

ANIMAL CLONING

Types of cloning

- Recombinant DNA cloning
- Therapeutic cloning
 - Stem cells
- Reproductive cloning
 - Embryo splitting
 - Somatic cell nuclear transfer (SCNT)

History of cloning by SCNT

- Nuclear transfer was performed with frogs in the 1950s
- Cattle were cloned by transfer of embryonic nuclei in the 1980s
- Dolly was the first animal cloned by SCNT from an adult cell in 1997



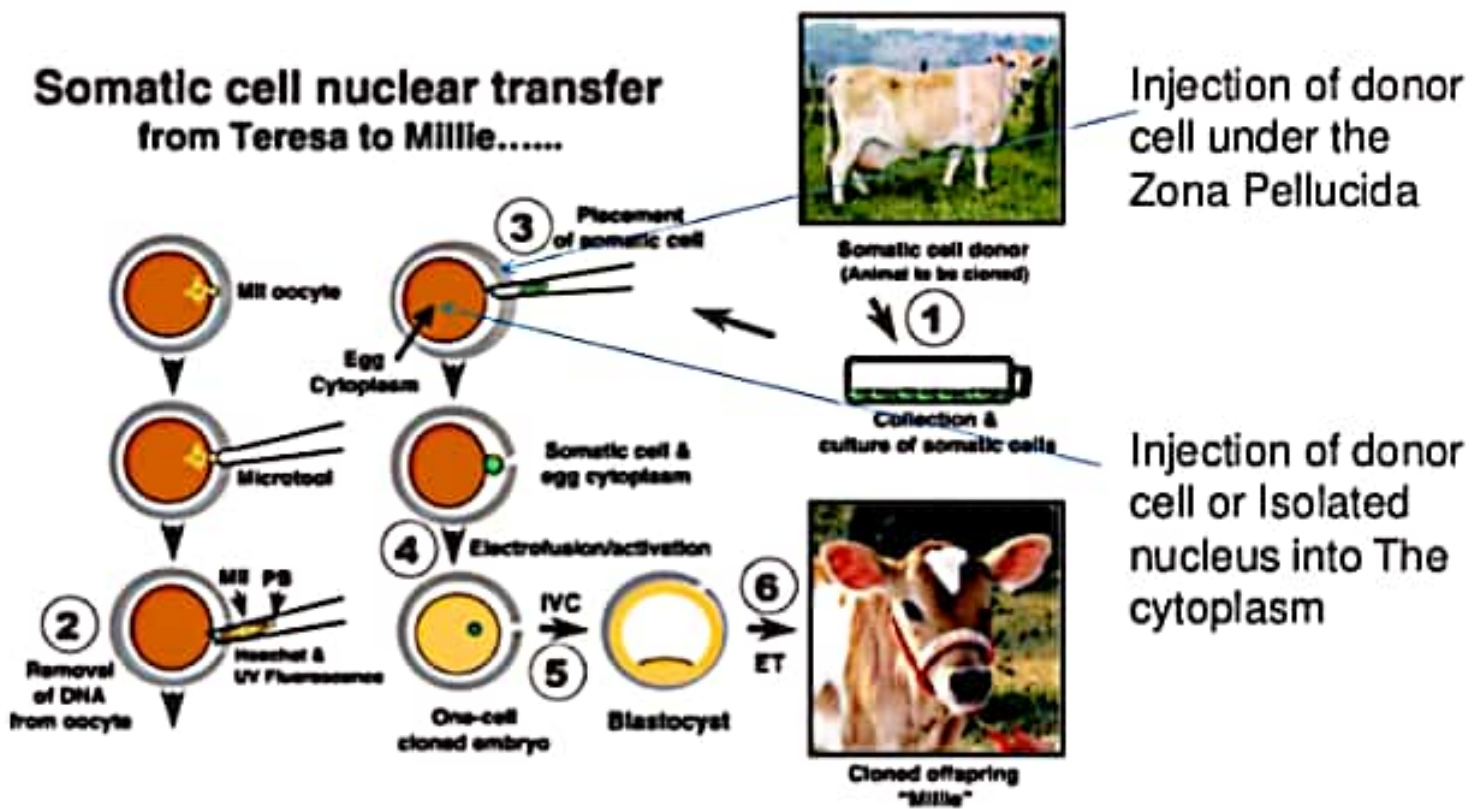
Animals cloned by SCNT

- Sheep, pig, goat, cattle, cat, rabbit, mouse, mule, horse, rat, deer, fish
- Cloning efficiency for Dolly, 1/277 reconstructed embryos (0.3%)



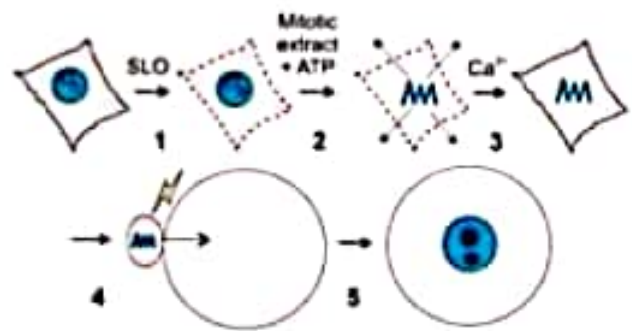
Basic SCNT Methodology

Somatic cell nuclear transfer from Teresa to Millie.....



SCNT-chromatin transfer

- Chromatin condensation
- Fusion with an enucleated egg
- Enhanced survival of clones



Challenges to successful SCNT

- Reprogram a nucleus from a differentiated stage (somatic cell) to an embryonic stage
- Properly activate genes necessary for early embryonic development and suppress differentiation associated genes

Pet cloning

- Dog cloning- Missiplicity Project



- Cat cloning

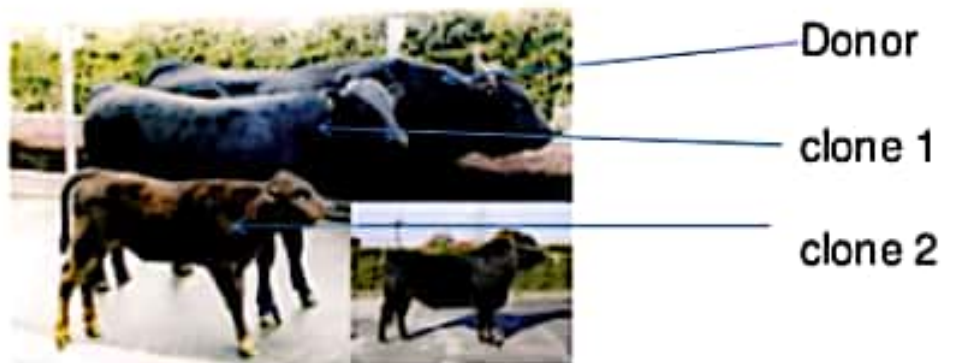


Shin et al., 2002

Clones of clones

- Mice have been serially cloned to 6 generations
- Cattle have been serially cloned to 2 generations (3rd generation failed)

Kubota et al, 2004



Cloned mice

- Cloned mice have an obese phenotype
- Phenotype is not transmitted to offspring
- Obesity due to epigenetic changes



Tamashiro et al., 2002

Cloning of endangered species

- Gaur bull calf cloned using a domestic cow embryo and surrogate mother
- Cells from skin cells frozen for 8 years
- Clone died 48 hours after birth



Lanza et al., 2000

Cloning of endangered species

- Cloned African wildcat
- Nucleus from frozen cell transferred into domestic cat oocyte



Future cloning issues

- Food consumption risks of cloned animals
 - Health of animal clones
 - Composition of meat and milk
- No differences in milk composition were seen between clones and control dairy cattle
 - total solids, fat, lactose, and protein (Norman and Walsh, 2004)

- Many different species have been cloned
- Animal cloning has many successes but also many complications
- Refinement of technique will overcome some of these problems
- Cloning Applications
 - transgenesis
 - gene knockout