

Cow Cloning

The term "cloning" itself provokes controversy. Strictly speaking, to clone is to obtain an identical organism from another through technology. The most commonly used technique is called somatic-cell nuclear transfer. It was used to create Dolly the sheep as well as other cloned animals, including these Jersey cows. The technique consists of replacing the nucleus of an ovule with the nucleus of a cell from a donor specimen. When the ovule then undergoes division, it gives rise to an organism identical to the donor. With all such processes, there exist slight differences between the donor and the clone. In only one case is the clone perfect, and it comes naturally: monozygous (identical) twins. ●

1 Obtaining the Nucleus

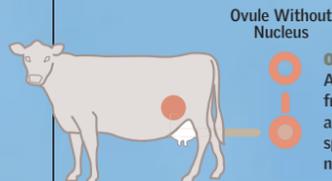
A specialized cell of an adult animal, whose DNA is complete, is isolated, and it is cultivated in vitro to multiply it. Various ovules of a donor cow are also isolated. The nucleus is then removed from both groups of cells—only those of adult cells.



NUCLEUS EXTRACTION

A fibroblast is extracted from the ear of an exemplary adult.

Nucleus with Complete DNA (60 chromosomes)



Ovule Without Nucleus

OVULE EXTRACTION

An ovule is obtained from the ovary of another exemplary specimen, and the nucleus is removed.

2 Nucleus Transfer

Consists of replacing the nucleus of the ovule with that obtained from the adult cell. In this form, the chromosomes carried by the new nucleus complete the ovule in the same way as if the ovule had been fertilized by a spermatozoon. Once fused, the cell will begin its program of division as if it were a zygote (fertilized ovule).

NUCLEUS OF THE CELL TO CLONE

The nucleus is transferred to the ovule.

OVULE WITHOUT NUCLEUS

Only the cytoplasm, with organelles like mitochondria, remains.

PIPETTE supports the ovule and prevents it from shifting in the operation.

DIVERSE USES

Cloning can be applied for obtaining new organisms and tissues and for reproducing segments of DNA.

PIPETTE

It is used to introduce the nucleus into the ovule.

3

Fusion

By means of light electric discharges, fusion of the donated nucleus with the cytoplasm of the ovule is initiated. Three hours later, calcium is added to the cell to simulate fertilization. An interchange begins between the nucleus and the cytoplasm, and the cell starts to divide.

2 cells

8 cells

16 cells

4 Cultivation

The new cell is cultivated in vitro, where it multiplies until forming a blastocyst (cellular group whose cells are not yet differentiated by function and is a precursor to an embryo). The developing blastocyst is maintained in a medium that contains hormones and 5 percent oxygen to simulate the conditions of a cow's uterus. After a week, the developing mass has become large enough that it can be implanted into the actual uterus of a cow.

5 Insemination

The blastocyst is implanted in the uterus of a donor cow on the sixth day after the cow has stopped being in heat so that the development of the blastocyst continues in a natural way. If everything goes as planned, the blastocyst adheres to the uterine wall.

6 Development of the Fetus

Once the blastocyst is implanted, its growth begins. The normal period of gestation for a cow is from 280 to 290 days. Because all the genetic information required was provided by a donor-cell nucleus, the calf that is born is an exact copy of the donor animal. It differs only in the mitochondrial DNA, which was provided by the receptor ovule.

Cost

The technology is still not efficient. For this Jersey, 934 ovules were transferred, of which 166 fused, and only one developed successfully.

