

**Assisted  
Reproductive  
Technologies  
(ART)**

**PresentedBy:**

**Manali Baghel**

**Ph.D Biotech 1<sup>st</sup> Sem**

# What is ART?

➤ The use of medical techniques, such as drug therapy, artificial insemination, or in vitro fertilization, to enhance fertility.

➤ Or

➤ ART procedures include fertility treatment in which both eggs and sperms are handled in the laboratory.

➤ Or

➤ Any procedure where the **gamete** is manipulated or removed from the body and returned either as an **oocyte** or as an **embryo**.

## Why ART?

- Couple who does not use any contraceptive, but can not conceive within 2~3 years are considered infertile, they require ART.
- A large percentage of couples face difficulties in getting pregnant, many have found success with Assisted Reproductive Technology (ART).
- ART involves a number of different procedures to help address fertility problems and increase the likelihood of pregnancy.

# Infertility

- Inability of a couple to achieve pregnancy (conception) after 12 months of unprotected regular sexual intercourse.

| Male Infertility  | Female Infertility   |
|---|--|
| 1.Oligospermia –<br>low sperm count                       | 1.Irregular ovulation-<br>Hormone imbalance<br>Absent ovaries or tubes                   |
| 2.Poor sperm quality-<br>Motility<br>Shape Abnormality    | 2. Physical blockage<br>Fibroids or Endometriosis<br>Blocked/abnormal Fallopian<br>tubes |
| 3.Antibodies against own<br>sperm—<br>Autoimmune disorder | 3. Vaginal secretions<br><br>Hormones or certain diseases                                |

## History

- First successful IVF births in 1959 in rabbits by a chinese scientist.
- The first human IVF pregnancy was achieved in Australia in 1973, but resulted in an early miscarriage.
- On July 25, 1978, Louise Brown, the first IVF baby was born in Oldham, England.
- First legislation to regulate IVF & its associated human research – The Government of Victoria, 1984.
- First surrogacy embryo transfer baby born in California- 1984.

- First pregnancy after ICSI-1992.
- Baby Hannah was 1<sup>st</sup> baby born via denoted embryos-1998.
- First birth using cryopreserved oocytes and frozen sperm-2000.
- **Samrupa**, the world's first Murrah buffalo calf cloned was born in february 2009 at **(NDRI) Karnal INDIA**. But died due to lung infection 5 days after she was born.

# Assisted Reproductive Technologies (ART)

- Timed Intercourse
- Artificial Insemination
  - Intracervical insemination (ICI)
  - Intrauterine insemination (IUI)
  - Intrauterine insemination (ITI)
  - Intraperitoneal insemination (IPI)
- In vitro fertilization (IVF) & Embryo Transfer (ET)
  - Gamete Intrafallopian Transfer (GIFT)
  - Zygote Intrafallopian Transfer (ZIFT)
  - Intra cytoplasmic Sperm Injection (ICSI)
- Somatic cell nuclear transfer (SCNT)
- Parthenogenesis

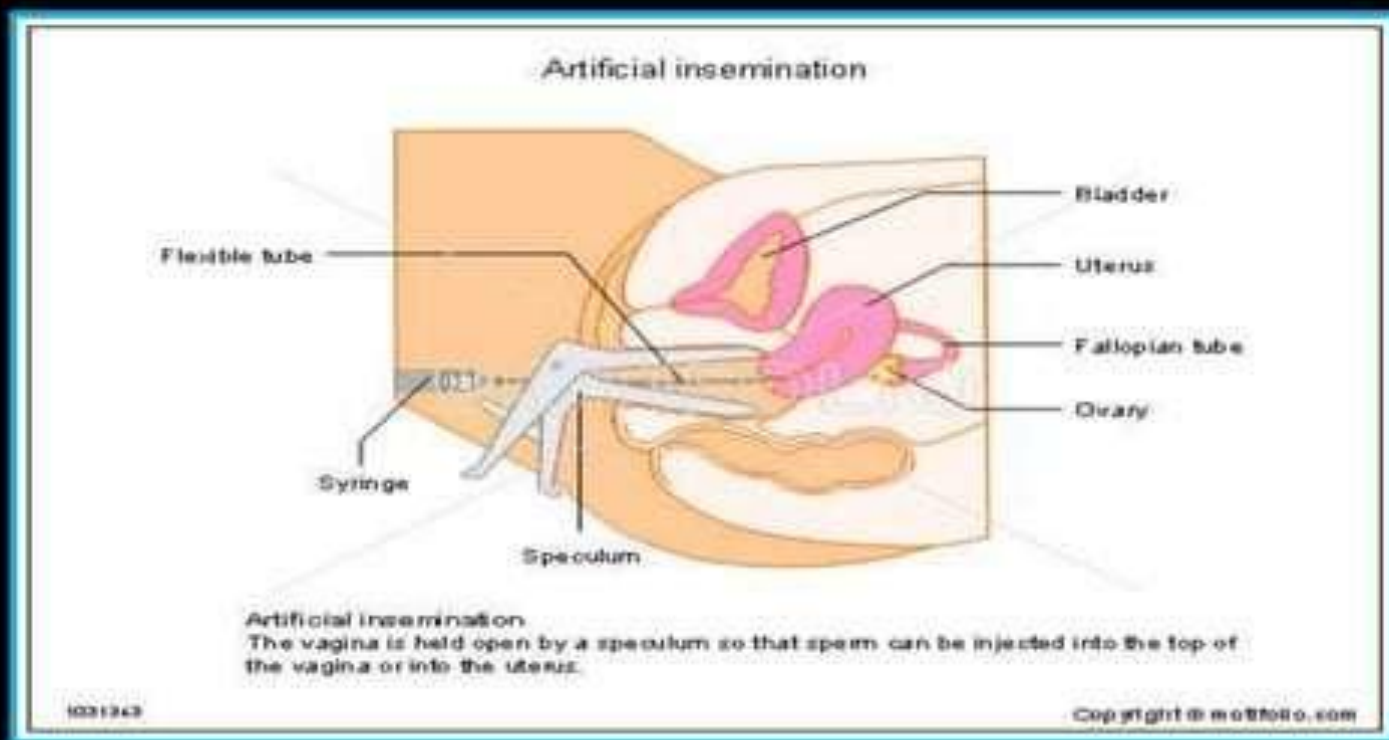
## Timed Intercourse

- Medications are administered to promote ovulation.
- Treatment monitored by ultrasound scanning to determine the precise timing of the egg release.
- The couples are then advised on the best timing of intercourse.



# Artificial Insemination(AI)

- Process by which sperms are placed into the reproductive tract of a female for the purpose of impregnating her by using means other than sexual intercourse.



# Artificial Insemination

- **Intracervical insemination (ICI)-**  
Unwashed' or raw semen may be used & semen is injected high into the cervix with a needle-less syringe.
- **Intrauterine insemination (IUI)-**  
Washed sperm' can be injected directly into a woman's uterus
- **Intratubal insemination (ITI)-**  
Semen is injected in intrafollapian tube. No beneficial effect compared with IUI.
- **Intraperitoneal insemination (IPI)-**  
Prepared semen is injected into Douglas pouch.

## Problems with AI

- Ovulation must be induced or synchronized by exogenous gonadotropins which frequently do not work.
- Gross female anatomical differences, i.e two uteri in marsupials, complex cervix in oryx, rhinoceros, others.
- Actual site of semen deposition frequently not known, usually transabdominally by laparoscope (invasive surgery).

# IVF & ET

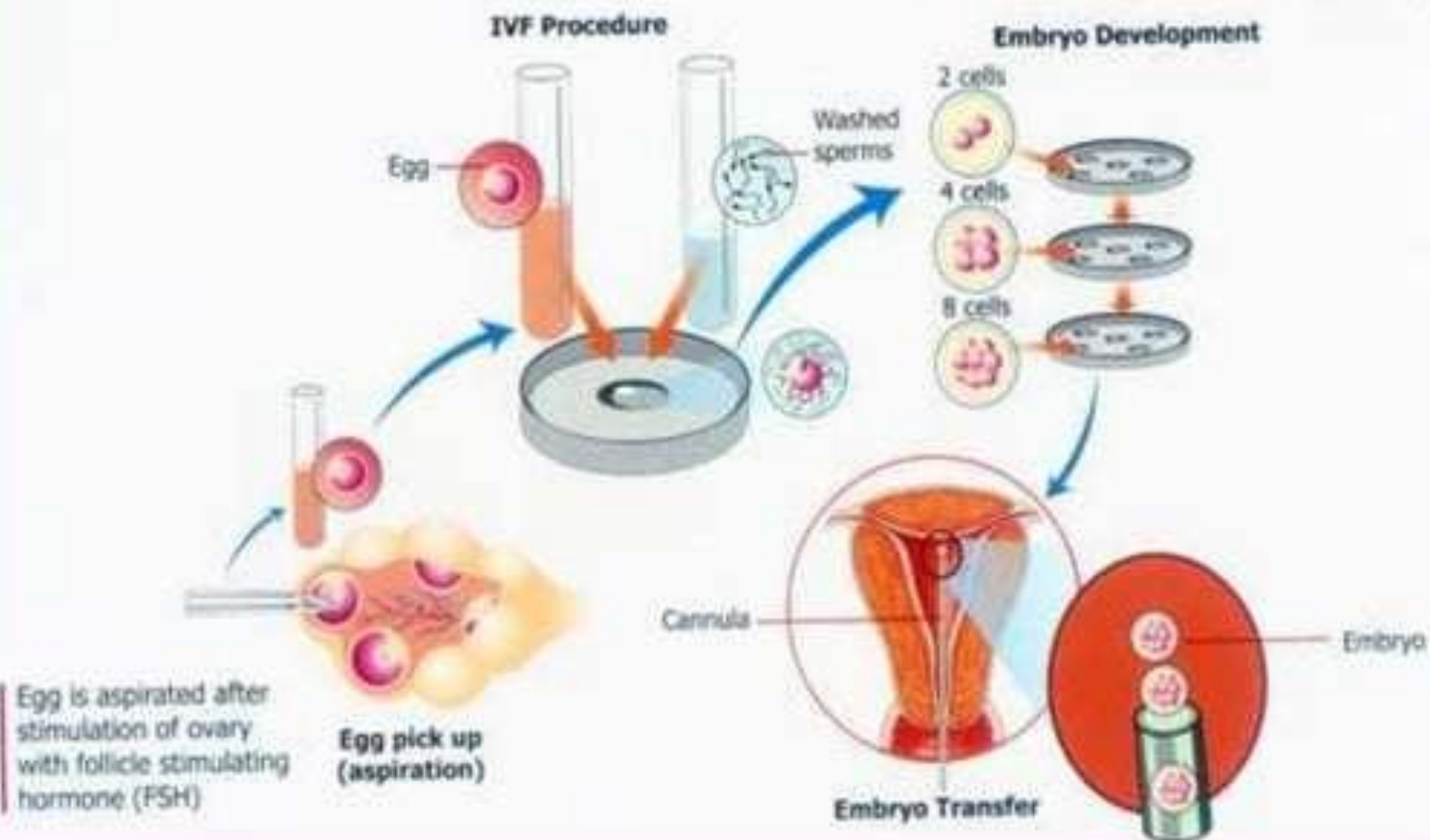
➤ IVF is a method in which egg cells are fertilized by sperm cells outside the mother's womb (in vitro). The resulting embryos are then transferred back into the uterus.

## Steps in IVF-

- Follicle suppression
- Controlled ovarian hyperstimulation
- Aspiration of eggs from follicles
- Fertilization
- Incubation and selection of embryos
- Embryo transfer
- Pregnancy test

# IVF & ET

## In Vitro Fertilization (IVF)



# Gamete Intrafallopian Transfer (GIFT)

- The oocytes will be harvested after ovarian stimulation, mixed with the prepared sperms suspension, and placed back into the woman's Fallopian tubes during a single laparoscopy.
- More simple, physiological & cheap than IVF.
- Results not better than IVF.

# Zygote Intrafallopian Transfer (ZIFT)

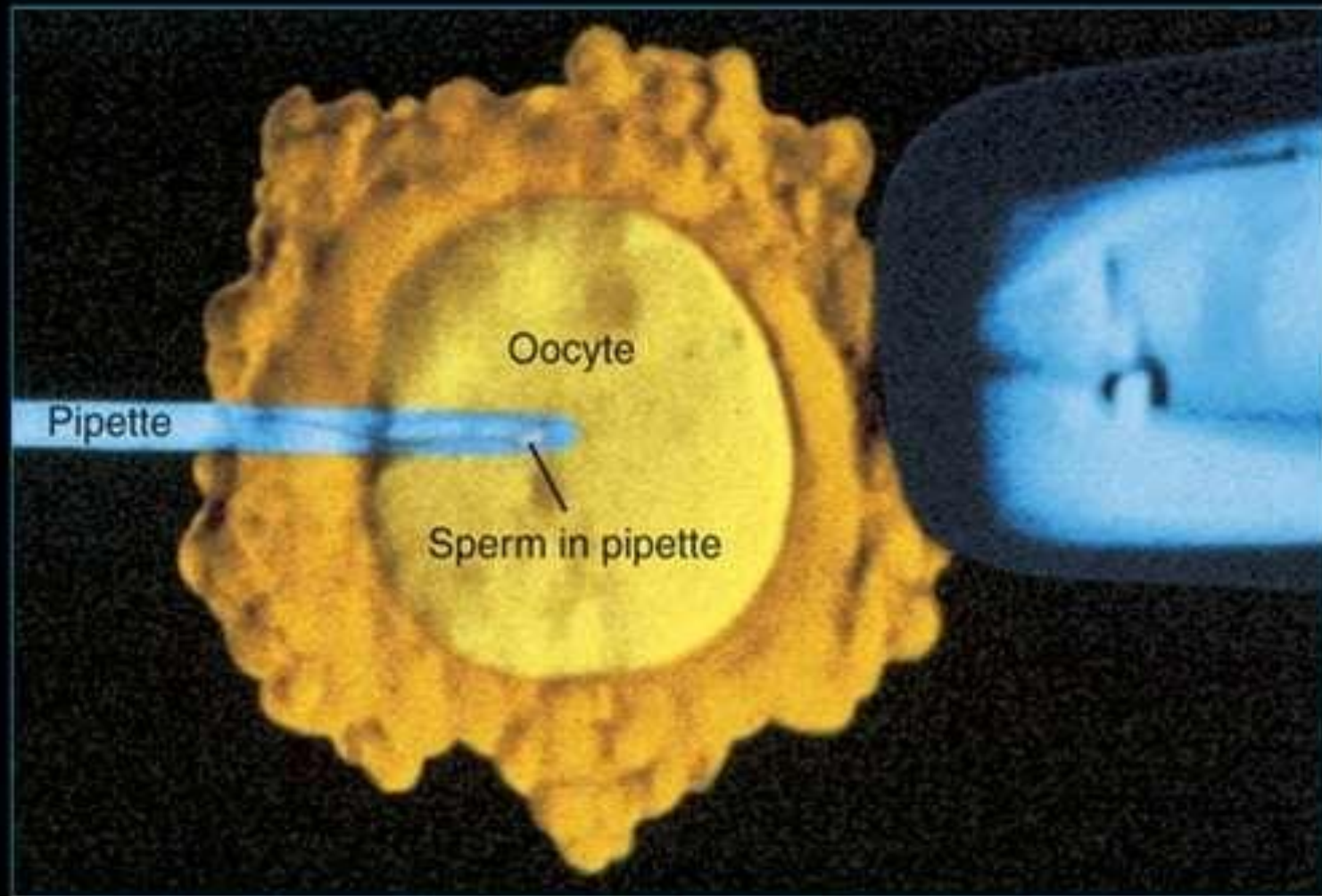
- The oocytes will be harvested after ovarian stimulation by transvaginal ultrasound-guided ovum retrieval. Co- incubation with prepared semen & after fertilization in the laboratory the resulting early embryos or zygotes are placed into the fallopian tubes using a laparoscope.
- However, the need for two interventions and the fact that IVF results are equal or better leaves few if any indications for this intervention.

# ICSI

- **Intracytoplasmic Sperm Injection(ICSI)** is an in vitro fertilization procedure in which a single sperm is injected directly into an oocyte or egg.
- This procedure is used to overcome male infertility.
- In ICSI, using micromanipulation technologies (micropipettes), the specialist draws a single sperm into a needle and inject it directly into an egg that has been collected from the female through the usual retrieval methods & fertilization takes place.
- The fertilized eggs are then left to culture for a few days before being transferred back to the woman's uterus.
- ICSI is always used alongside IVF.



# ICSI



# Species in which IVF Has Been Accomplished (Bavister, 1982)

| Species            | Fertilization in Vitro | Cleavage in vitro | Birth of Young after ET |
|--------------------|------------------------|-------------------|-------------------------|
| Mouse, rat, rabbit | +                      | +                 | +                       |
| Human              | +                      | +                 | +                       |
| Cat                | +                      | +/-               | -                       |
| Hamster            | +                      | -                 | -                       |
| Guinea pig, dog    | +                      | -                 | -                       |
| Nonhuman primates  | +/-                    | +/-               | -                       |
| Cow, pig           | +/-                    | -                 | -                       |
| Sheep, horse       | -                      | -                 | -                       |

# Complications of IVF

## ➤ Multiple Pregnancies

- 1 in 5 IVF pregnancies are multiple if transferring 3 embryos or less.
- Transferring more than 3 embryos results in multiple pregnancies in about 40% of IVF babies.

## ➤ Ovarian hyperstimulation syndrome(OHSS)

Excess response to ovarian stimulants can lead to ovarian enlargement, abdominal distension and pains in up to 7% of IVF patients.

## ➤ Pelvic Infection-serious infection is rare in IVF.

## ➤ Haemorrhage-can occur during egg collection.

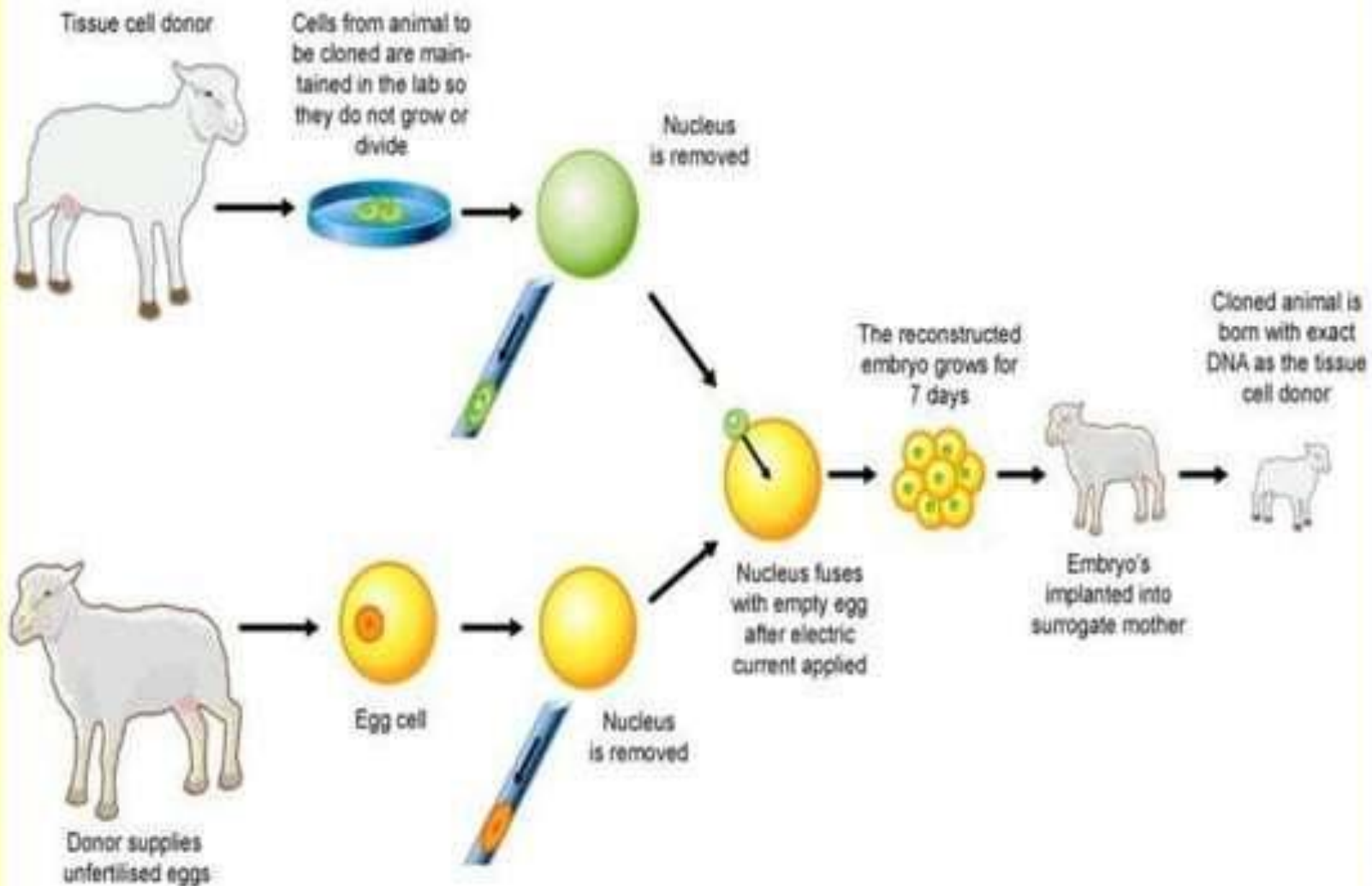
## ➤ Spontaneous Abortion

## ➤ Intrauterine Growth Restriction

# Somatic Cell Nuclear Transfer(SCNT)

- A technique in which the nucleus of a somatic (body) cell is transferred to the cytoplasm of an enucleated egg.
- Has been attempted in:
  - giant panda (Chen, et al. 2002)
  - Argali sheep (White et al. 1999)
  - gaur (Lanza et al. 2000)but these attempts did not result in viable offspring.
- Apparently healthy offspring resulted in transspecies cloning in mouflon sheep (Loi, et al. 2001)

# SCNT



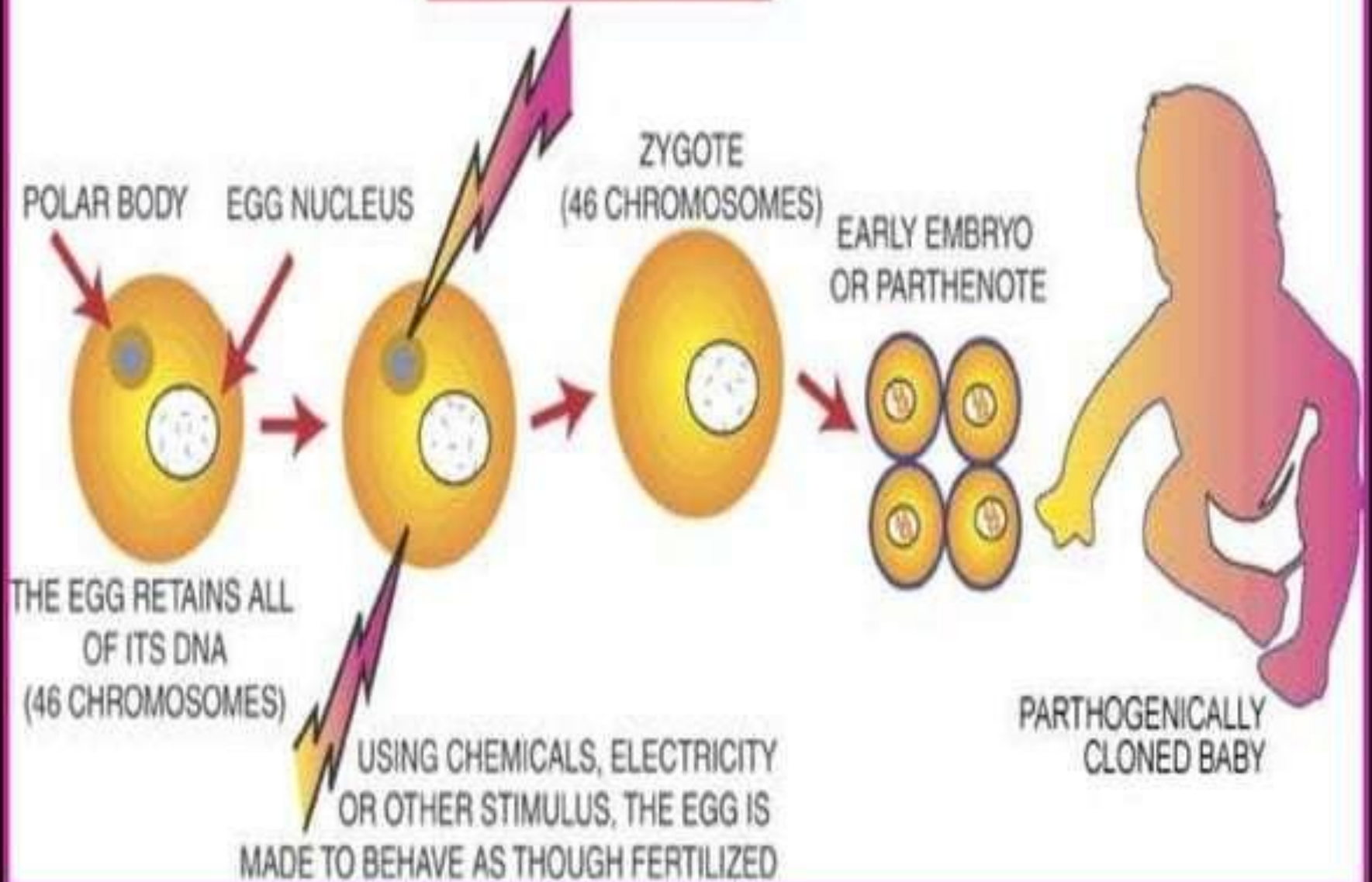
# Applications of SCNT

- The most practical application is in the reproductive cloning of farm animals that have exceptional qualities like abilities to produce large quantities of milk.
- **Dolly** the sheep, born in 1996, was the first mammal cloned using SCNT.
- Stem cells can be extracted 5-6 days later from SCNT derived early embryos.
- Because of SCNT, science could advance to a point where people will have access to life saving therapies developed using their own DNA.

# Parthenogenesis

- Parthenogenesis occurs naturally in aphids, Daphnia, rotifers, nematodes and some other invertebrates but can also be induced efficiently in mammalian oocytes by providing appropriate stimuli *in-vitro*.
- Parthenogenesis is a process in which an embryo is created solely from a female oocyte without any genetic contribution from a male.
- Sometimes referred to as a “virgin birth” & resulting individual is called parthenogen.
- The experimental induction of parthenogenesis in mammals began with the pioneering studies of Pincus and his collaborators in the rabbit.

# PARTHENOGENESIS





# Issues In ART

- Cost effectiveness
- Ethical / moral / legal considerations
- Emotional issues

# Conclusion

- The introduction of these advances has provided not only hope and treatment for the infertile couple but also stimulated continuing research in the field of reproduction.
- Reproductive advances will make more COUPLES happier.

Thank You

