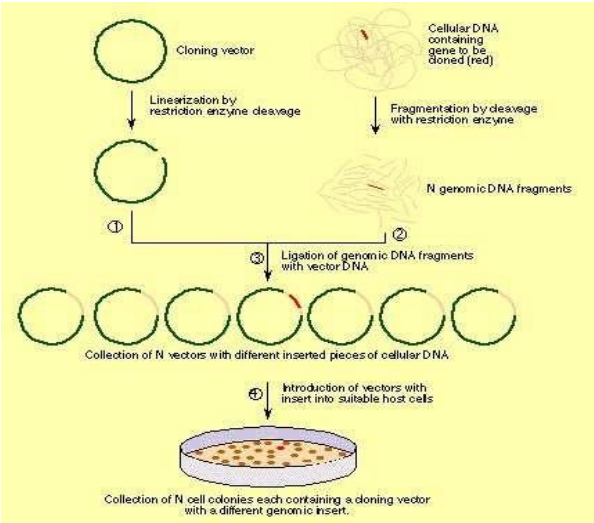
-Maintain good DNA in animal reproduction.-Cloning genetically modified animals: - Xenotransplantation (avoid tissue rejection)

-Insulin producers

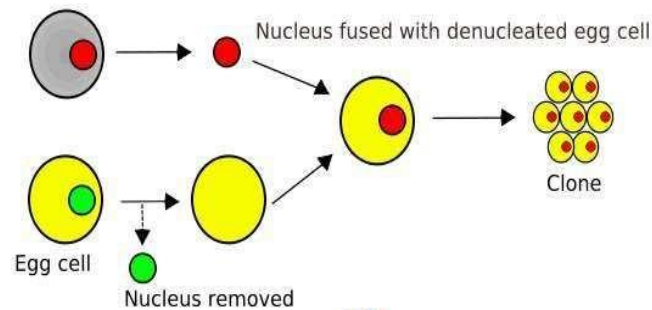
Risk

-Highly inefficient: - -Die mysteriously - High cost -Morally wrong to experiment with animals. -Could lead to the cloning of humans

Gene Cloning



Somatic body cell with desired genes



REPRODUCTIVE CLONING

THERAPUTIC CLONING

Surrogate Mother

Tissue Culture

## Therapeutic Cloning

Which creates embryonic Stem Cells. Researchers hope to use these cells to grow healthy tissue to replace injured or diseased tissues in the human body.

### Benefits

- Produce whole organs from cloned stem cells.
- Produce healthy cells for transplantation.
- Reduce need for organ donors
- Test drugs, understand diseases

### Risk

- Killing embryos in the process

## Animal Cloning

- The pet cloning started in 1997 when a billionaire from Arizona wanted to clone his dog. He paid millions to a company called Genetics saving and clone in order to clone his dog.
- The first cloned cat was born in 2001.
- The scientists perform a biopsy to a on a live or very recently deceased animal to collect DNA.
- Next , the tissues are grown and the cells are preserved until the next phase of the cloning process.
- To produce a cloned embryo ,the cells are treated to prevent them from being assigned to a particular function( hair , skin...).
- The genetic material is removed from eggs obtained from random cats.
- The eggs and cells are fused together by electricity ,resulting in cloned embryos.
- Multiply cloned embryos are implanted into female cats during an artificially – induced reproductive cycle. The cats may or may not develop pregnancies and are monitored by ultrasound.

### Advantages vs Disadvantages

#### Advantages

There will be an endless supply of animals to clone, and we will never run out of food from animals, because we have been able to clone based on previous efforts, the most famous of these was the first ever cloning of an animal, Dolly the lamb which was a successful cloning where Dolly was a healthy lamb.

#### Disadvantages

Many believe cloning is quite inhumane, especially that of religious and some governmental parties which don't want to move forward with this research. They think life is just too precious to take away, even if it is a clone in which we are testing.

#### Cloning Good Or Bad:

- People can get an animal that looks the same as the pet they had .
- Scientists can clone organs and help people live longer.
- Scientists can also clone body parts such as ears to surgically attach to a person, Cloned animals are safe to eat.
- The offspring of cloned animals are often born deformed It is against religious beliefs
- Pets that are cloned often do not come out having the same personality and can look different

### **What are the risks of cloning?**

- Expensive and highly inefficient.
- More than 90% of cloning attempts fail to produce a viable offspring.
- In addition to low success rates, cloned animals tend to have more compromised immune function and higher rates of infection, tumour growth, and other disorders.
- Many cloned animals have not lived long enough to generate good data about how clones age.
- Appearing healthy at a young age unfortunately is not a good indicator of long term survival.
- Clones have been known to die mysteriously. For example, Australia's first cloned sheep appeared healthy and energetic on the day she died, and the results of her autopsy failed to determine a cause of death.

### **APPLICATION**

- Biomedical research
- Animals as drug producers
- Animal models
- Breeding androgenic body tissue
- Xenotransplantation
- Livestock breeding and agriculture
- Transgenic clones
- Changes to agricultural structures
- According to FDA Meat and milk from cow, pig, and goat clones, and the offspring of any clones, are as safe as food we eat every day.
- The main use of clones is to produce breeding stock, not food.