

2 Types of Reproduction

- Asexual
 - Genetically identical offspring
- Sexual
 - Advantage =
 - increases genetic diversity
 - Genetic diversity → stability

2 Types of Cell Division

- Mitosis → new identical cells
- Meiosis → sperm and eggs ($\frac{1}{2}$ DNA)

Draw these in notes

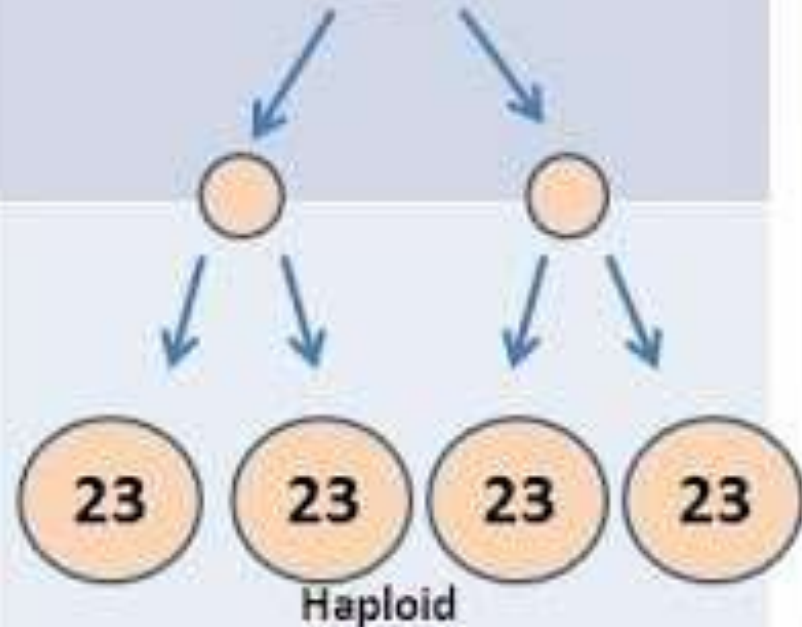
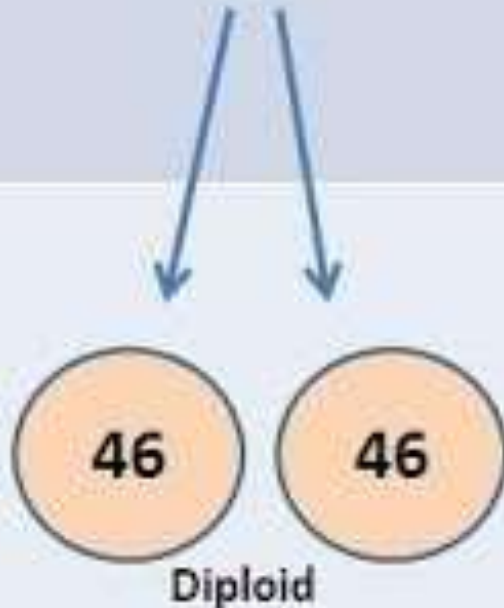
Mitosis

Meiosis

Start

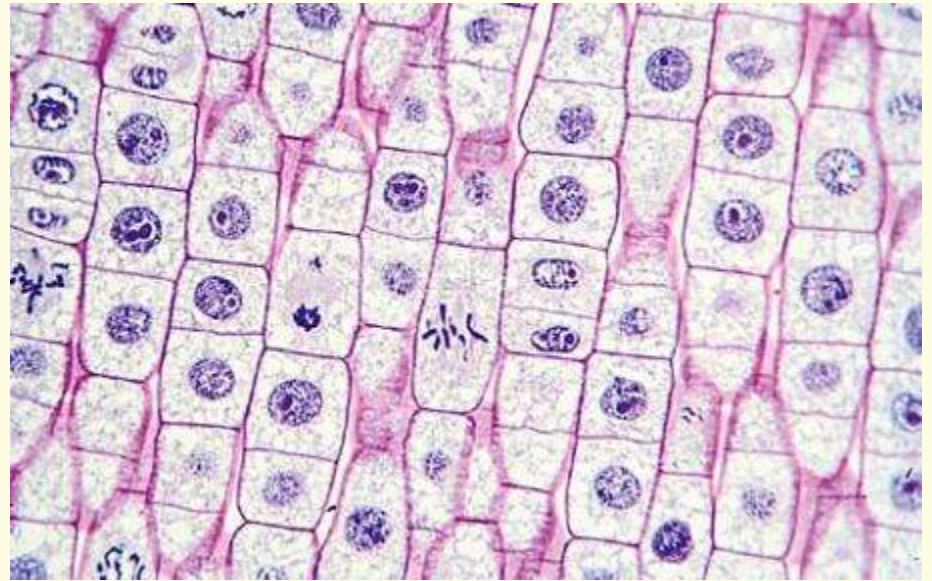
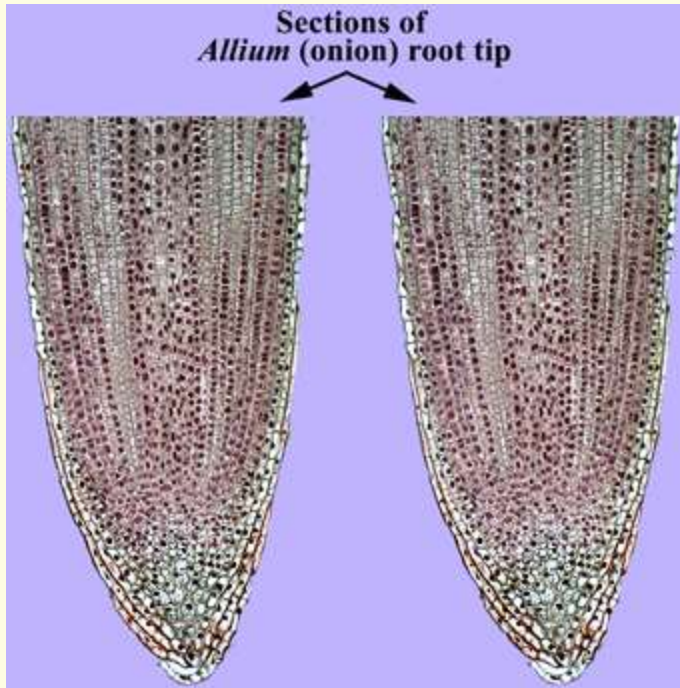


End

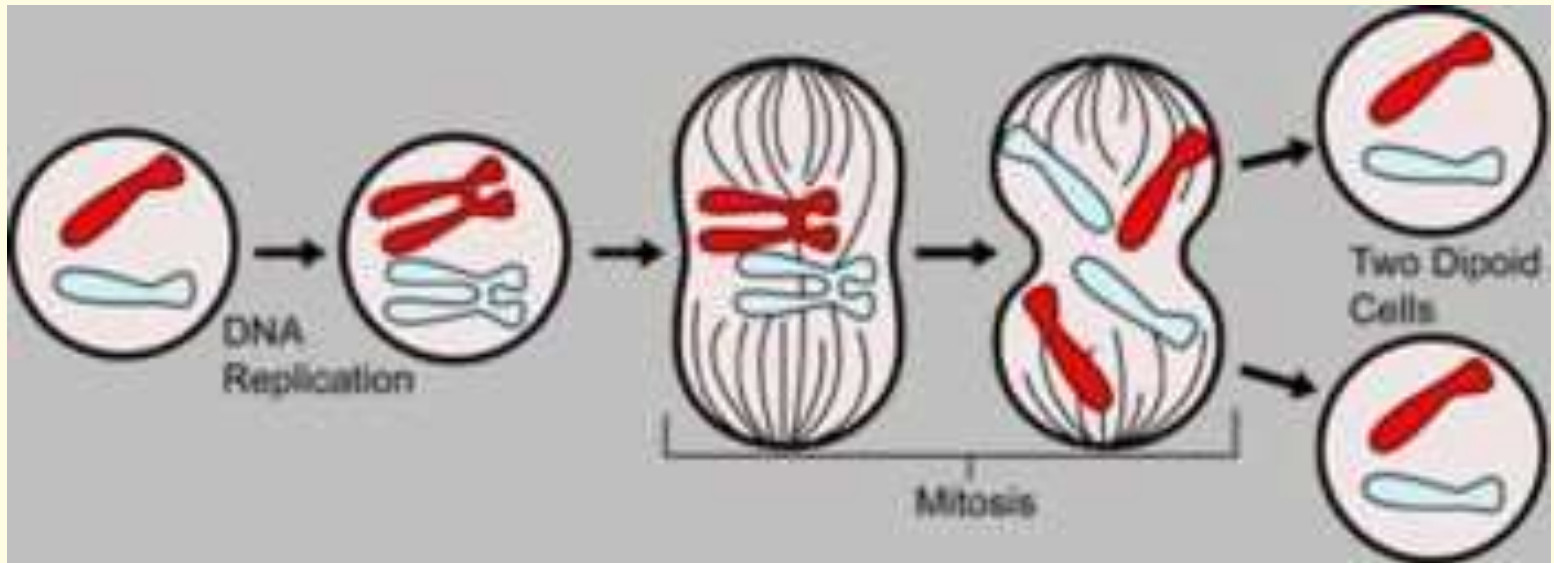


What are the differences
between mitosis and meiosis?

Mitosis

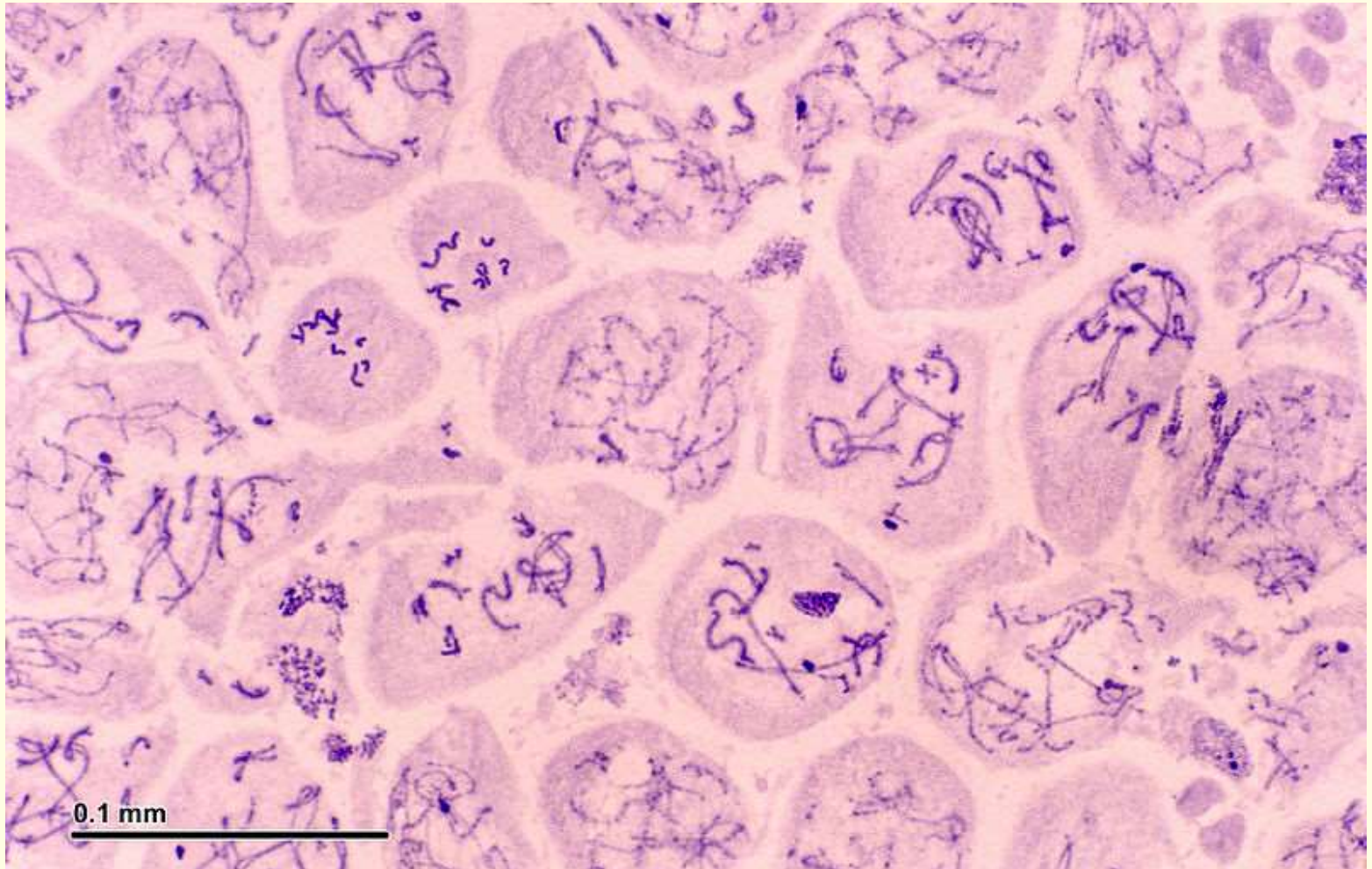


Mitosis

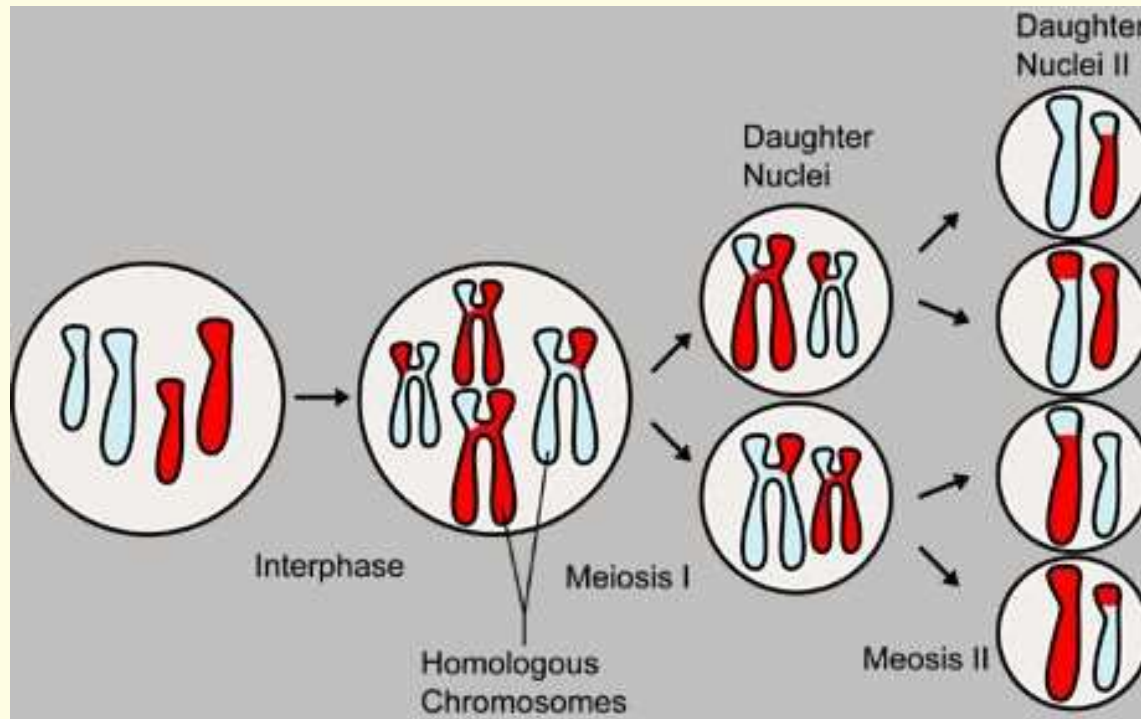


- DNA copies itself (replication)
- New cells have same amount of DNA as parent cell
- Cell splits once
- New cells are genetically identical to parent cell

Meiosis in grasshopper testes



Meiosis



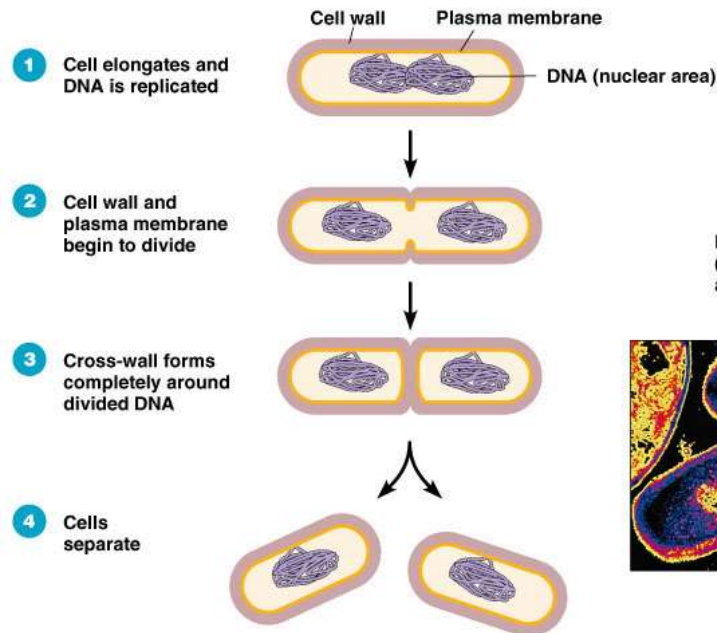
- Replication = DNA copies itself
- New cells have $\frac{1}{2}$ the amount of DNA as parent
- Cell splits 2 times
- Each new cell is genetically different (unique)

Asexual Reproduction

- 1 parent
- Mitosis only
- Offspring = genetically identical to the parent

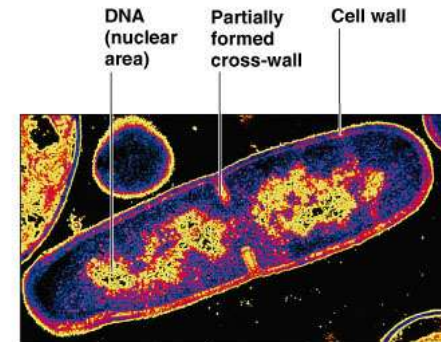
Examples of Asexual Reproduction

- Ex 1: single celled organisms (Bacteria and protists)
- DNA replicates = DNA copies itself
- Cell splits



(a) A diagram of the sequence of cell division.

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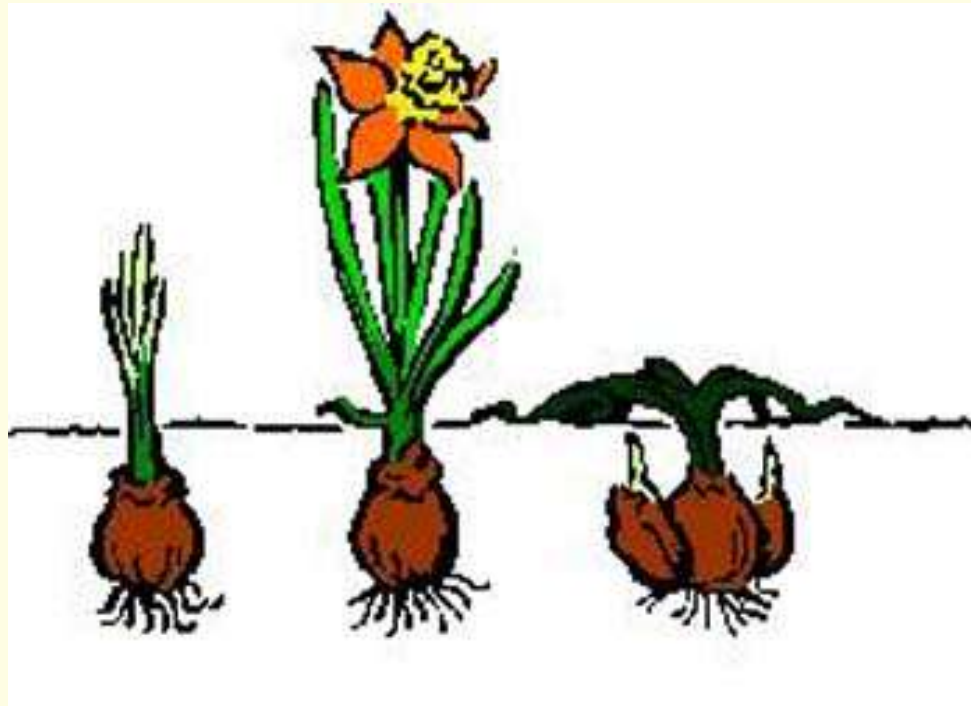


(b) A thin section of a cell of *Bacillus licheniformis* starting to divide.

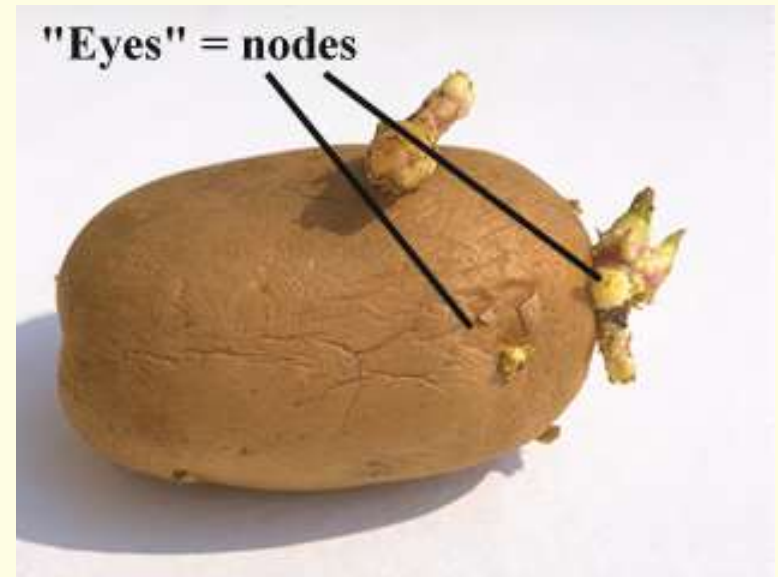
- Ex 2: Asexual in plants = vegetative propagation
- strawberry plants reproduce from runners



- Daffodils and garlic → bulbs → new plants

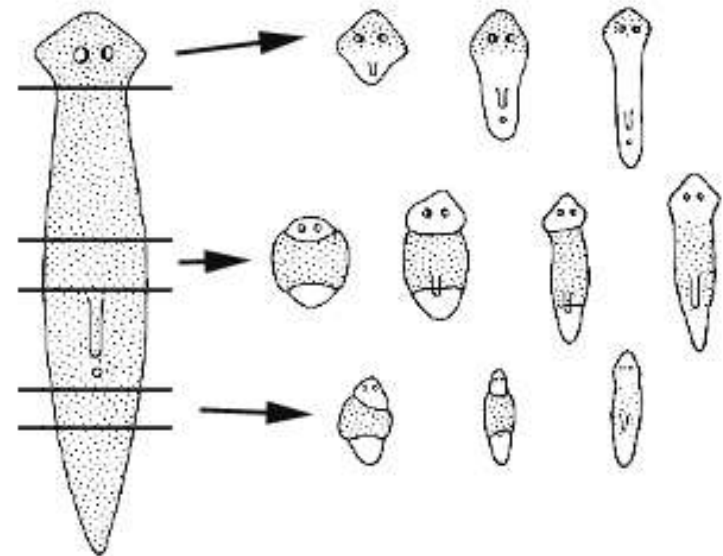


- Each eye on a potato → new plant



Ex 3: Some animals can regenerate asexually

- Ex: Planaria (flatworm) (cut it in half parts can re-grow → new worms)



- Starfish can regenerate



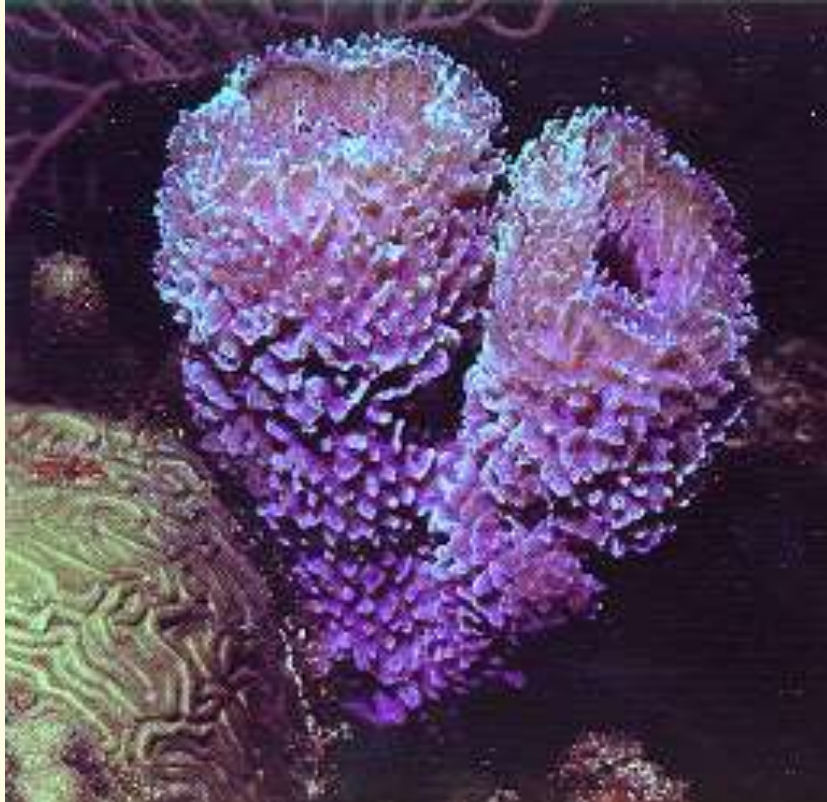
http://www.imagequest3d.com/ImageFolio3_files/gallery/aquatic/echinodermata/asteroidea/tn_RGS00723.jpg

Ex#4: Some animals and fungi reproduce by budding

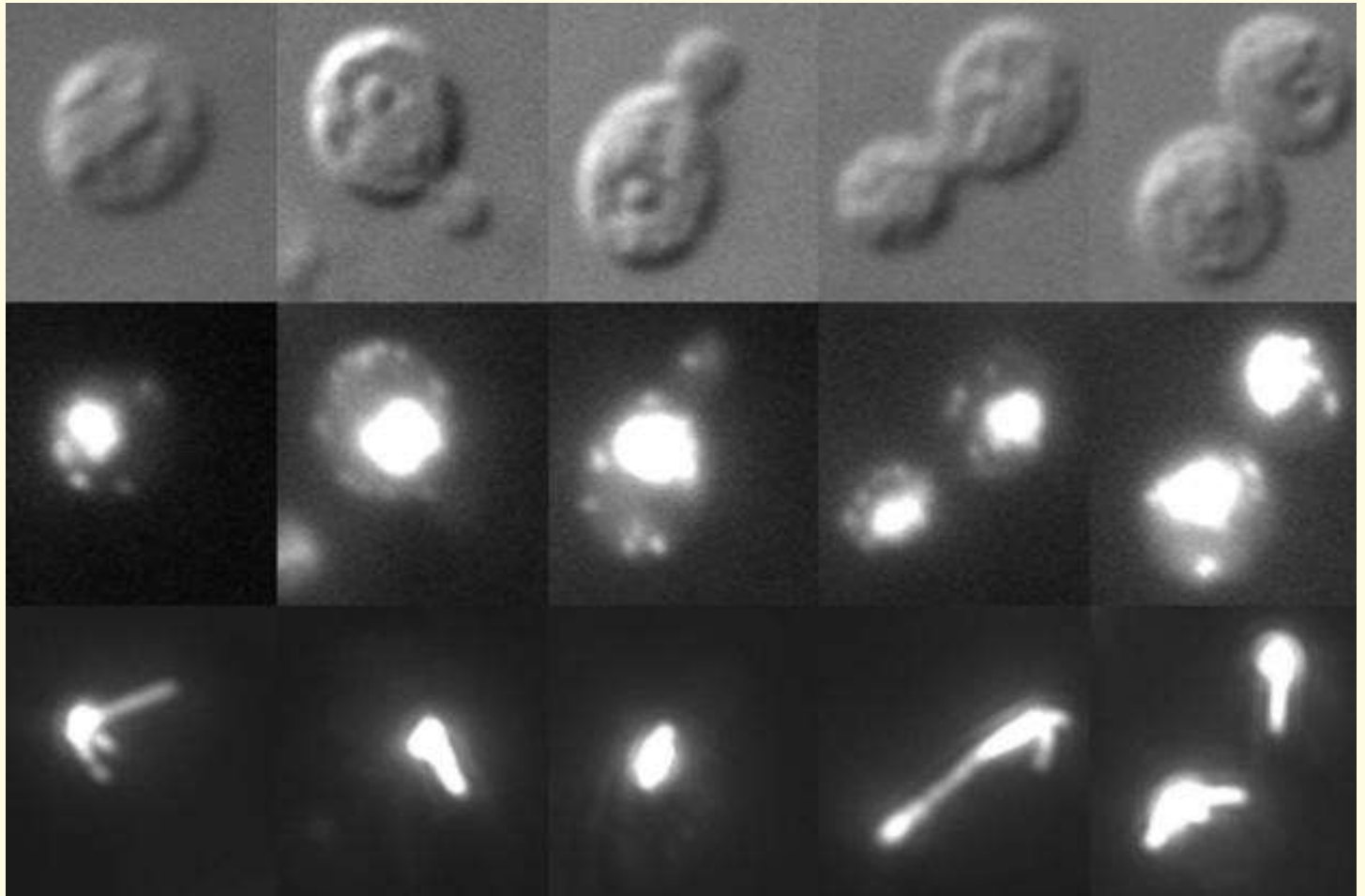


- Budding = new organism grows off the side of the parent
- ex: Hydra

and Sponge (animal)



Yeast is a fungus that reproduces by budding

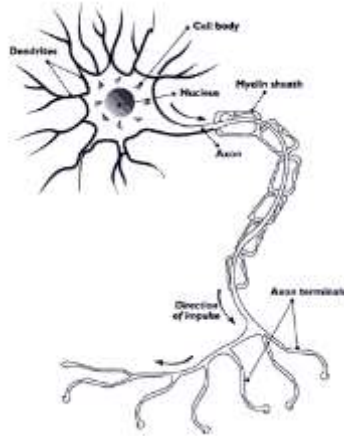


Body cells reproduce

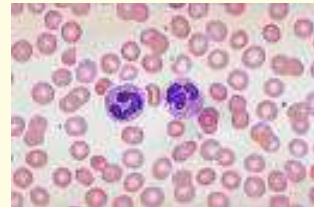
Mitosis → Growth

- How do multi-celled organisms grow
- Describe the DNA of cells in a multi-celled organism

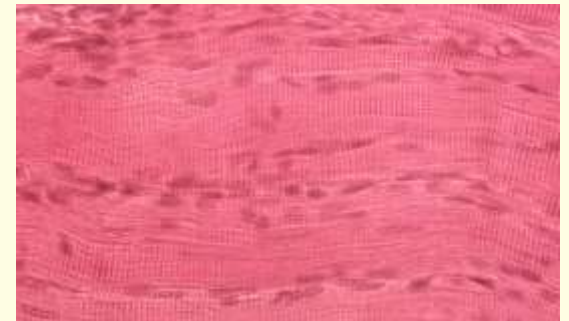
Human cells can look and function differently



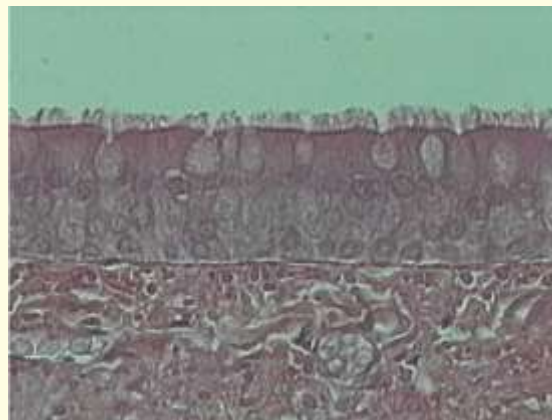
Nerve cell



Blood cells



Muscle cells



Tracheal cells

Human cells can look and function differently even if they have the same DNA

- Body cells = same DNA different shapes and function
- How?
- Environment controls which genes each cell uses

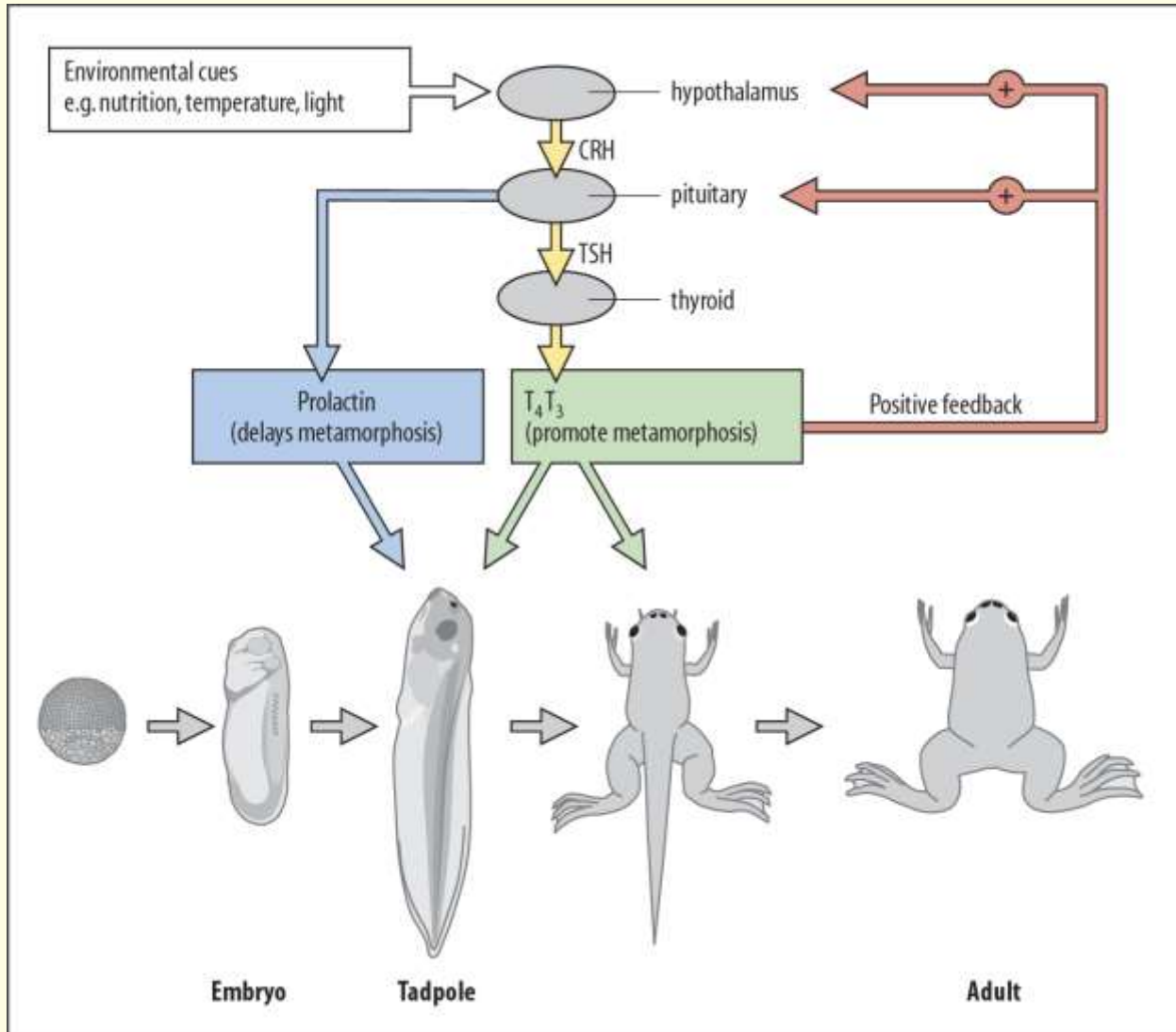
Define Metamorphosis



- Change from one form to another

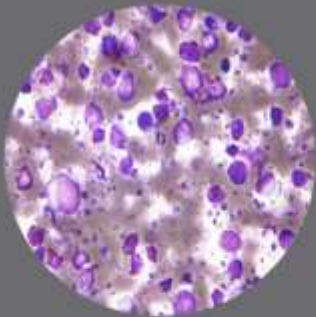
What causes metamorphosis?

- Hormones

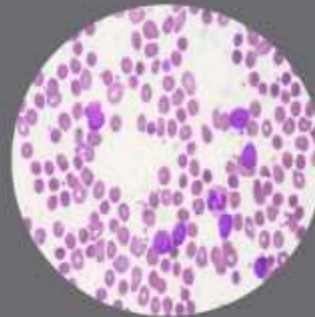


Define cancer

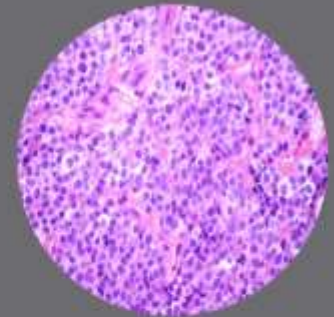
A Sampling of Cancer Cells



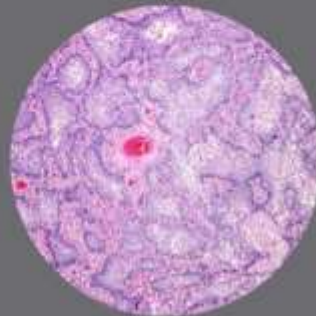
lymphoma



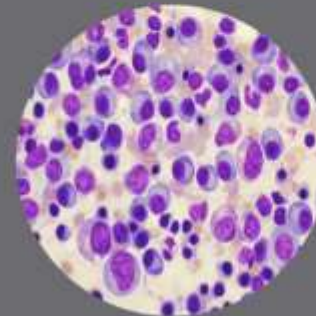
leukemia



ewing sarcoma

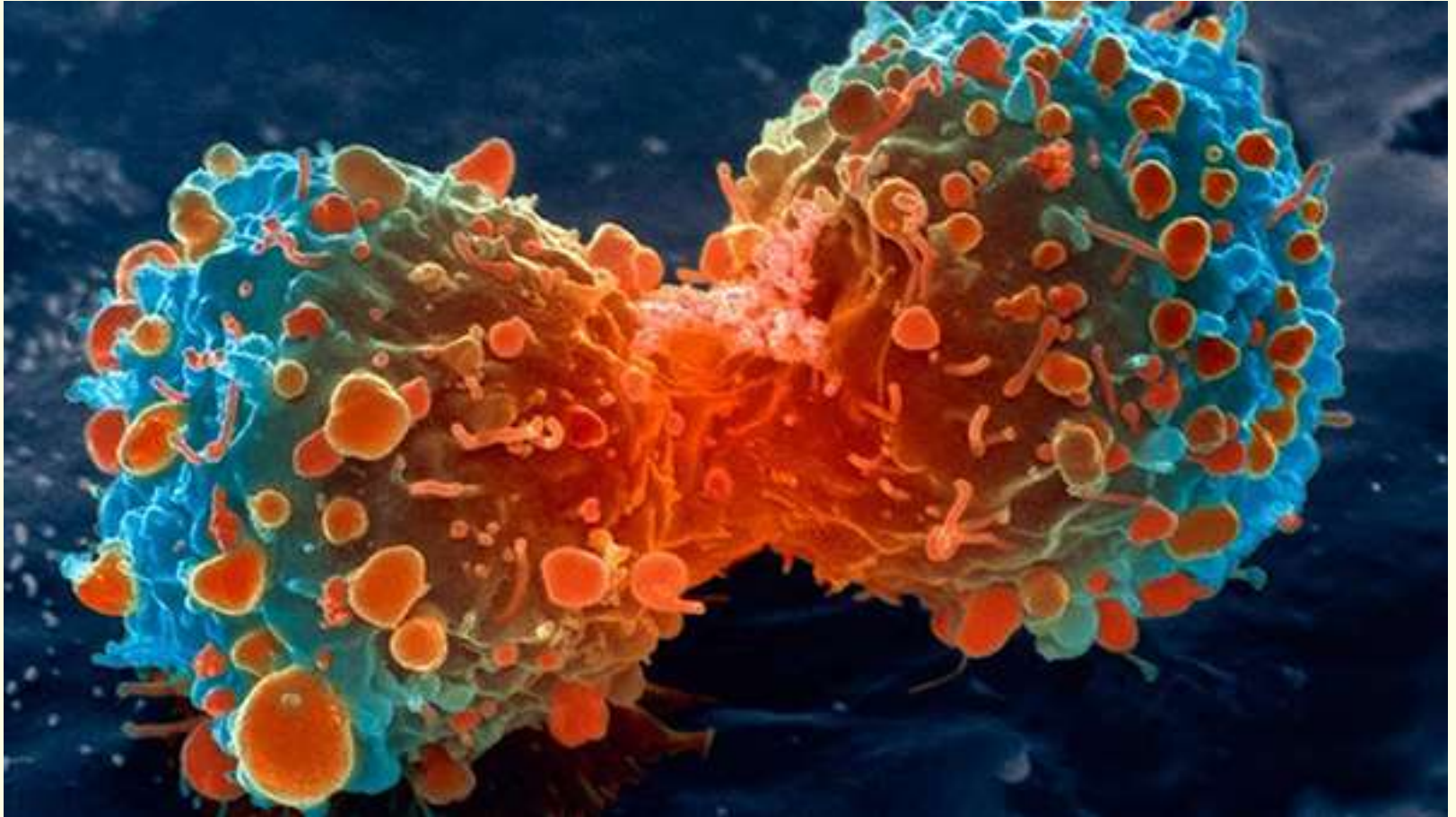


Basaloid squamous
cell carcinoma

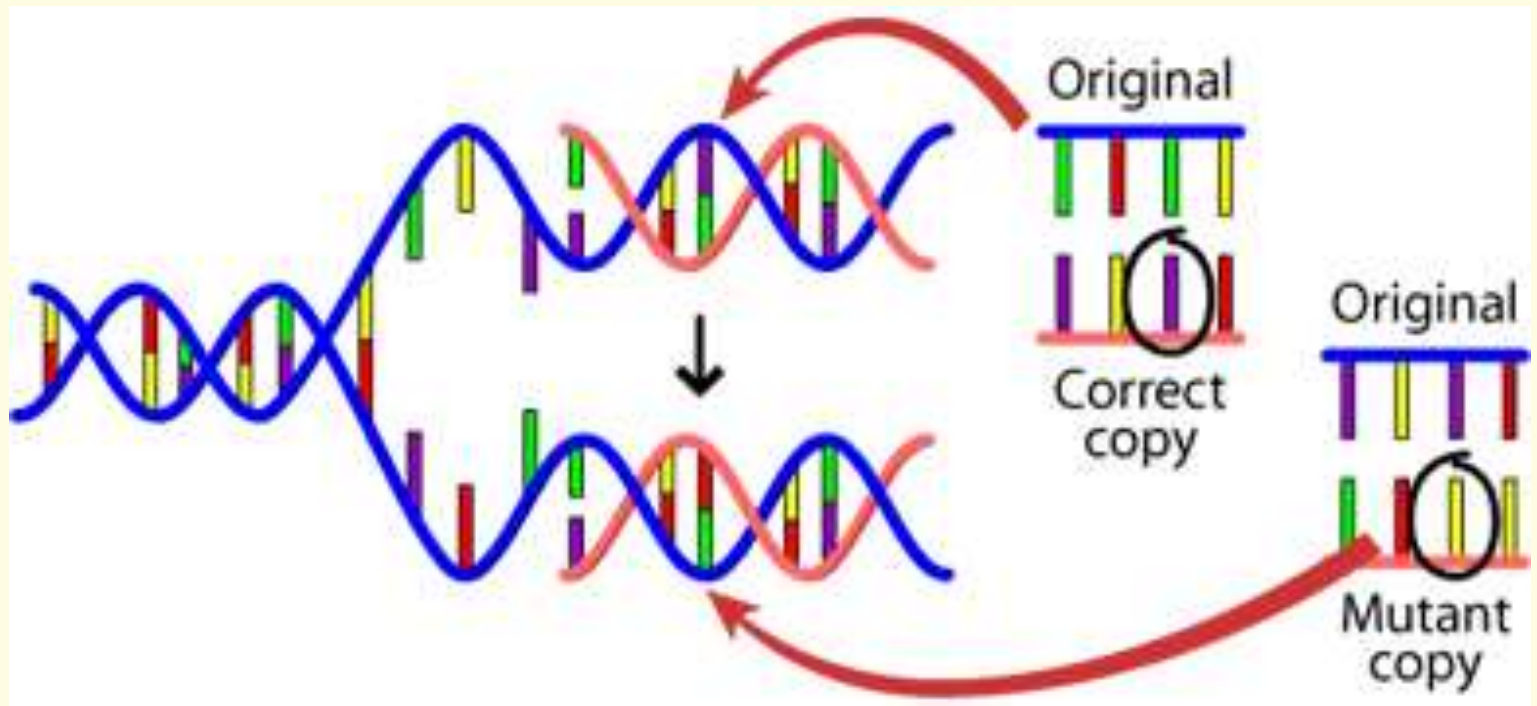


multiple myeloma

Uncontrolled cell division



Caused by a mutation



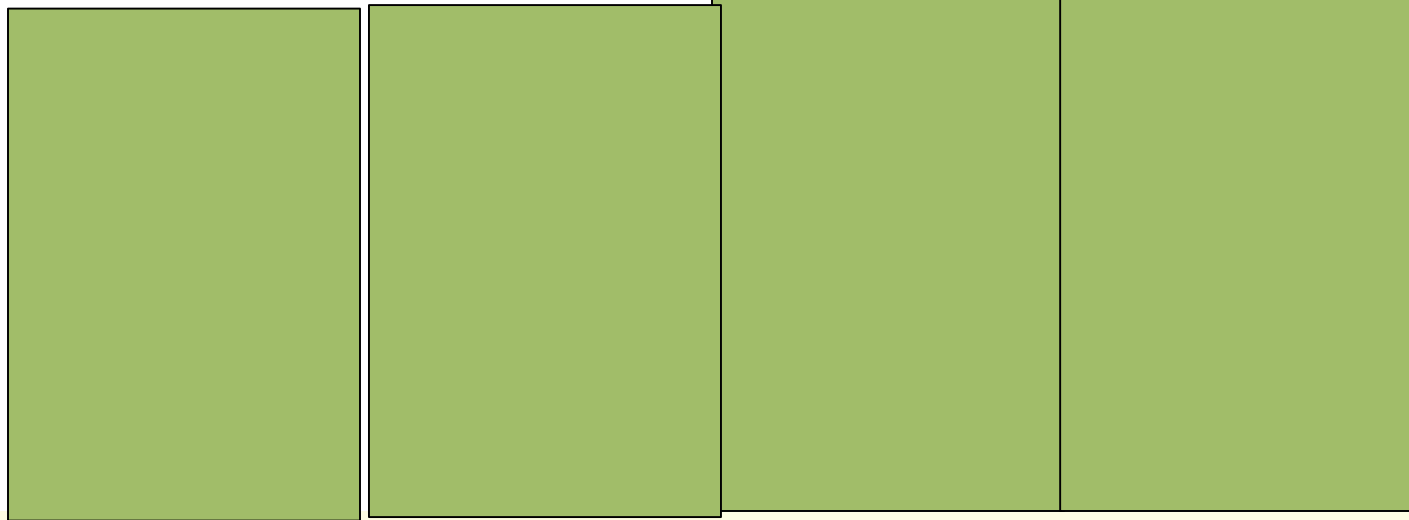
Define mutation

- Any change in DNA

Normal



BEAST

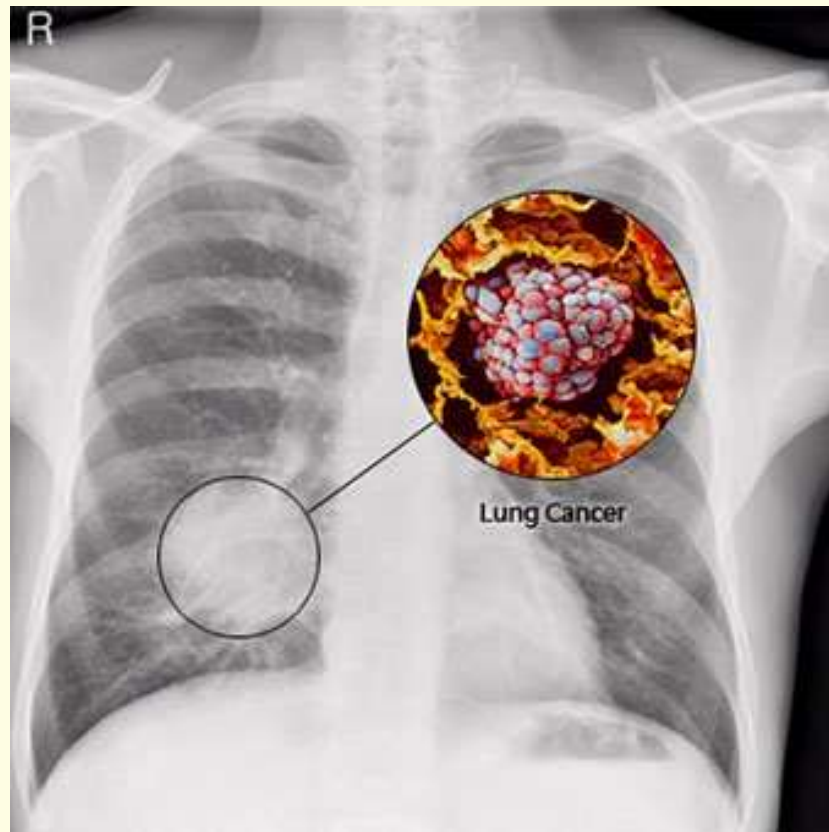


Why do mutations happen?

- Random errors
- Radiation
- Toxic chemicals (ex: cigarettes)

What happens when cancerous cells grow?

- Mass of cells = tumor



2 types of tumors

- Benign tumors stay in place
- Malignant tumors spread

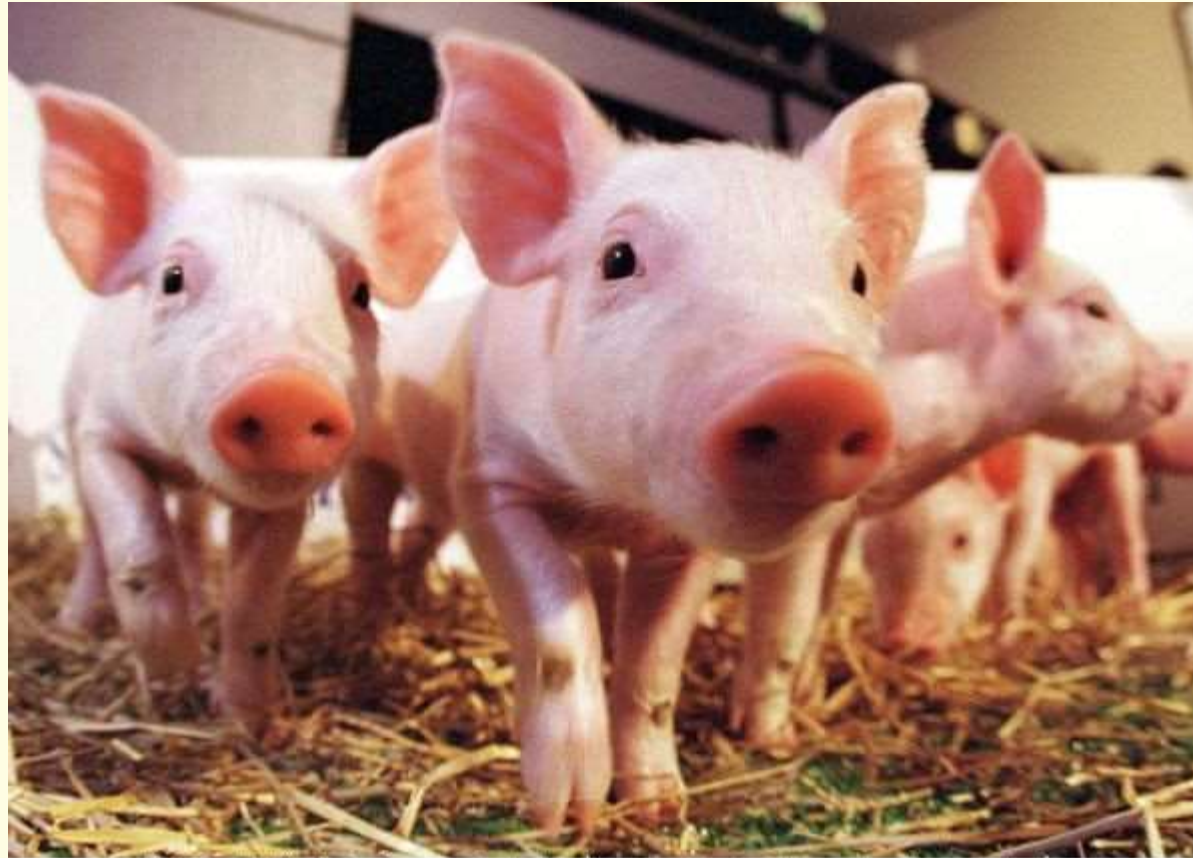
What is a clone?



- Farmers often clone plants
- Pros
- Cons



Animals can be cloned as well



N306079-01: Millie, Christa, Alexis, Carrel and Dotcom, the world's first cloned pigs, are shown in a pen in Blacksburg, Virginia, March 15, 2000. Britain's PPL Therapeutics announced that the pigs, born on March 5, 2000, were cloned from adult pig cells. PPL Therapeutics is the same company that gave the world Dolly the sheep. (Photo by Michael Smith)



Dolly The Sheep



Dolly was the first mammal cloned from an adult cell.

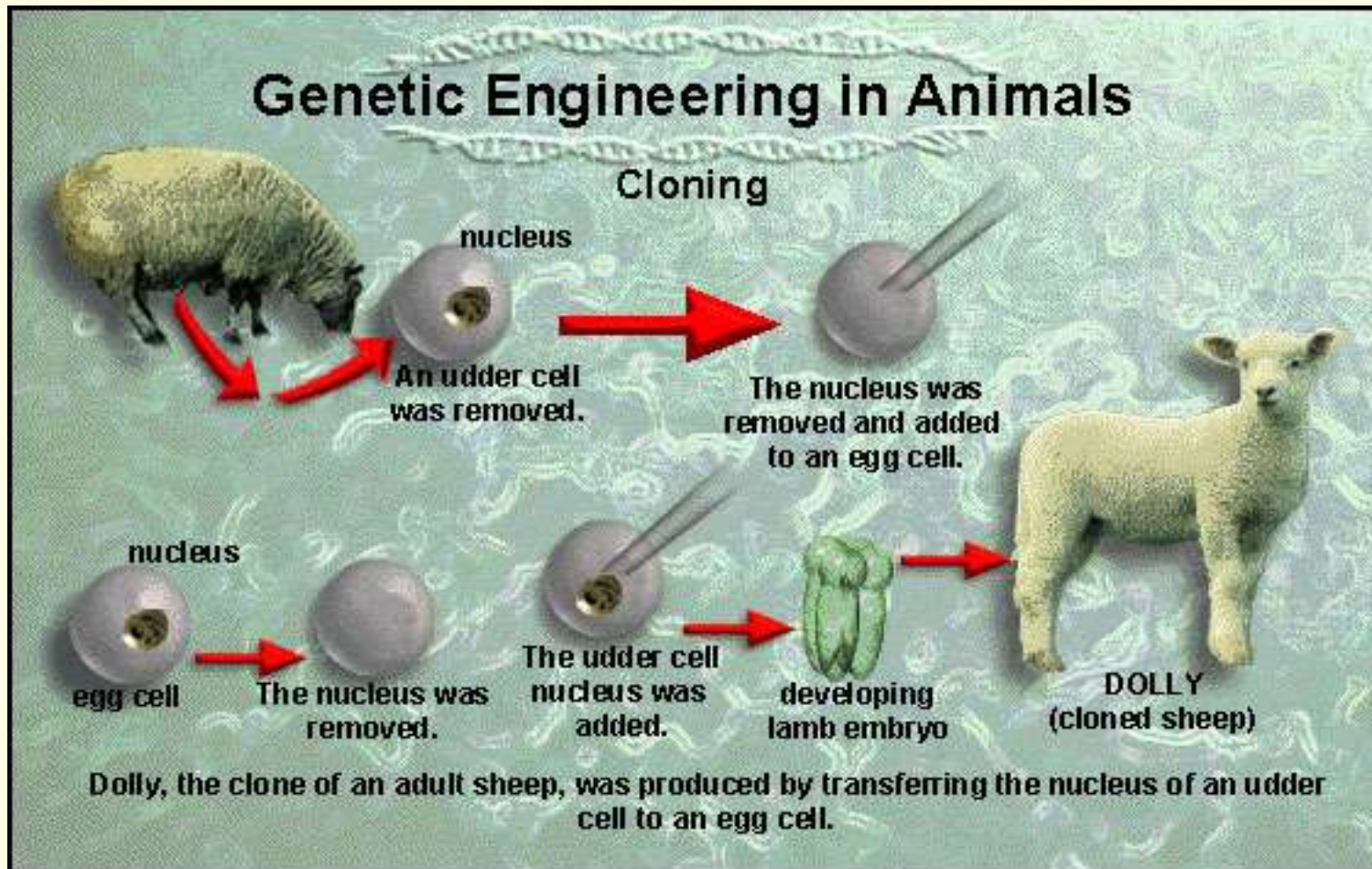
She was born in 1996 and died in 2003.

She was 6 when she died, about half the usual age for a sheep

Recently cloned animals



Describe the technique used to make cloned animals



Cloning animals

- Techniques used to make identical offspring
- Take nucleus out of an egg
- Insert DNA from a body cell of organism to be cloned
- Mitosis only → new organism = genetically identical to the nucleus inserted

Can Cloning bring back extinct species

Case study: the [Gastric Breeding Frog](#)



Darwin's frog

- Do cloning questions in notes

Practice regents questions

Problems with cloned crops

- 1) No genetic variation = no adaptation

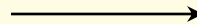


No adaptations + change in environment →



- Ex: virus infects a plant in a field
 - no variation → all die

Virus →

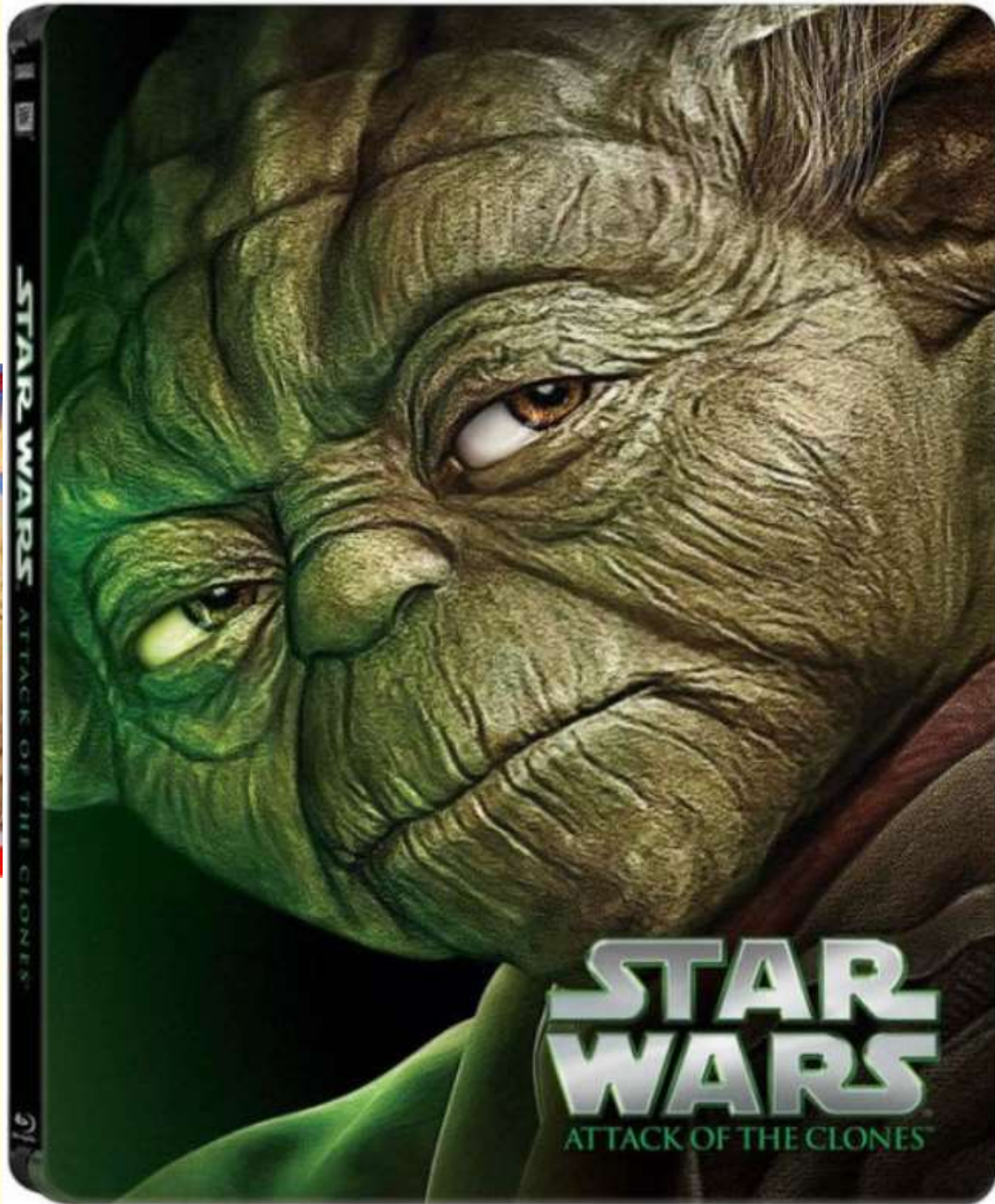


- 2) Planting the same plants in same soil
- removes the same nutrients each year →
- nutrient poor soil

Diversity > Stability

Questions about clones

- Do they live as long?
- Are they as healthy?
- Is it ethical to produce them?



How can you increase diversity?

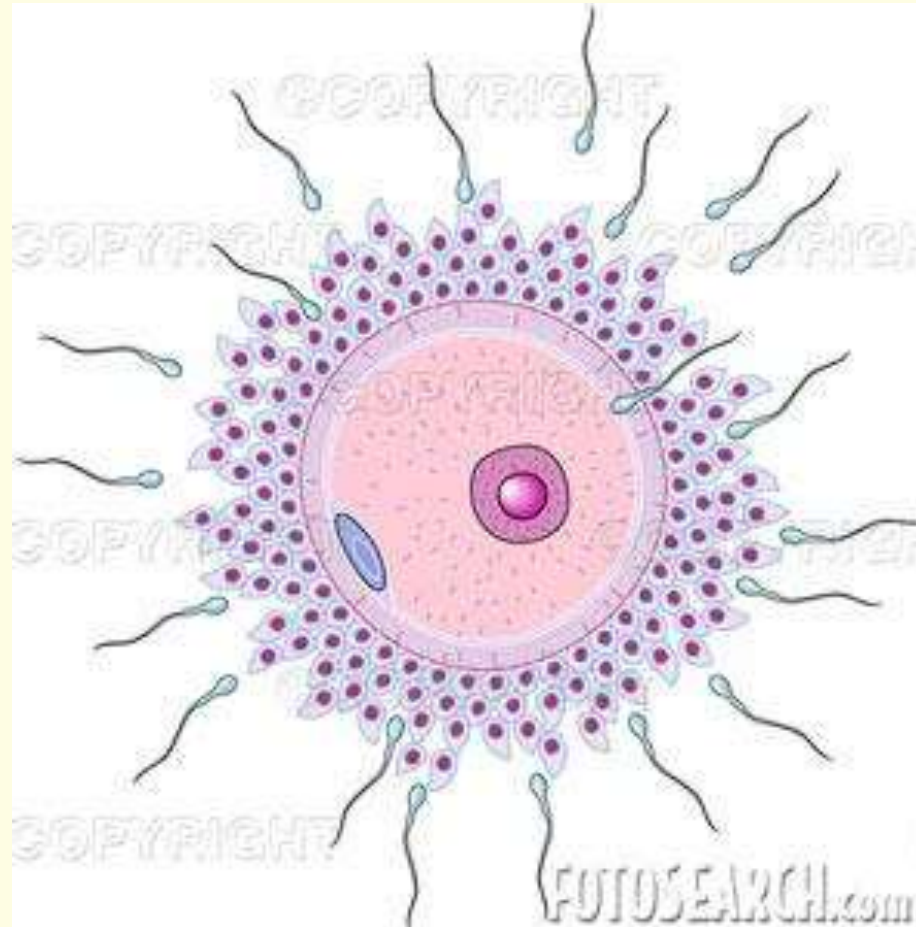
- Sexual Reproduction → diversity

What are the Chances????

Question

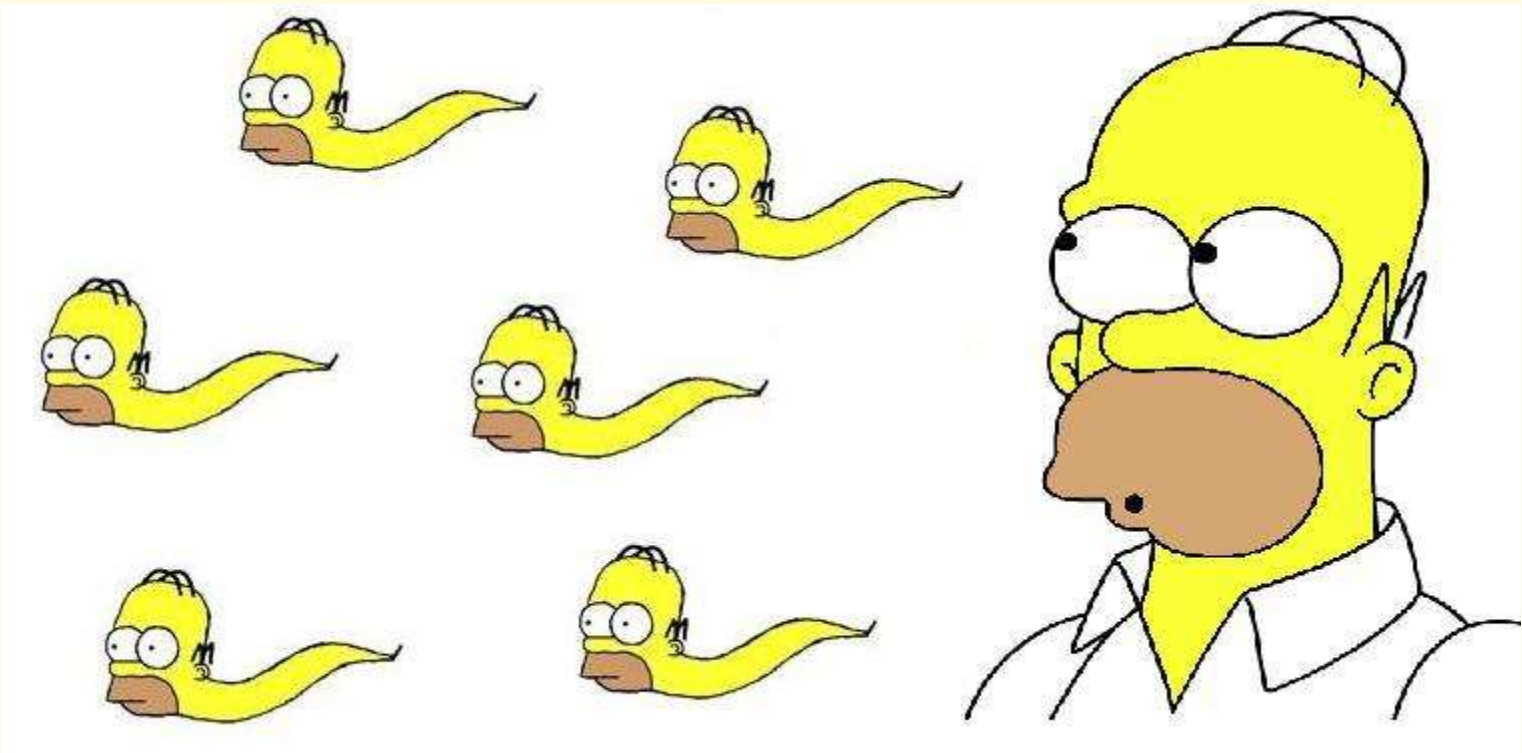
- Describe what happens during sexual reproduction

- Fertilization!!!
ONE sperm fuses with ONE egg

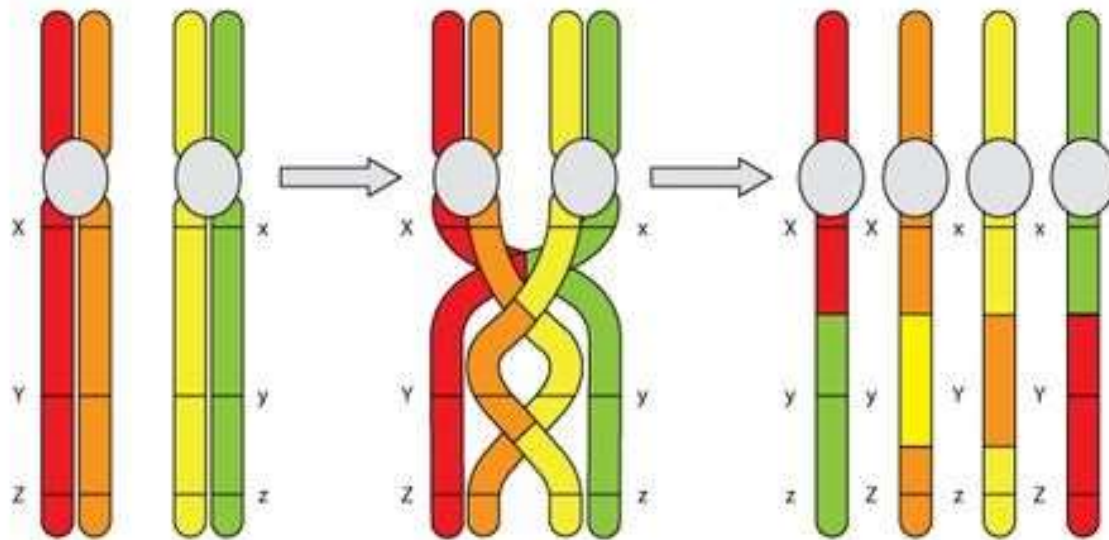


Consider the following:

- During his lifetime, the average male produces and dispenses ~ 300 trillion sperm

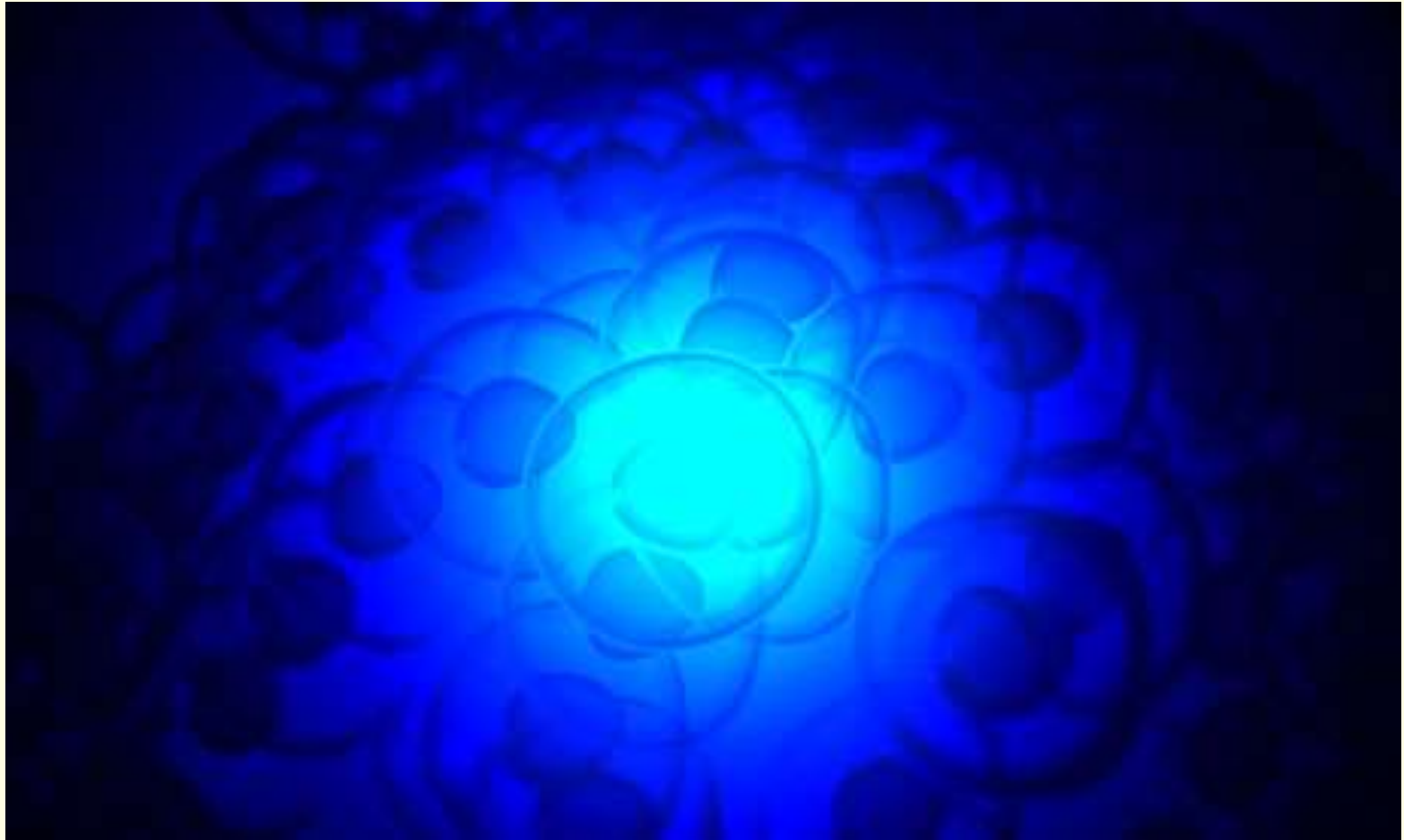


Each sperm is a unique combination of traits

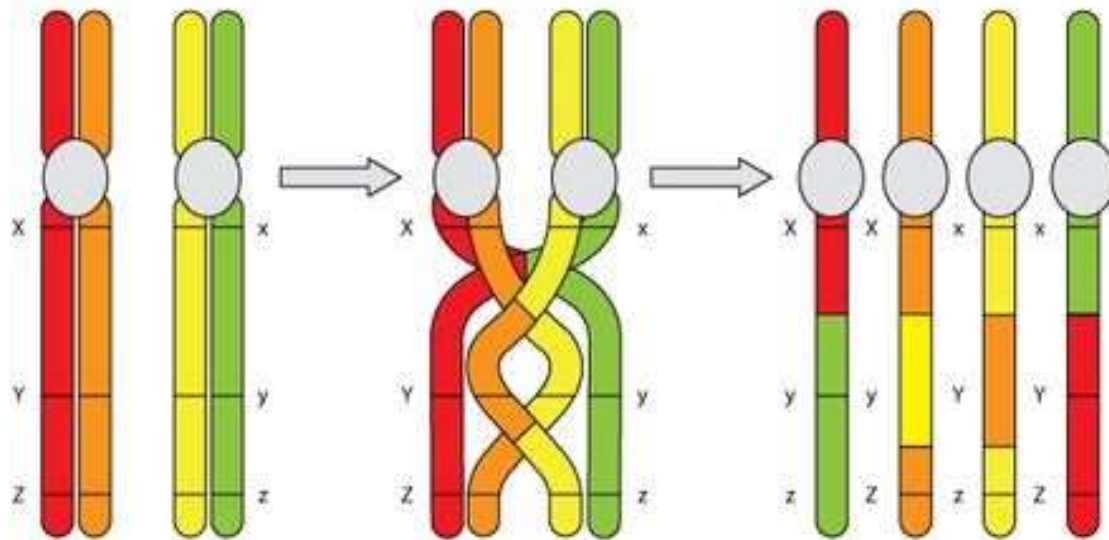


Consider the following:

- Women are born with ~ 300,000 egg cells



Each egg is a unique combination of traits

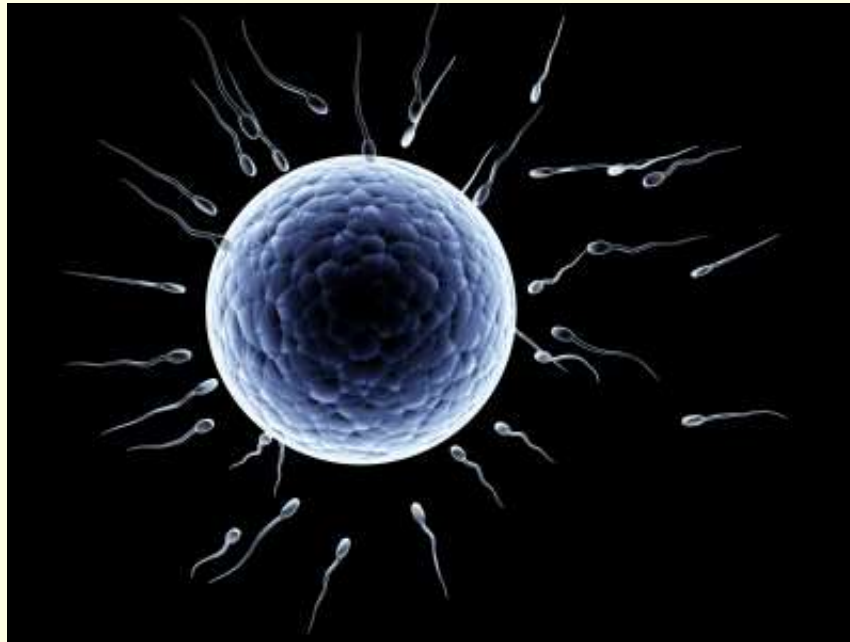


Do the math

- Chance of getting the one sperm that made you
 - $1/300,000,000,000,000$
- Chance of receiving the one egg that made you
 - $1/300,000$

What are the chances?

- What is the probability that the one sperm and the one egg that made you ever met?
- $1/300,000,000,000,000 \times 1/300,000$



And that chance is.....(drum roll please!)

- $1/900,000,000,000,000,000$
- =900 quadrillion chances

WOW!!!!

- That means you are one in 900 Quadrillion!!

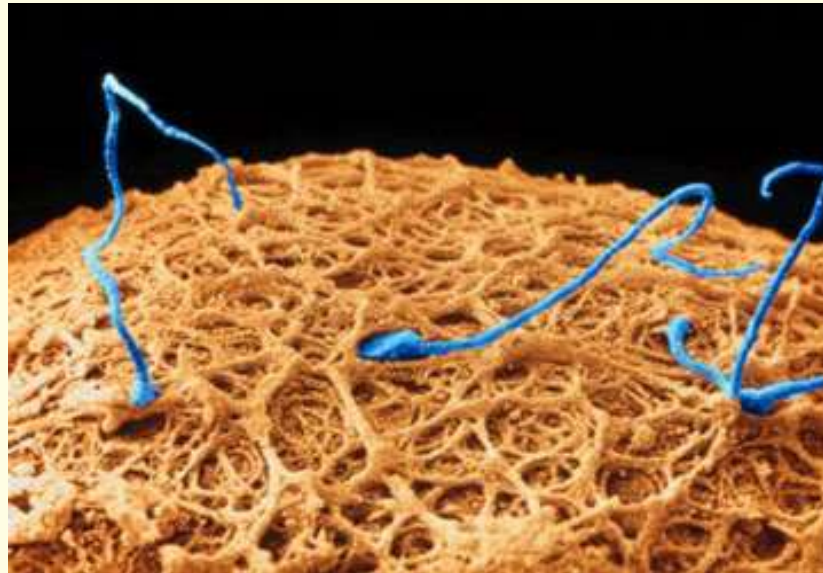
The person next to you is also 1 in
900 quadrillion

- Your relationship with that person is a once in a lifetime opportunity
- Don't waste that opportunity!!!!!!

Respect Genetics

Sexual reproduction

- DNA from a sperm and DNA from an egg join together to make one new cell



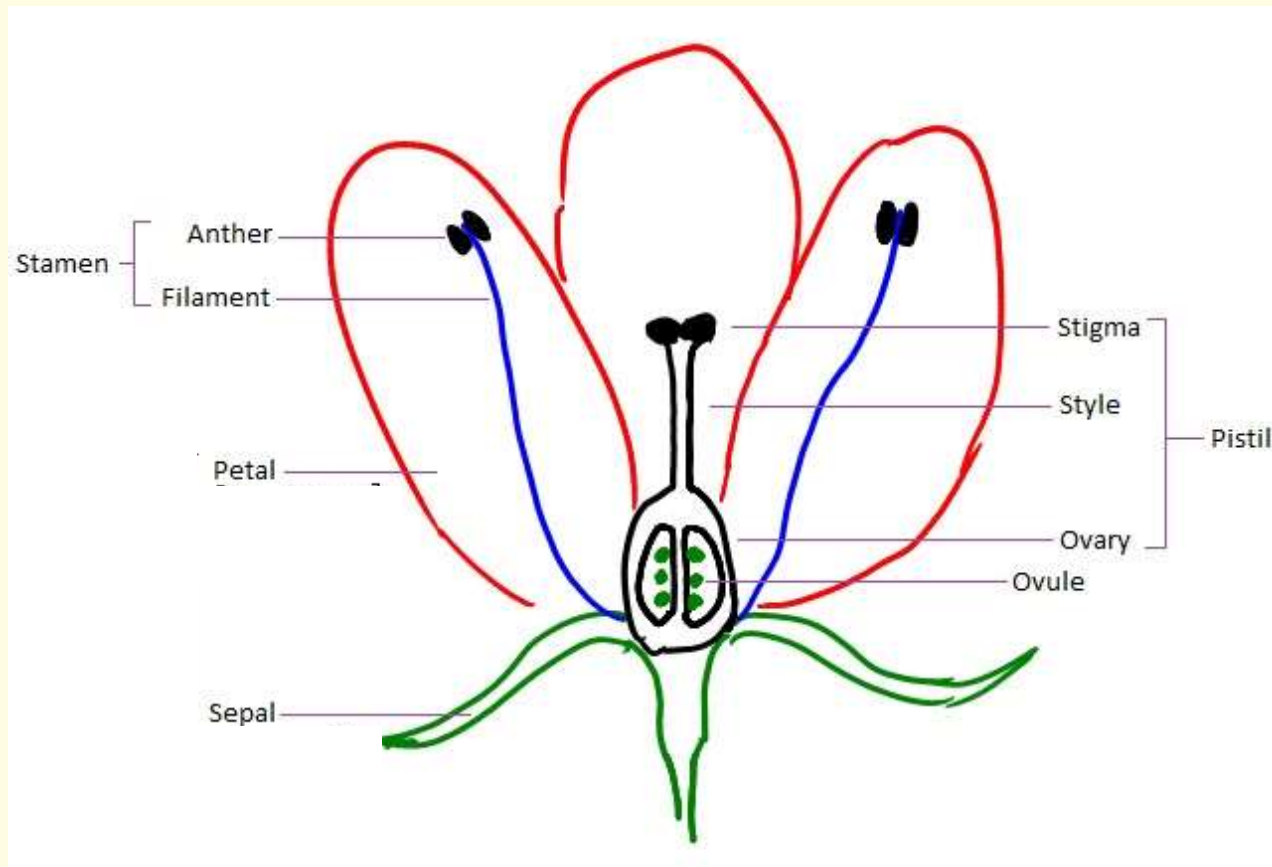
What is this called

- Fertilization



Flowers → Sexual Reproduction
in Plants

Draw and label the parts of a flower



What happens during sexual reproduction in plants

- **Pollination (pollen fuses with an egg)**

POLLEN



Eggs form in an ovary

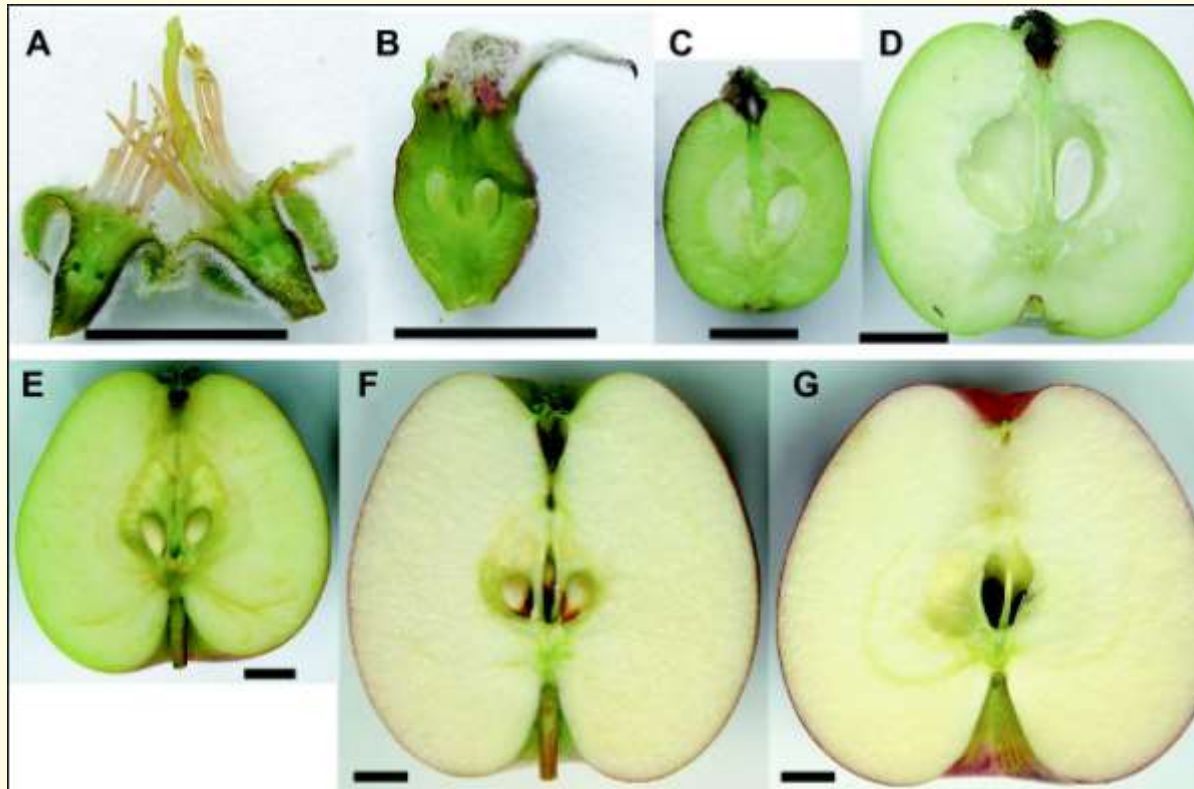


Fertilized eggs in plants =



Ripened ovary (with seeds)

Fruit



What is the advantage of sexual
reproduction

Sexual reproduction → diversity



OBSERVED VARIATION WITHIN ONE POPULATION

Review activity

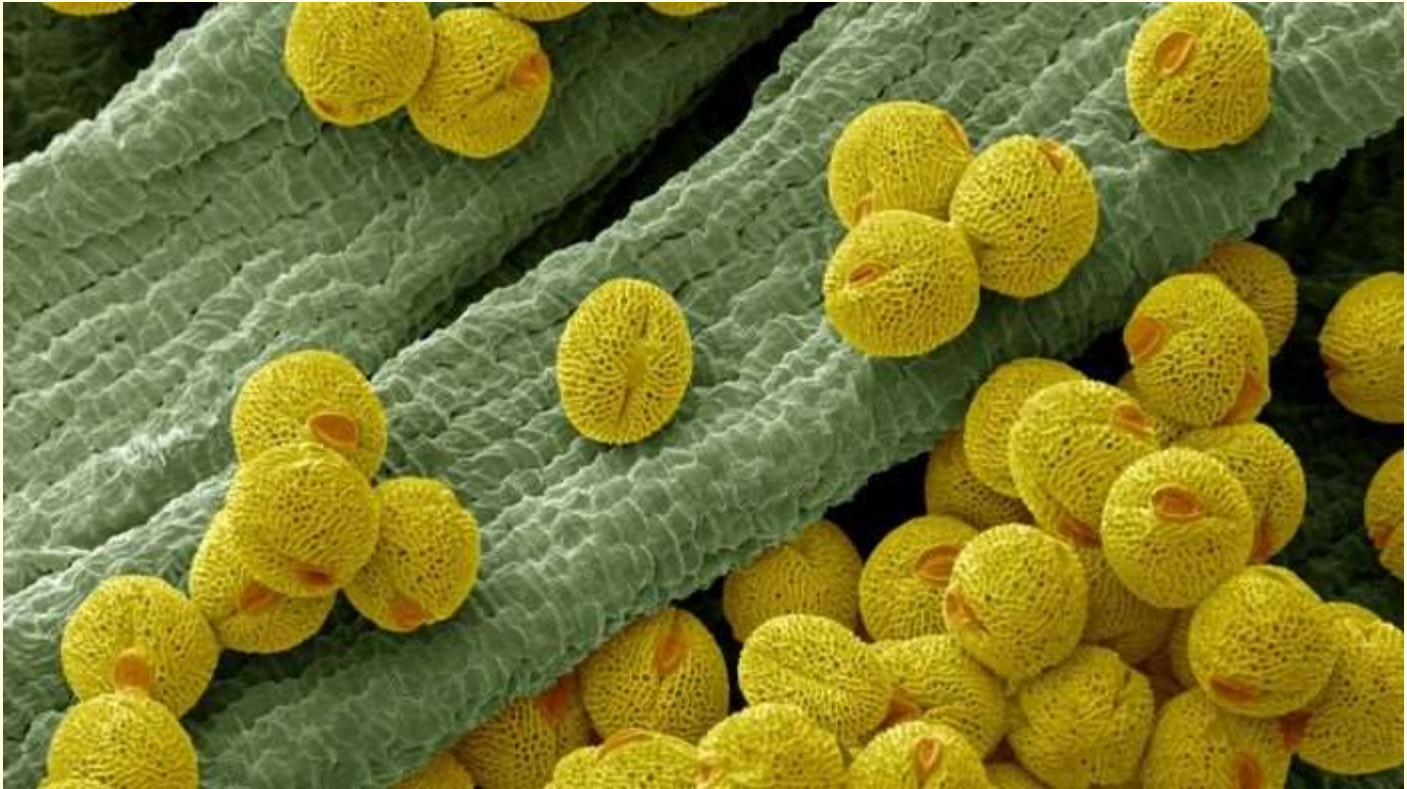
- List similarities and differences between
- Mitosis and meiosis
- Sexual and asexual reproduction
- Label parts of the flower

Sexual Reproduction in Plants

1. Meiosis → Pollen and Eggs
2. Pollination = pollen carried to stigma
3. Fertilization → Seeds inside fruit (ripened ovary)
4. Germination = seed sprouts

Define Adaptation

Pollen adaptations



Thick walls prevent drying out

Pollen is lightweight and sticky



Pollination = transfer of pollen to stigma

- Self pollination = same plant
- Cross pollination = different plants →
- Increased diversity

- Wind, insects, birds = pollinators

Bees pollinate flowers = Mutualism

- Mutualism = symbiotic relationship
 - (both benefit)



Case study: Bee Bummer

Germination

- When do seeds germinate
- Favorable environment



How do they grow

- Cells divide
 - Mitosis
- Cell specialize
 - Hormones → stems, roots, leaves...

Selective Breeding in plants =

- Humans control which plants pollinate
- Pros:
- Select good traits
- Cons:
- → less diversity
- Offspring inherit same bad traits

Advantage of sexual reproduction and cross pollinating

- Increased diversity → stability

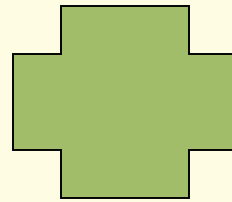
Sexual reproduction →

- Increased variation →
- More Adaptation →
- Increases the rate of evolution →
- Diversity of life

Formation of gametes

- Meiosis → Gametes
- Gametes = cells with half the DNA
- Ex: eggs and sperm

Fertilization and Development



- Fertilization = fusion of gametes → zygote
- Zygote divides by mitosis
- Hormones control development

2 types of Fertilization (both require moist environment)

1) External fertilization

- Ex: Fish, amphibians, insects
- Have to produce lots of eggs → survive

External ???



- Most frogs and toads hold female in a pose called amplexus.
- Sperm are deposited as the eggs are laid.

2) Internal Fertilization

- Required for life on land
- Most vertebrates
- Ex: (birds, reptiles, mammals)

Internal fertilization



Mammals



Characteristics of mammals

- Internal fertilization
- Warm-blooded
- 4 chambered heart
- Hair or fur
- Mammary glands
- (most give birth to live young)

Whales are mammals not fish
(internal fertilization, live young)



2 Types of Development

- External



- Internal



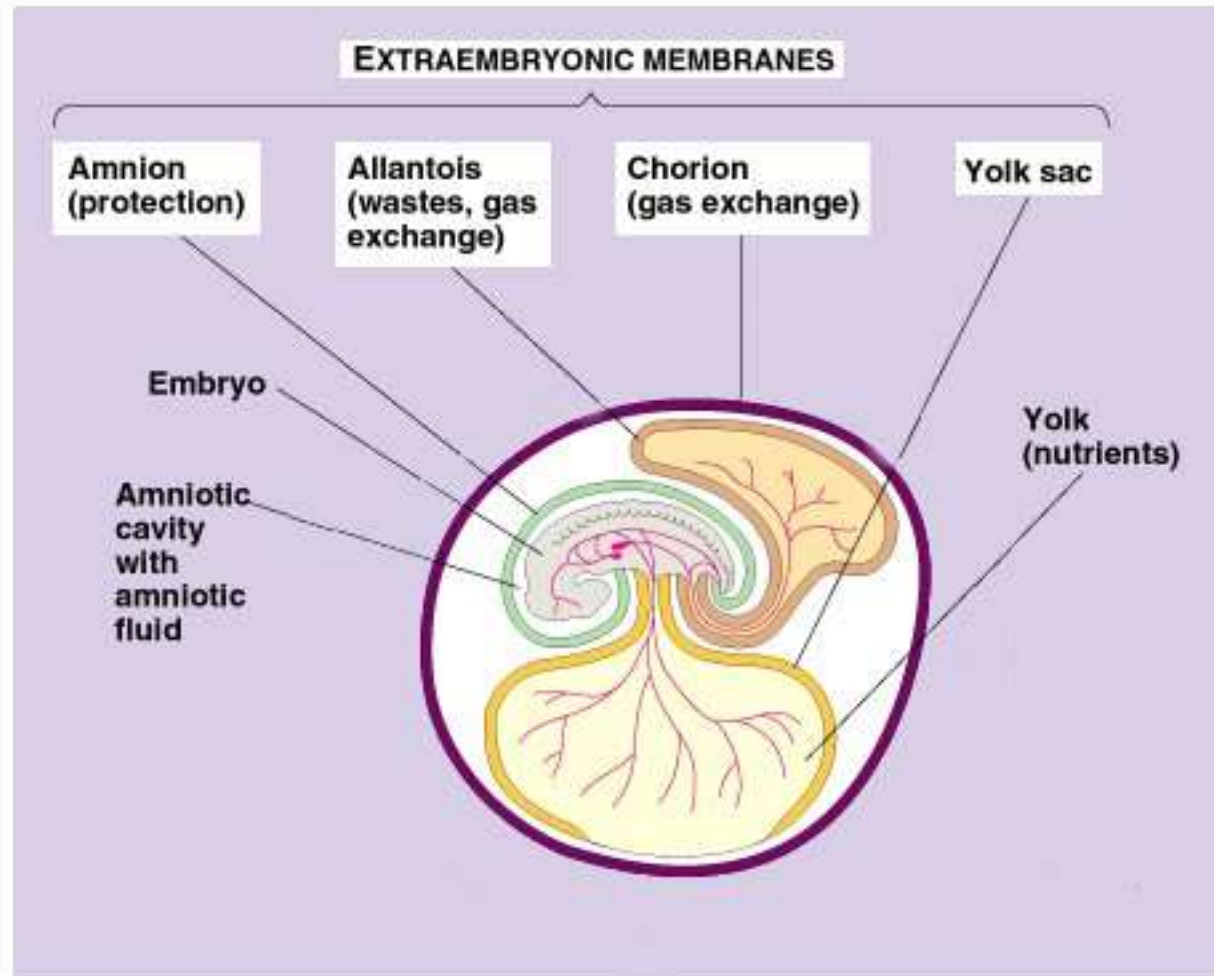
External development

In water

- Fish,
- amphibians,
- insects

- On land
- Birds,
- reptiles,
- a few mammals
(duckbilled platypus,
spiny anteater)

Amniotic Eggs → life on land



Egg laying mammals of Australia



Internal development (most mammals)

2 types of mammals

- Marsupials (kangaroo and opossum)
 - Food = egg yolk
 - Embryo born premature in a pouch → food from milk (mammary glands)

Marsupials



Placental Mammals

- Embryo develops in uterus
- Placenta = organ → nutrients and waste removal
- Amniotic fluid → moist environment and protection

Placental Mammals give birth to live young



Human Fertilization and Development

Describe the DNA of a human cell

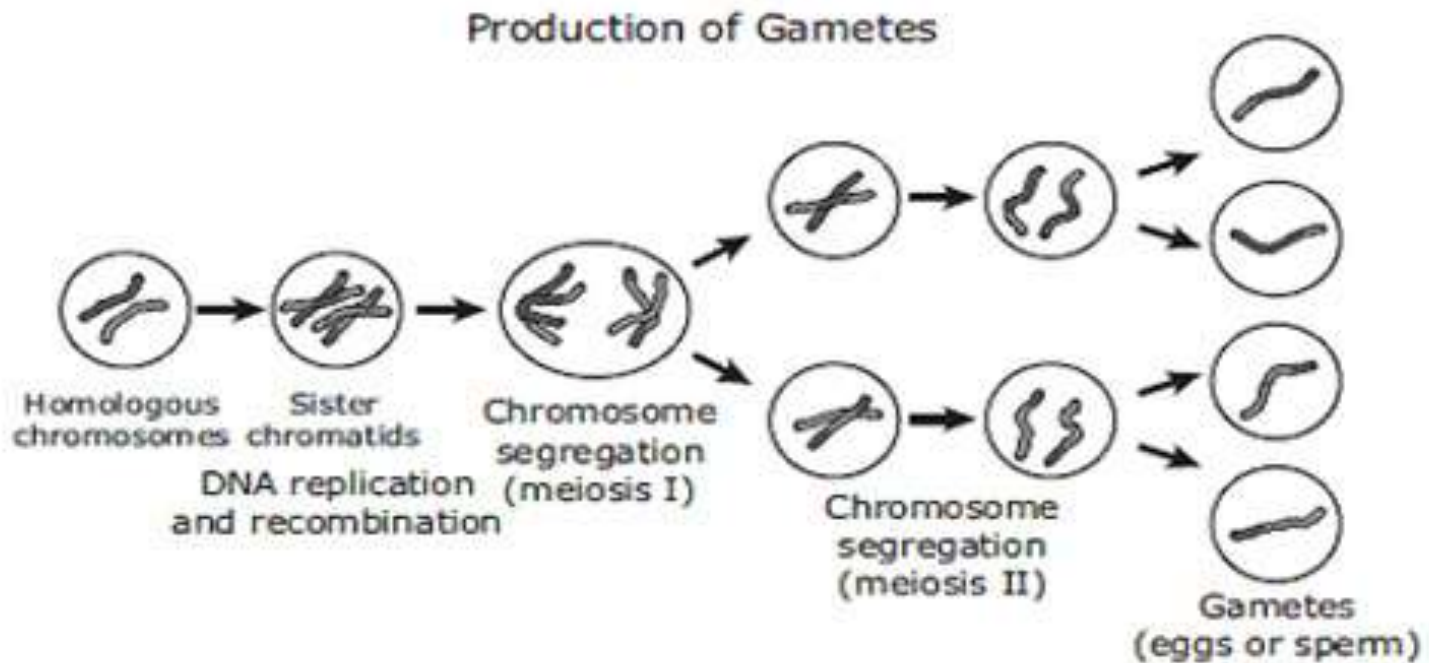
- Found in nucleus
- All cells are genetically identical in an organism
- Made of base pairs
 - A-T
 - C-G

Each cell has 46 chromosomes



Define and describe human
gametes

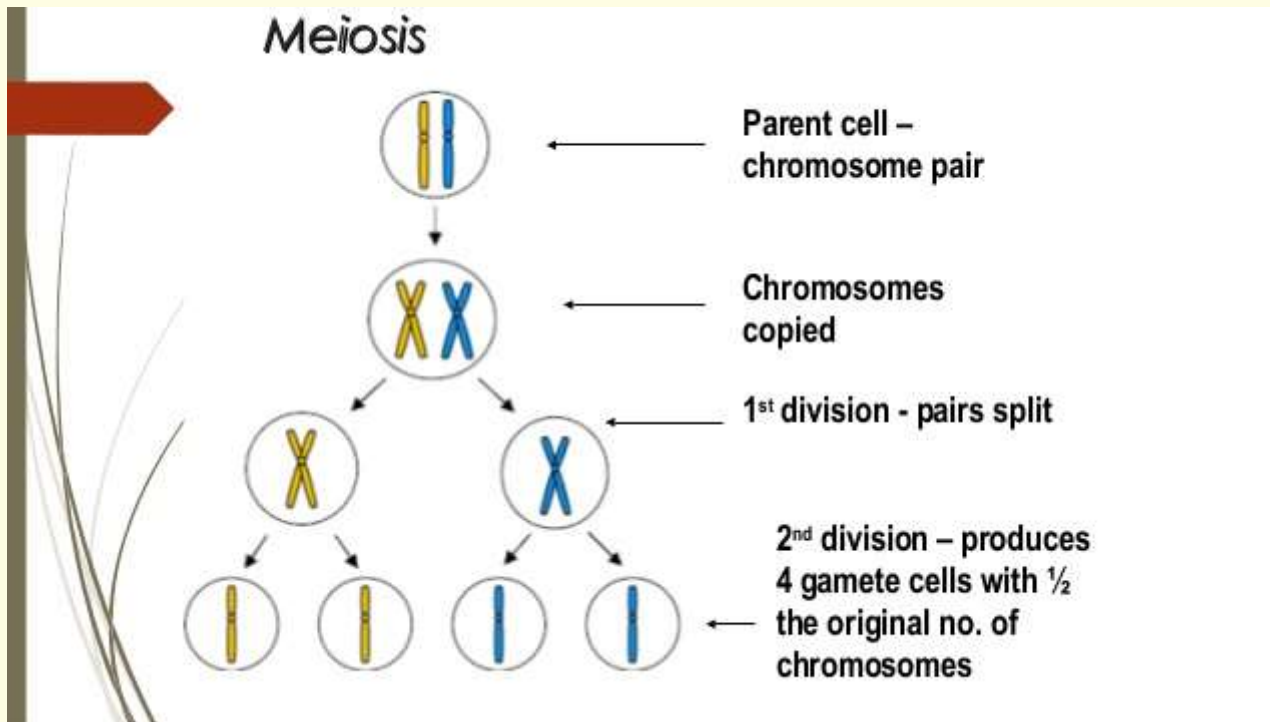
Gametes (eggs and sperm) = 23 chromosomes



How are gametes made

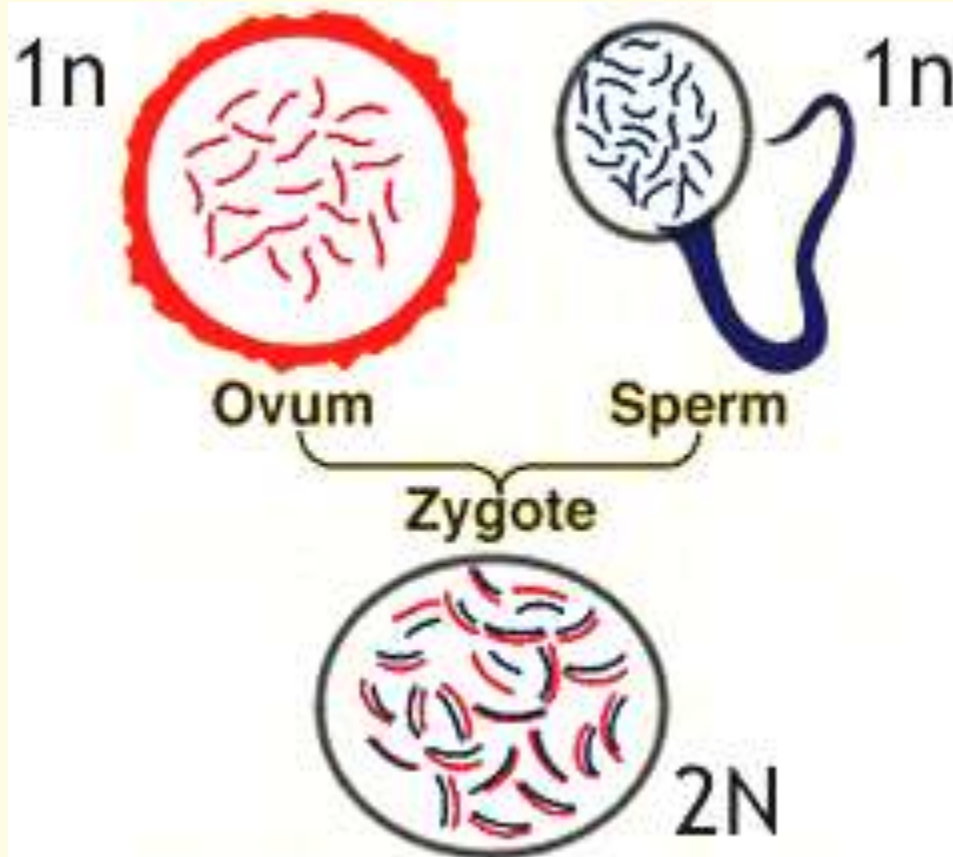
Meiosis =

- Type of cell division → gametes
- Cuts # chromosomes in half



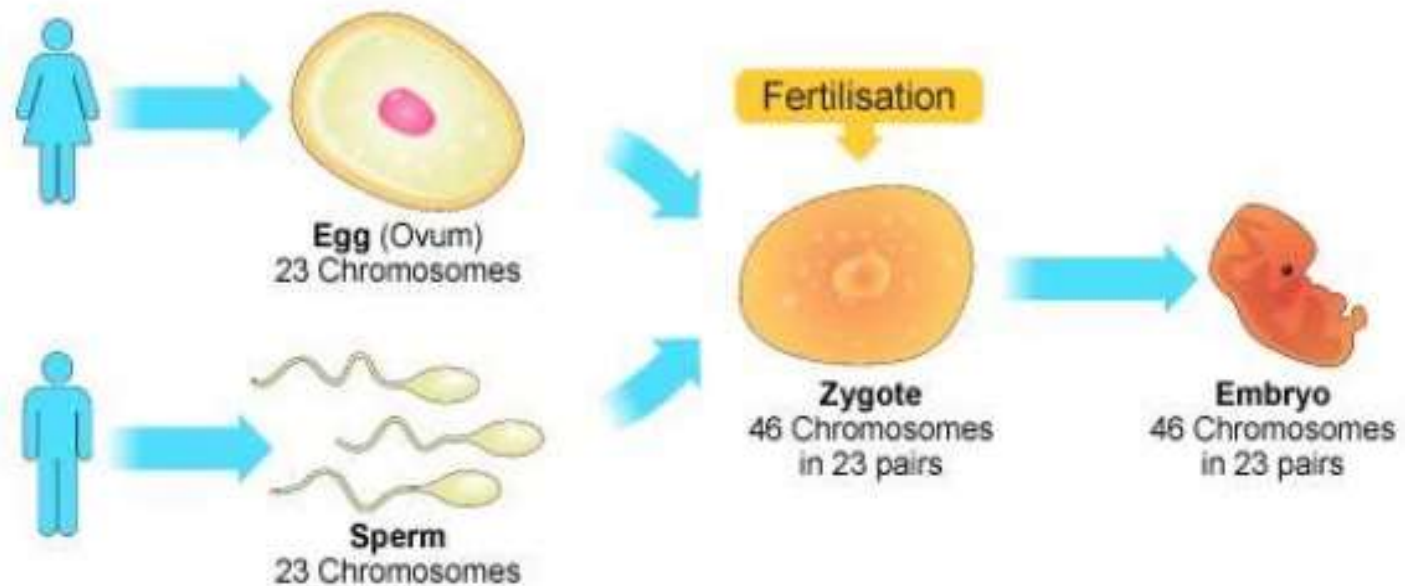
How are babies made?

Fertilization = fusion of gametes
→ zygote

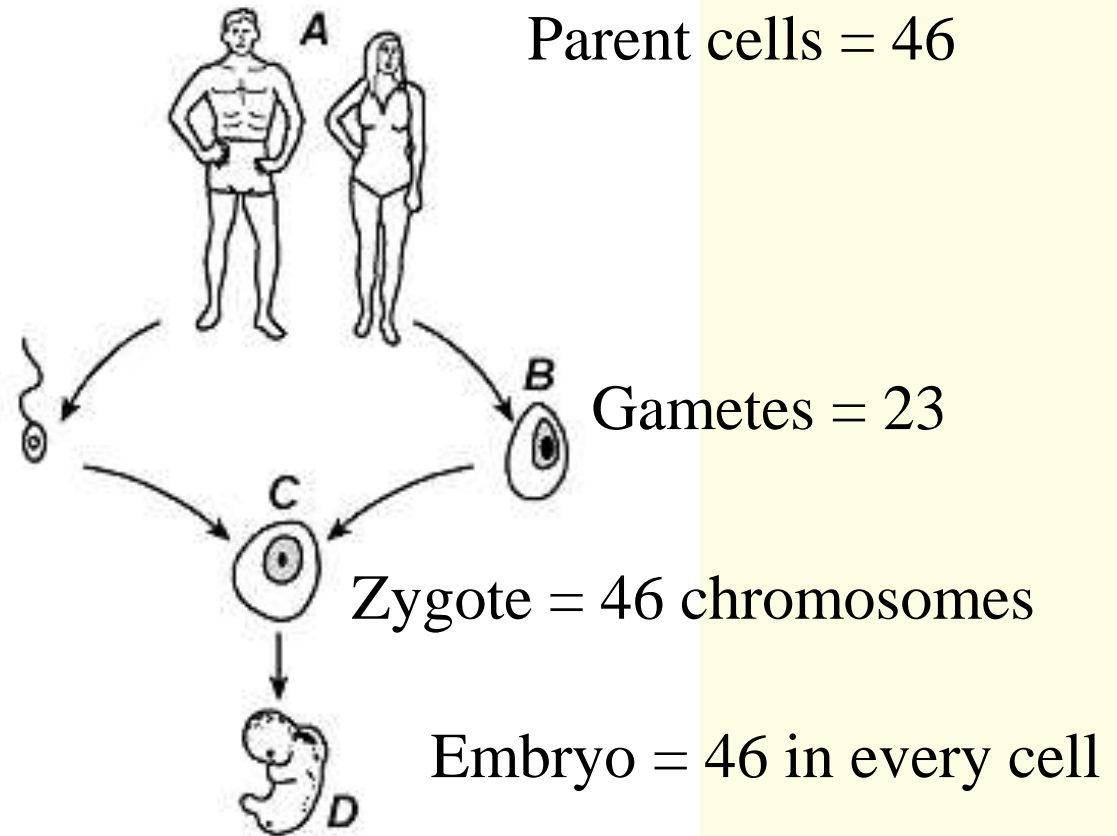


Fertilization, Zygote, Embryo(Review)

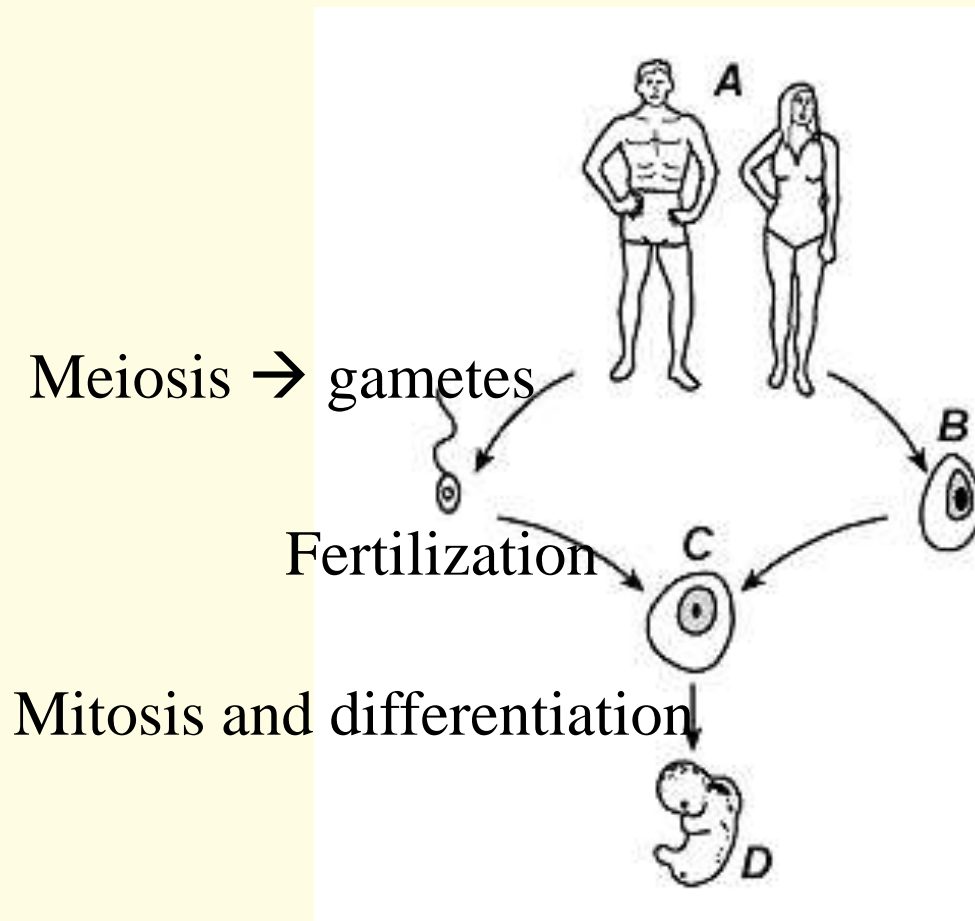
3.2 understand that fertilisation involves the fusion of a male and female gamete to produce a zygote that undergoes cell division and develops into an embryo



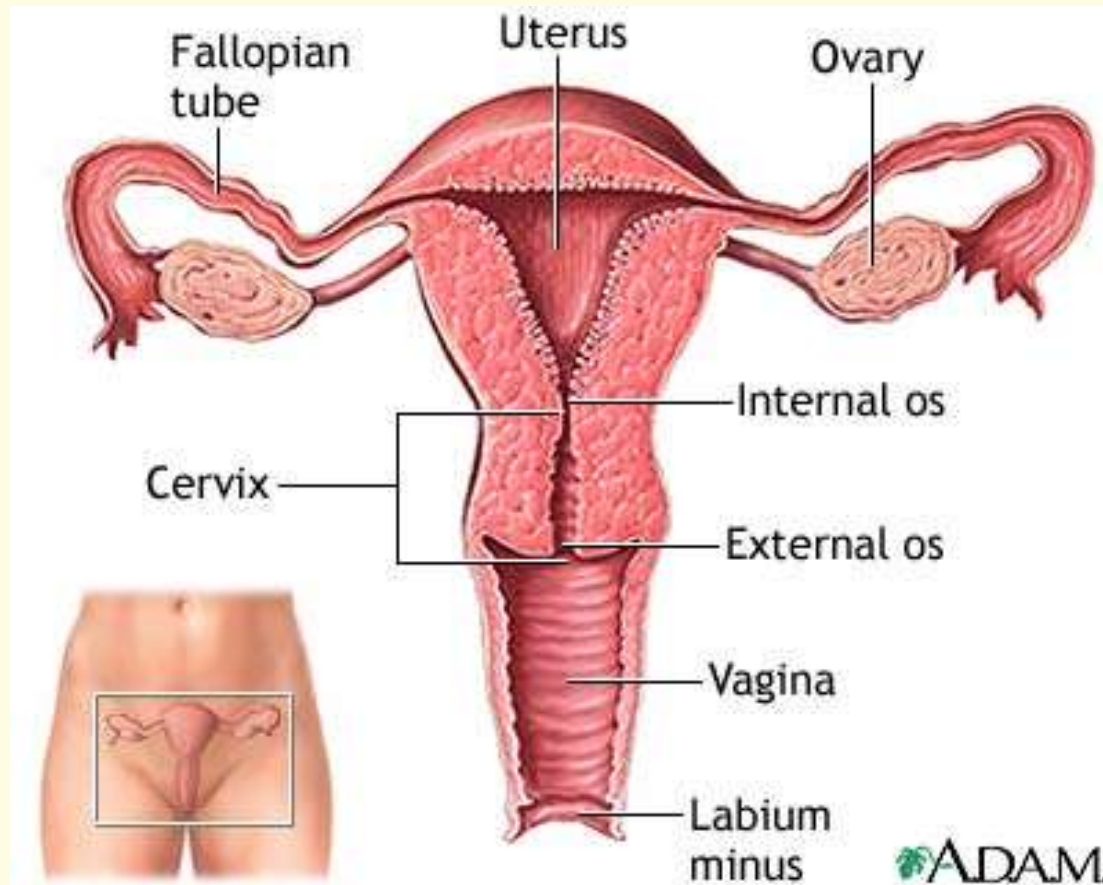
Label the cells and state number of chromosomes in each



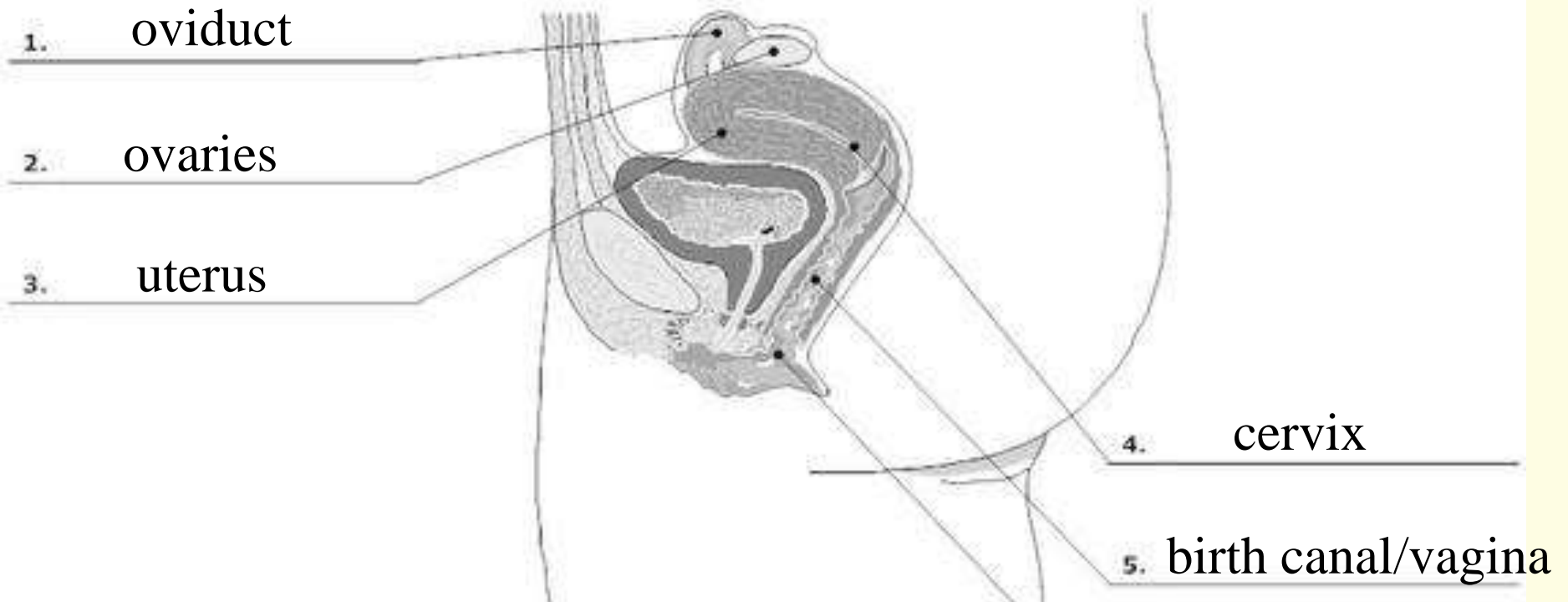
Label each step/process (represented by the arrows)



Female reproductive system



Female Reproductive System and Organs

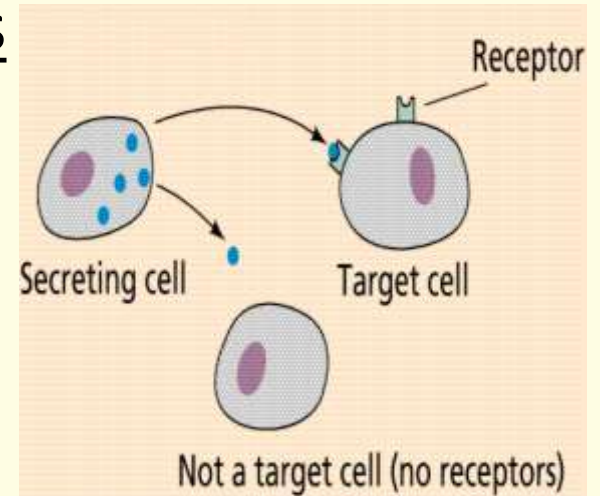


Human Female Reproductive System

- Ovaries → eggs and hormones
- Oviduct → tube between ovaries and uterus (fallopian tube)
 - Fertilization occurs here
- Uterus = where embryo develops
 - Lining of uterus forms mother's part of the placenta

Ovaries = glands

- → hormones
 - Ex: (estrogen, progesterone)
- Hormones = chemical messengers
 - Target cells have receptors
 - Receptors and hormones =
 - specific because of shape
- Eggs produced in ovaries
 - Meiosis → eggs
 - (in humans eggs have 23 chromosomes (1N))



Hormones control female reproductive cycles

Human = menstrual cycle

- Once a month uterus prepares for pregnancy
- If not → shed the extra tissues and blood

Dogs and other mammals = estrous cycle

- Only sexually active during estrus phase (in heat)
- Lining is reabsorbed - not shed

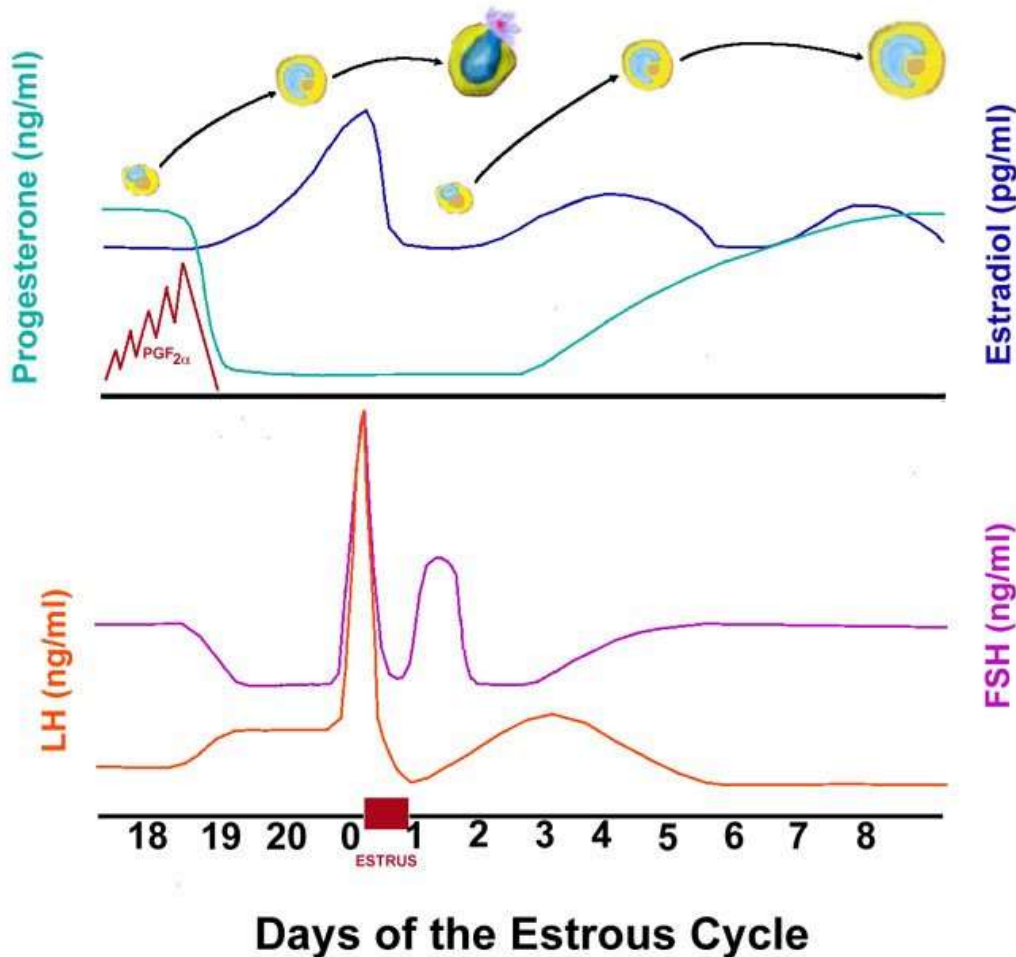
Female Mammals

- Monoestrous = once a year
 - Bears, wolves, fox
- Diestrous = 2x's a year
 - Dogs
- Polyestrous (several times a year)
 - Short day breeders (fall or winter = sheep, goats, deer)
 - Long day breeders (spring and summer = horses and cattle)
- Some like rabbits have no estrous cycle and can reproduce throughout the year.

Reproduction in Farm Animals

Cow

© 1997 Oklahoma State University



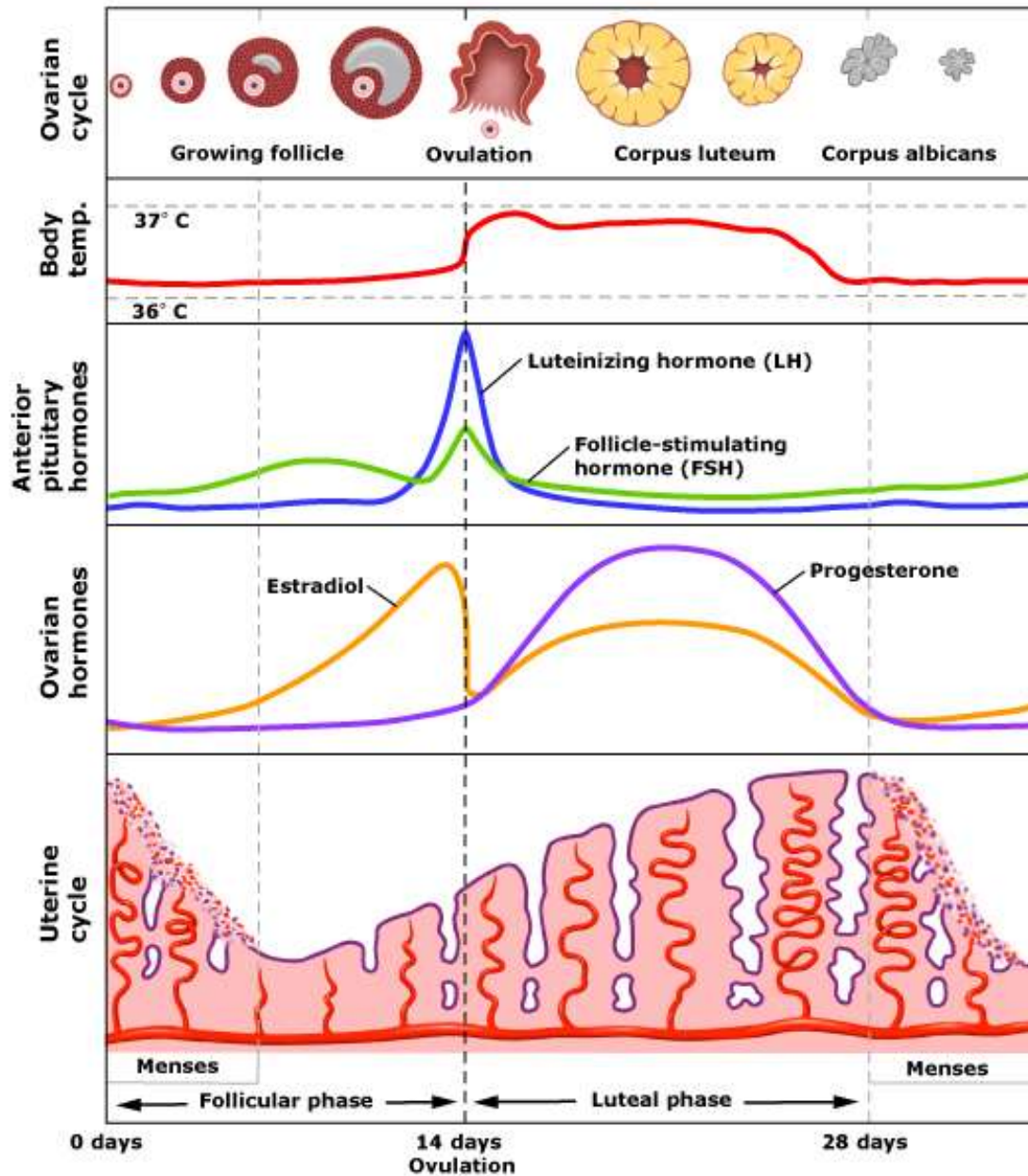
Artificial insemination

- Step 1 get sperm (Horse farm in England)
- <https://www.youtube.com/watch?v=MUB-CT6k-o>
- Step 2 fertilization (Dairy farmer)
- <https://www.youtube.com/watch?v=Y43YAYHJ2Ng>

Human menstrual cycle

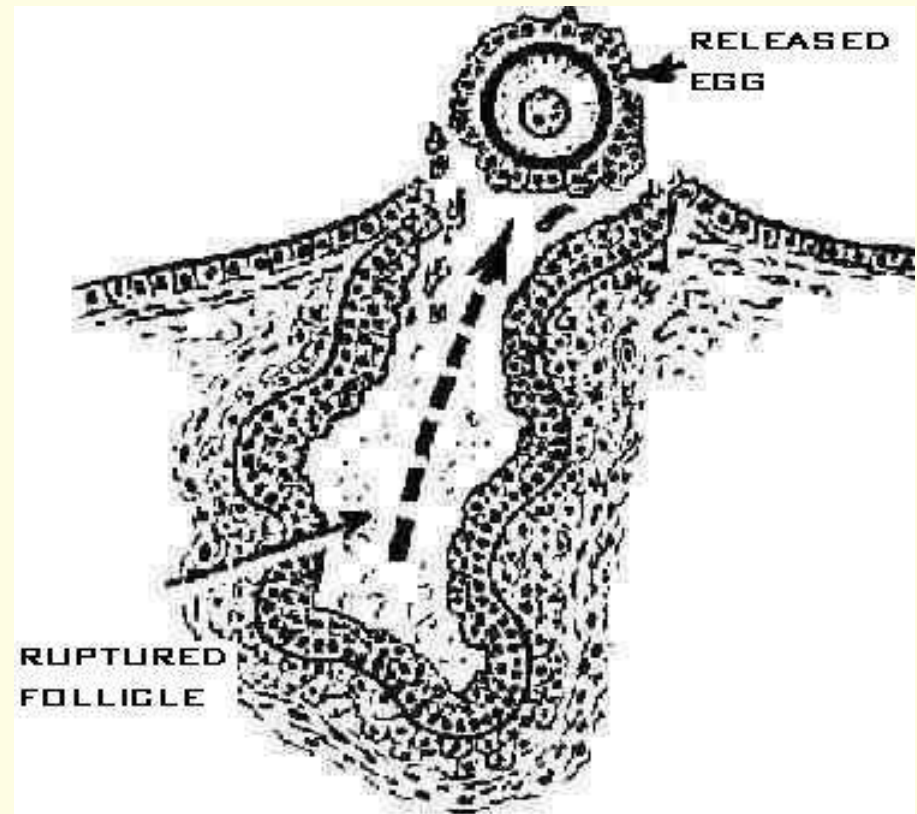
- <https://www.youtube.com/watch?v=cjbgZwgdY7Q>

Human Menstrual Cycle Lab



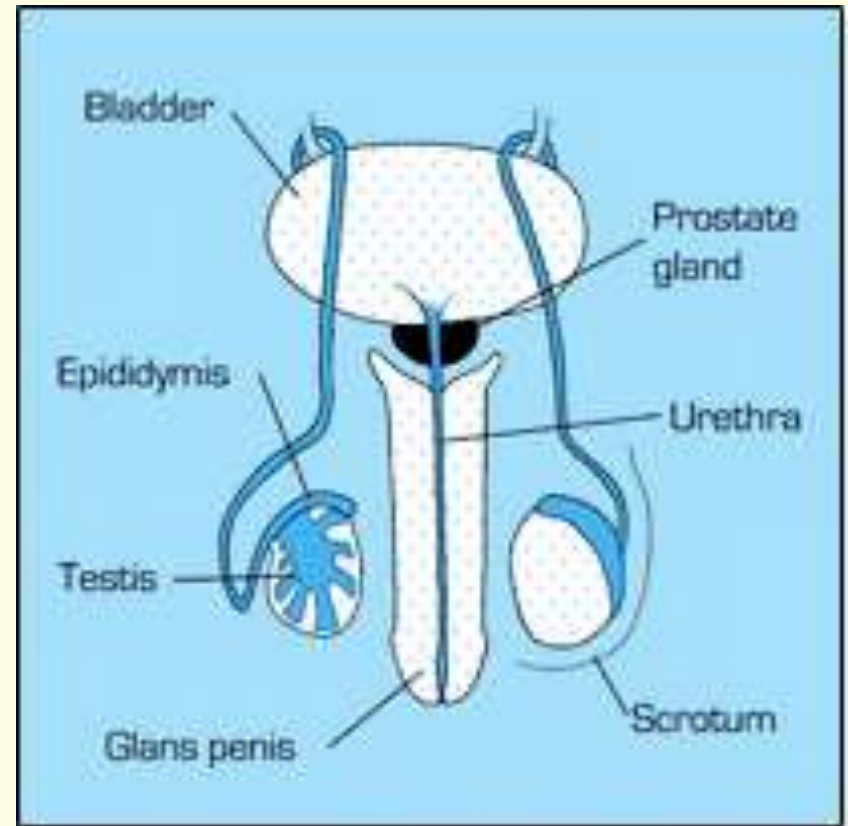
Ovulation

- Release of an egg from the ovary
- Once a month in human females
- Controlled by hormones



Male Reproductive system

- Testes →
 - hormone testosterone
 - → male characteristics
- Testes → sperm
- Prostate gland =
 - stores seminal fluid (for sperm) (hi pH)
- Urethra →
 - excretion and
 - reproduction



Review:

Fertilization and development in animals

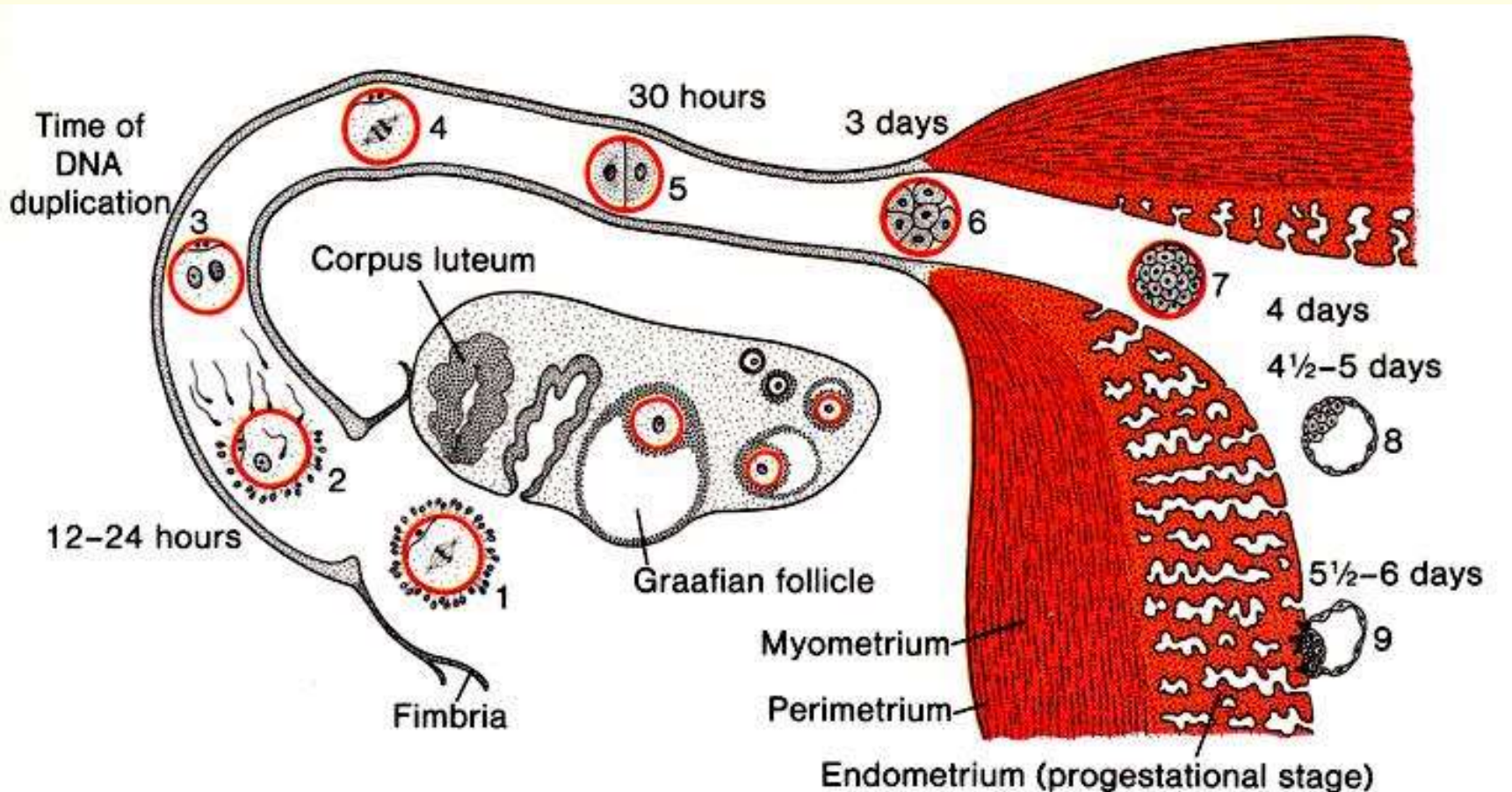
- Most bony fish, insects, and amphibians = external fertilization and development
- Birds and reptiles = internal fertilization and external development
- Mammals = internal fertilization and development

Human Fertilization

- Fusion of gametes (egg and sperm)
- Fertilization occurs in the oviduct
- 23 + 23 → 46 chromosomes



Fertilization occurs in the oviduct



- An average of 200,000 – 300,000 sperm are deposited in the vagina during intercourse but only 1 sperm can fertilize an egg
- Sperm use enzymes to penetrate the wall of the egg
- When one sperm reaches the membrane → series of chemical reactions → a barrier to keep other sperm out

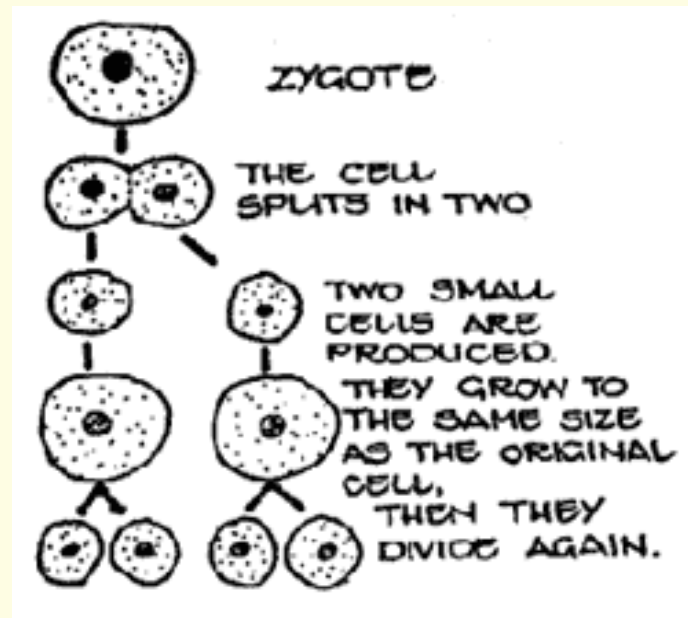
Fertilized eggs are called zygotes



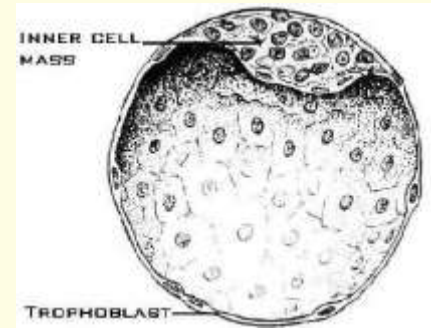
<http://www.ndpteachers.org/perit/Zygote.JPG>

Fetal development

- Zygote divides by mitosis →
 - Genetically identical cells
 - Cells Differentiate → tissues → organism



Week 1



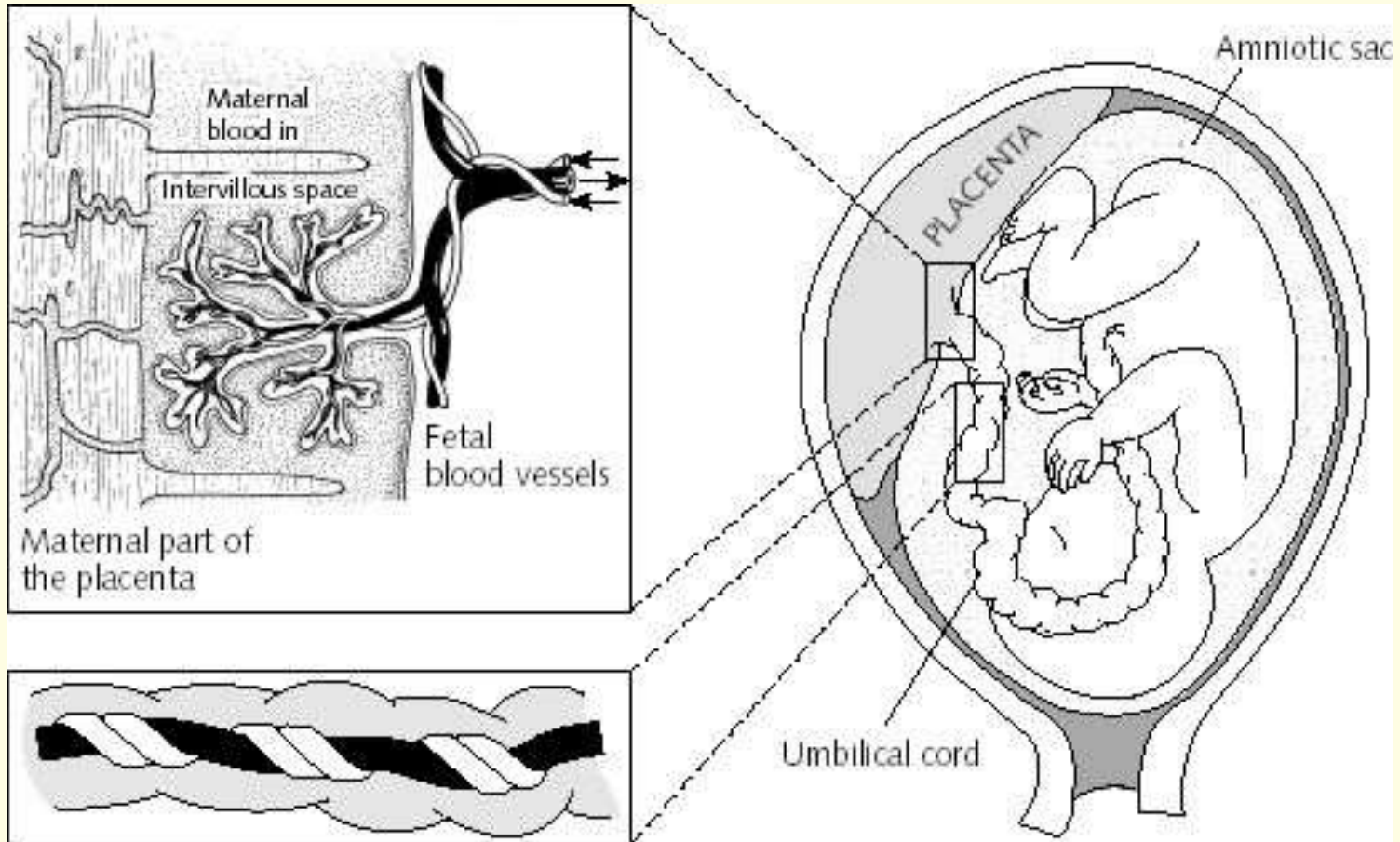
only need notes that are underlined

- During 1st week (cilia help developing zygote travel to uterus)
- 36 hours after fertilization → cleavage = rapid cell divisions
- Day 5 → fluid filled ball of cells = blastocyst
 - Outer layer (trophoblast) → placenta
 - Inner layer = embryo → differentiate into body parts
- Day 7 = implantation = embryo embeds itself into uterine wall

1st Trimester (1st 3 months)

- Trophoblast forms membranes that will nourish and protect
- Amniotic fluid protects embryo from physical impact
- Chorion → placenta
- Placenta = structure for nutrient exchange
 - Mothers blood remains separate
 - materials diffuse through membranes
 - (note: alcohol, drugs, and viruses can move from mother to baby across the placenta)
- Umbilical cord connects baby to placenta

Placenta and umbilical cord



Embryo Development

- Develops 3 layers (inner, middle, outer)
- Differentiation = environment controls gene expression
- Gastrulation
 - Inner > digestive tract and lungs
 - Outer > skin and nervous system
 - Middle > other organs

4 weeks



- By 4 weeks the embryo has a tail, head, backbone and arms and legs, the beginning of eyes and ears,
- The heart is already beating and other organs are forming fast and an umbilical cord starts to grow
- During this time, the embryo is sensitive to drugs and infections of the mother

Note: early embryonic stages of all vertebrates are similar

May support idea of evolution from common ancestor



After 9 weeks fetus has all of its major organs and body parts

8-9 Weeks



2nd Trimester

- Fetal heartbeat is easily detected and fetus is very active
- Fetus increases in size from about 6 – 20 cm
- Placenta begins to secrete hormones

3rd Trimester

- Fetus gets bigger and begins to get ready for birth

Key ideas to remember

- 2 types of twins
 - Fraternal = from 2 different eggs and 2 different sperm
 - Identical = from 1 egg and sperm (genetically identical)
- Growth = increase in cell size and number
- Differentiation = different gene expression → different cells
- Growth and development controlled by hormones

- Placenta = organ formed from embryo and mothers uterus → exchange of nutrients and wastes
- Most development occurs in first few weeks
- Mothers health and lifestyle affect the fetus
- Alcohol consumption during pregnancy → fetal alcohol syndrome → delayed physical and mental development
- Calcium deficiencies in mother effects bone development
- Smoking → low birth weights and respiratory problems
- HIV and other viruses (measles, chicken pox...) can be transferred from mother to baby

Vocabulary

- Meiosis, fertilization, differentiation
- Gametes → zygote
- Female: ovaries, estrogen, oviduct, uterus
- Male: testes, testosterone, prostate gland, urethra
- Placenta, amniotic fluid, umbilical cord
- Internal vs external fertilization and development

Universe within