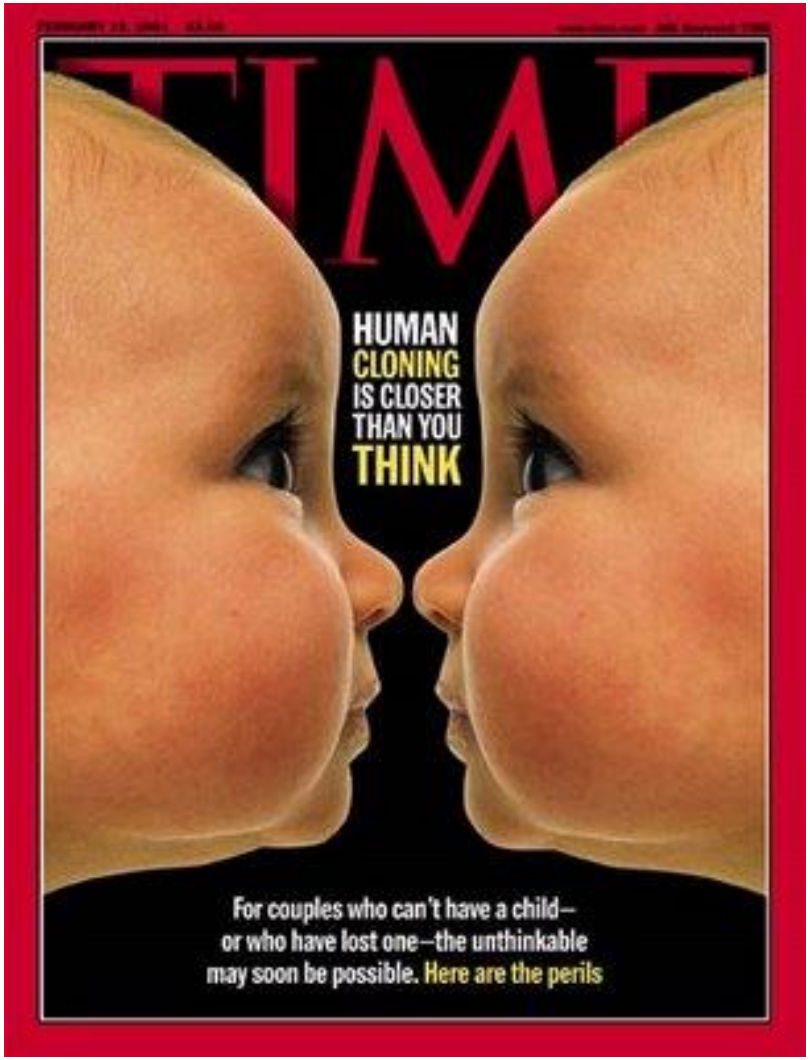
Cloning - Science or Science Fiction?

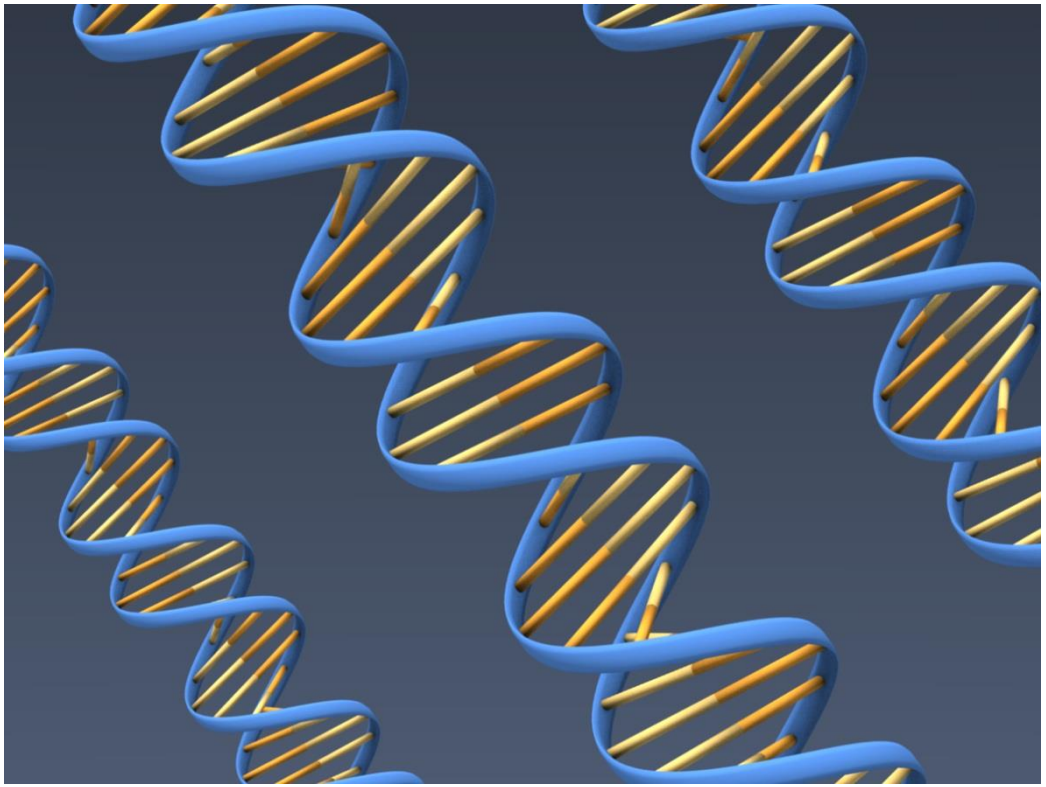


What if we could clone you?

- Would you go for it?
- In what ways would your clone be like you?
- In what ways would your clone NOT be like you?

What is a Clone?

- Genetically identical organisms.

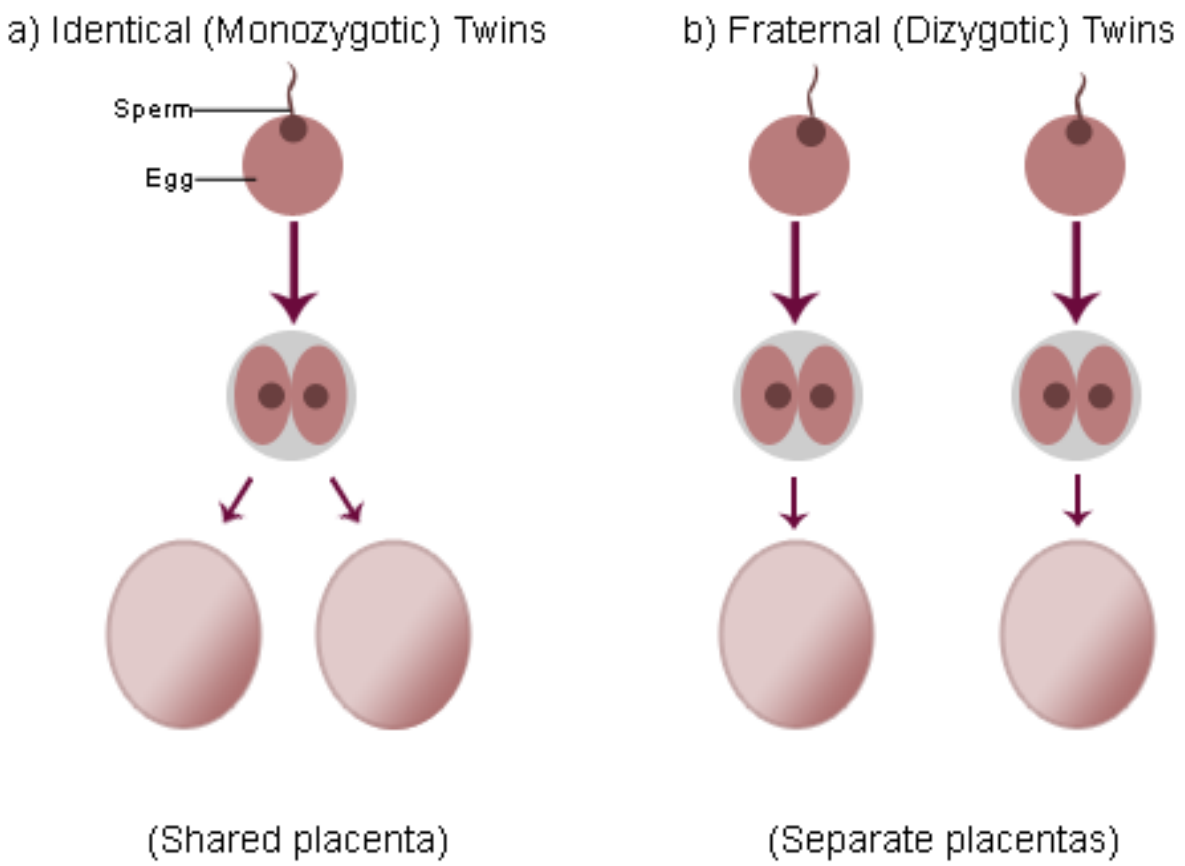


Have you ever met a human clone?

- I bet you have!
- Identical twins are clones – they share the same DNA.
- Do they have the same blood type?
- Do they have the same eye color?
- Do they have the same hair color?
- Do they have the same brain?
- Do they have the same mind?

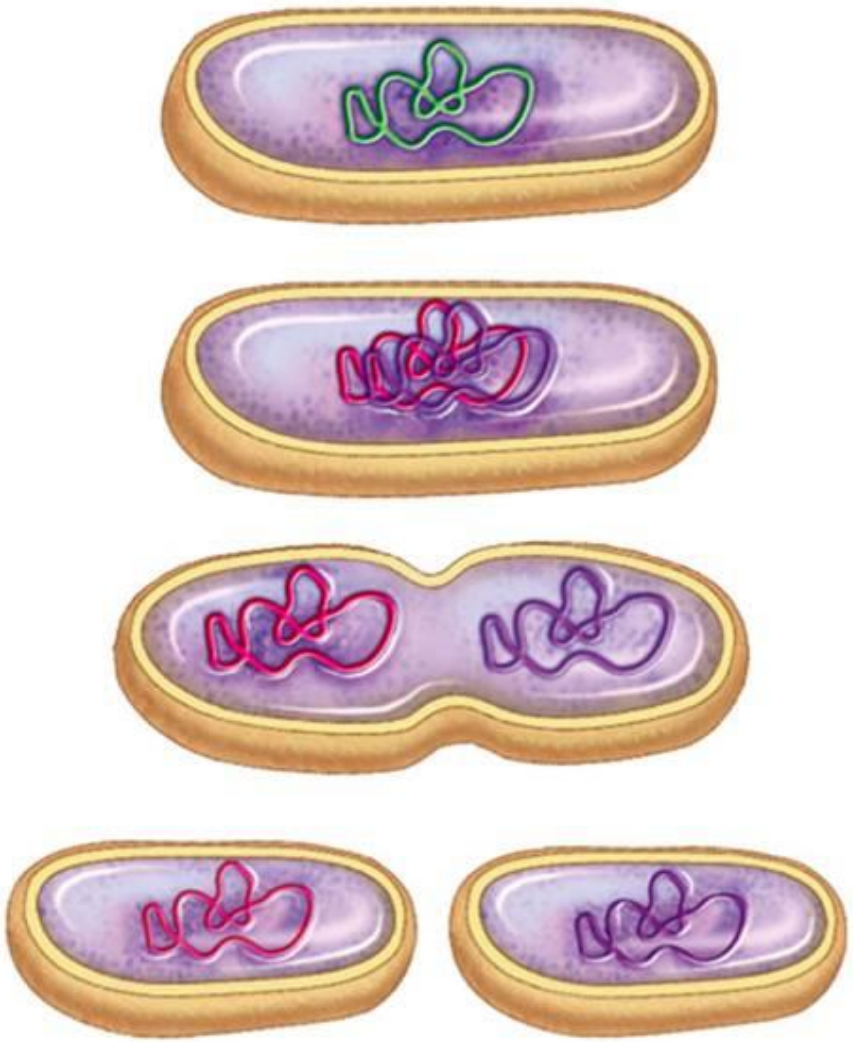
Twins

- There are 2 types of twins.
- 1) Identical (monzygotic)
- 2) Fraternal (dizygotic)



Asexual Reproduction

- **Asexual reproduction needs only one parent.**
- **Since there is only one parent, there is no fusion of gametes and no mixing of genetic information.**
- **As a result, the offspring are genetically identical to the parent and to each other. They are clones.**



Asexual Reproduction

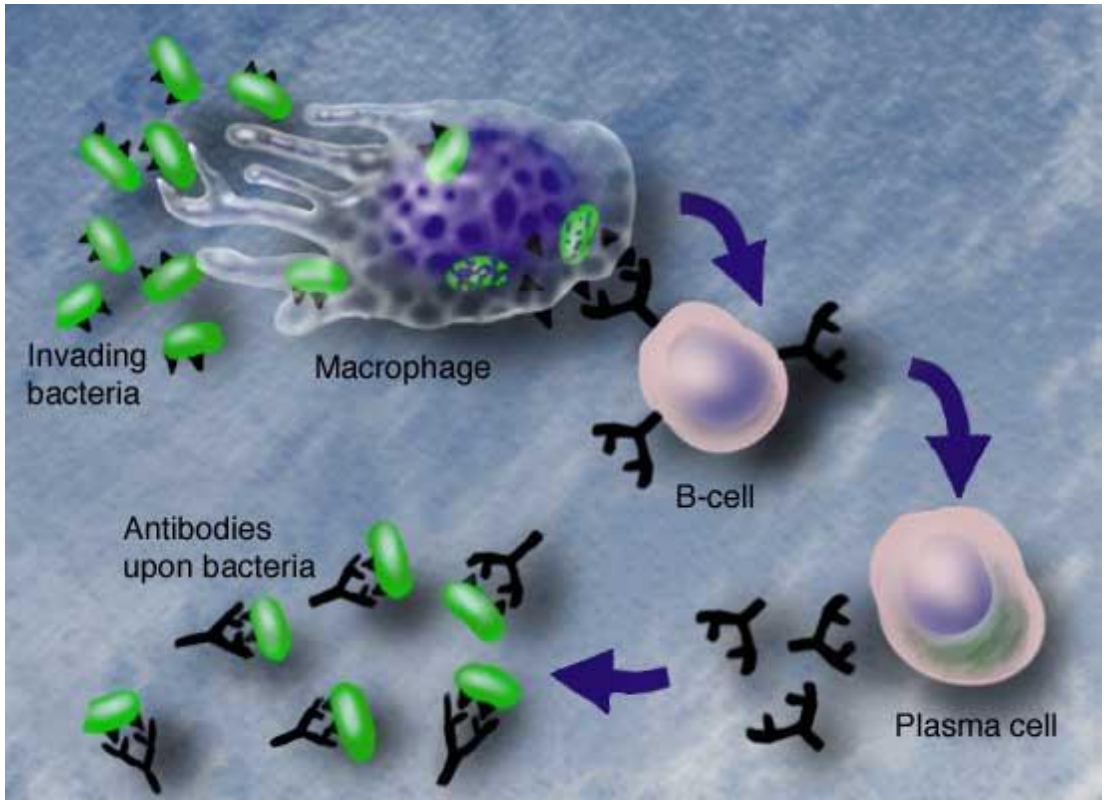
- What are some advantages in reproducing asexually?
- No need to find a partner.
- Speed of reproduction.

Asexual Reproduction

- Bacteria can often divide every 20 minutes.
- How many bacteria would you have living in your intestine in 8 hours if one cell makes it past your acidic stomach?

Asexual Reproduction

- What is the major disadvantage in reproducing asexually?
- No variation.
- They all share the exact same DNA. The same strengths and weaknesses.
- If the host cell produces an antibody, it will easily wipe out the entire population.

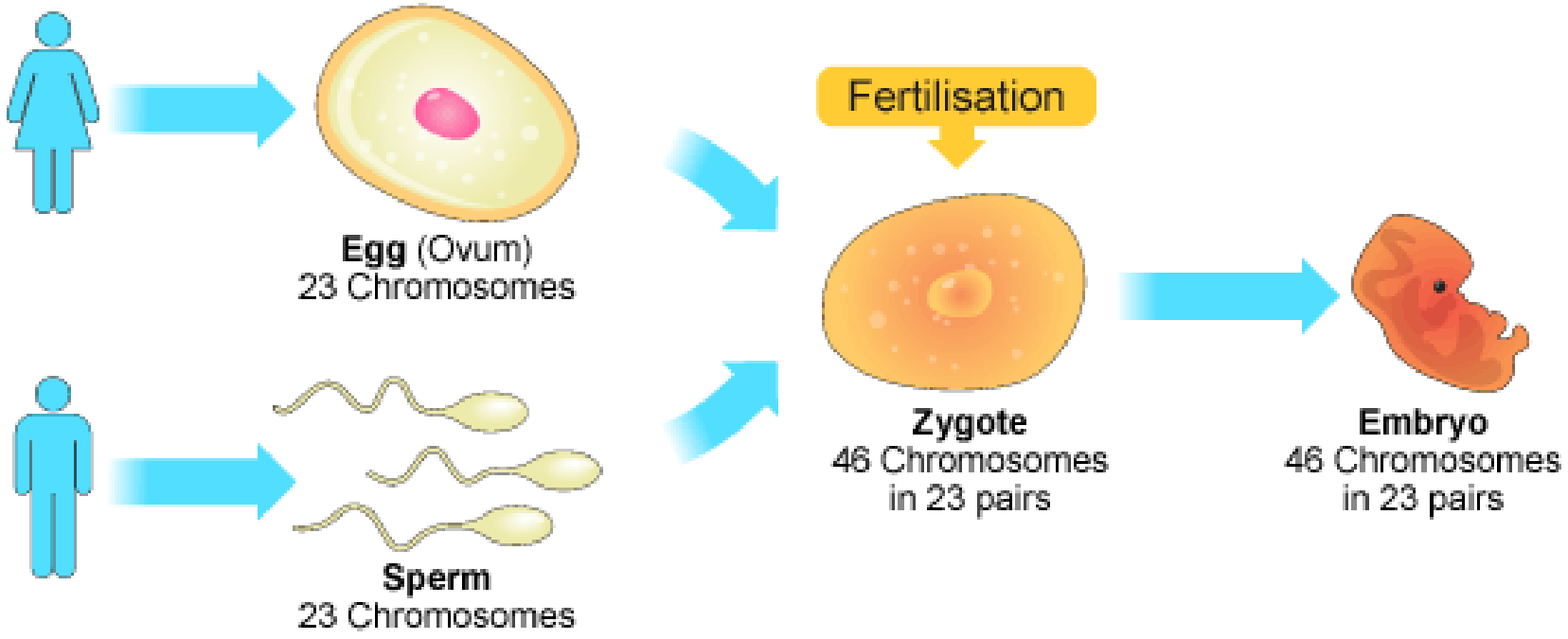


Sexual Reproduction

- Sexual reproduction requires two parents. Each contributes ½ of the genetic information.

- Occurs when two gametes (sperm and egg) join together to form a single cell (zygote).

- It occurs mainly in plants and animals.



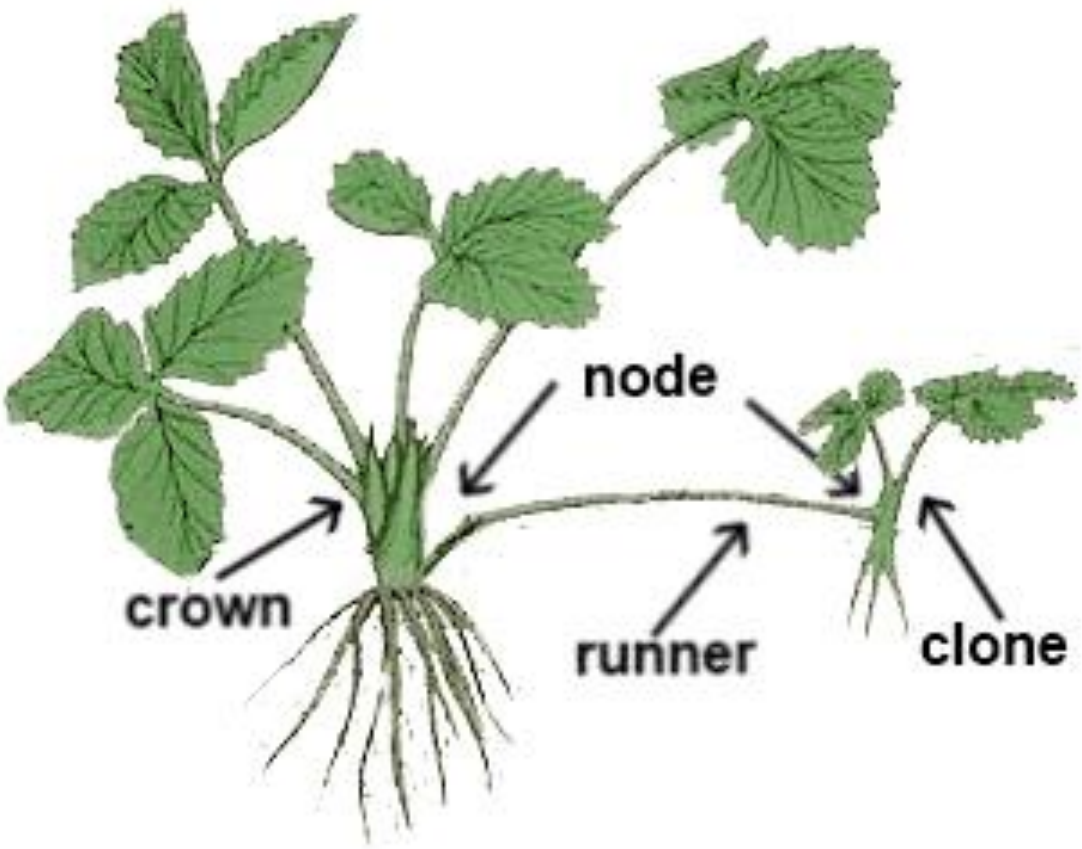
Sexual Reproduction

- What is the main advantage in sexual reproduction as compared to cloning?
- Variation!!!

Cloning in Plants

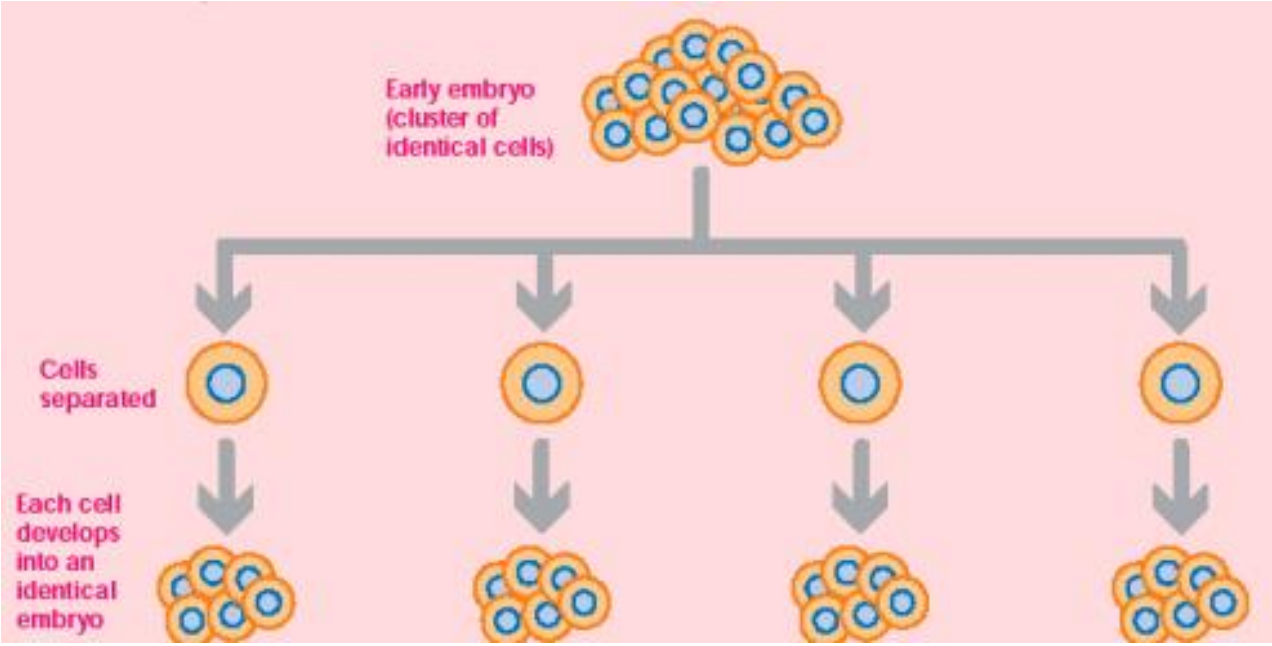
- Nature has been cloning plants for billions of years.

- For example, when a strawberry plant sends out a runner (a form of modified stem), a new plant (clone) grows where the runner takes root.

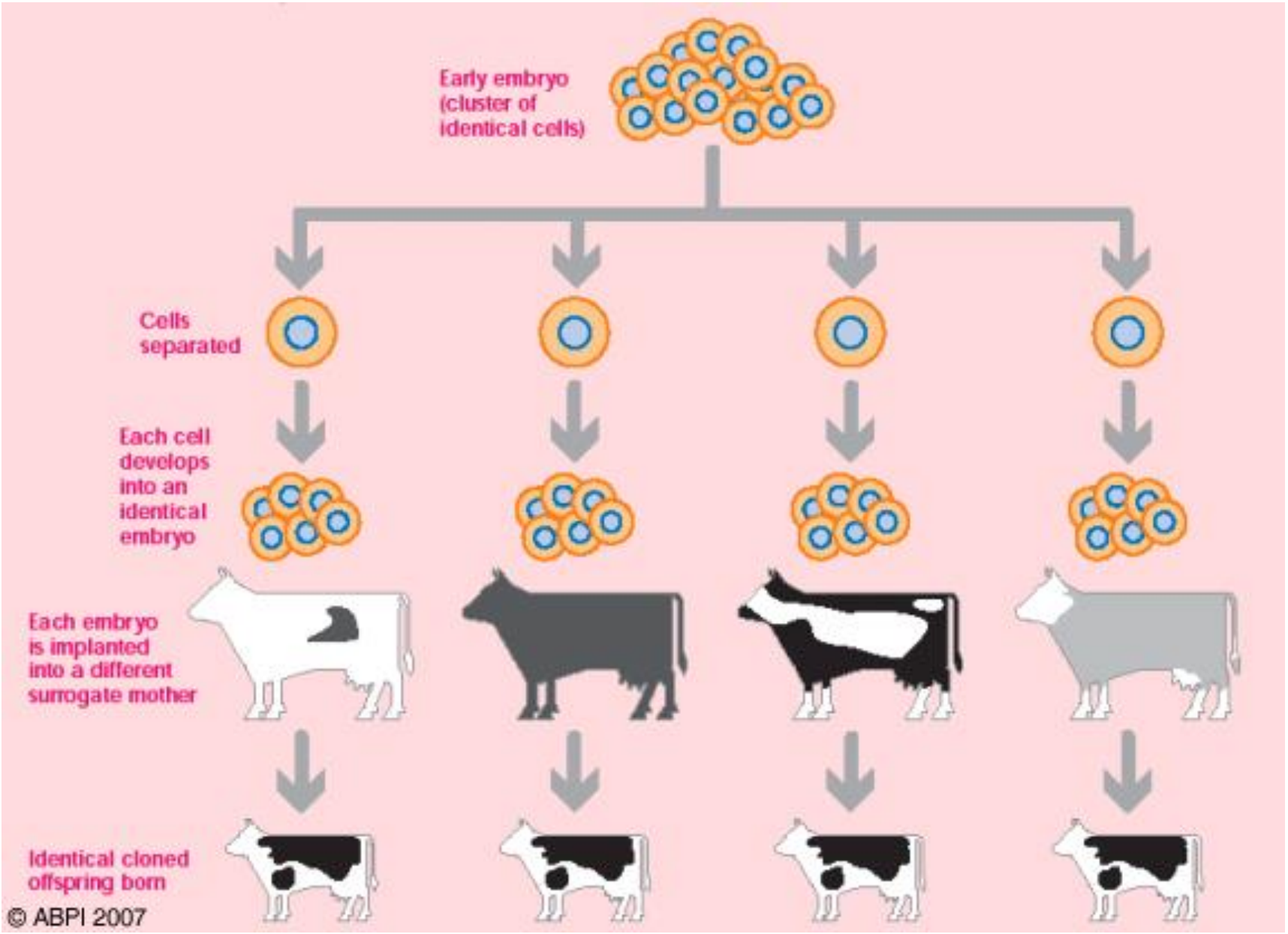


Embryo Cloning

- The very first successful animal clones of mammals was performed with embryos.
- What embryo is this?

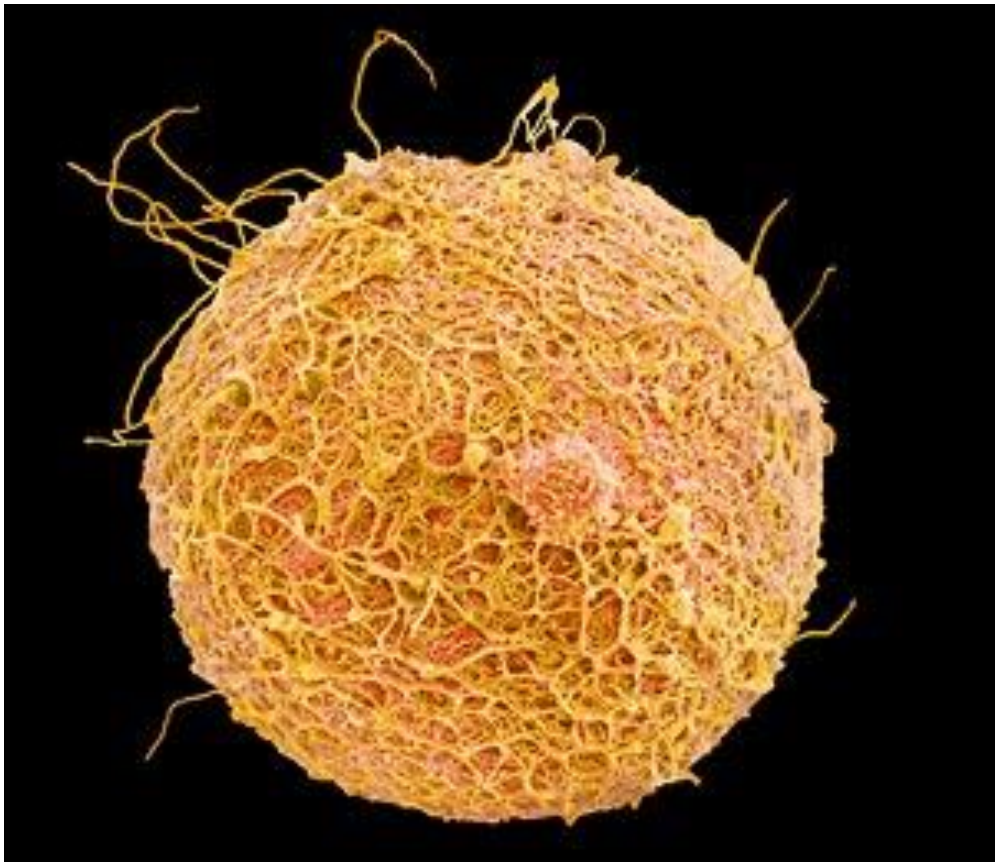


Embryo Cloning



The Egg is Key

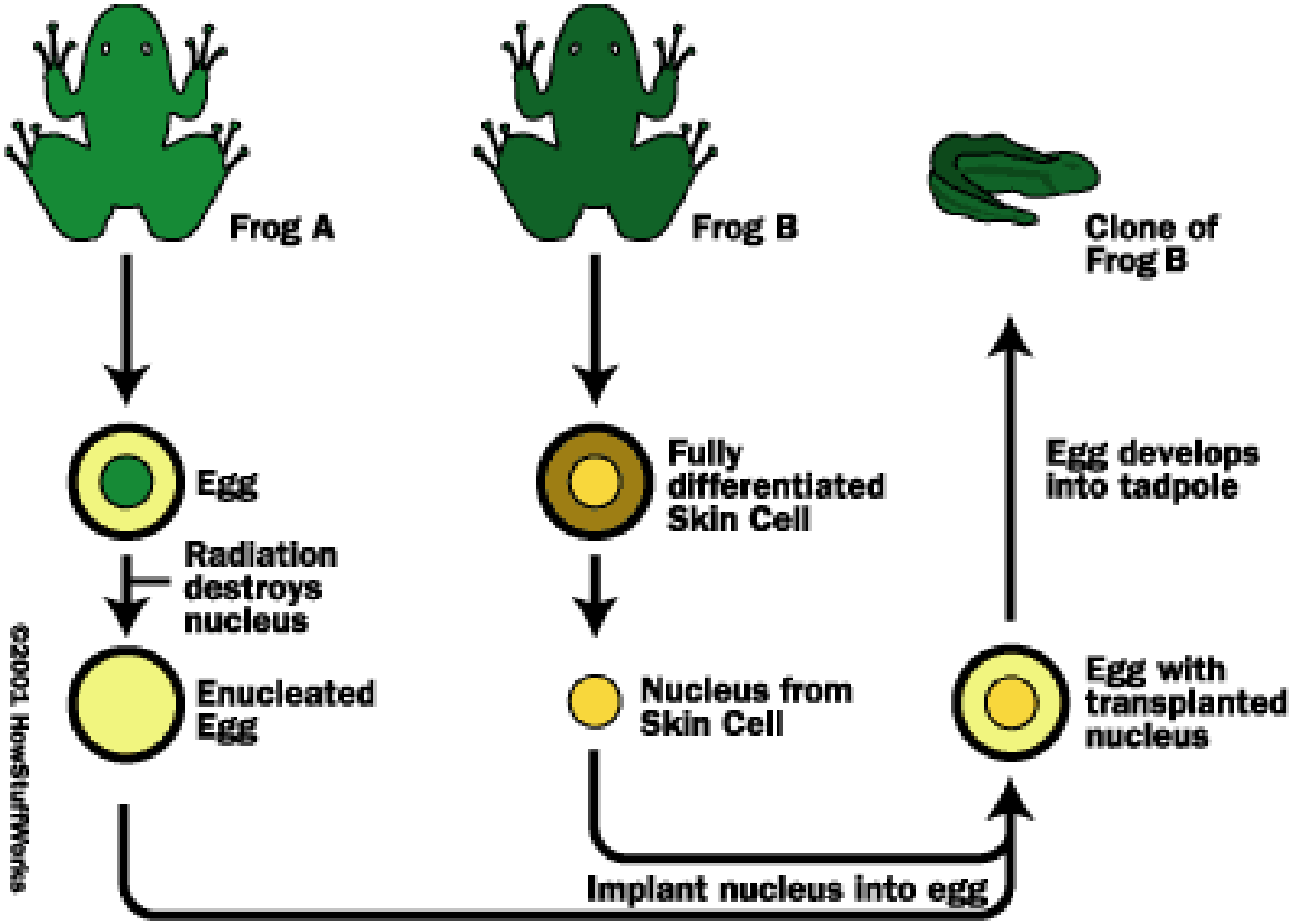
- Then in the 1970s, a scientist named John Gurdon came to an important conclusion. The only cell that has the ability to grow into an entire individual is a fertilized egg.



Fertilized Egg with the Two Nuclei

Gurdon developed two key techniques:

Enucleation – removing the nucleus of a cell.
Nuclear Transfer – Transferring the nucleus from 1 cell to another.



Dolly

- In 1997, cloning was revolutionized when Ian Wilmut and his colleagues at the Roslin Institute in Edinburgh, Scotland used enucleation and nuclear transfer to successfully cloned a sheep named Dolly.

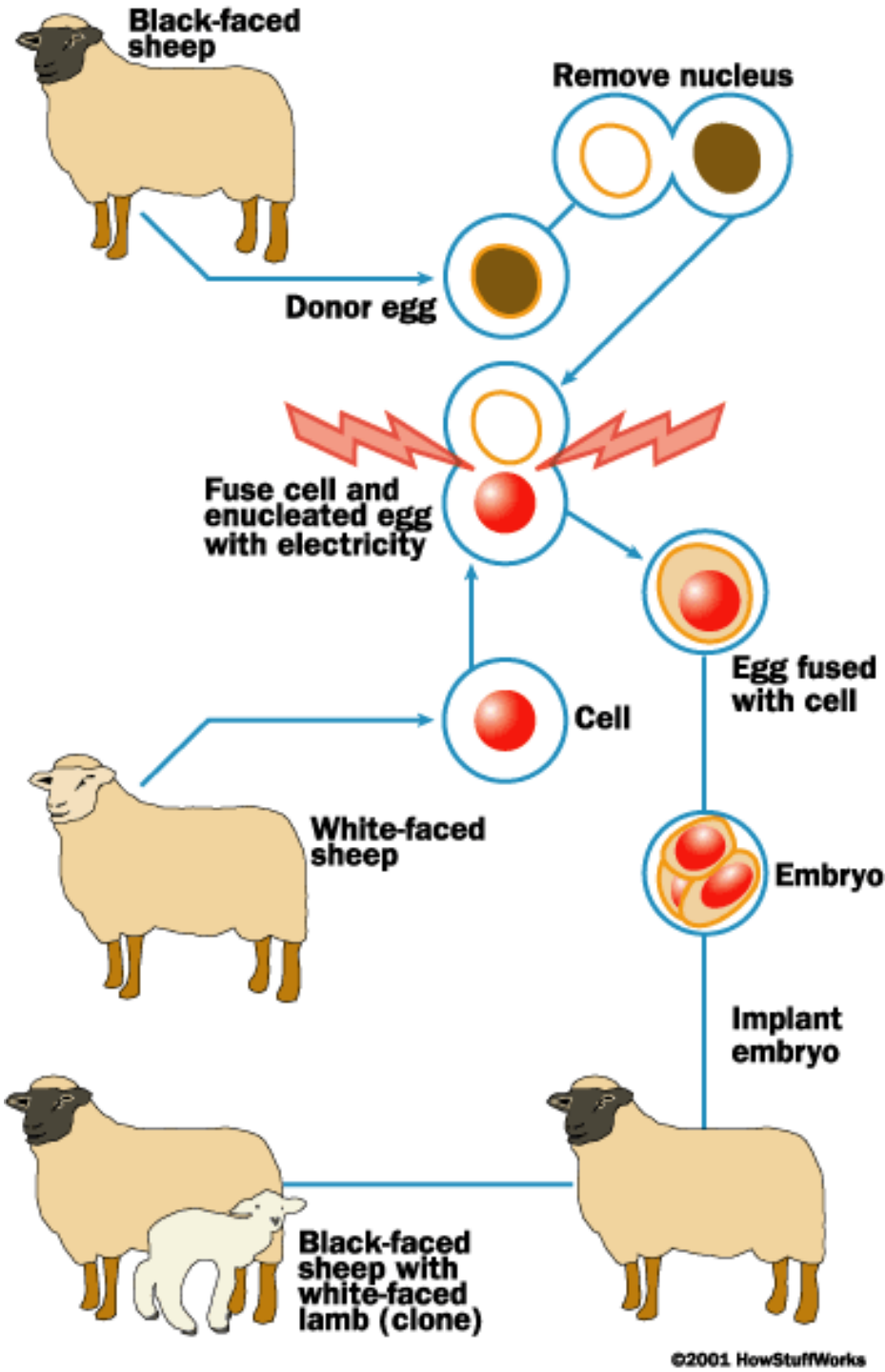
Dolly

- The fact that Dolly was the first animal to be cloned from the genetic material of an adult was key.

Enucleation and Nuclear Transfer

Creating Dolly

- It took 276 attempts before the experiment was successful.
- DNA testing proved Dolly was genetically identical to the Finn Dorsett and not to the blackface ewe.



Dolly

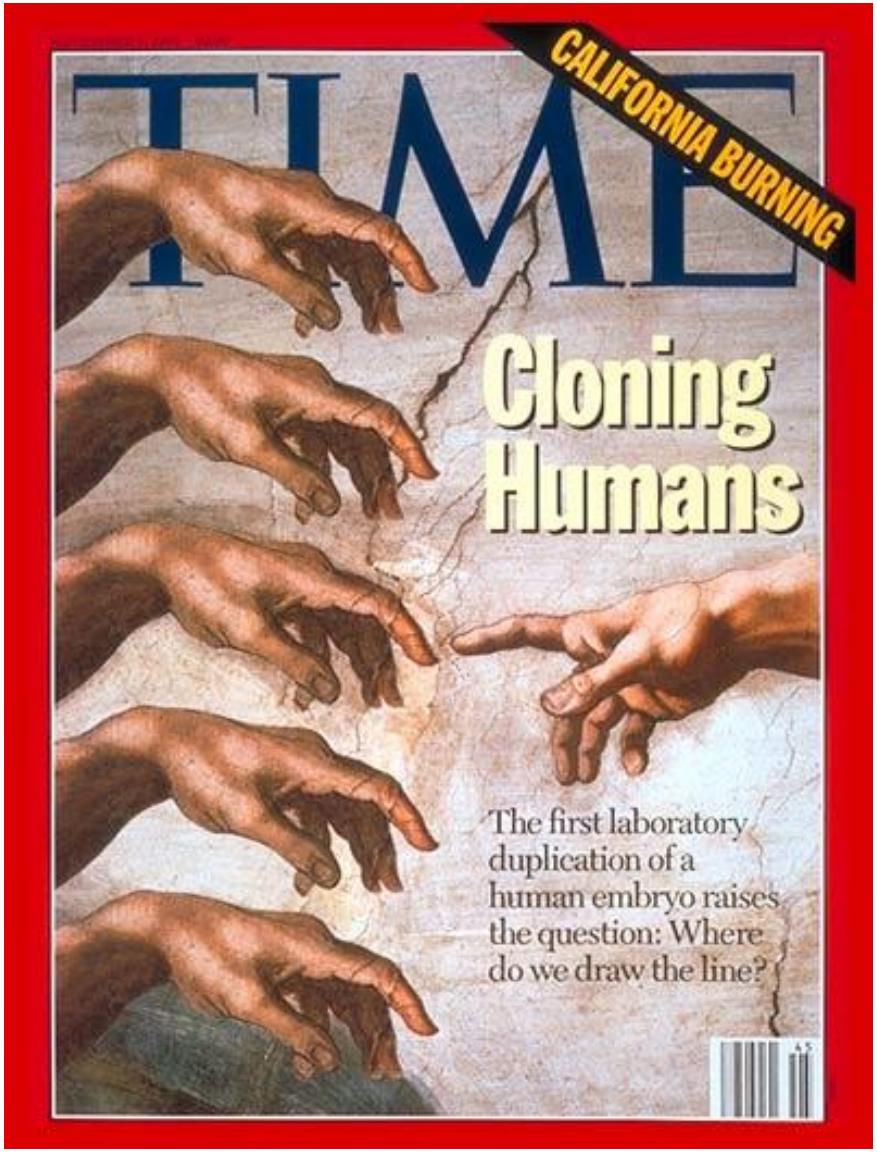
- Dolly only lived 6 years, approximately half the natural life expectancy of sheep.
- She developed premature arthritis.
- She did however reproduced through normal sexual means.

A Few Other Successful Clones - using the nuclear transfer technique.

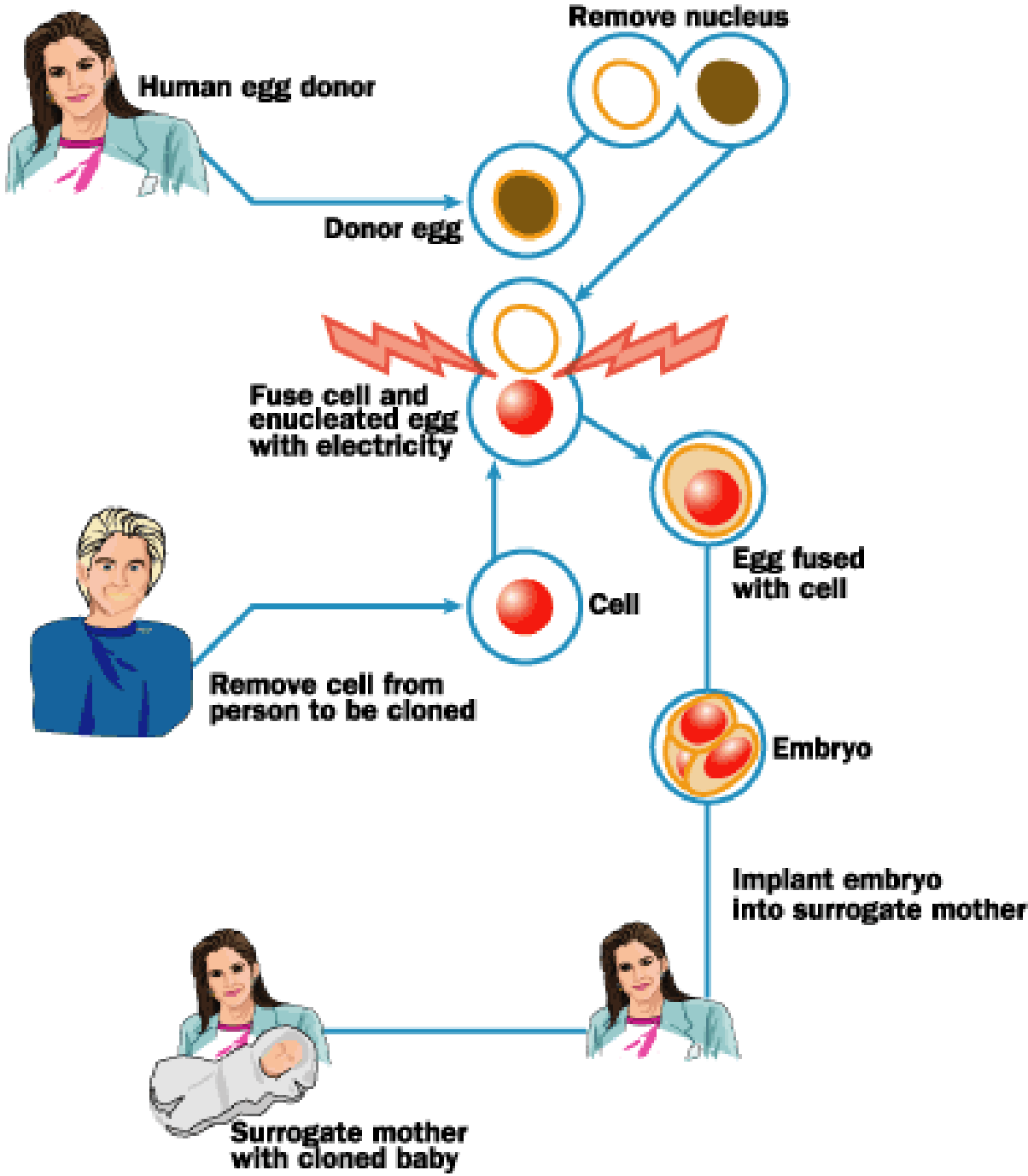
- Camels
- Carp
- Cats
- Cattle
- Deer
- Frogs
- Ferrets
- Flies
- Gaur – like a bison
- Goats
- Horses
- Mice
- Mules
- Pigs
- Rabbits
- Rats
- Monkeys
- Sheep
- Buffalo
- Wolves

Applications of Cloning

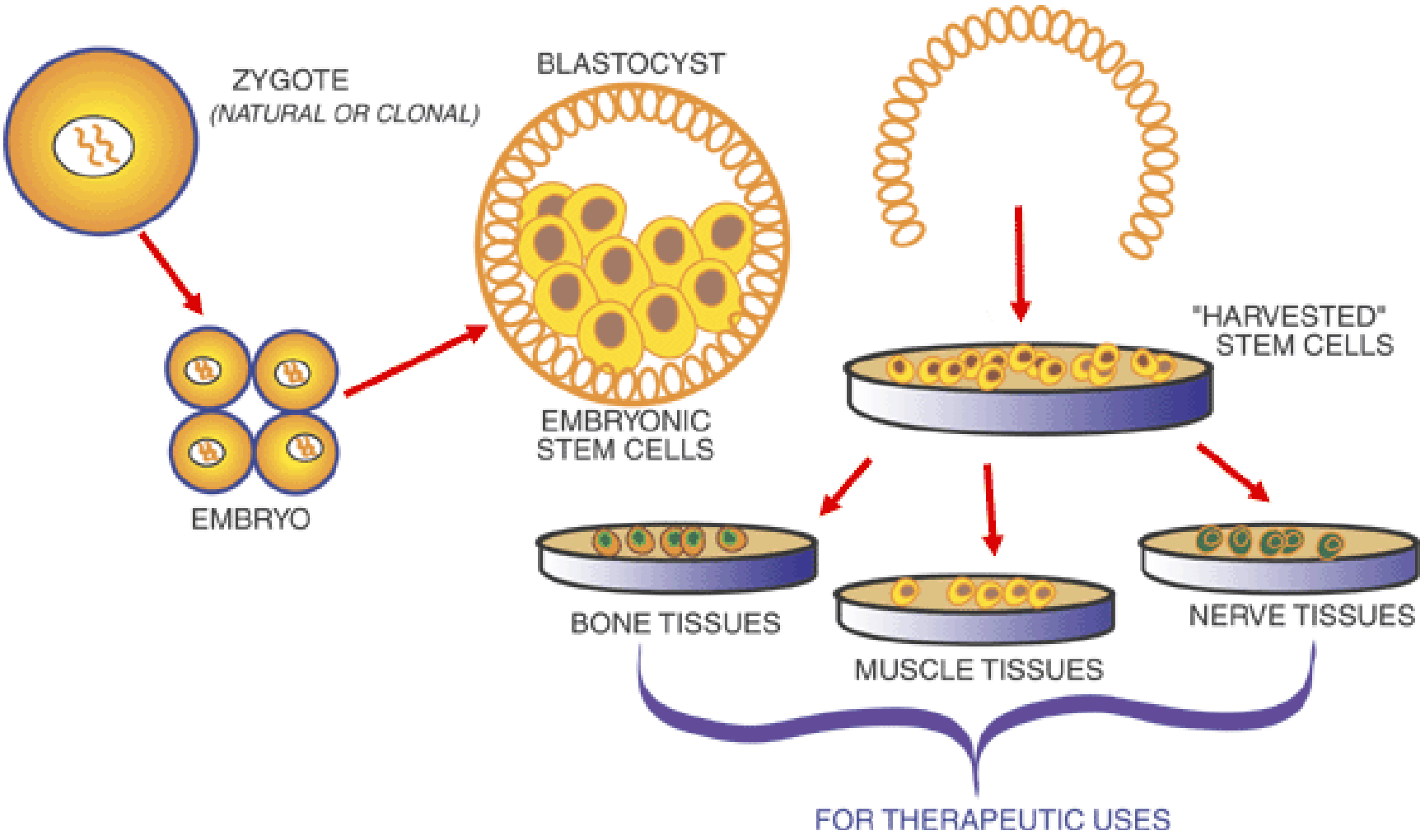
- The two major applications of cloning.
- 1) Reproduction – to make more people.
- 2) Medical Research - Cell, tissue or organ therapy.



Cloning Humans for Reproductive Purposes



Human Cloning For Medical Research/Therapy



Cloning for Organ Therapy

- Is it possible to one day clone entire organs?
- Pictured is a cloned rat heart that was produced in a lab that was made to beat.
- If we could in fact one day clone entire organs, why would it be beneficial for the organ recipient to also be the DNA donor?