

# CLONACIÓN

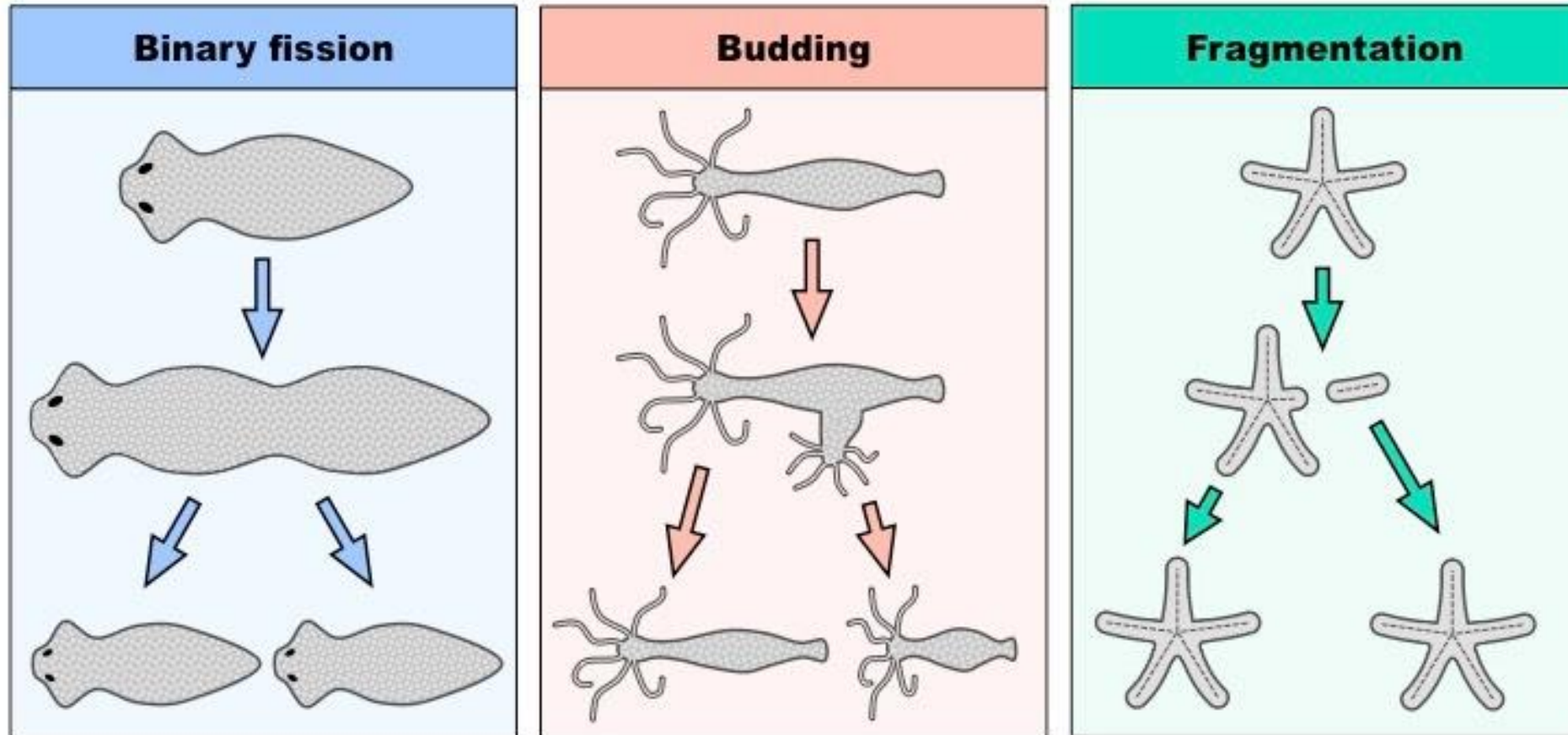


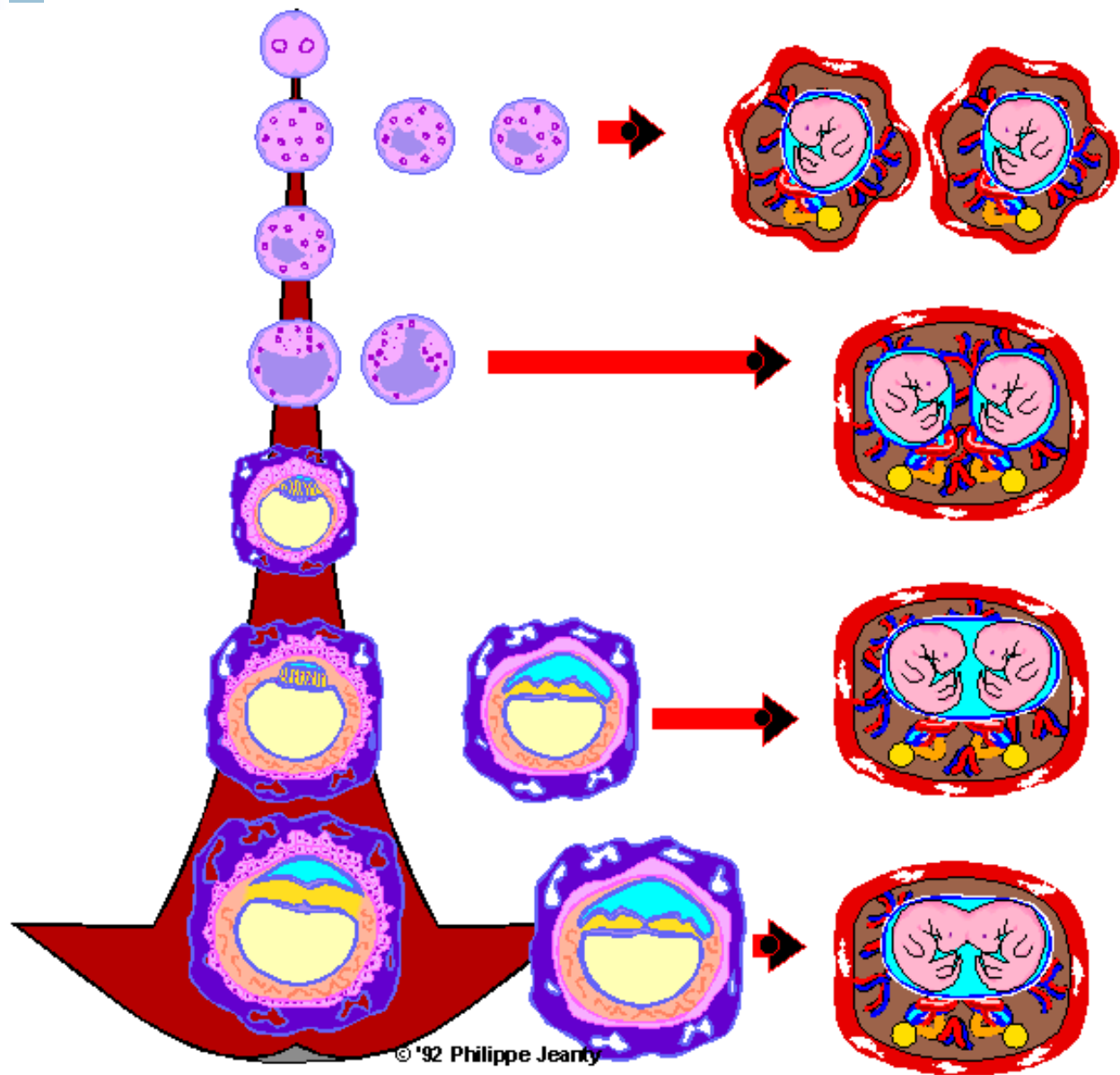
- Producción de copias genéticamente idénticas (clones) de una entidad biológica

# Clonación



# Clonación natural: reproducción asexual







Genes (ingeniería genética)

Células (cultivos celulares)

Tejidos (cultivos tisulares)

Organismos (nuevos organismos)



# Clonación artificial

Clonación génica

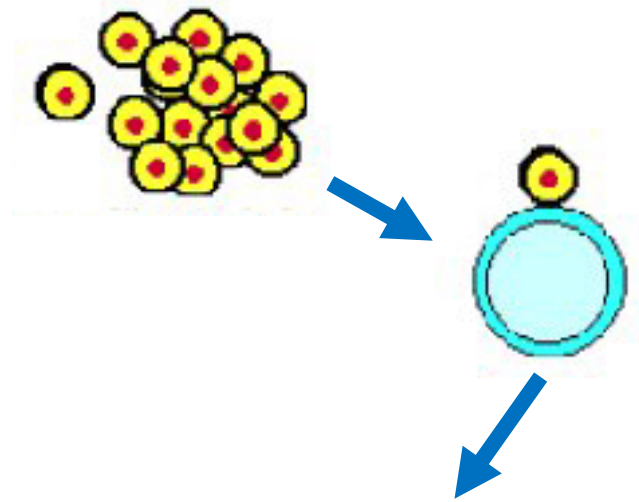
Clonación  
reproductiva

Clonación  
terapéutica

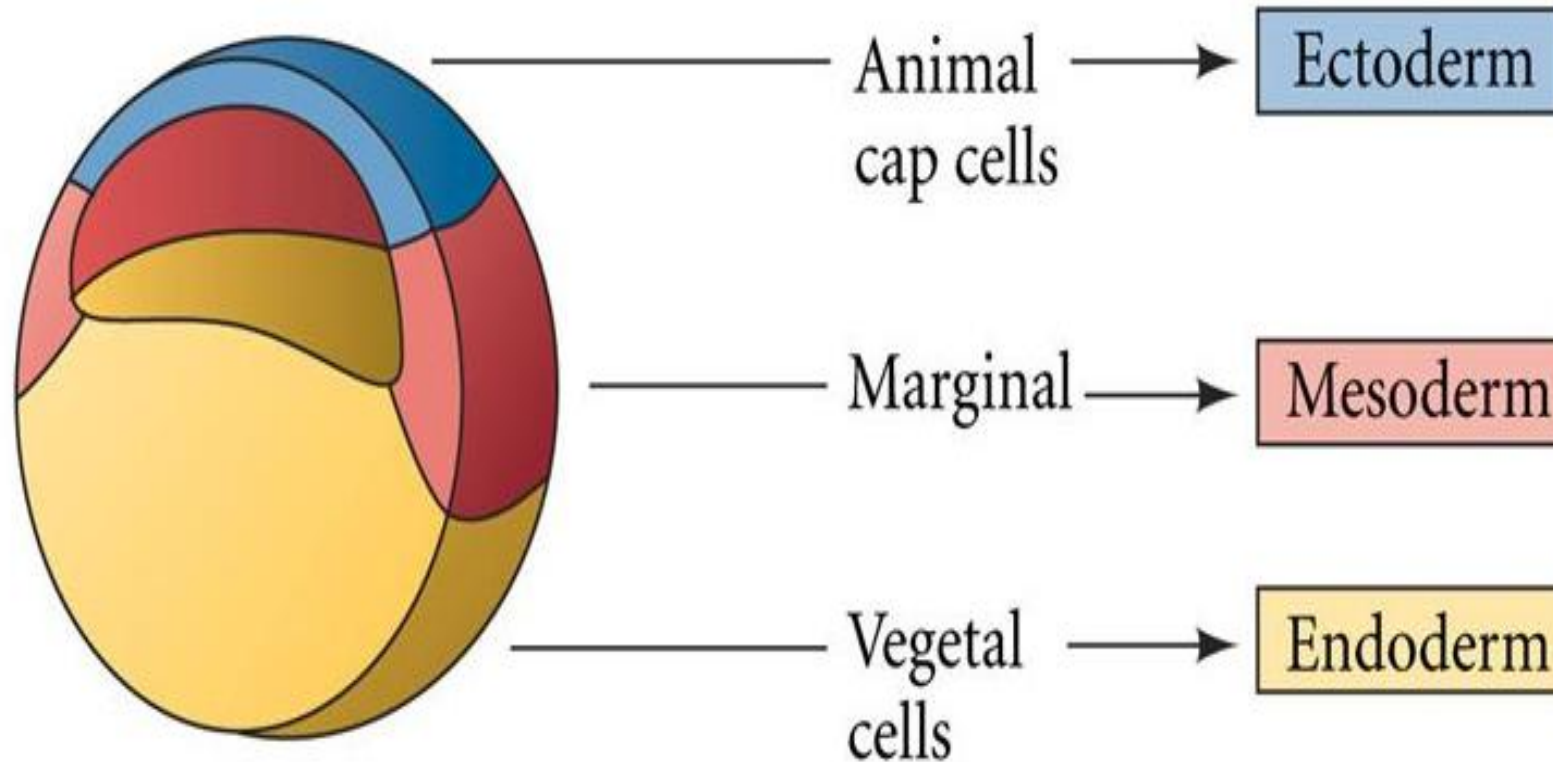


- Obtención de uno o varios individuos a partir de una célula o núcleo somáticos

## Clonación reproductiva



(A) Dissected blastula fragments give rise to different tissue in culture:

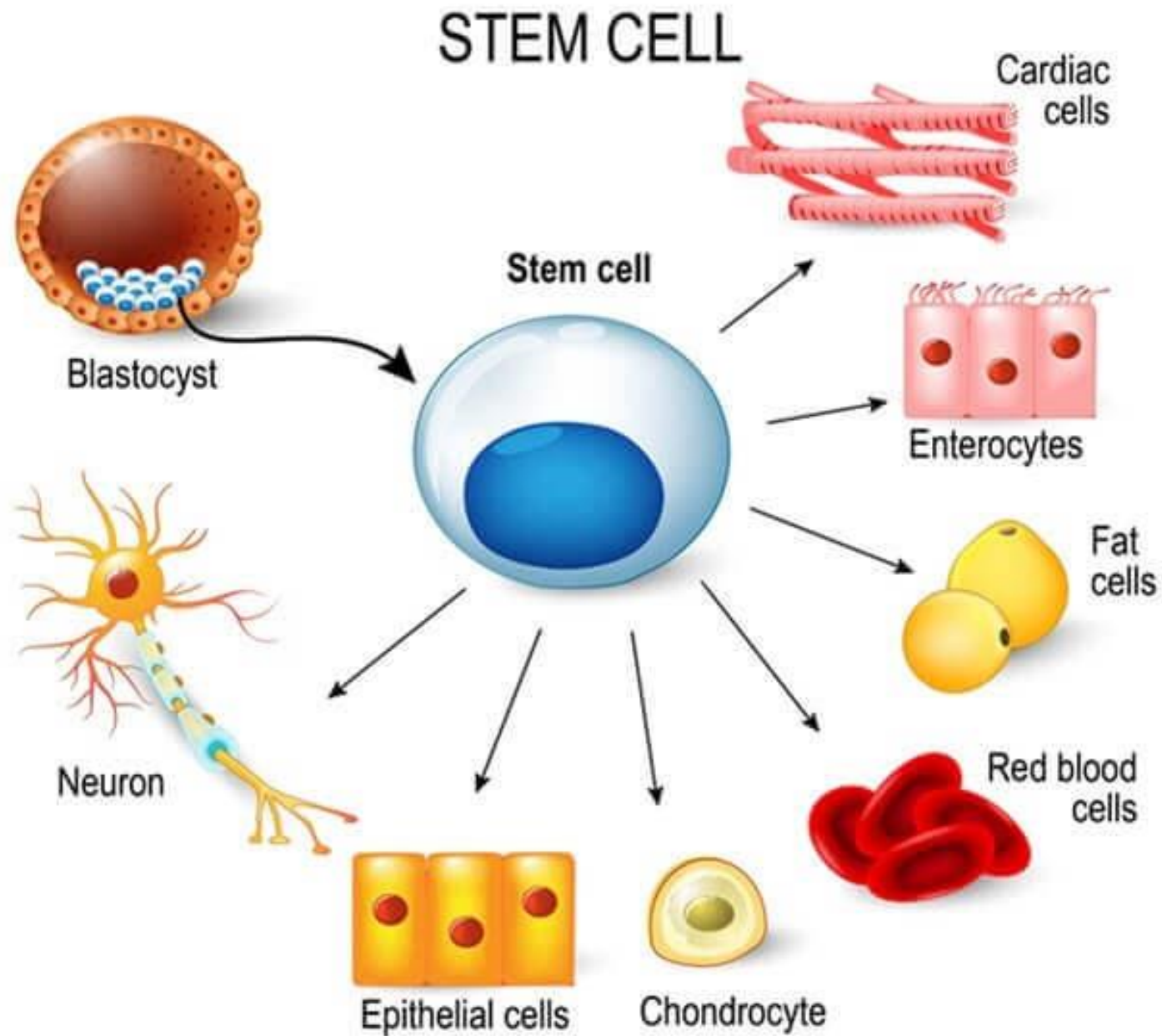


Células somáticas embrionarias determinadas con destinos definidos



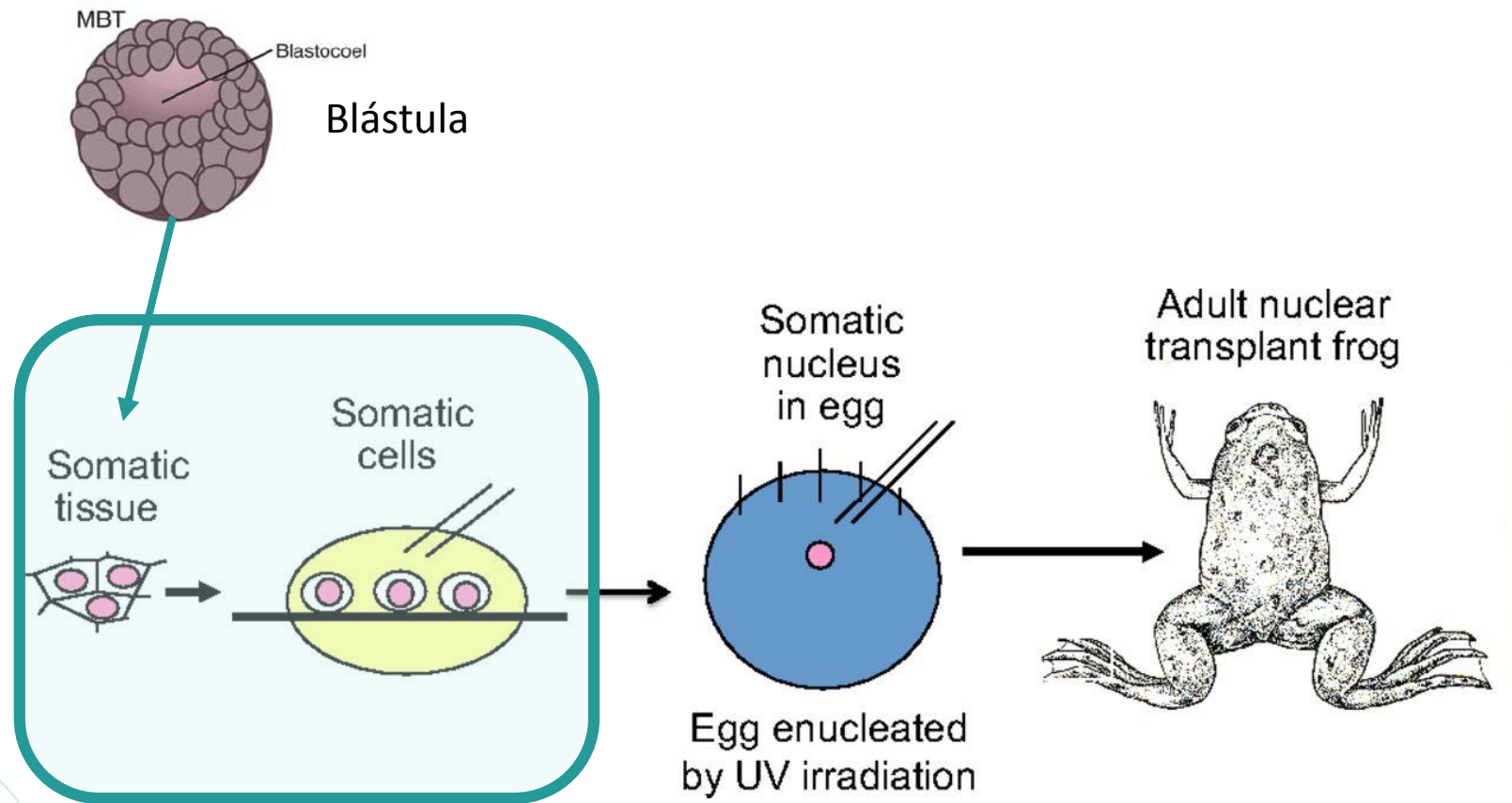


Células  
somáticas  
embrionarias  
pluripotenciales



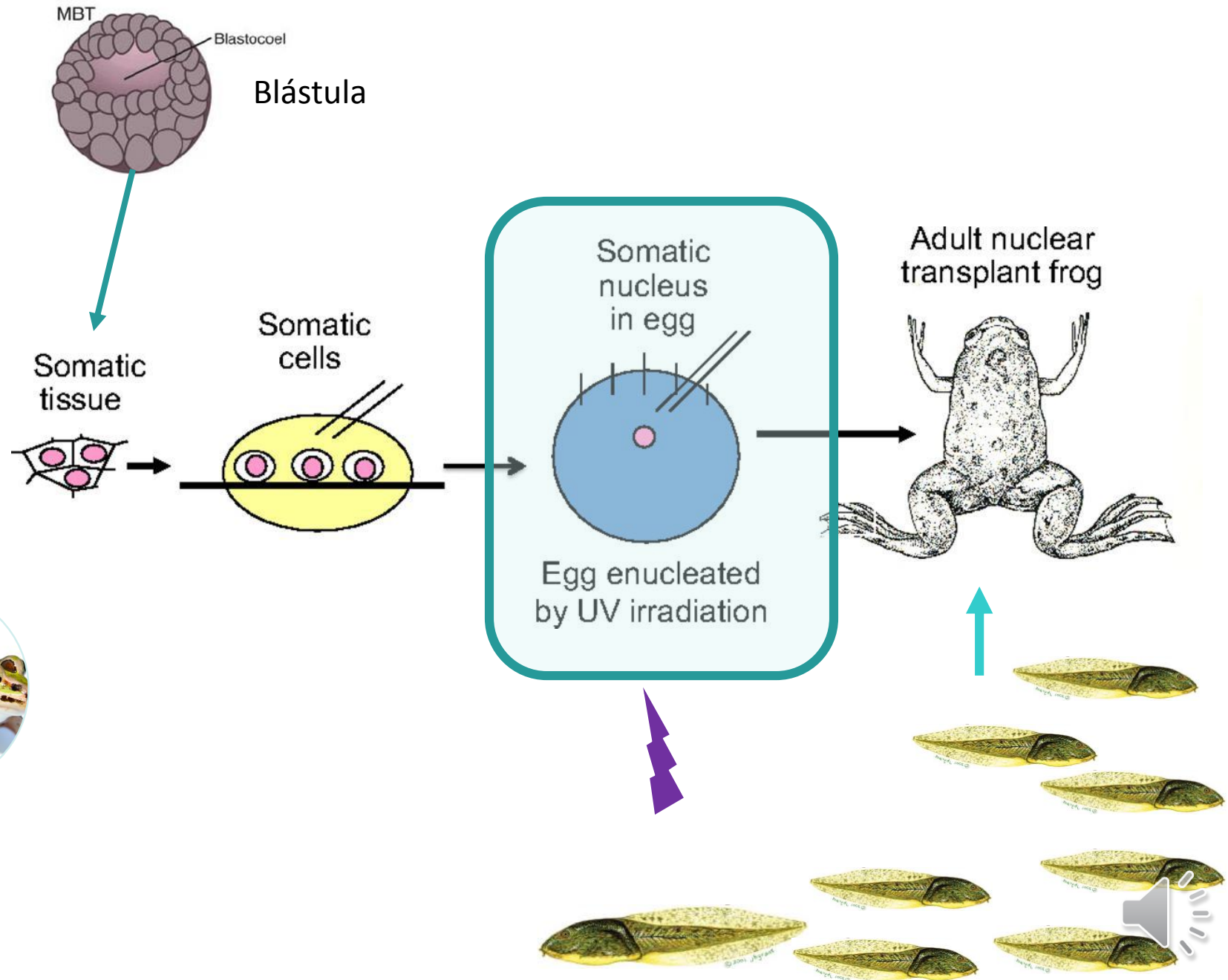
- Clones de ranas (*Rana pipiens*)

1952



- Clones de ranas (*Rana pipiens*)

1952



- Clones de ranas (*Xenopus laevis*)

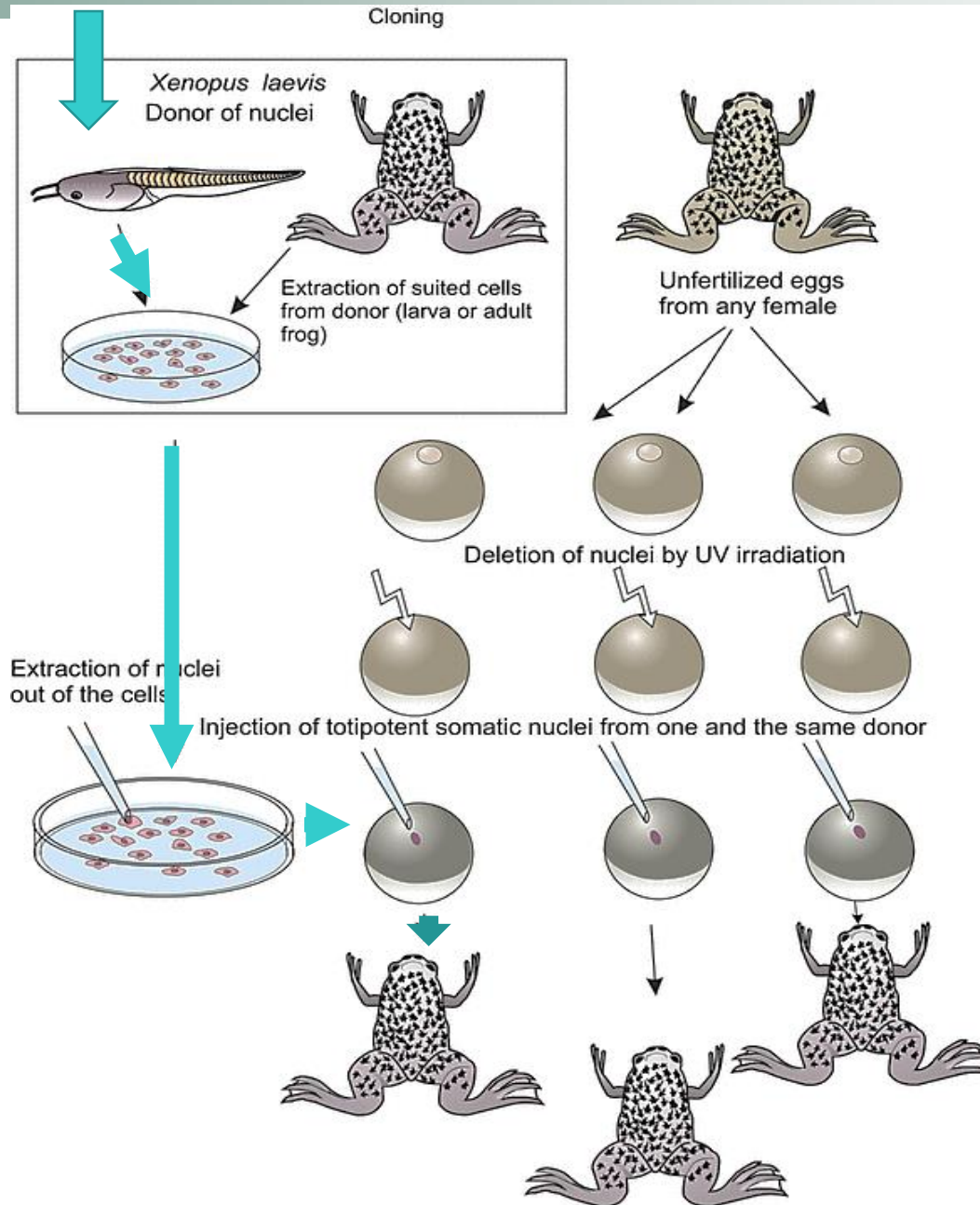
1970's



Células somáticas larvarias de una rana



Inyección de estas células en el huevo enucleado



Obtención de ovocitos de una rana



Enucleación por irradiación UV



Inyección de células somáticas de otro o el mismo espécimen

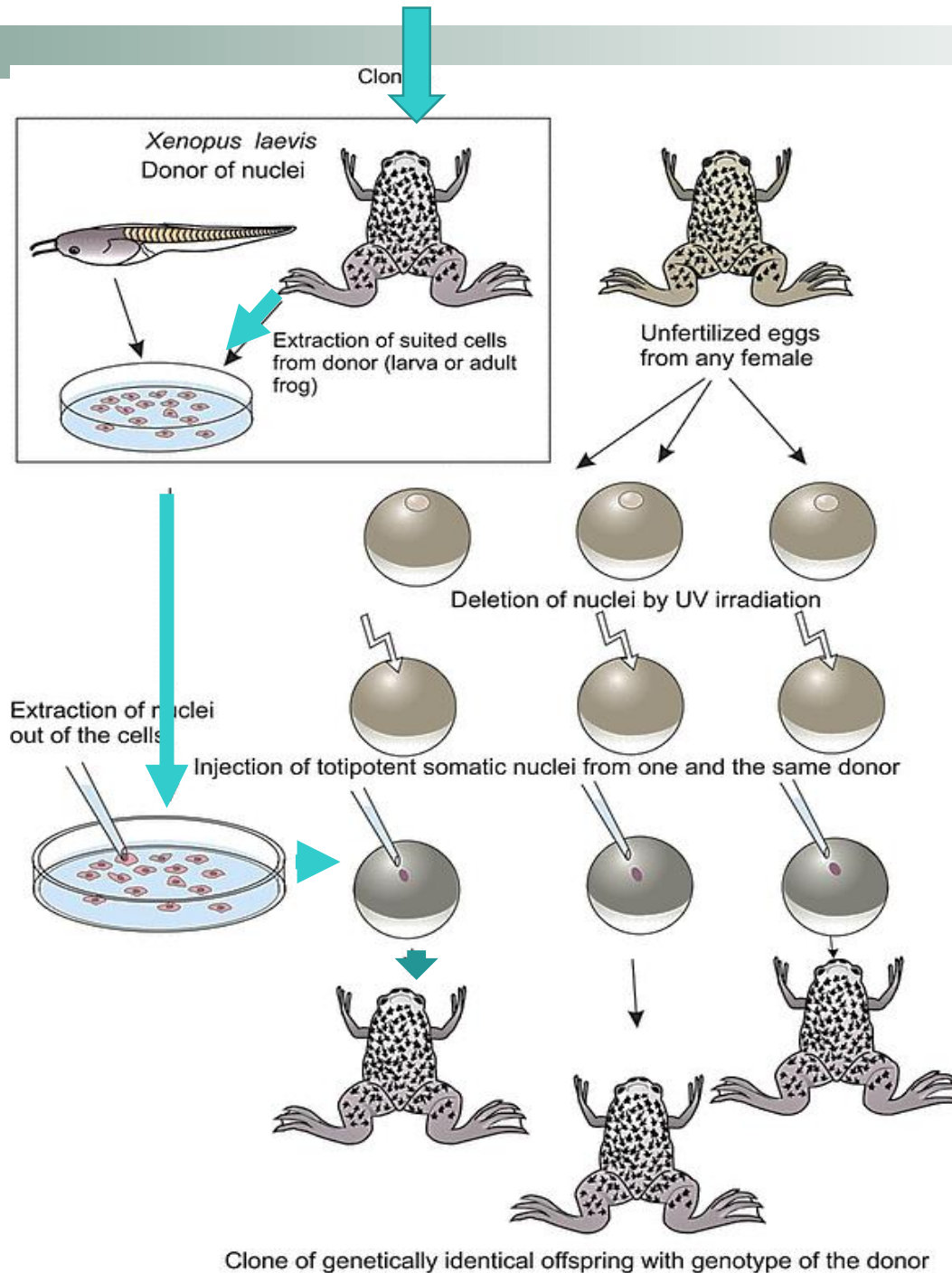


Obtención de clones de la rana donante de las células somáticas



Células somáticas larvarias de una rana

Inyección de estas células en el huevo enucleado



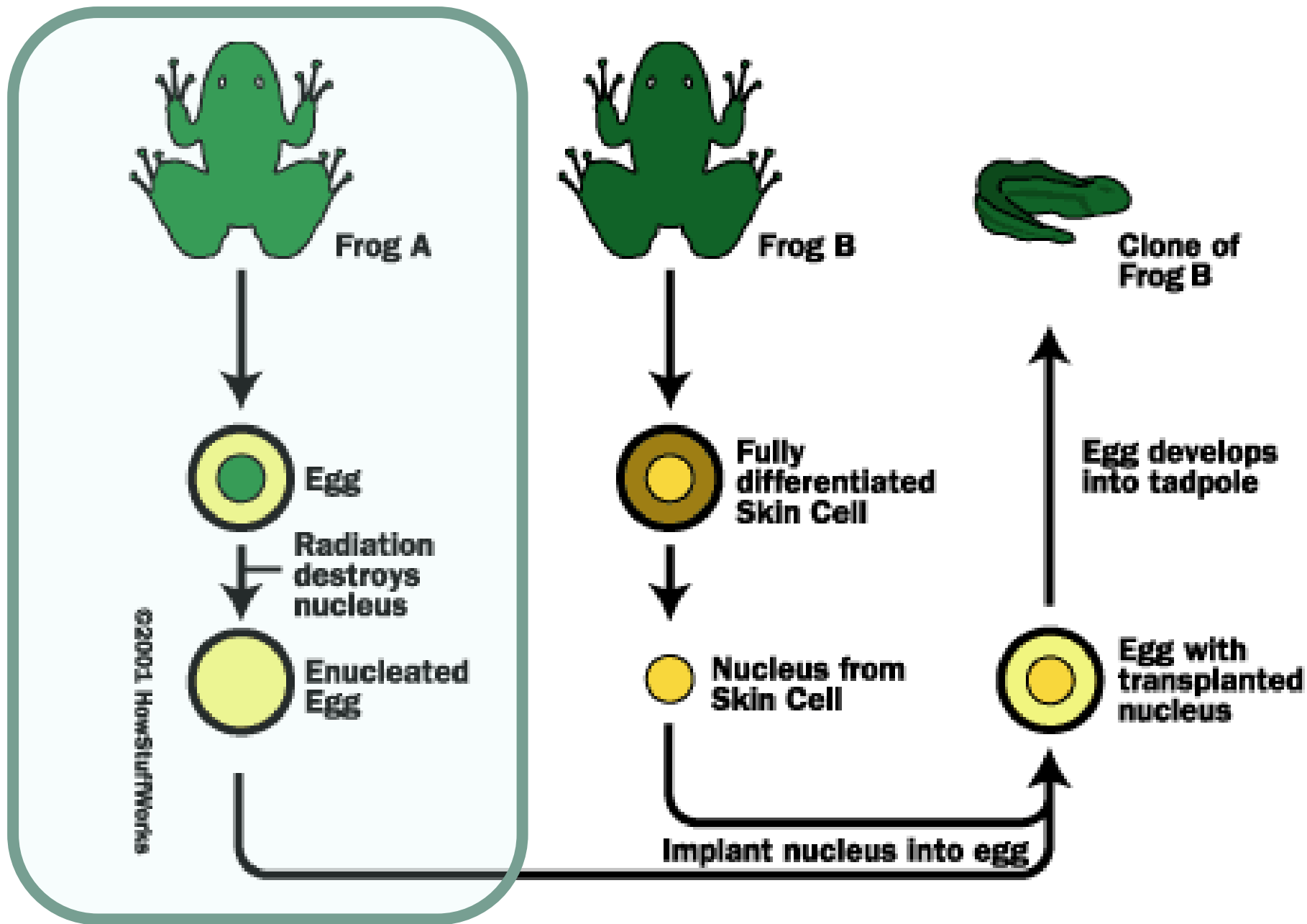
Obtención de ovocitos de una rana

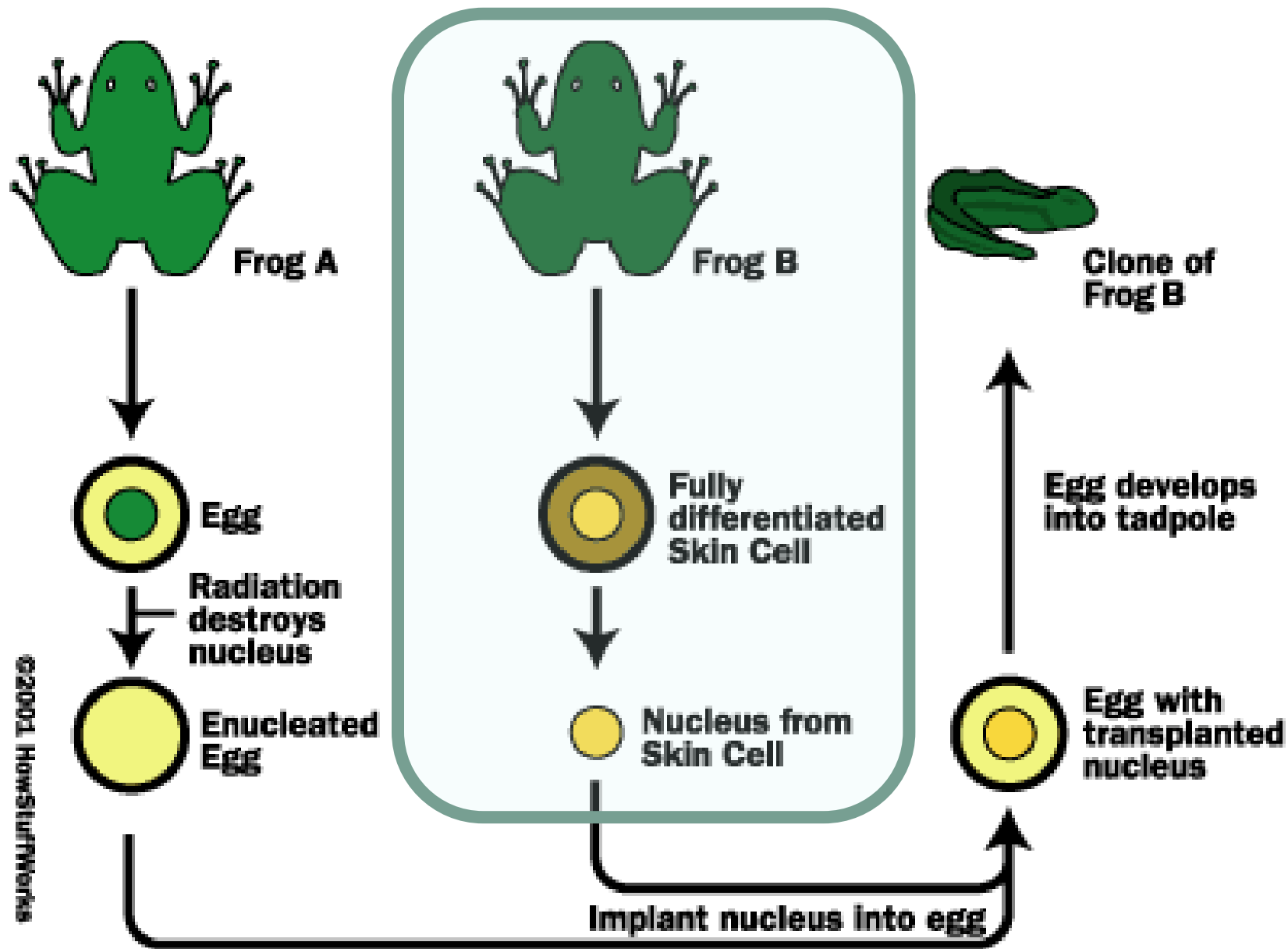
Enucleación por irradiación UV

Inyección de células somáticas de otro o el mismo espécimen

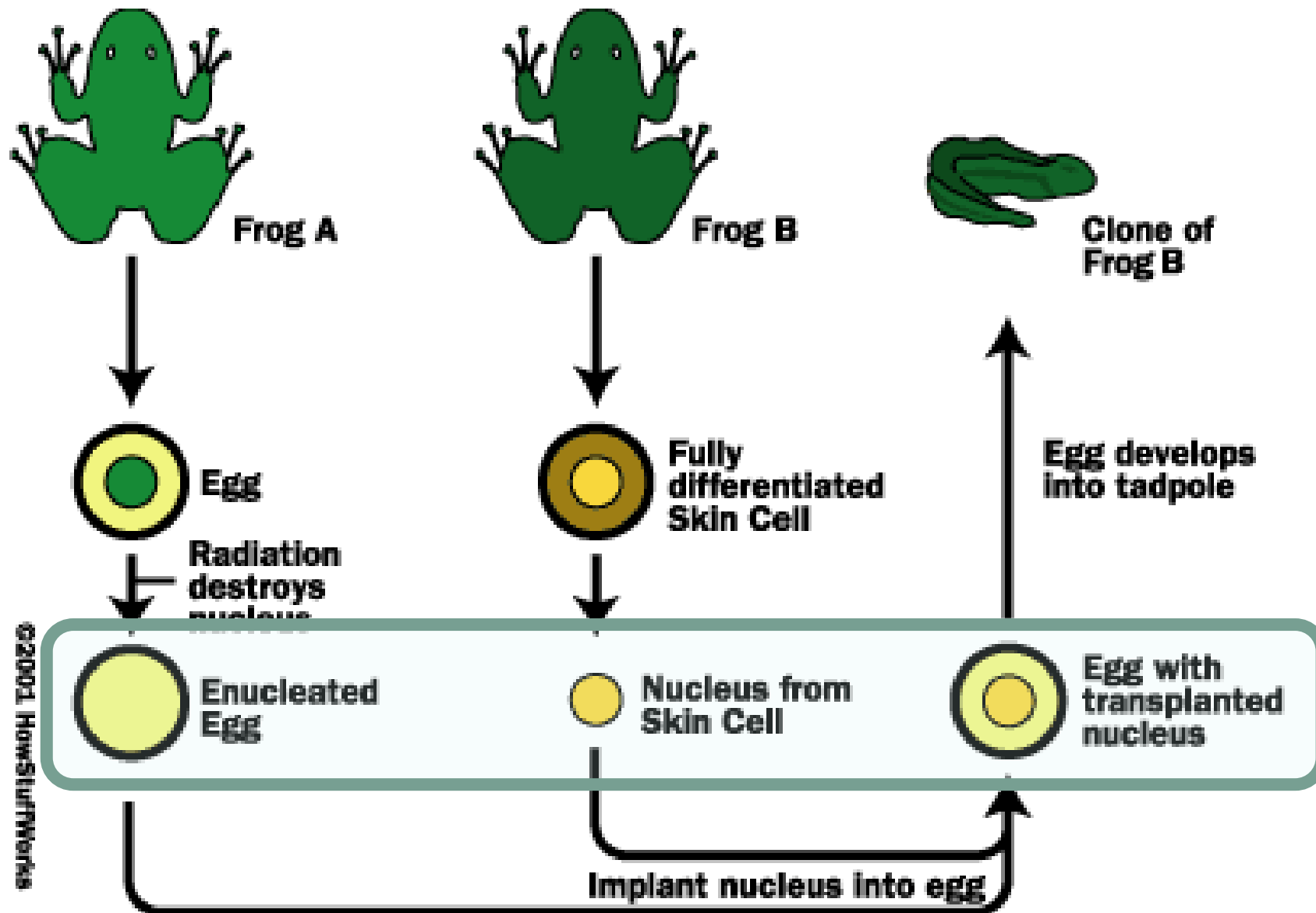
Obtención de clones de la rana donante de las células somáticas





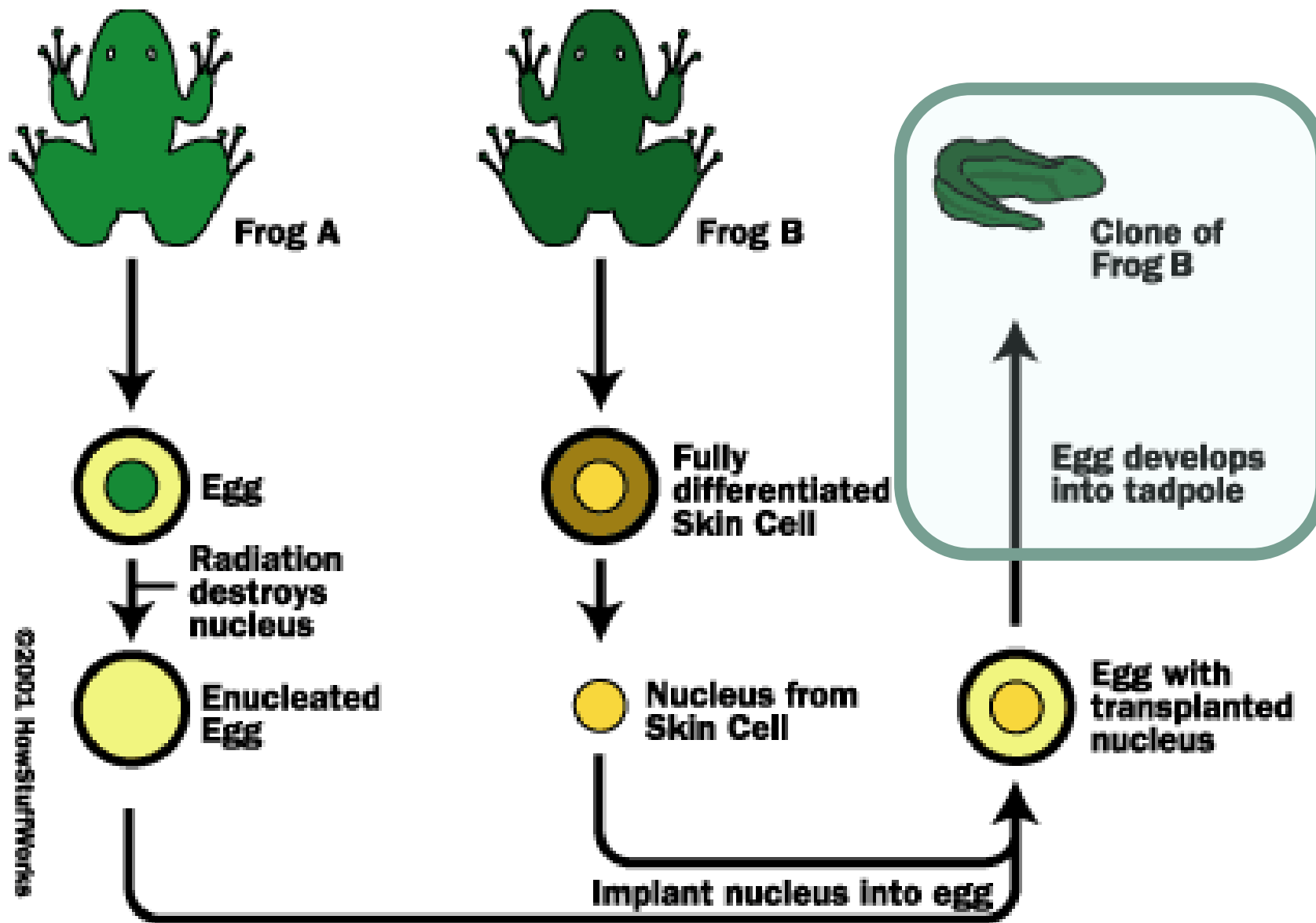






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# Clonación reproductiva en mamíferos

Partición  
embrionaria

Transferencia  
nuclear

Doble transferencia  
nuclear



Early embryo  
(identical cells)

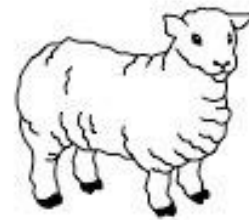
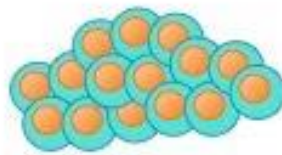
Cells  
separated

Identical  
embryos

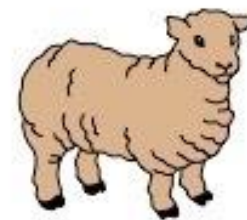
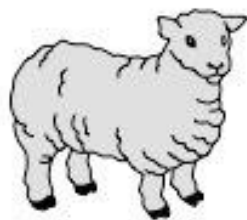
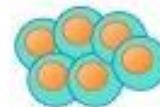
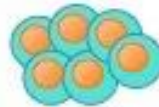
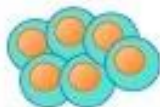
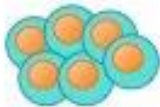
Embryos  
implanted into  
surrogates

Identical  
offspring  
develop  
(clones)

morula  
8 cells  
2½ days



Original  
sheep



Partición  
embrionaria



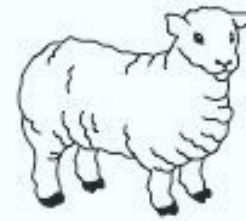
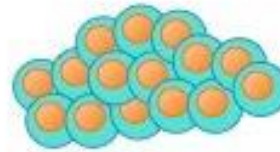
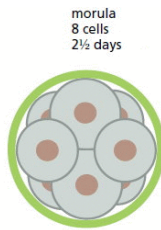
Early embryo  
(identical cells)

Cells  
separated

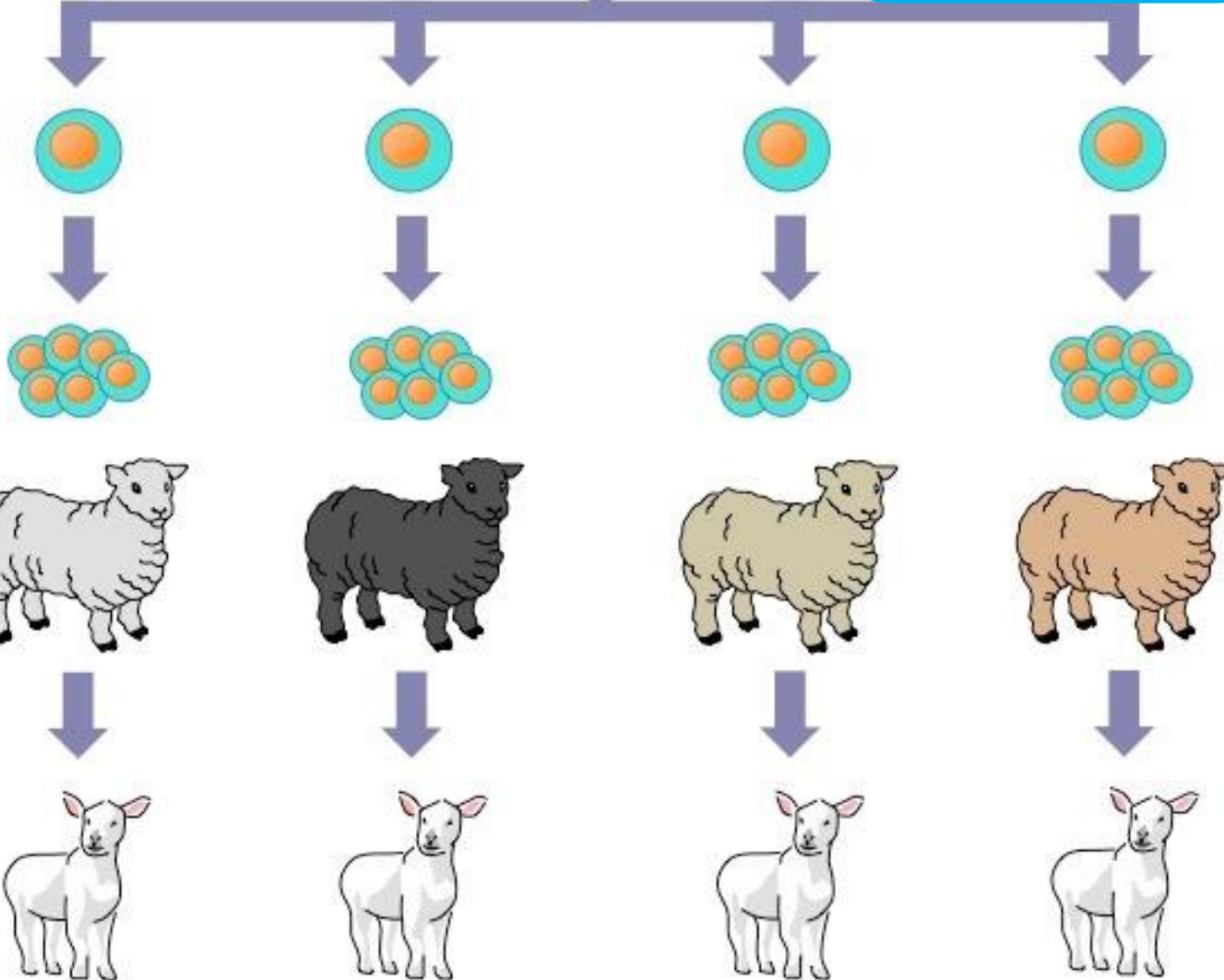
Identical  
embryos

Embryos  
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Partición  
embrionaria



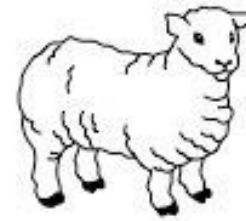
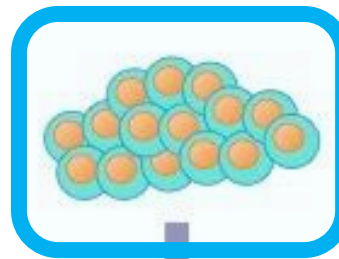
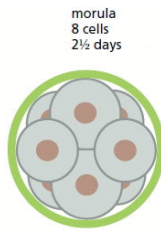
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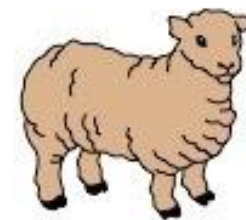
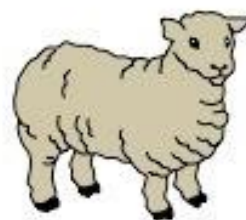
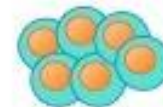
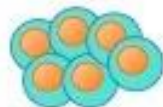
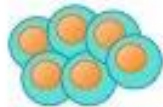
Identical  
embryos

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Original  
sheep



Partición  
embrionaria



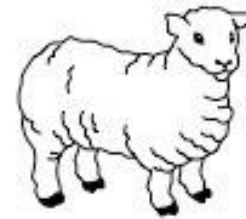
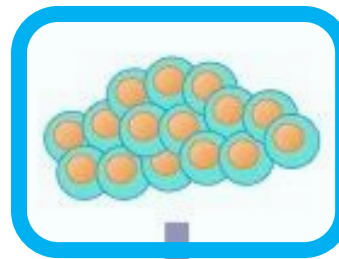
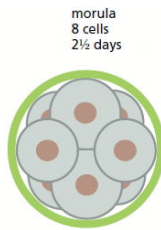
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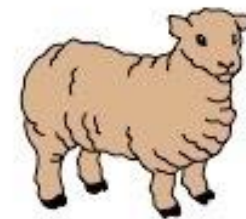
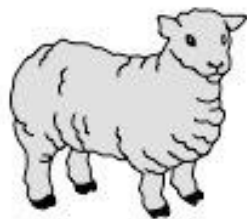
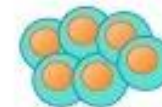
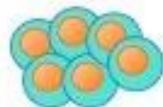
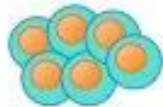
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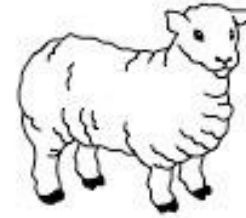
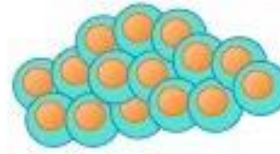
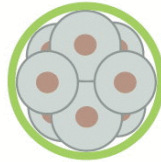
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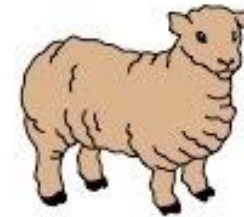
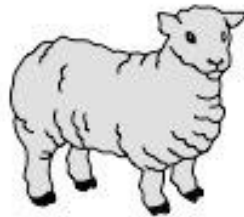
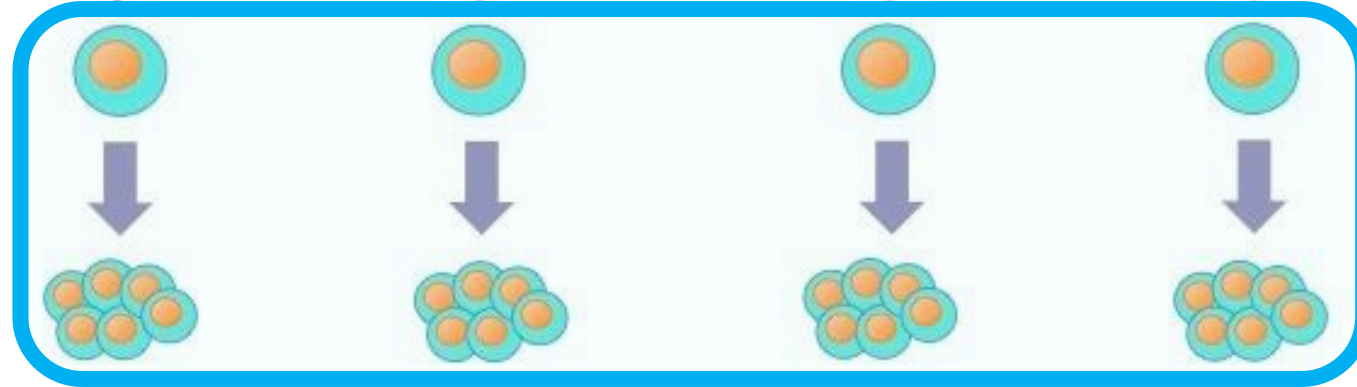
Embryos  
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surrogates

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offspring  
develop  
(clones)

morula  
8 cells  
2½ days



Original  
sheep



Partición  
embrionaria





Early embryo  
(identical cells)

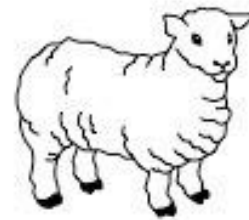
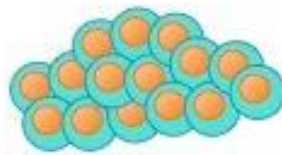
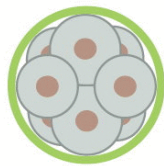
Cells  
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Identical  
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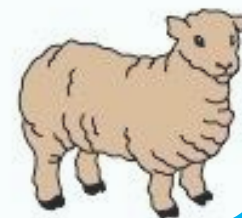
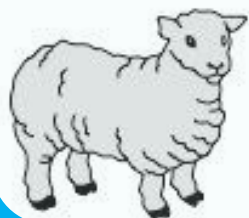
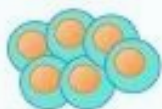
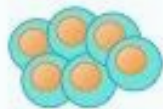
Embryos  
implanted into  
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Identical  
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8 cells  
2½ days



Original  
sheep



Partición  
embrionaria



Early embryo  
(identical cells)

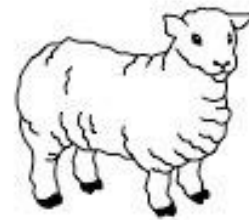
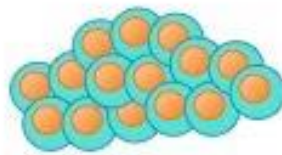
Cells  
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Identical  
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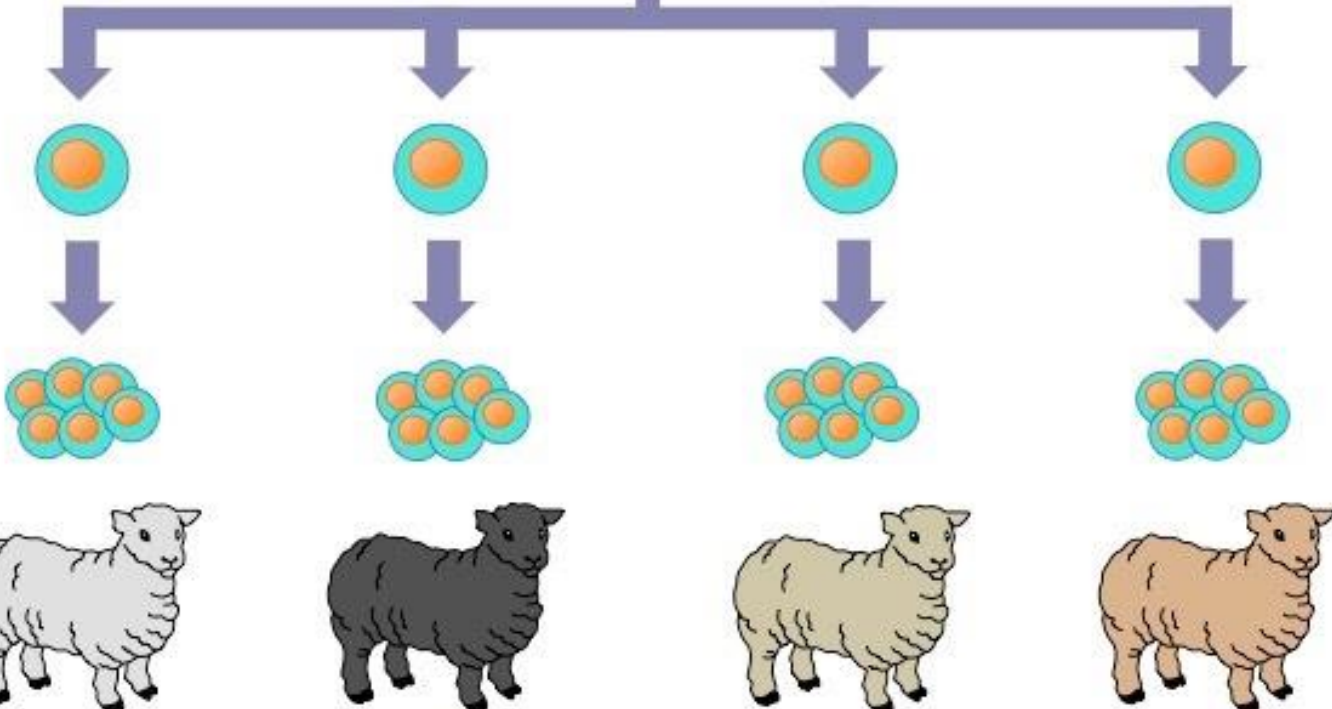
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8 cells  
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sheep



Partición  
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embrionaria

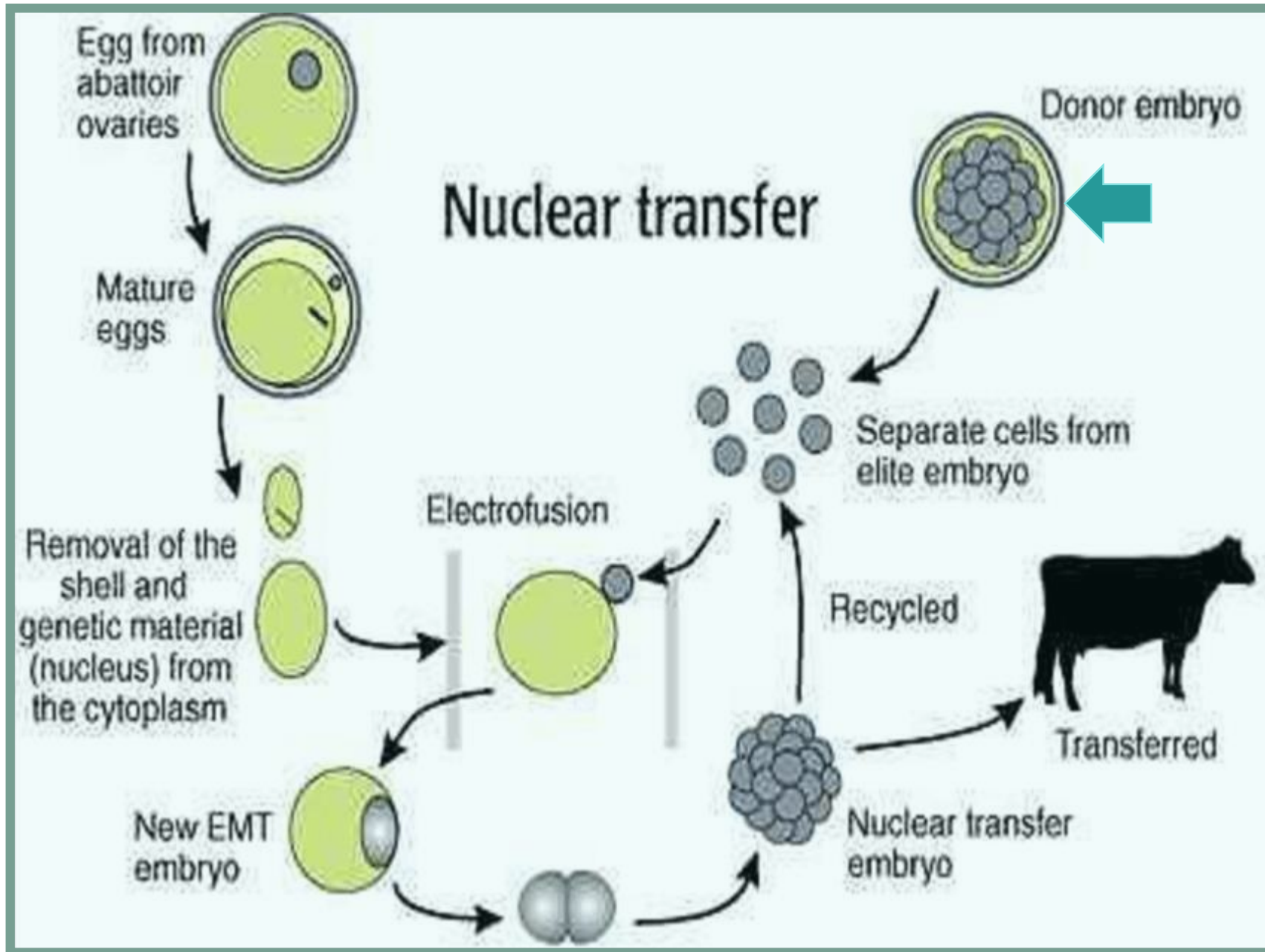
Para qué?

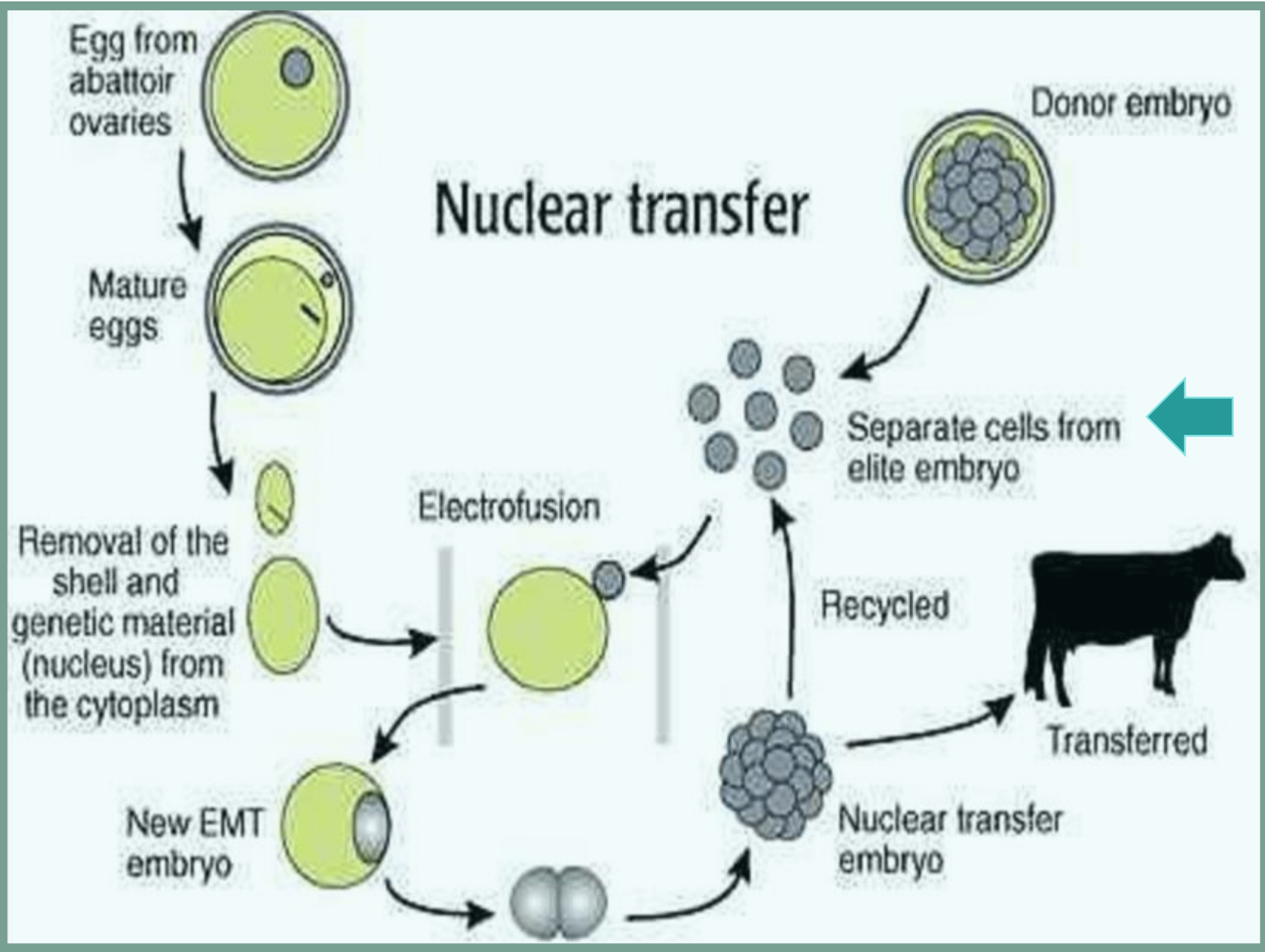
Investigación básica

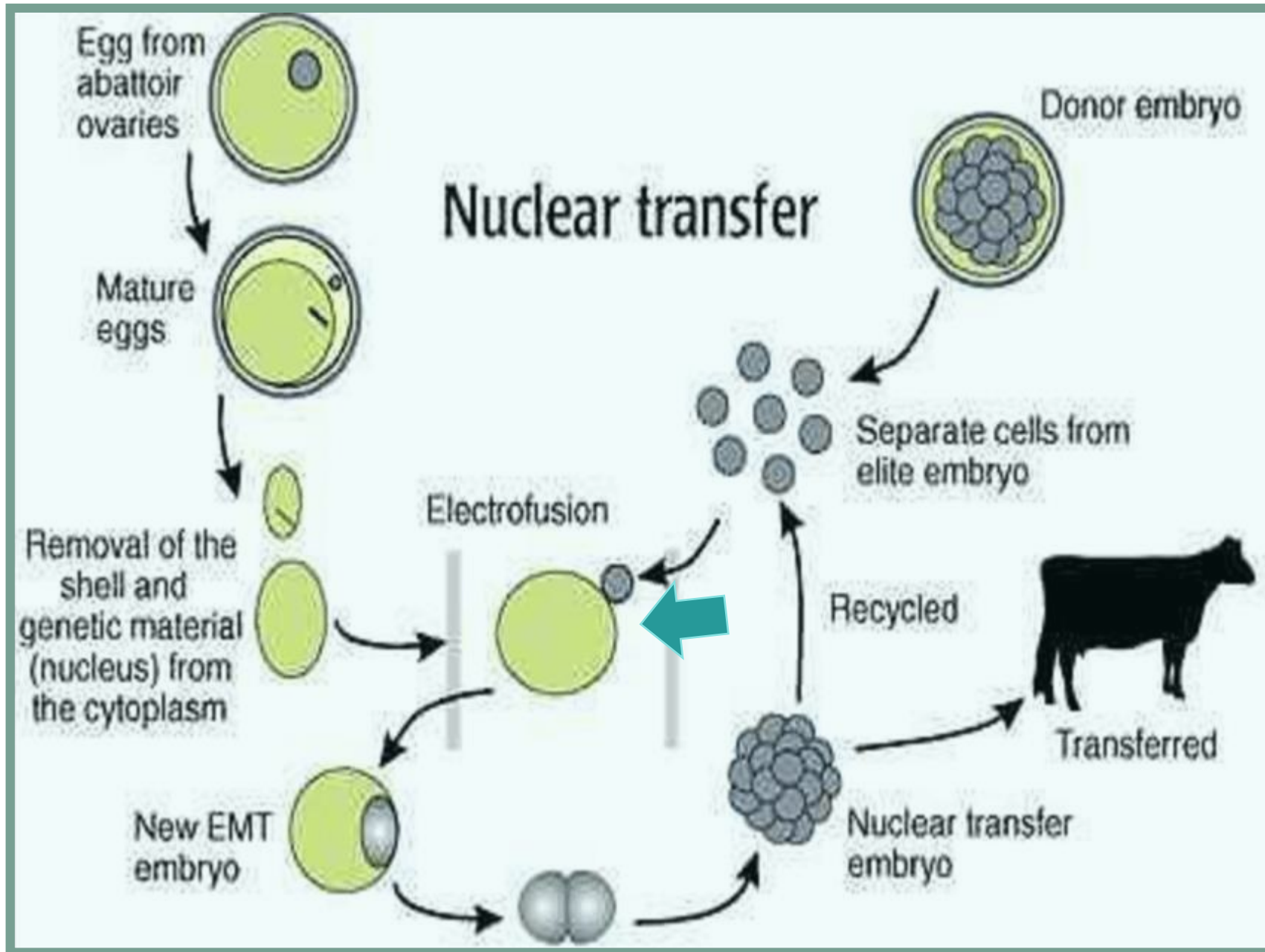
Mejorar fertilidad de individuos con  
pobre estimulación ovárica

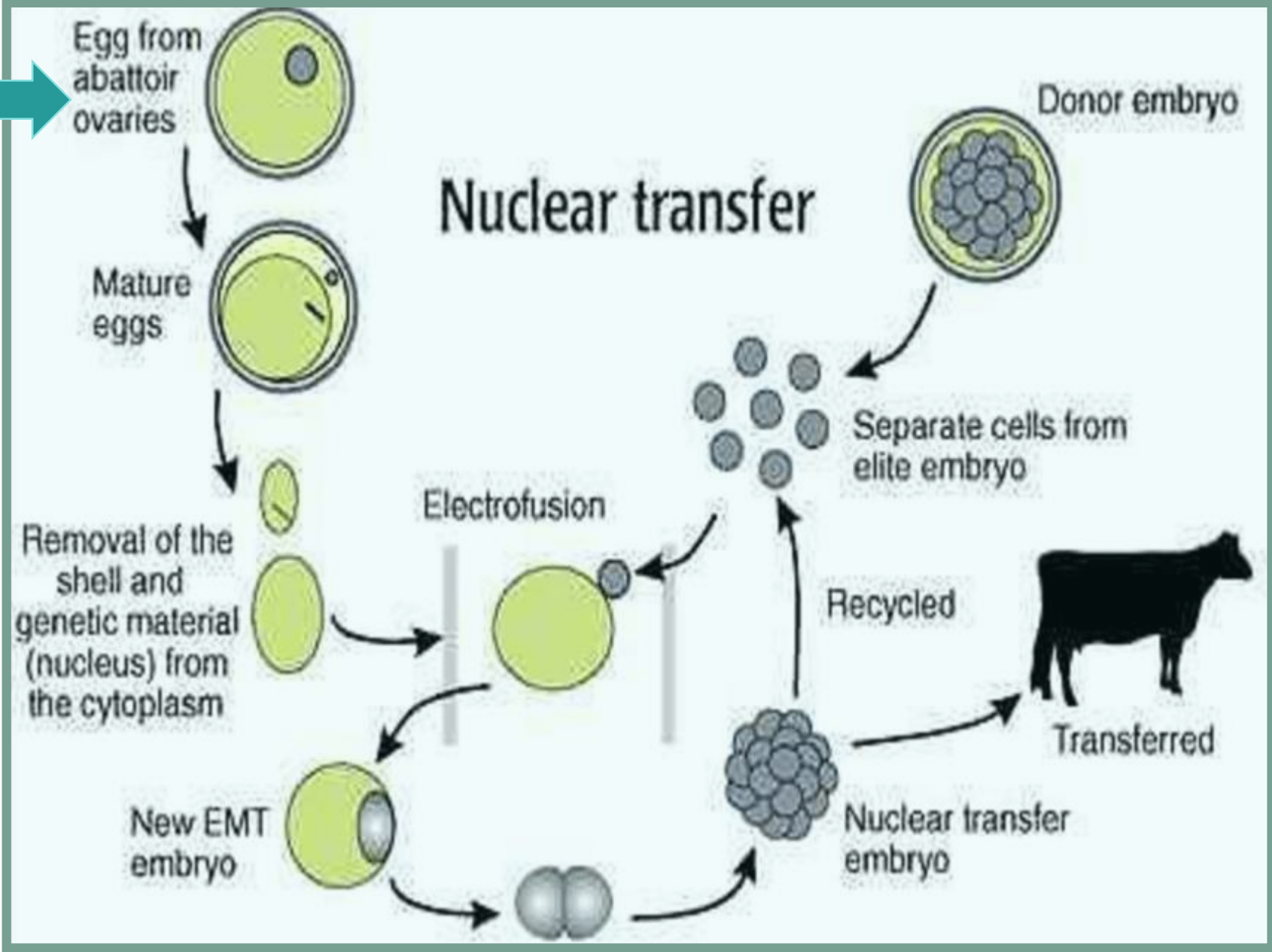
Clones idénticos separados en el  
tiempo

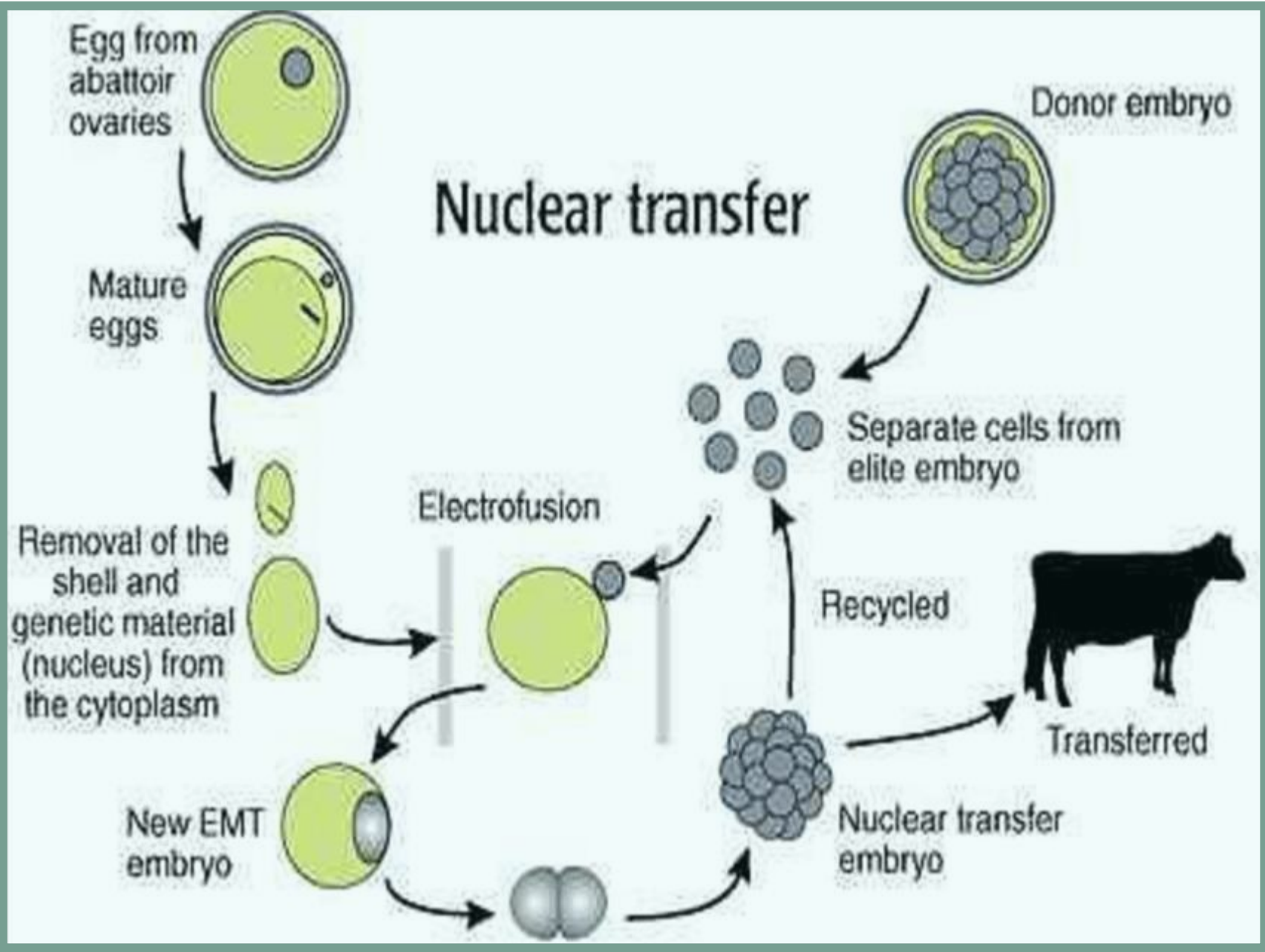




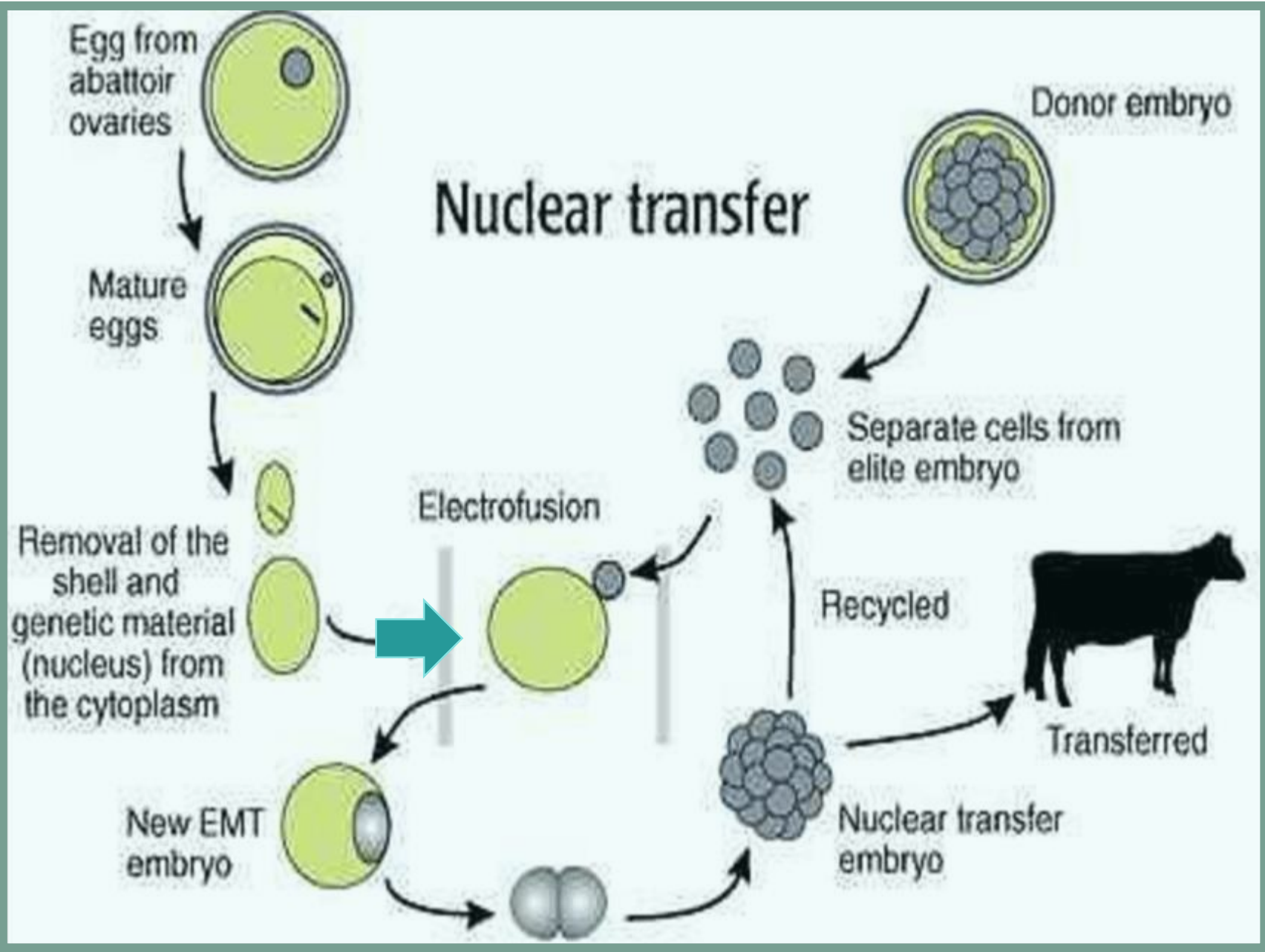


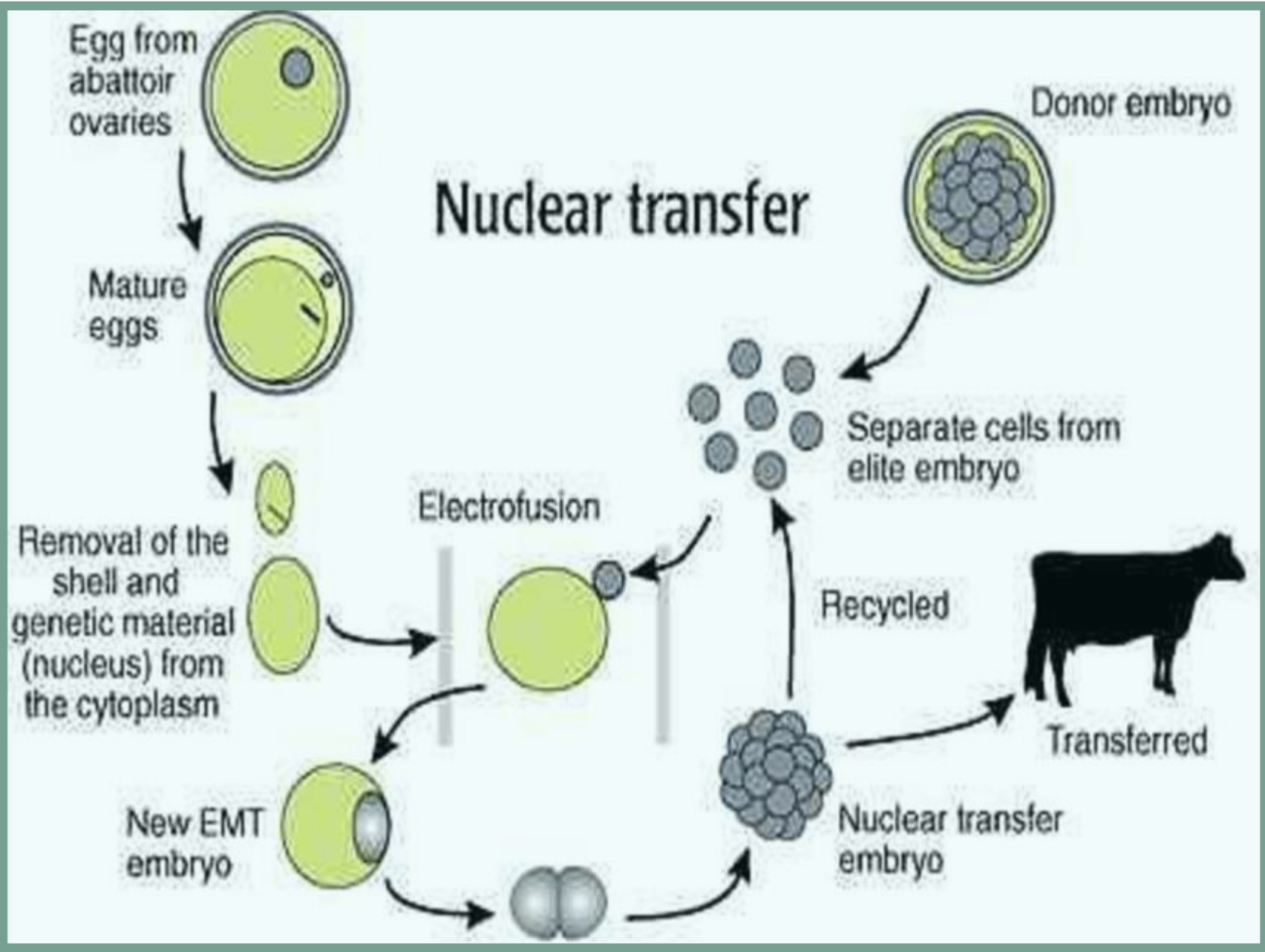




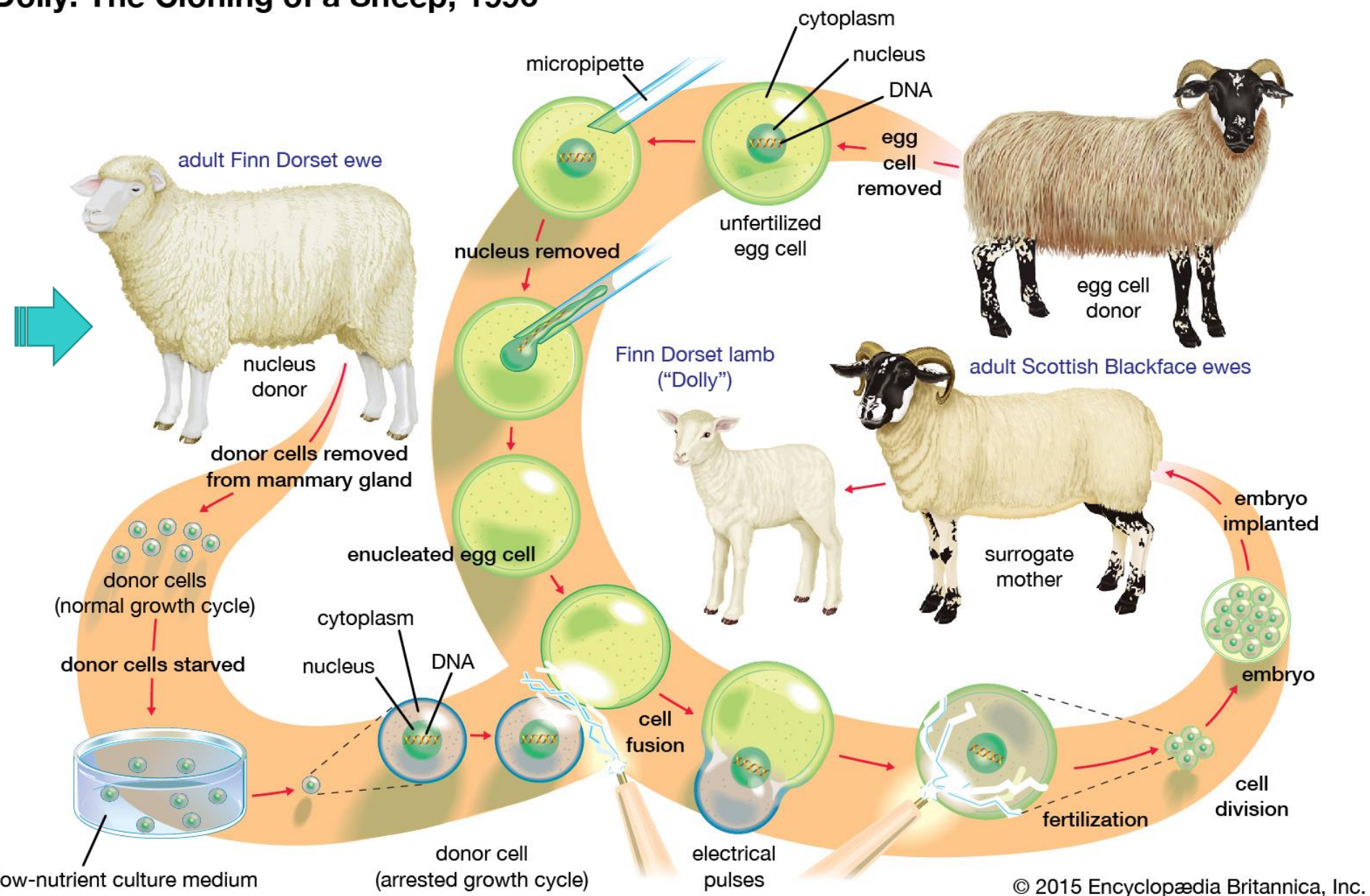


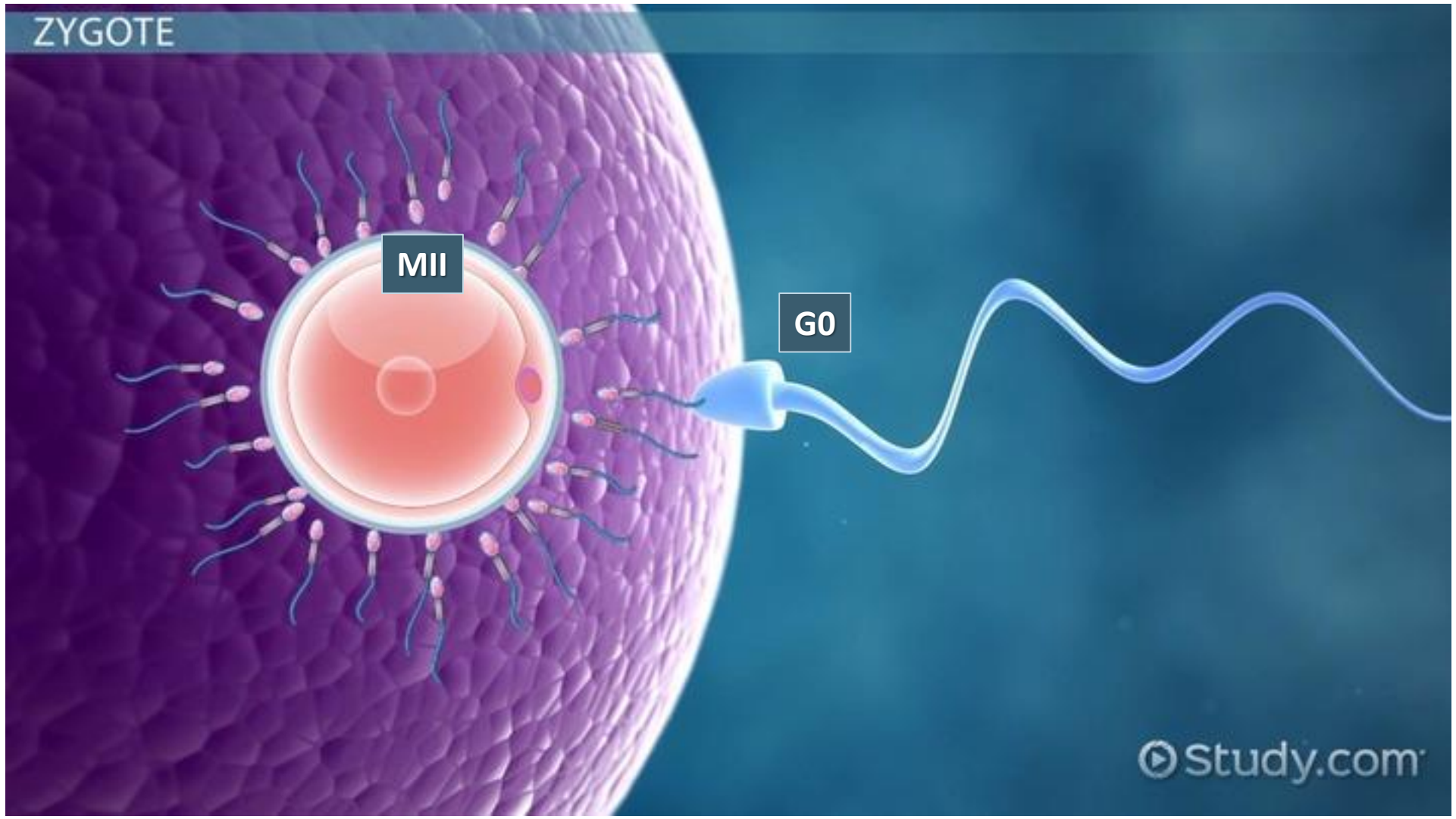




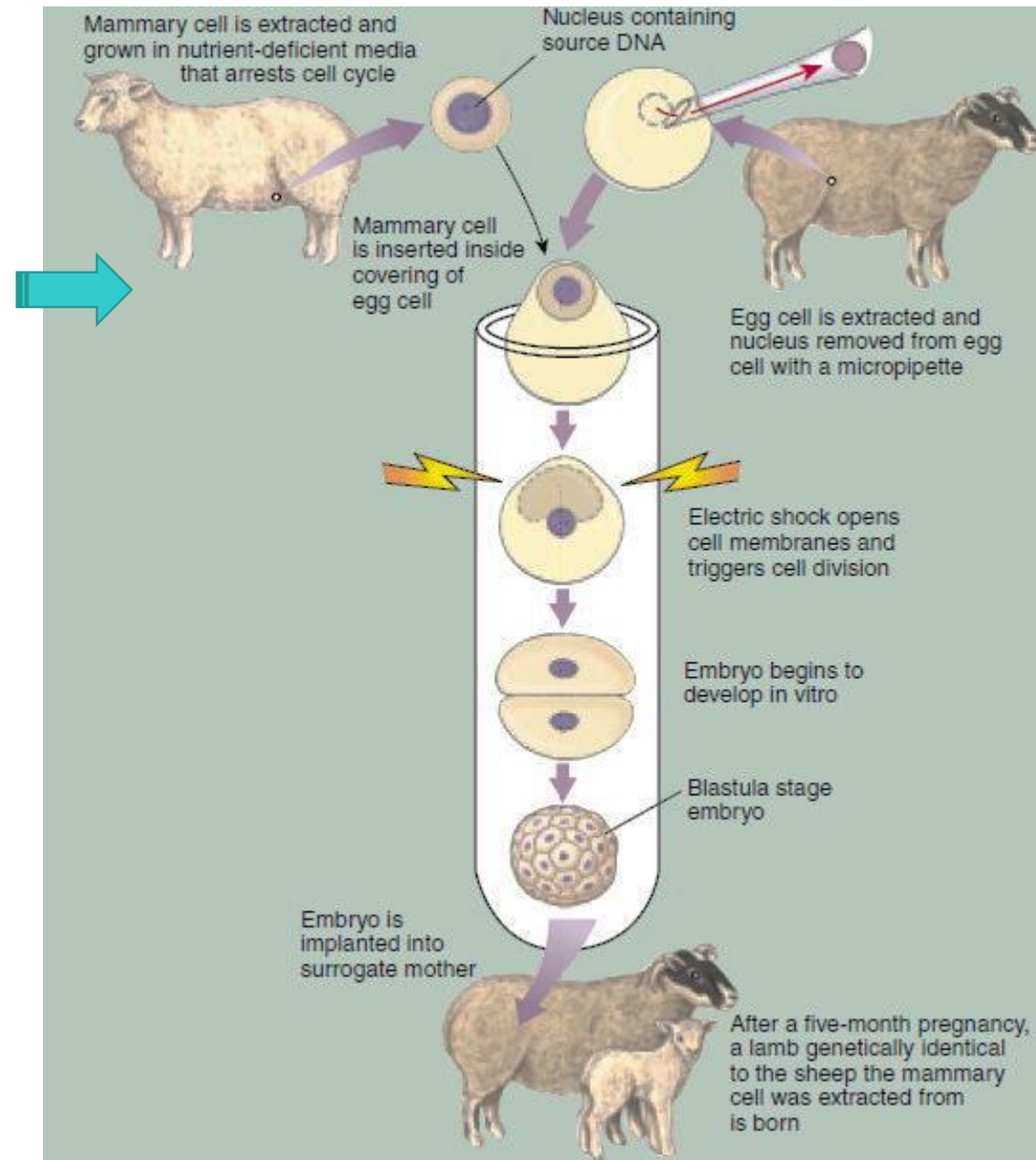


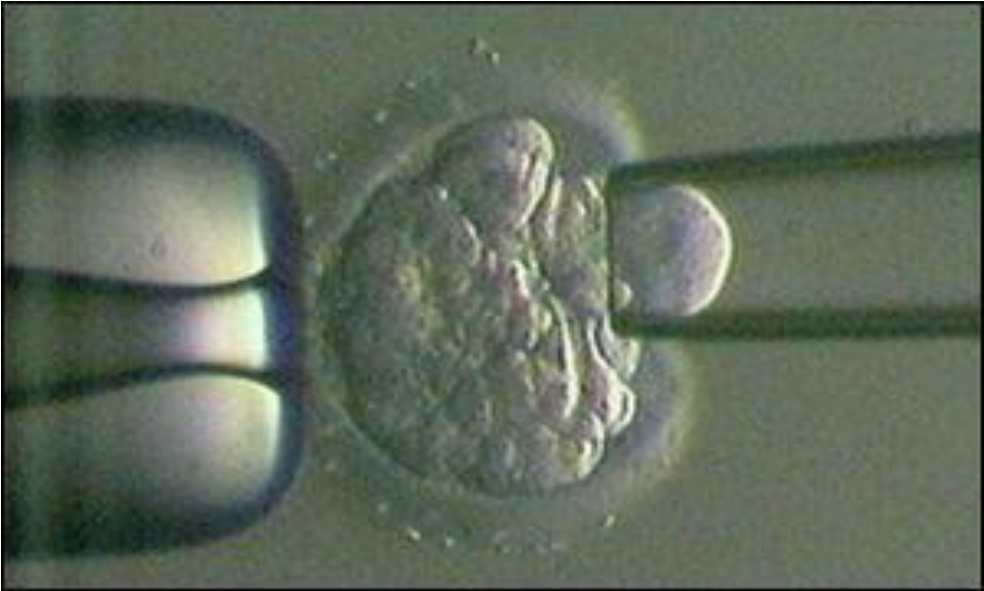
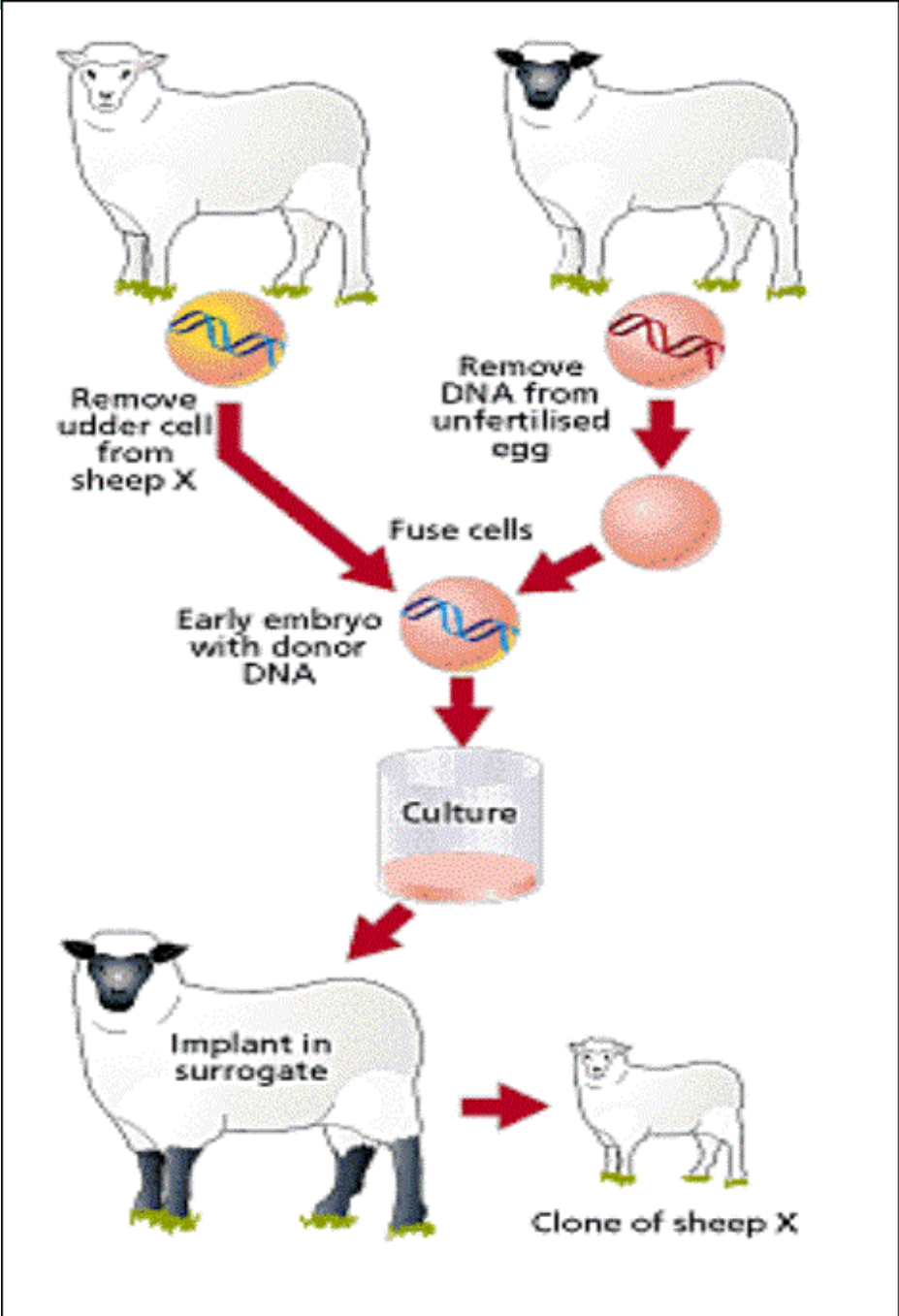
# Dolly: The Cloning of a Sheep, 1996





Célula donadora  
sin nutrientes  
permanece en  
estado G0

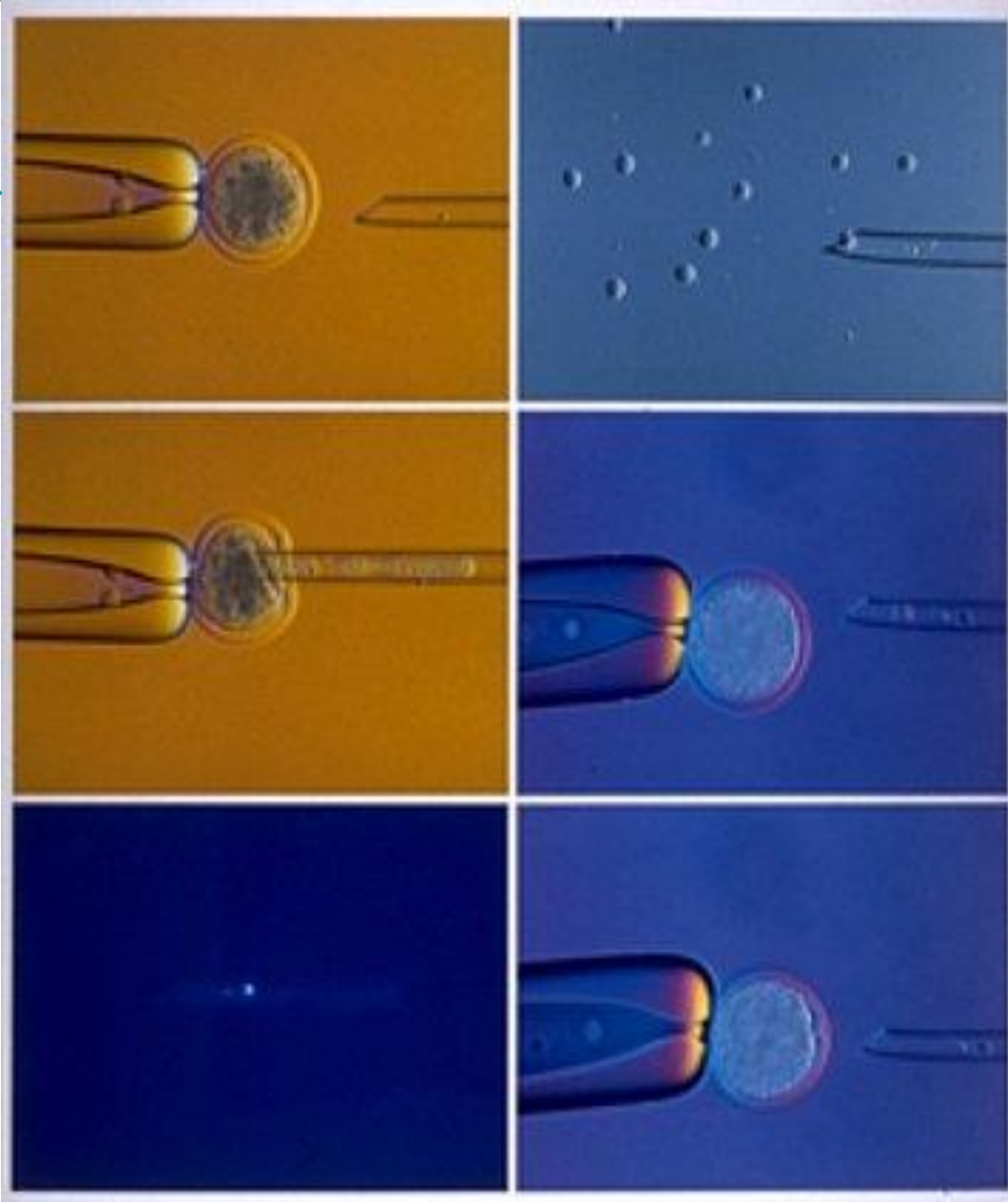




Procedimiento de manipulación de la célula huevo.



Pinza de sujeción por aspiración



Micropipeta recogiendo la célula donadora del DNA

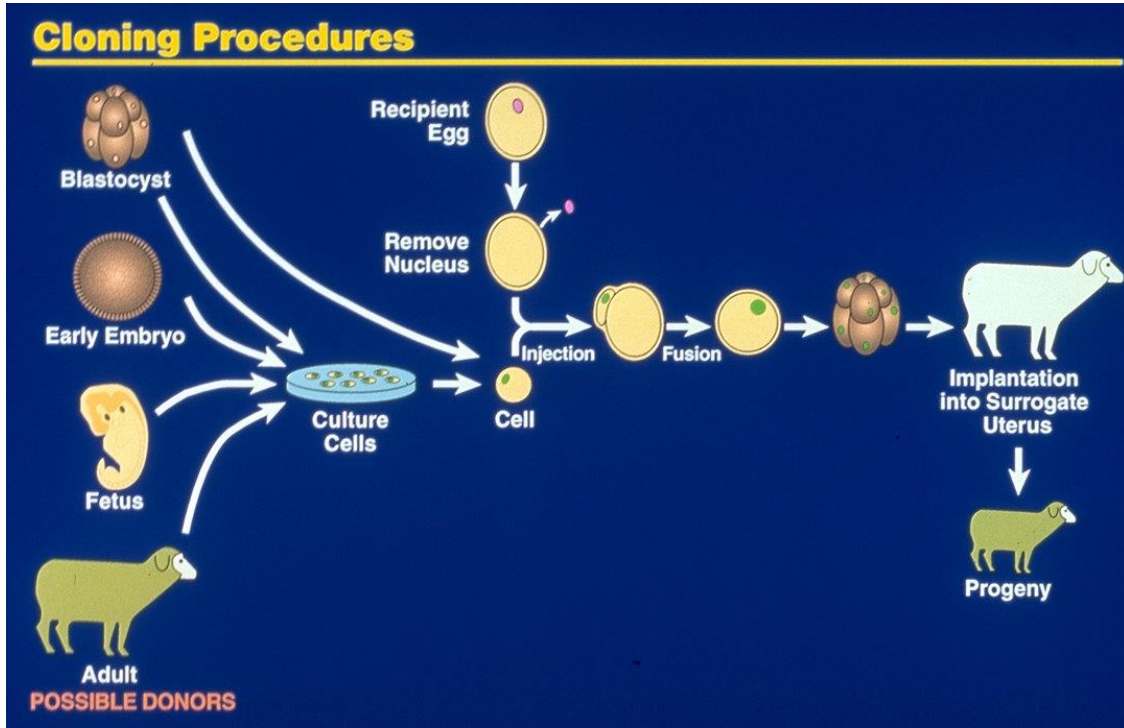


La célula donadora se inyecta dentro de la célula huevo

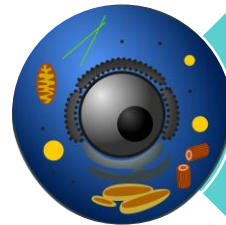


Se activa el desarrollo mediante un pulso eléctrico o químico

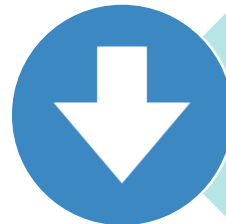




Es posible clonar animales adultos



Célula diferenciada se puede des-diferenciar



1 de 277 intentos



No es comercialmente exitoso





Técnica de Honolulu

1998

Ratones éxito 1/100

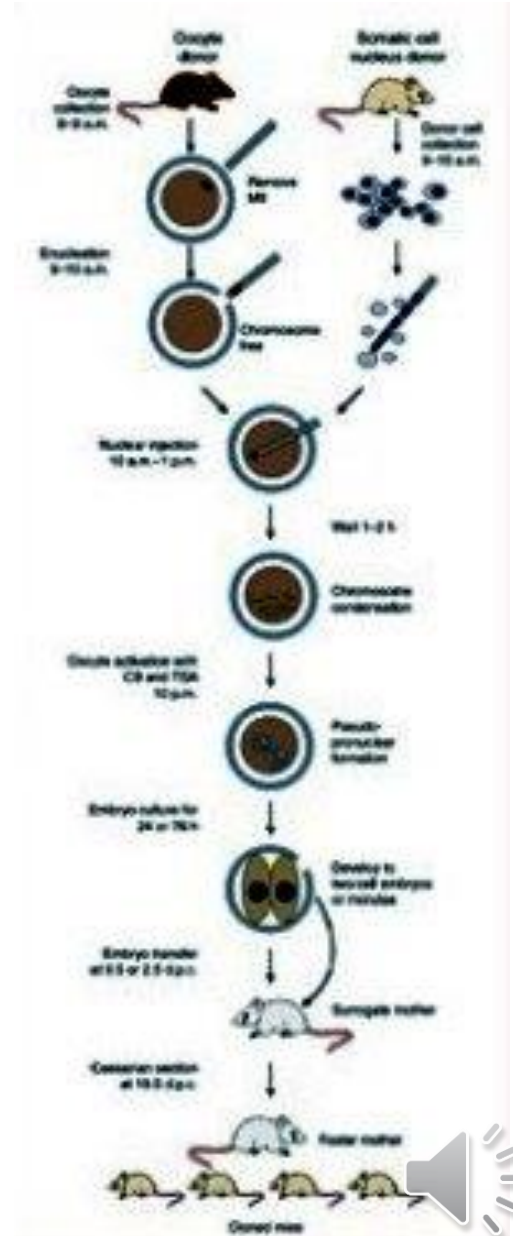
Células naturalmente en estado G0

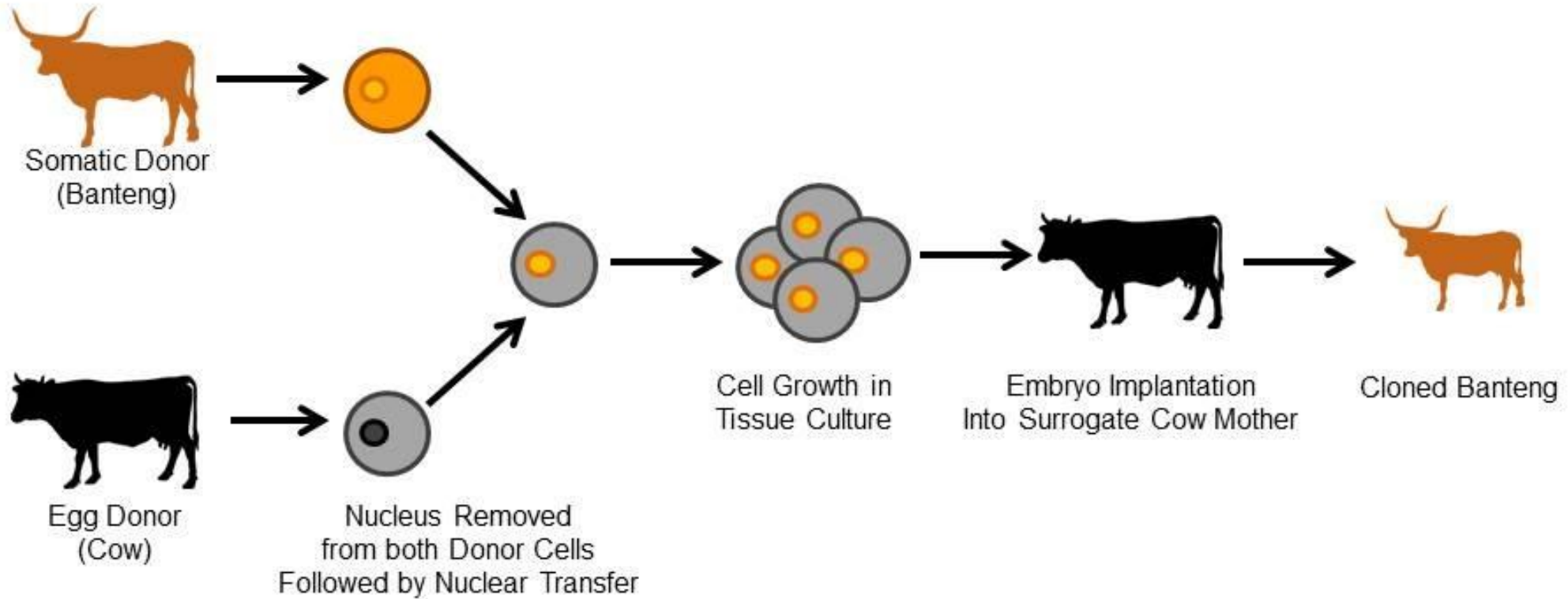
Poco tiempo entre obtención de las células donadoras y la inyección en el ovocito

No se hicieron cultivos celulares de las células donadoras

Menos manipulación

Hace más eficiente el proceso



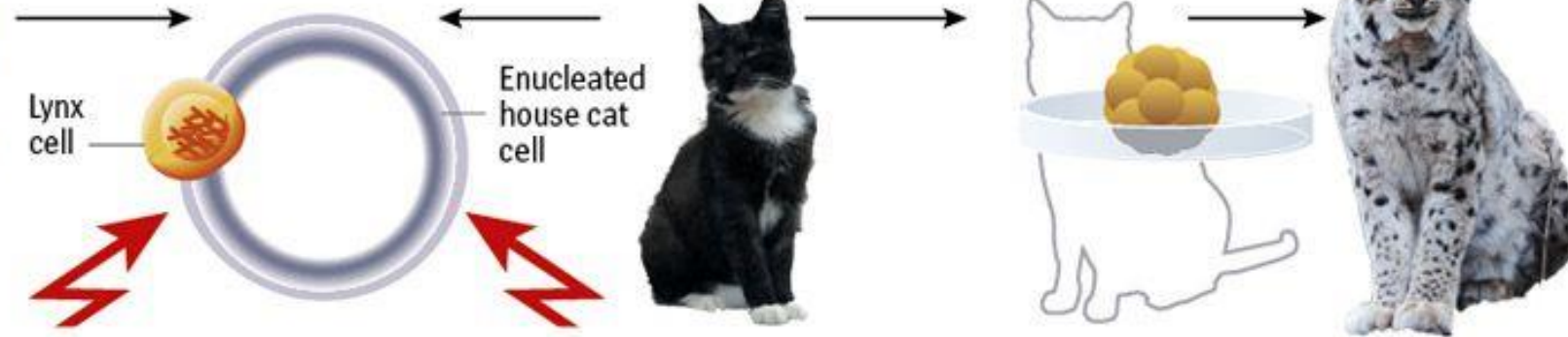


## Preservation In a Lab

How Scientists Hope to Clone Endangered Species

A cell is taken from an Iberian lynx, for example, and using electrical impulses, fused with a house cat's egg cell that has been enucleated, or had its nucleus removed.

After successful cell division, an embryo is formed that has cell nuclei with the genetic makeup of the lynx. The embryo is then implanted into the uterus of a house cat, which serves as a surrogate for the lynx.



DEB SPIEGEL

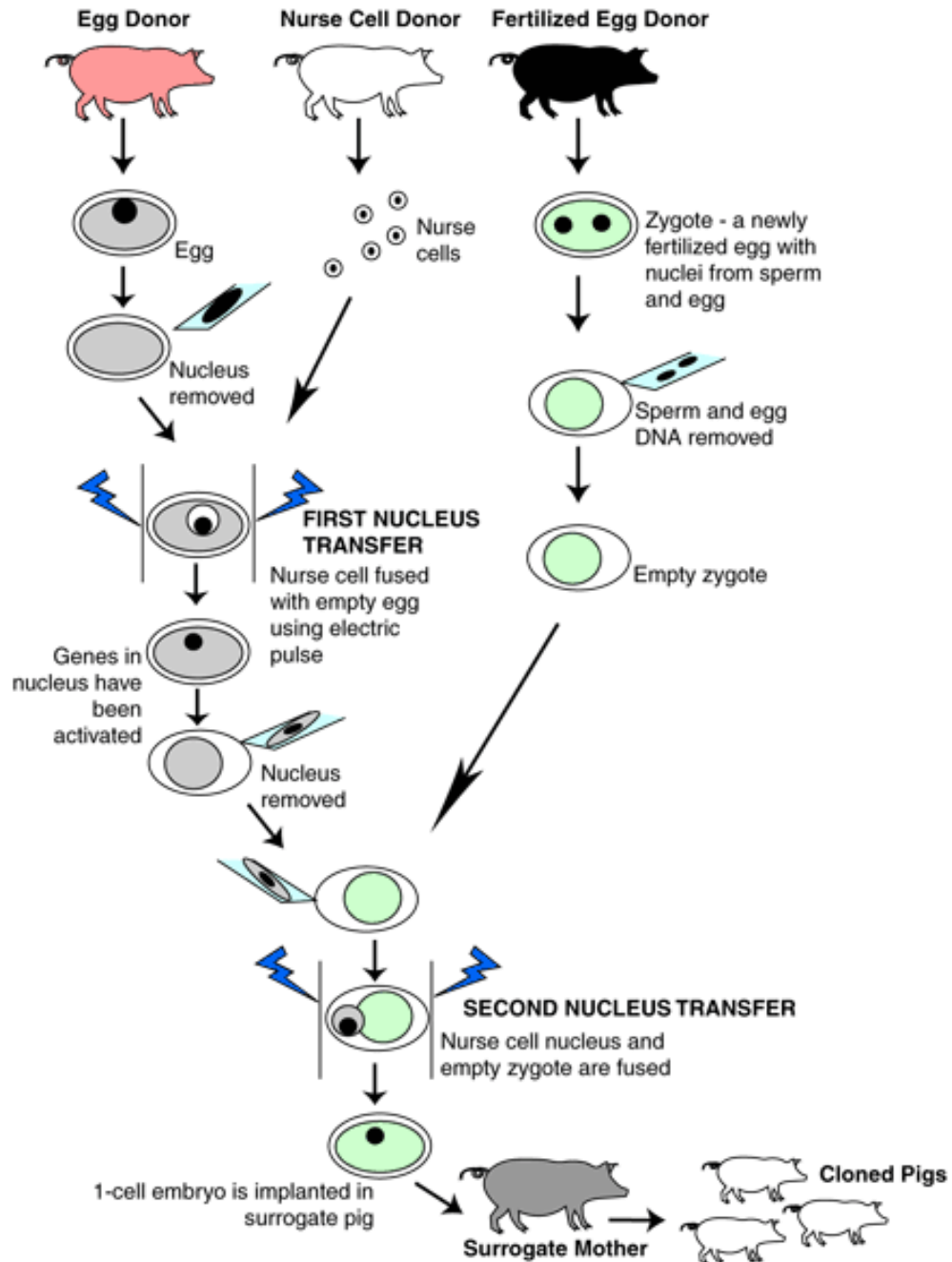
GETTY IMAGES / DPA

CLONING AND STEM CELLS  
Volume 6, Number 3, 2004  
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### Birth of African Wildcat Cloned Kittens Born from Domestic Cats

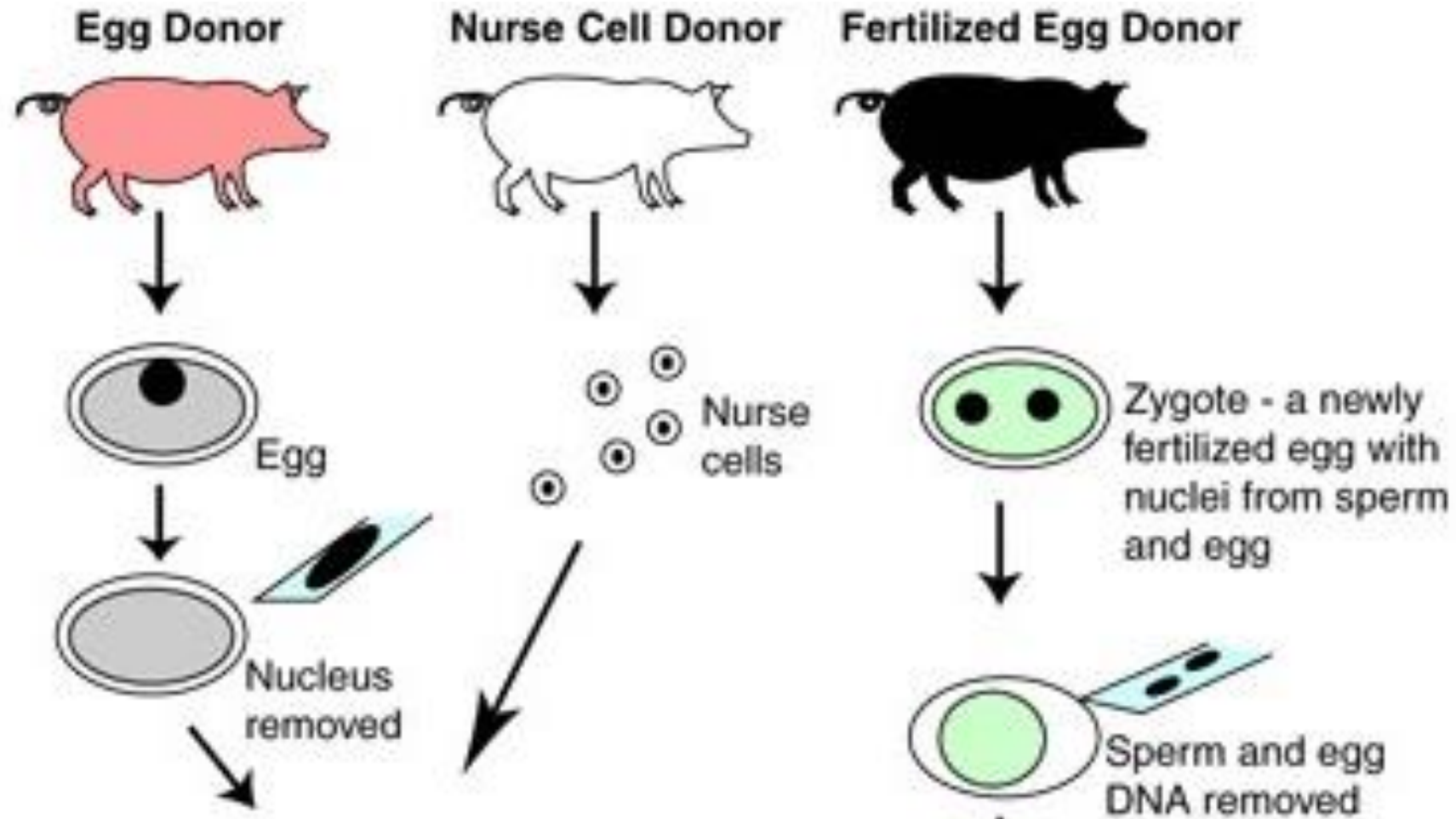
MARTHA C. GÓMEZ,<sup>1,2</sup> C. EARLE POPE,<sup>1</sup> ANGELICA GIRALDO,<sup>1,2</sup> LESLIE A. LYONS,<sup>3</sup>  
REBECCA F. HARRIS,<sup>1</sup> AMY L. KING,<sup>1</sup> ALEX COLE,<sup>1</sup> ROBERT A. GODKE,<sup>2</sup>  
and BETSY L. DRESSER<sup>1,4</sup>

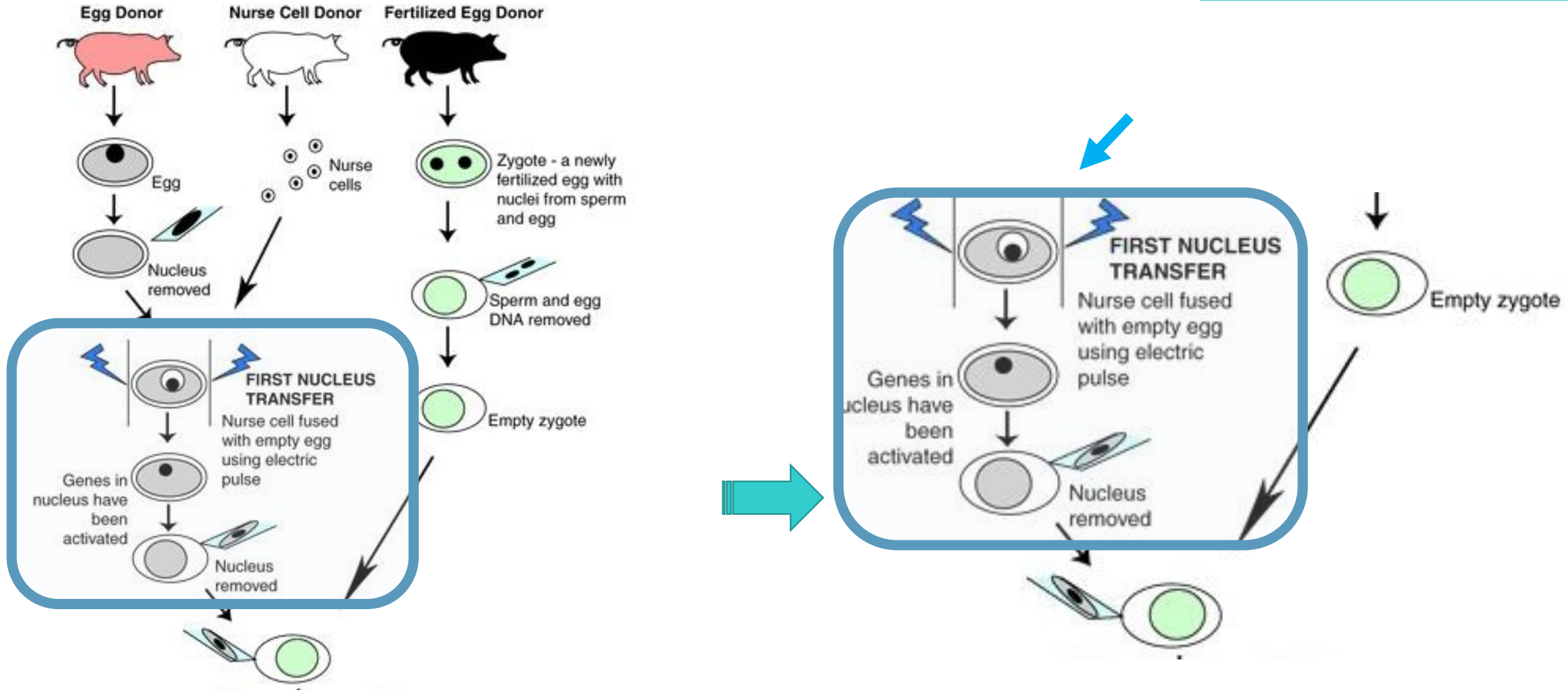




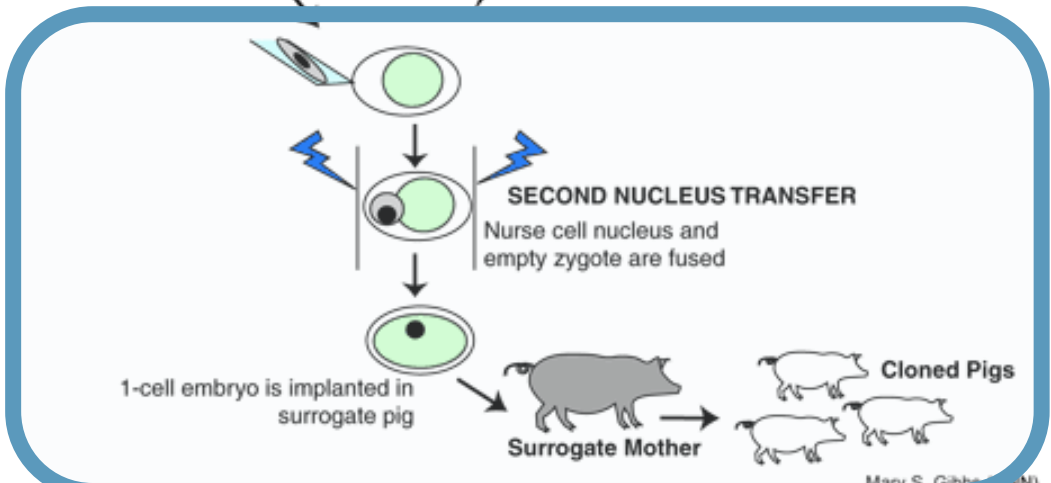
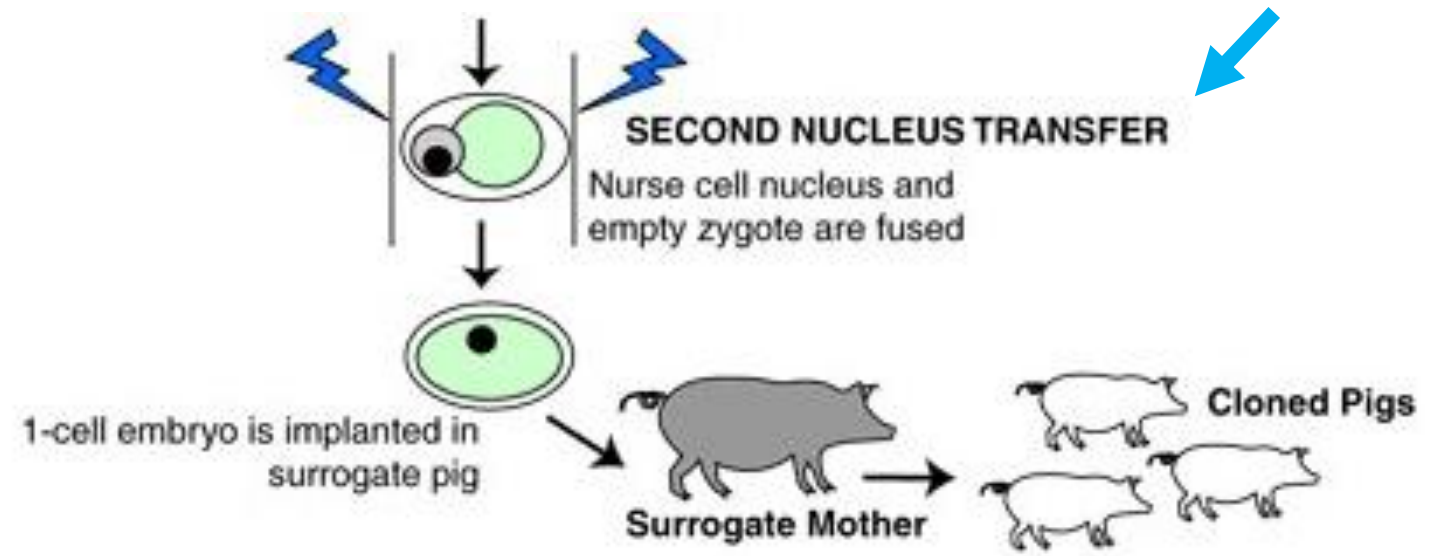
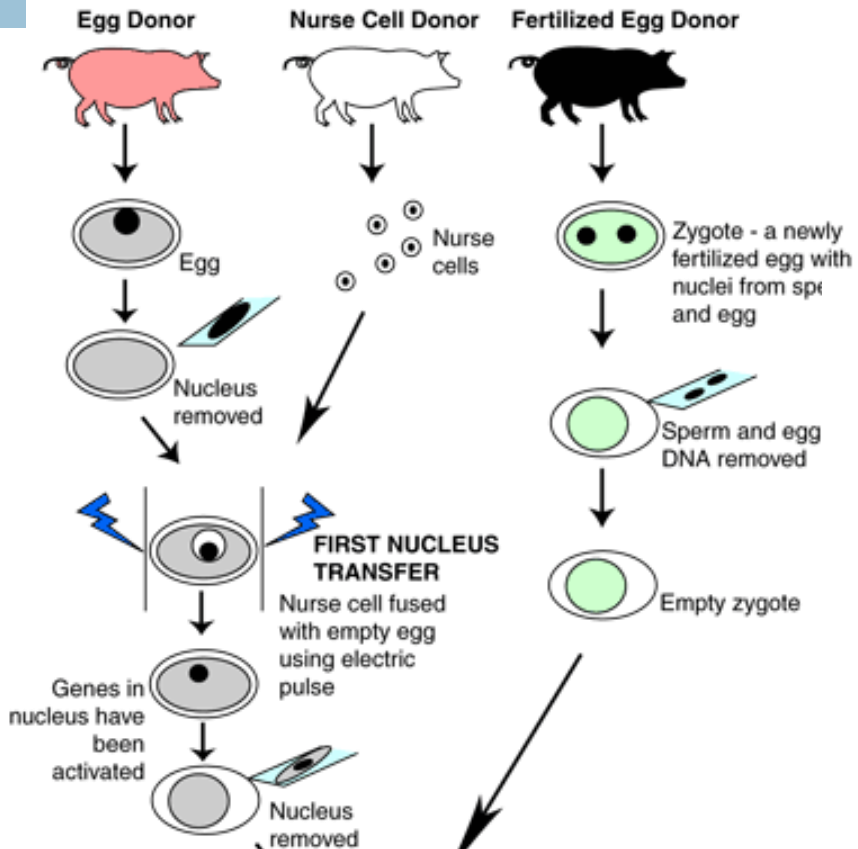
## Doble transferencia nuclear



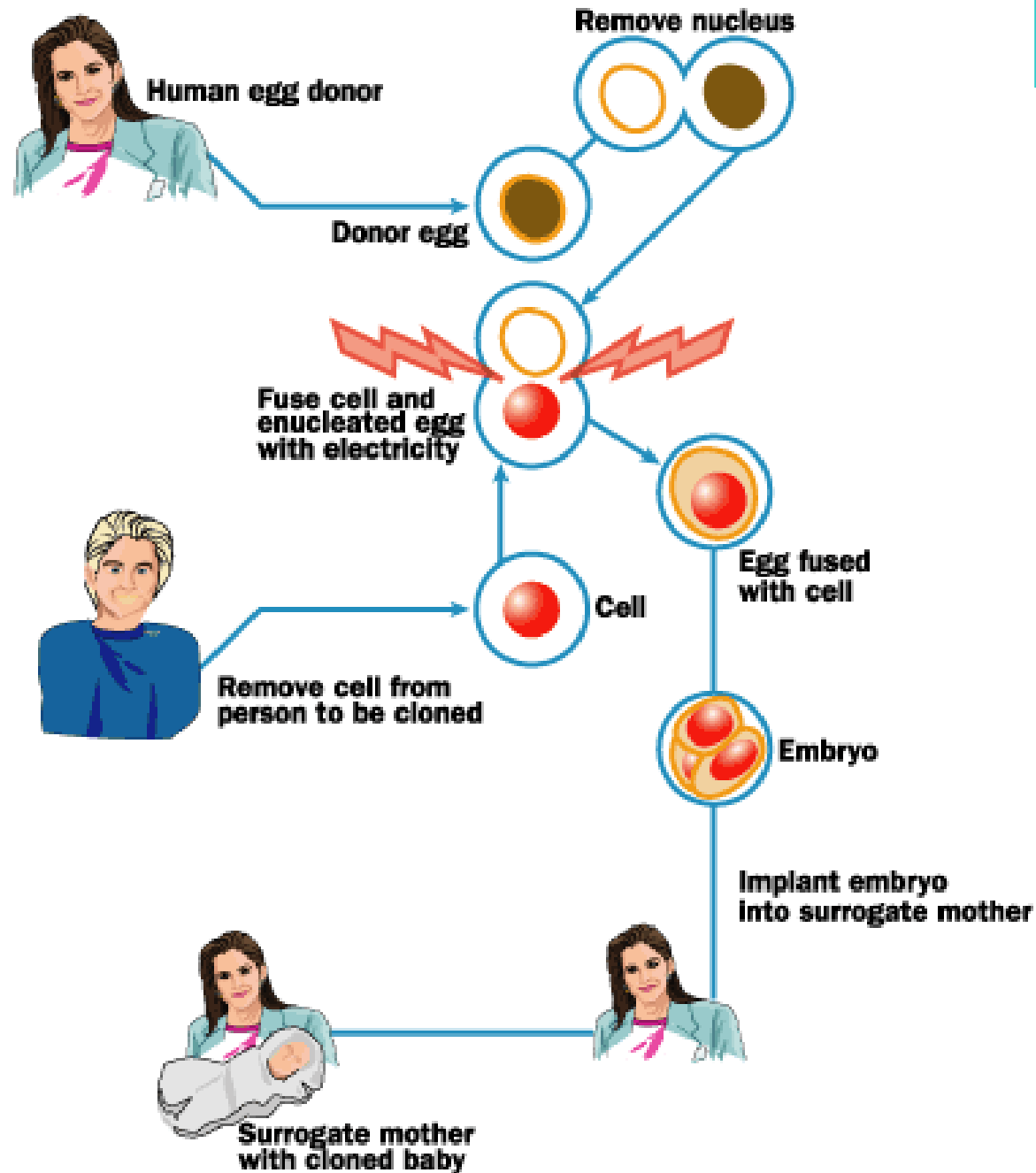




# Transferencia nuclear



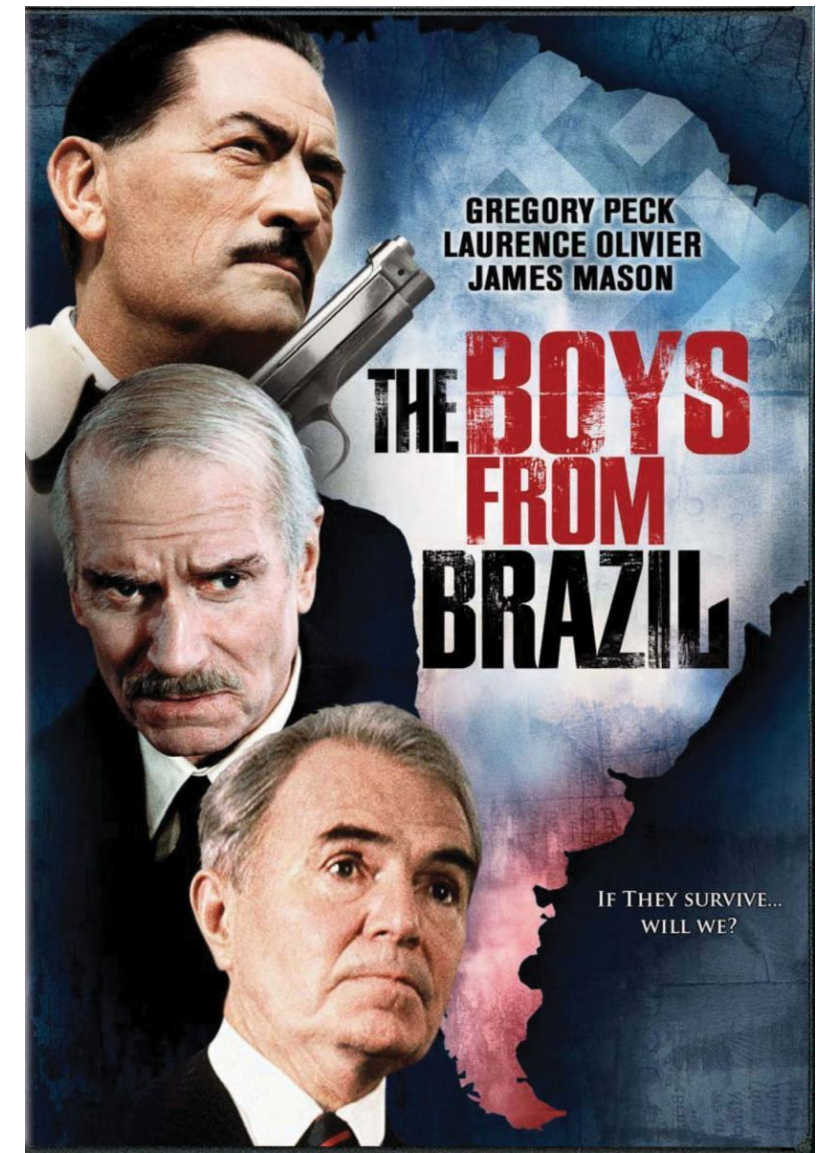
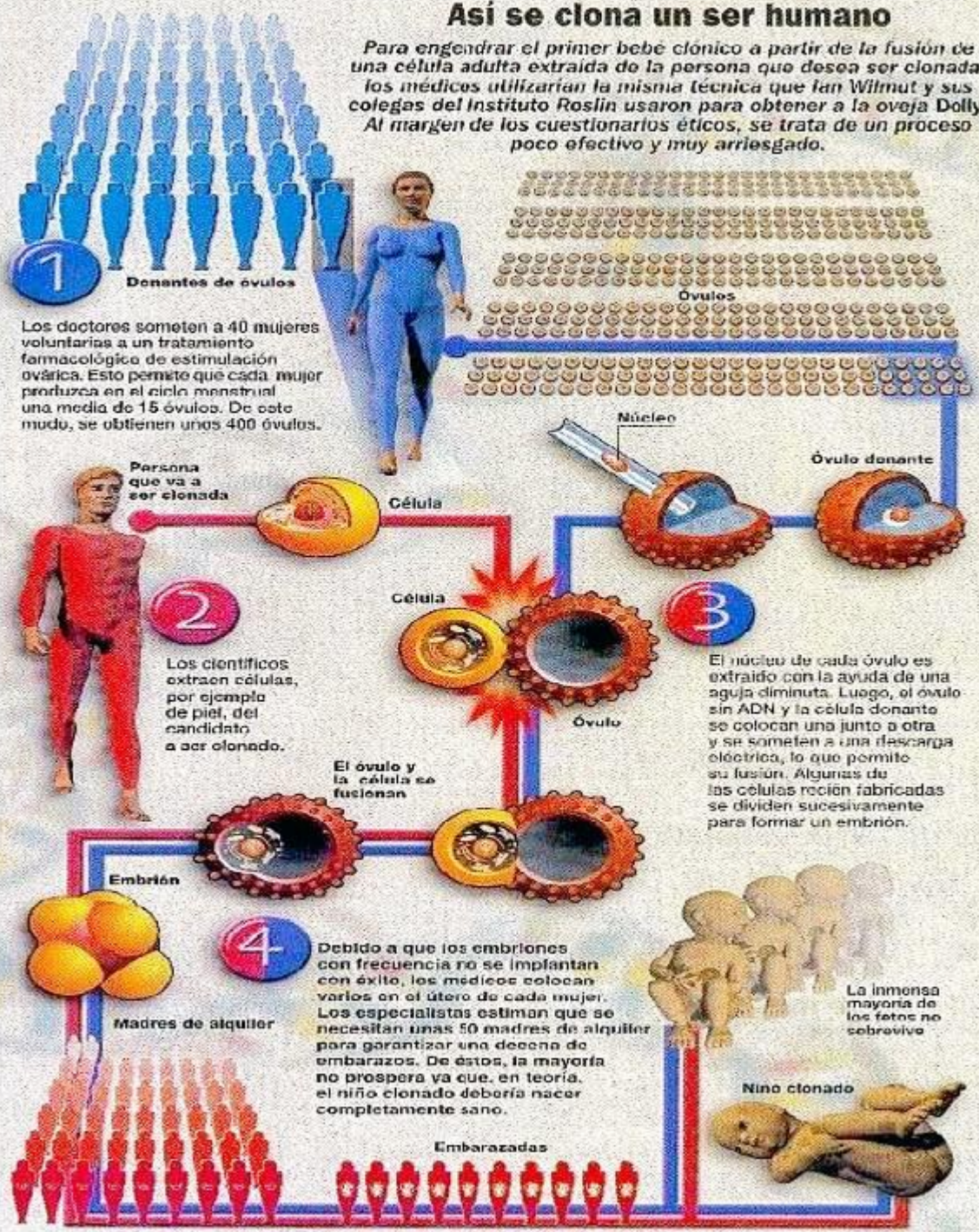
# Clonación reproductiva en humanos?





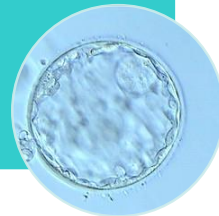
### Así se clona un ser humano

Para engendrar el primer bebé clónico a partir de la fusión de una célula adulta extraída de la persona que desea ser clonada, los médicos utilizarían la misma técnica que Ian Wilmut y sus colegas del Instituto Roslin usaron para obtener a la oveja Dolly. Al margen de los cuestionarios éticos, se trata de un proceso poco efectivo y muy arriesgado.



- Robert Lanza et al.
- Empresa ACT
- Primer embrión humano clonado por transferencia nuclear
- No superó el estado blástula

2001



- Dr. Davos en USA
- Dr. Antinori en Italia
- No se conoce el primer bebé producto de transferencia nuclear

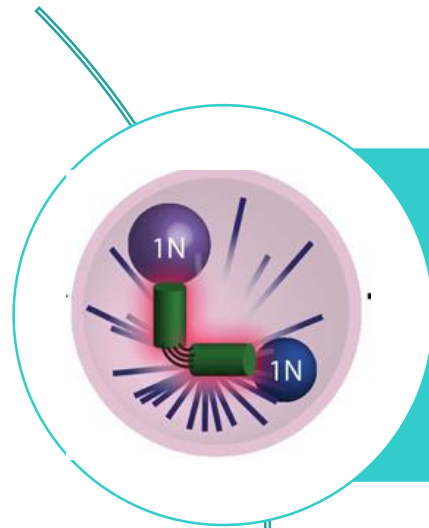
2000's



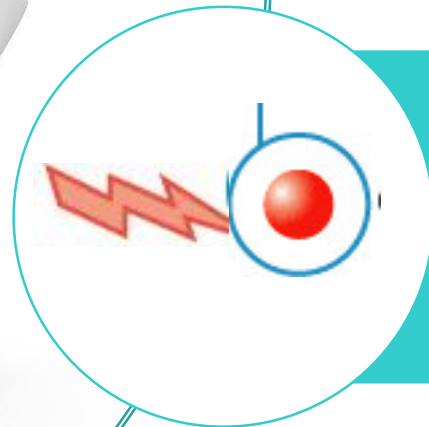
- Clonaid, compañía de la secta Rael
- Clonar mesías muerto prematuramente
- Publicitaron el nacimiento de Eva
- Nadie ha visto a Eva ni se ha probado que sea un clon

2002





Proteínas del huso muy cerca al núcleo → Se elimina al enuclear el ovocito, no hay segmentación



Deben usarse colorantes y UV que dañan el ovocito



Ha sido prohibida por acuerdos internacionales

Alta incidencia de malformaciones y anomalías

Alto número de ovocitos requerido

Los procedimientos para extraer los ovocitos son riesgosos y costosos

Posibilidad de daño genético con la manipulación es alta

¿Cuál es la edad genética del clon?

Problemas éticos y legales

Abuso sobre los niños clonados /  
¿Consecuencias psicológicas?



Para qué

