



RAMA
UNIVERSITY

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FACULTY OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY

REPRODUCTIVE CLONING

Reproductive cloning is a method used to make a clone or an **identical copy of an entire multicellular organism**. Most multicellular organisms undergo reproduction by sexual means, which involves the contribution of DNA from two individuals (parents), making it impossible to generate an identical copy or a clone of either parent. Recent advances in biotechnology have made it possible to reproductively clone mammals in the laboratory.

Natural sexual reproduction involves the union, during fertilization, of a sperm and an egg. Each of these gametes is haploid, meaning they contain one set of chromosomes in their nuclei.

The resulting cell, or zygote, is then diploid and contains two sets of chromosomes. This cell divides mitotically to produce a multicellular organism.

However, the union of just any two cells cannot produce a viable zygote; there are components in the cytoplasm of the egg cell that are essential for the early development of the embryo during its first few cell divisions. Without these provisions, there would be no subsequent development.

Therefore, to produce a new individual, both a diploid genetic complement and an egg cytoplasm are required. The approach to producing an artificially cloned individual is to take the egg cell of one individual and to remove the haploid nucleus.

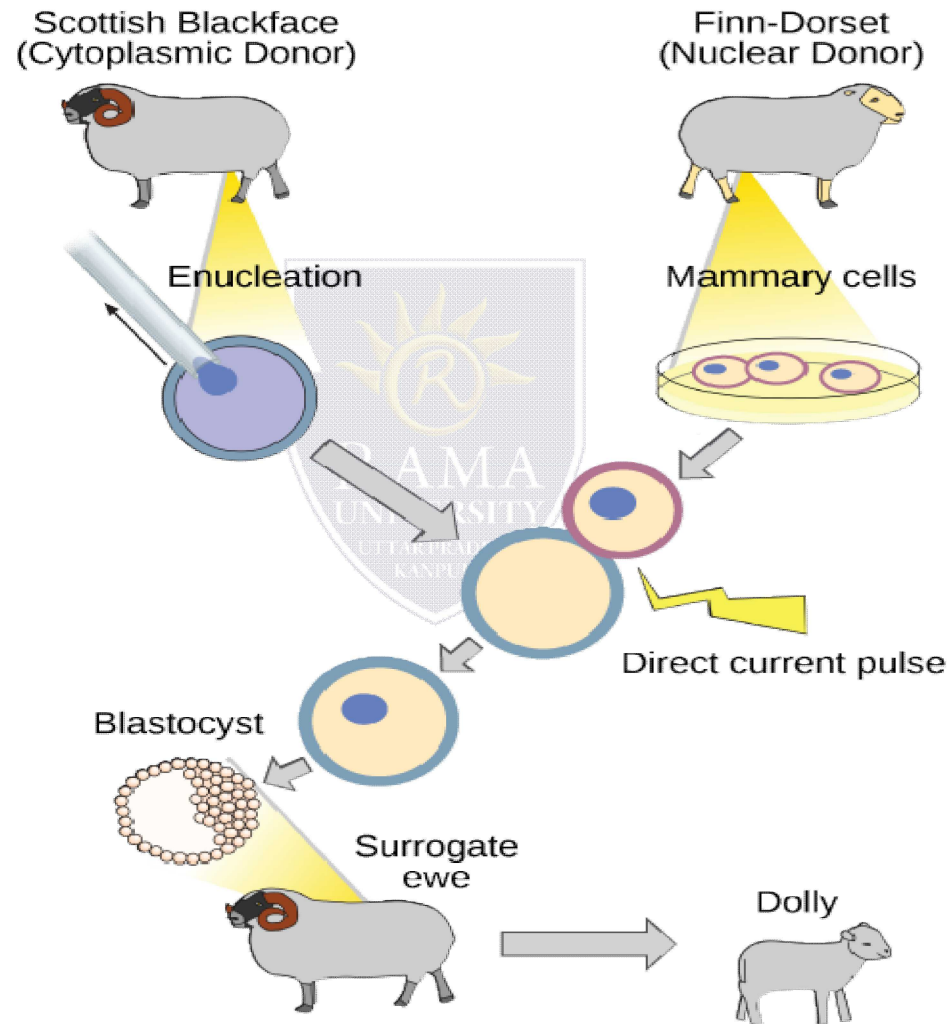
Then a diploid nucleus from a body cell of a second individual, the donor, is put into the egg cell. The egg is then stimulated to divide so that development proceeds.

This sounds simple, but in fact it takes many attempts before each of the steps is completed successfully.

The first cloned agricultural animal was Dolly, a sheep who was born in 1996. The success rate of reproductive cloning at the time was very low. Dolly lived for six years and died of a lung tumor.

There was speculation that because the cell DNA that gave rise to Dolly came from an older individual, the age of the DNA may have affected her life expectancy. Since Dolly, several species of animals (such as horses, bulls, and goats) have been successfully cloned.

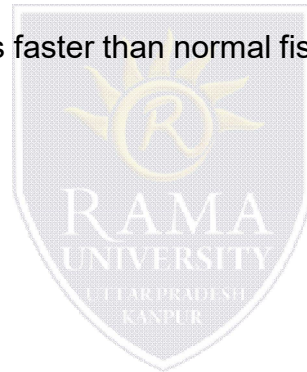
REPRODUCTIVE CLONING



EXAMPLES OF CLONING (Transgenic Fish)

Superfish

- ❖ Increased growth and size
- ❖ Growth hormone gene inserted into fertilized egg.
- ❖ Transgenic salmon grows about 10 – 11 times faster than normal fish.



Glo fish

- ❖ GM freshwater zebra fish (Danio rerio)
 - ❖ Produce by integrating a fluorescent protein gene from jelly fish into embryo of fish.
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EXAMPLES OF CLONING (Transgenic Mouse)

Alzheimer's mouse

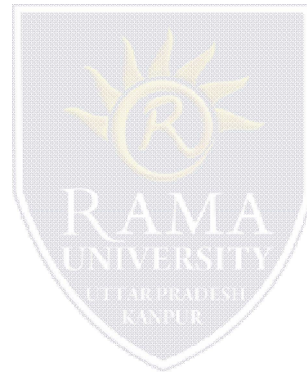
In the brain of Alzheimer's patients, dead nerve cells are entangled in a protein called amyloid.

Mouse made by introducing amyloid precursor gene into fertilized egg of mice.

Oncomouse

Mouse model to study cancer

Made by inserting activated oncogenes.



Smart mouse

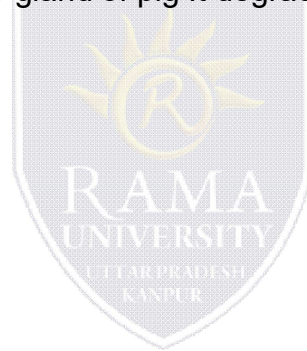
Biological model engineered to overexpress NR2B receptor in the synaptic pathway.

This makes the mice learn faster like juveniles throughout their lives.

EXAMPLES OF CLONING (Transgenic Pig)

Enviro pig

- ❖ Pigs have trouble fully digesting a compound known as phytate found in many cereal grains used to feed them.
- ❖ Transgenic pigs are created by introducing phytase gene of *E.coli*.
- ❖ Phytase enzyme is thus produced in the salivary gland of pig It degrades indigestible phytate with the release of phosphate that is readily digested by pigs.



Pig for organ transplant

- ❖ Pigs with human genes, in order to decrease the chance of organ rejection by human body.

EXAMPLES OF CLONING (Transgenic Livestock)

Bioreactors whose cells have been engineered to synthesis marketable proteins.

More economical than producing desired protein in cell culture.

Transgenic cattle

Transgenic cows are made to produce proteins lactoferrin and interferons in their milk.

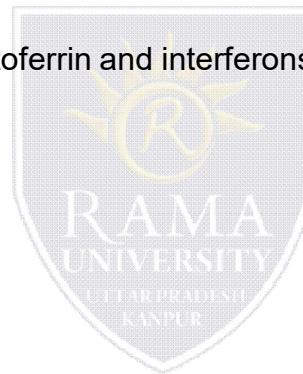
Prion free cows resistant to mad cow disease.

Transgenic sheep

For good quality wool production.

Transgenic goat

Goats that could express tissue plasminogen activator, anti thrombin III, spider silk etc in milk.



EXAMPLES OF CLONING (Transgenic Livestock)

Transgenic rabbit

- ❖ Alba, the EGFP (Enhanced Green Fluorescent protein) bunny
- ❖ Created in 2000 as a transgenic artwork.

Transgenic monkey

- ❖ ANDi was the first transgenic monkey, born in 2000.
- ❖ “ANDi” stands for “inserted DNA” spelled backwards.
- ❖ An engineered virus was used to insert the harmless gene for green fluorescence protein (GFP) into ANDi’s rhesus genome.
- ❖ ANDi proves that transgenic primates can be created, and can express a foreign gene delivered into their genome

