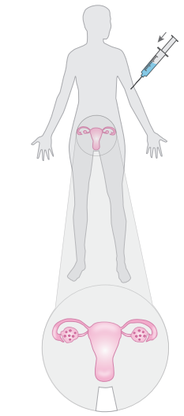
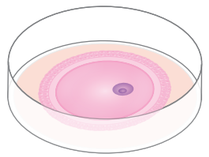
EMBRYO . GENETICALLY MODIFIED EMBRYO . *Parthenote in vitro*



oocyte
cultured

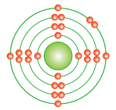


Ca^{++} *ionophore*

OR

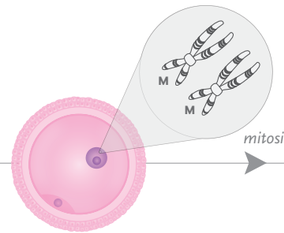
electricial stimulation

OR



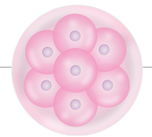
calcium

DNA replication

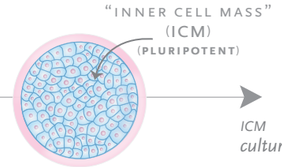


mitosis

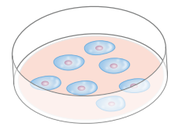
TOTIPOTENT
cells



mitosis

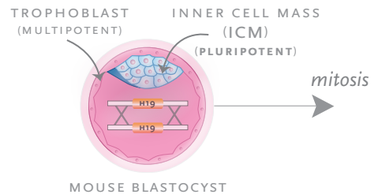


ICM cultured



phESC LINE

HUMAN EMBRYOID BODY



mitosis

MOUSE

MOUSE BLASTOCYST

PLURIPOTENT
cells

OOCYTE PROCUREMENT

For the purposes of stem cell research, oocytes are procured from humans. Hormones are injected into a person with ovaries to mature multiple oocytes (eggs) *in vivo*, which are then surgically removed. This process poses a risk of ovarian hyperstimulation syndrome (OHSS), with symptoms ranging from mild to severe and in rare cases can result in death. Long-term health consequences are unknown.

GENOME DUPLICATION & MITOTIC ACTIVATION

To artificially induce parthenogenesis, mature oocytes are exposed to agents that mimic the calcium gradient waves that accompany sperm entry during fertilization. The electrical gradient triggers duplication of the maternal genome and mitosis. Although the parthenote has two sets of DNA, both are maternally imprinted. Therefore, paternal genes that would be inactivated in a zygote are turned on, or activated in a parthenote, altering gene expression levels. The parthenote is cultured in a Petri dish with growth factors and placed in an incubator that mimics the uterine environment.

LIZARD

PARTHENOGENESIS: ***Parthenogenesis is a form of asexual reproduction*** *resulting in an embryo from an unfertilized oocyte. This type of reproduction occurs in nature in some species. Parthenogenesis can be induced artificially in a few species, resulting in organisms that contain only maternal genomic information and thus, referred to as "half clones."*

BLASTOMERES
day 3
8 cells

Clonal Cell Division: In response to cell culture conditions, the parthenote undergoes mitotic cell division.

Mouse Blastocyst: In 2004, Kuno et al. demonstrated that genetic inactivation of H19, a single gene in the maternal genome of a parthenote, mimics the paternal imprint of H19. By knocking out one maternal H19 gene in the parthenote, the trophoblast forms, resulting in the birth of a mouse.

Embryoid Body: In mammals the paternal genome is essential for the formation of trophoblast. Thus, a parthenote with only a maternally imprinted genome does not form a blastocyst and, rather, forms an embryoid body (EB), unable to implant into the uterine lining.

Parthenogenetic Stem Cell Lines: In 2004, South Korean scientist Woo-Suk Hwang claimed to have cloned human blastocysts for stem cell research. George Daley, another stem cell scientist, revealed that although much of Hwang's work was falsified, he had successfully procured parthenogenetic human embryonic stem cells (phESCs). In 2007, Elena Revazova's team created phESCs to produce commercially available stem cell lines for transplant therapy, as the "half clones" would result in reduced immune rejection due to less genetic diversity.

STEM CELLS ACROSS THE CURRICULUM . www.stemcellscurriculum.org
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