

Cloning



Cloning is :

duplicate a cell or an organism, usually asexually, which is genetically an exact replica of the other cell or organism.

Clone is :

an organism which is genetically an exact replica of another organism.

Wishful Thinking!!!



STAR WARS
EPISODE II
ATTACK OF THE CLONES

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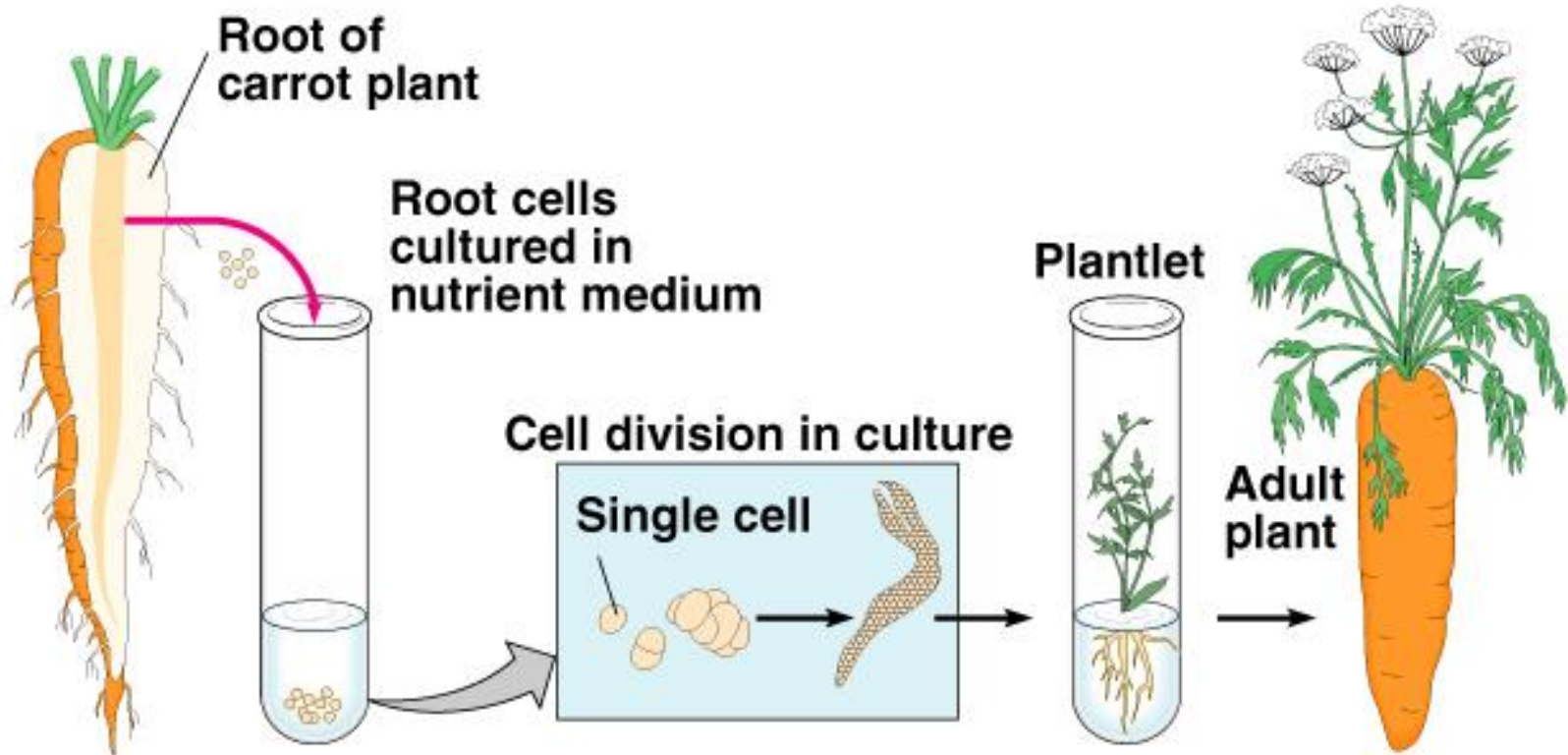
STAR WARS
ATTACK OF THE CLONES

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Cloning in Plants



Asexual Reproduction always produces clones

Animals that have been cloned

1 Carp

2 Cat

3 Cattle

4 Deer

5 Dog

6 Ferret

7 Frog (tadpole)

8 Fruit Flies



9 Gaur

10 Goat

11 Horse

12 Mice

13 Mouflon

14 Mule

15 Pig

16 Pyrenean ibex

17 Rabbit

18 Rat

19 Rhesus Monkey

20 Sheep

21 Water Buffalo

22 Wolf



Cloning in Animals

- Laboratory Techniques have been developed that have allowed this to happen in Animals.
- Animals were cloned more than 20 years ago
- Two techniques:
 - Embryo splitting
 - Nuclear transfer

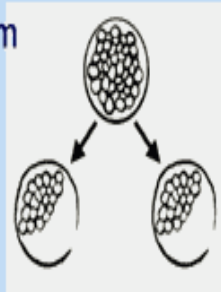
Embryo Splitting

- Egg collected
- Fertilized by *in vitro* fertilization (IVF)
- Embryo is grown to 8–16 cells
- Cells are separated
- Separated cells grown into separate embryos
- Embryos transplanted into surrogate mothers
- May be used to clone any mammalian embryos, including humans

Embryo Splitting

Cloning by Embryo Splitting

Embryo is split to form two half-embryos



Embryos are transferred to an unrelated surrogate mother



Pregnancy is monitored by ultrasound



Sheep gives birth to identical twins

Nuclear transfer :

- First done in 1986
- More difficult
- Nucleus is removed from an egg
- Enucleated eggs are fused with other cells
- Embryos are transplanted into a surrogate mother
- In 1997, **Dolly the sheep** was the first mammalian clone from an adult donor cell

A donor cell is taken from a sheep's udder.



Donor Nucleus



These two cells are fused using an electric shock.

Egg Cell



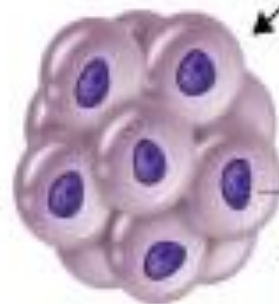
An egg cell is taken from an adult female sheep.



The nucleus of the egg cell is removed.



The fused cell begins dividing normally.



Embryo

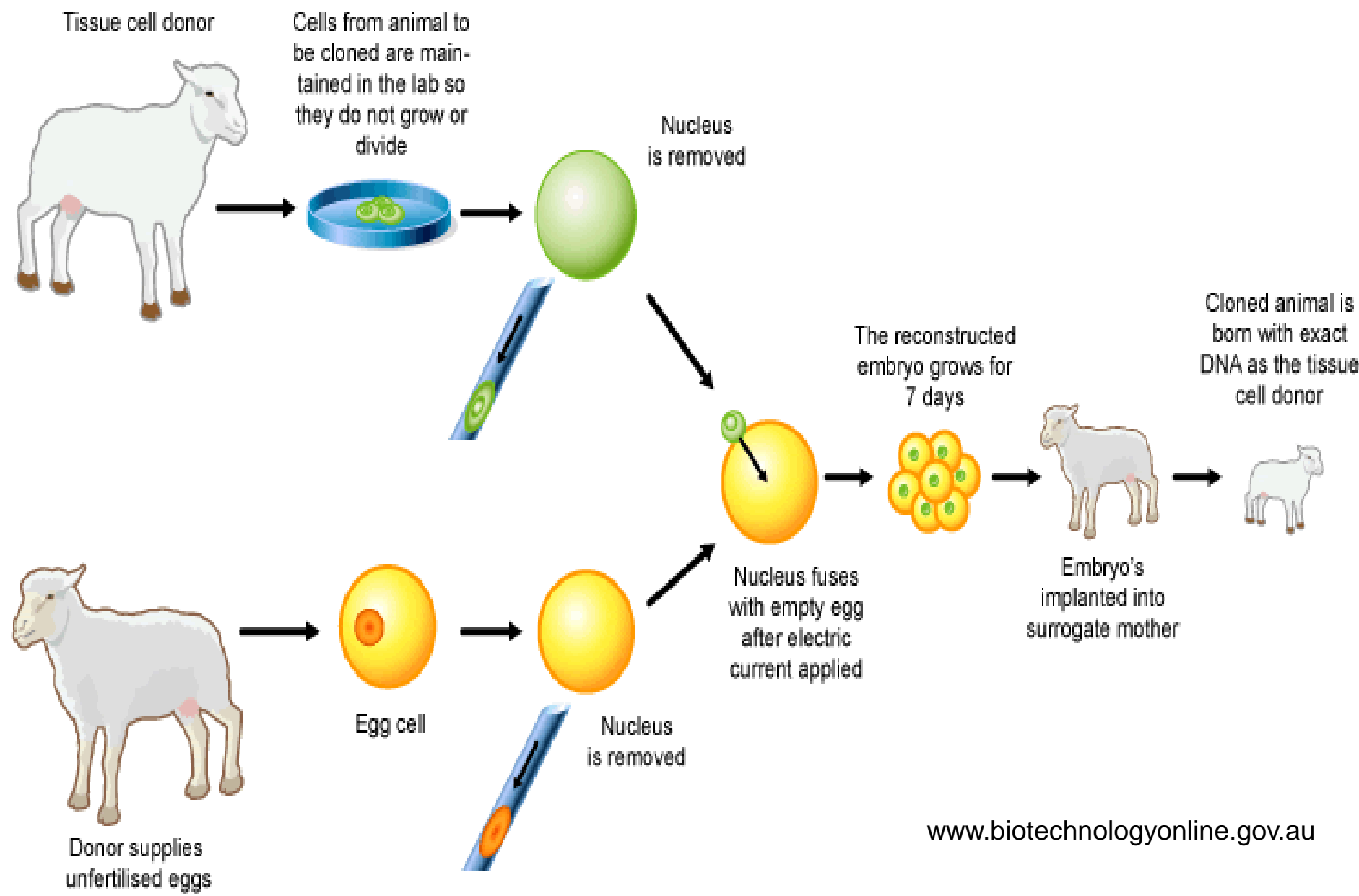
The embryo is placed in the uterus of a foster mother.

Cloned Lamb



The embryo develops normally into a lamb—Dolly





النعجة دوللي ومُستسخها
" إيان ويلموت "



Dolly was born 5 July 1996 to three mothers (one provided the egg, another the DNA and a third carried the cloned embryo to term). She lived for 6 years



Dolly: The Cloning of a Sheep

- **Dolly** the sheep was successfully cloned in Britain in **1996** by the scientist “Ian Wilmut” and was put down in February **2003** after developing a **lung infection and arthritis**.
- Dolly was a **genetic copy** of the Finn Dorset ewe.
- Her birth, more than 10 years ago showed that nuclei from specialized adult cells can be reprogrammed into all the cells of an organism.
- The technique that led to Dolly is called
- **somatic cell nuclear transfer** and has
- remained essentially unchanged over
- the last decade.



Human Cloning

- Very Controversial Topic
- Difference Between:
 - Therapeutic Cloning – Culturing of Human Cells for use in Treating Medical Disorders
 - Reproductive Cloning – Development of a cloned human embryo for the purpose of creating a cloned Human Being

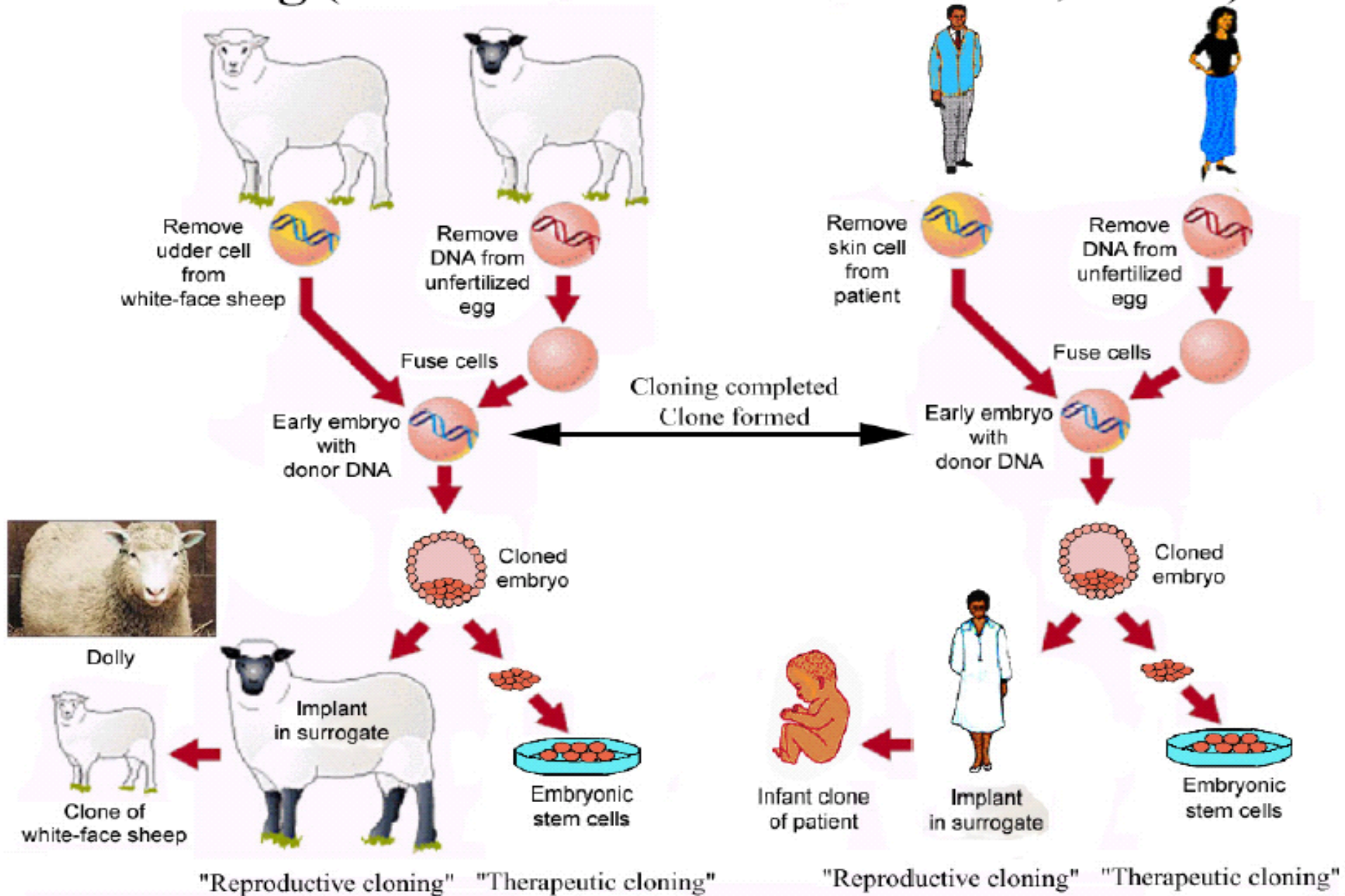
- Reproductive cloning

The regeneration of a whole organism by cloning techniques

- Therapeutic cloning

The creation of specific cell types from a cloned embryo

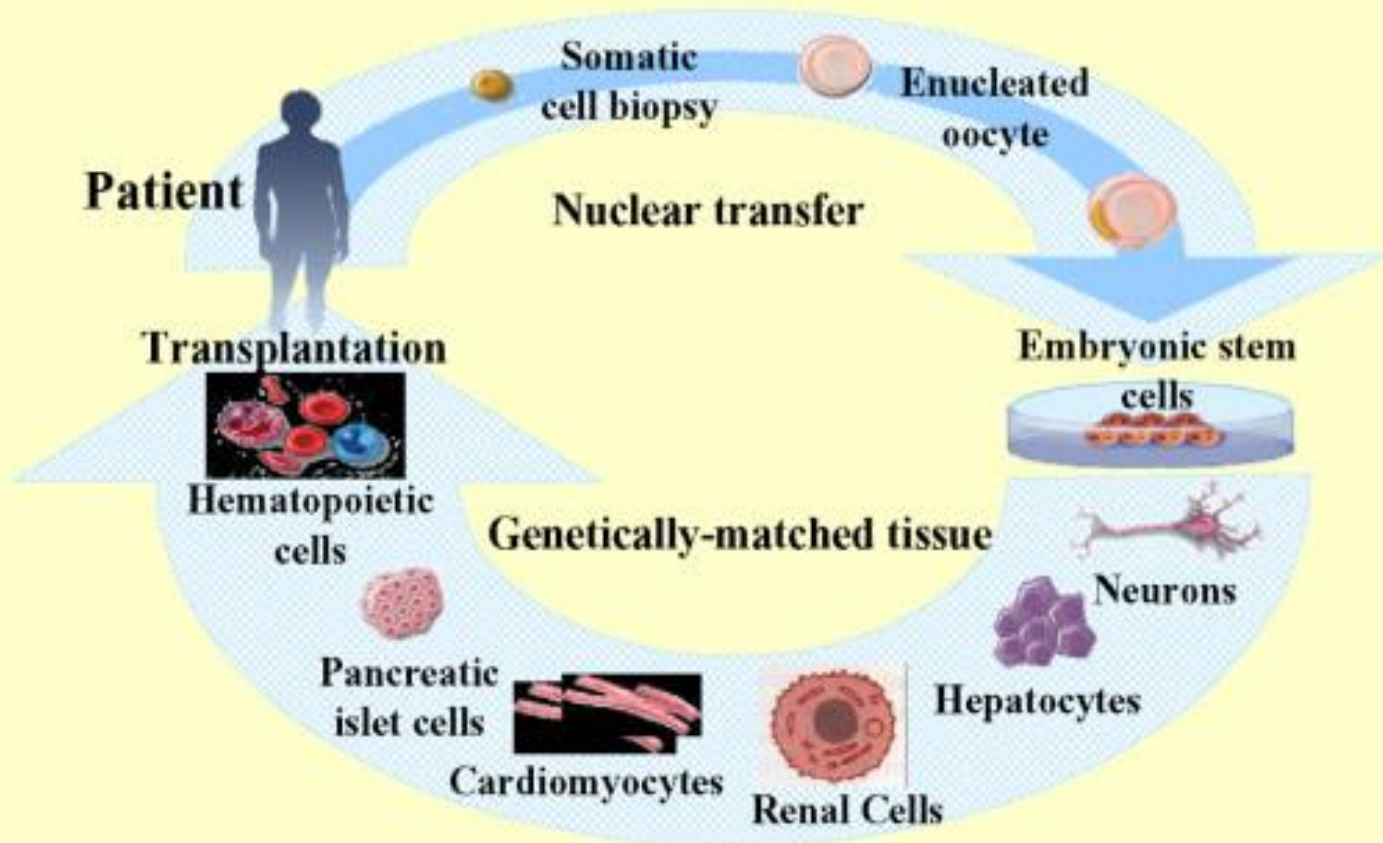
Cloning (Somatic Cell Nuclear Transfer, SCNT)



Therapeutic Cloning

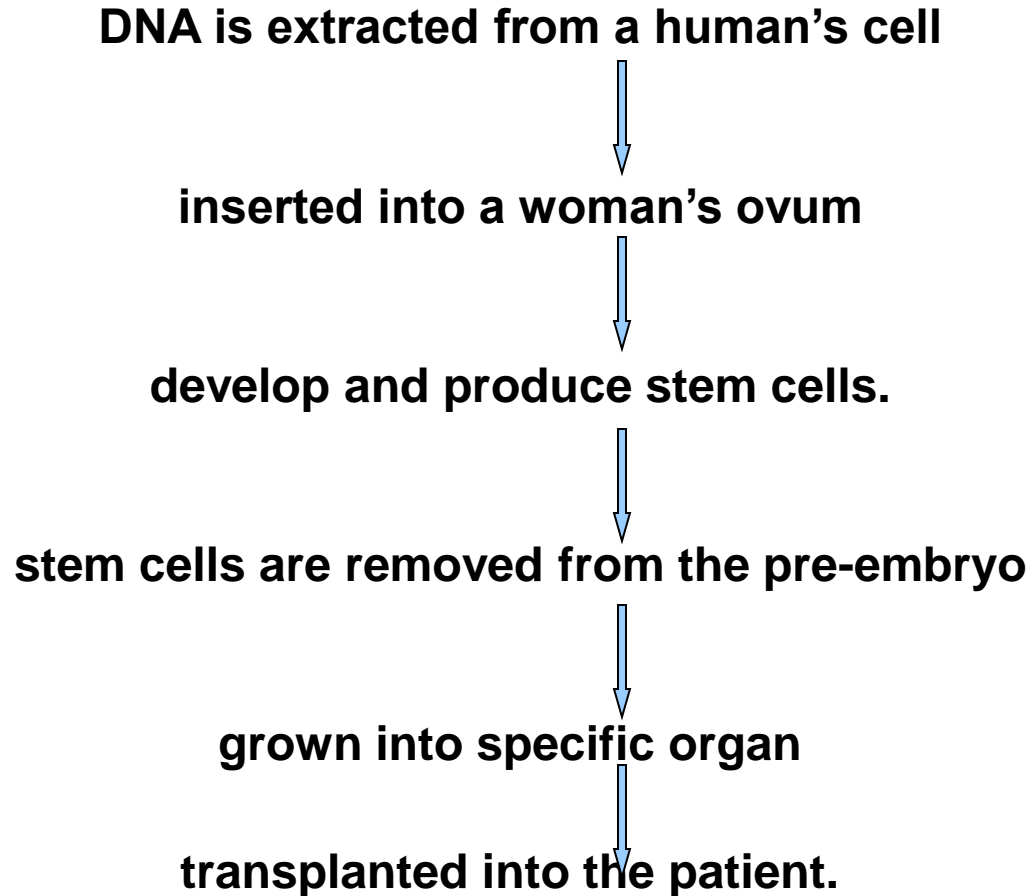
- Somatic Cell Nuclear Transfer(SCNT)
- Biomedical Cloning
- Research Cloning
- Regenerative Medicine
- Nuclear Transplantation Therapy(NTT)

Therapeutic Cloning Strategies



- **Therapeutic cloning (research cloning) is when stem cells are extracted to grow into a piece of human tissue which is encouraged to grow into a human organ for transplant**

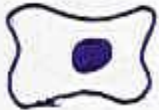
Therapeutic Cloning



What is the difference between reproductive and therapeutic cloning?

Reproductive cloning involves creating an animal that is genetically identical to a donor animal through somatic cell nuclear transfer. In reproductive cloning, the newly created embryo is placed back into the uterine environment where it can implant and develop. Dolly the sheep is perhaps the most well known example. In therapeutic cloning, an embryo is created in a similar way, but the resulting "cloned" cells remain in a dish in the lab; they are not implanted into a female's uterus.

Steps in Cloning



Step 1: Take any cell from your body, e.g. from the skin



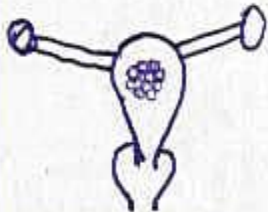
Step 2: Take an egg cell (ovum), from the ovary of any woman.



Step 3: Take the nucleus out of the egg cell.



Step 4: Put together the cell of your skin and the egg without nucleus. It will start to multiply forming a microscopic ball of many identical cells.



Step 5: In about 6 days place it in the uterus of the woman.

A PERSON
Like You!

Step 6: In 9 months a baby will be born just like you, an identical twin of you... without any genetic characteristics of the woman who gave the ovule and provided the uterus, and gave birth to your twin.

Why we want to do cloning ?

Researchers hope that these techniques can be used in researching and treating human diseases and genetically altering animals for the production of human transplant organs.

Pros and Cons of Cloning

PROS:

- Produce animals with desirable traits.
- Increase the efficiency of the livestock production.
- Offset losses of among endangered species populations.
- Enable better research for finding cures to many diseases.

•CONS:

- Decline in genetic diversity.
- Religious and moral reasons.
- Physical problems, such as birth defects.
- Possibility of mental and emotional problems of the clone.