



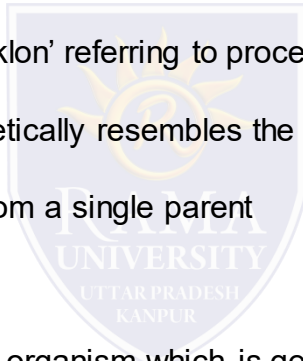
FACULTY OF ENGINEERING & TECHNOLOGY  
DEPARTMENT OF BIOTECHNOLOGY

# CLONING

- Cloning is an ambiguous term
- Molecular cloning : Duplication of strings of DNA containing genes in a host bacterium
- Cellular cloning: Copies of a cell are made, resulting in a 'cell line'
- Embryo twinning: Embryo which has already been formed sexually is split into two identical halves
- The word Clone is taken from the Greek word 'klon' referring to process whereby a new plant is created from a twig
- An organism produced non sexually which genetically resembles the original organism
- No clone, theoretically has all the 100% DNA from a single parent

## **Animal Cloning:**

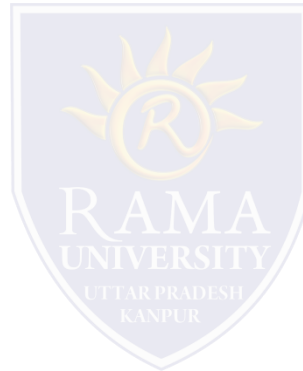
- Procedure of creating a whole new multicellular organism which is genetically identical to original organism
- Non sexual
- No fertilisation or inter-gamete contact takes place



# TYPES OF CLONING

There are three types of Cloning

1. Gene cloning
2. Reproductive cloning
3. Therapeutic cloning



# CLONING

1891: Hans Driesch separated the blastomeres of a two-cell embryo of sea urchin mechanically by shaking them in seawater resulting in two whole sea urchins (Driesch, 1891)

Hans Spemann repeated in a vertebrate (salamander) using a hair from his baby boy to separate the cells (Spemann, 1902)

Eventually the first successful embryo splitting was performed in domestic animals with the purpose of rapid multiplication of valuable individuals (Willadsen, 1979; Ozil et al., 1981)

1981: The first success in mammalian nuclear transfer

The birth of three mice was reported following the trans-plantation of early embryonic cells into enucleated zygotes (one-cell embryos)

Embryologists declared that the cloning of mammals by simple nuclear transfer was biologically impossible (McGrath and Solter, 1984)

In 1986, cloning technology was successfully established. Cloned sheep were created from embryonic cell nuclei transferred into enucleated oocytes (Willadsen, 1986)

Same technique was successfully established in goat, cattle, pig etc.

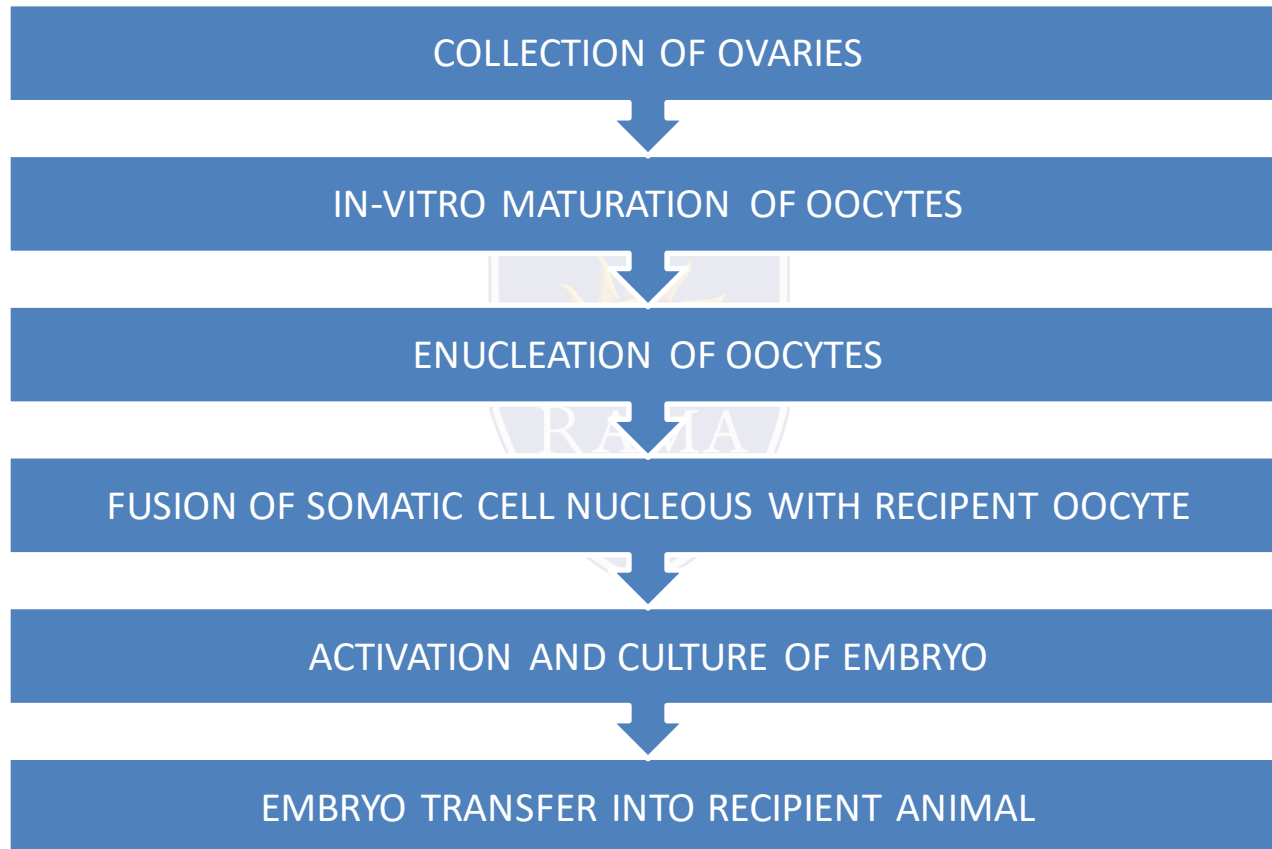
Embryonic cell donors were always used

**Somatic cell nuclear transfer (SCNT)** is the technique of transferring the nucleus of a somatic cell into an oocyte and activate it to develop into a full embryo.

Technique established by the birth of world's first cloned mammal from adult somatic cells, **Dolly, in 1996** (Wilmut et al., 1996)

Subsequently, cloning by SCNT has been successful in Cattle, Mice, Pigs, Goats, Rabbits etc. (Edwards et al., 2001)

# STEPS IN CLONING



# PROBLEMS CONCERNED WITH CLONING

- DEVELOPMENTAL ANAMOLIES
- SHORT LIFE SPAN
- LARGE OFFSPRING SYNDROM
- AGING OF CLONED ANIMALS
- SAFETY APPREHENSIONS

## DEVELOPMENTAL ANAMOLIES

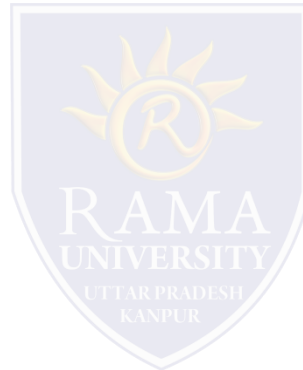
- ❖ Low pregnancy rates
- ❖ Stillbirths
- ❖ Early postnatal deaths

## SHORT LIFE SPAN

- ❖ There was a myth that spread due to early death of Dolly
- ❖ Unfortunately Dolly died of retroviral Disease (Bridget et al., 2003)
- ❖ Almost all the cloned animals have a normal life span (Trounson et al., 2007)

## LARGE OFFSPRING SYNDROM

Most Common in Cattle & Sheep but not observed in goats & pigs (Betthausen et al., 2000).



# PROBLEMS CONCERNED WITH CLONING

## ARE CLONED ANIMALS ALREADY AGED

There is telomere shortening after each cell cycle

Which possibly works as biological clock (Xu and Yang, 2003)

Telomere shortening in the somatic cells to be used for cloning would already have occurred

The telomeres of Dolly were also found to be relatively shorter (Shiels et al., 1999)

## SAFETY APPREHENSIONS

- About human consumption of products from cloned animals
- No biological & nutritional difference between milk & milk products of normal & cloned animals (Tome' et al., 2004)
- No significant difference between meat of normal & cloned animals (Walker., 2006)

## CURRENT SCENARIO

- Cloning is a developing research field & active efforts for farm animal cloning are going on in more than 30 countries including:
  - New Zealand & Australia
  - UK & other European countries
  - U.S.A. & Argentina □ China, Iran & India etc.

## Animal Cloning Scenario in India

- At NDRI Karnal & SKUAST Kashmir worlds first cloned buffalo & pashmina goat produced here
- Success rates still very low
- Research going on to improve efficiency & applicability of animal cloning

