# Life's Common Challenges

## Reproduction

# Life's Common Challenges

## Introduction

# The Purpose of Life!?*#?

- This unit that I call "common challenges" illustrates the many biological imperatives necessary for life.
- This unit will explore the last and perhaps most unique of all biological imperatives...Reproduction.
- 1. Reproduction is unique, in that, it is <u>not</u> an imperative for individuals to be alive or remain alive.
  - It is however imperative for the continuation of the species.
- 2. Many biologists feel that Reproduction is in fact "THE" biological imperative and that ultimately Reproduction drives all actions and adaptations of living organisms.
  - **It could be said that the purpose of life from a biological perspective it pass your genes (or closely related genes ) to the future generations.**

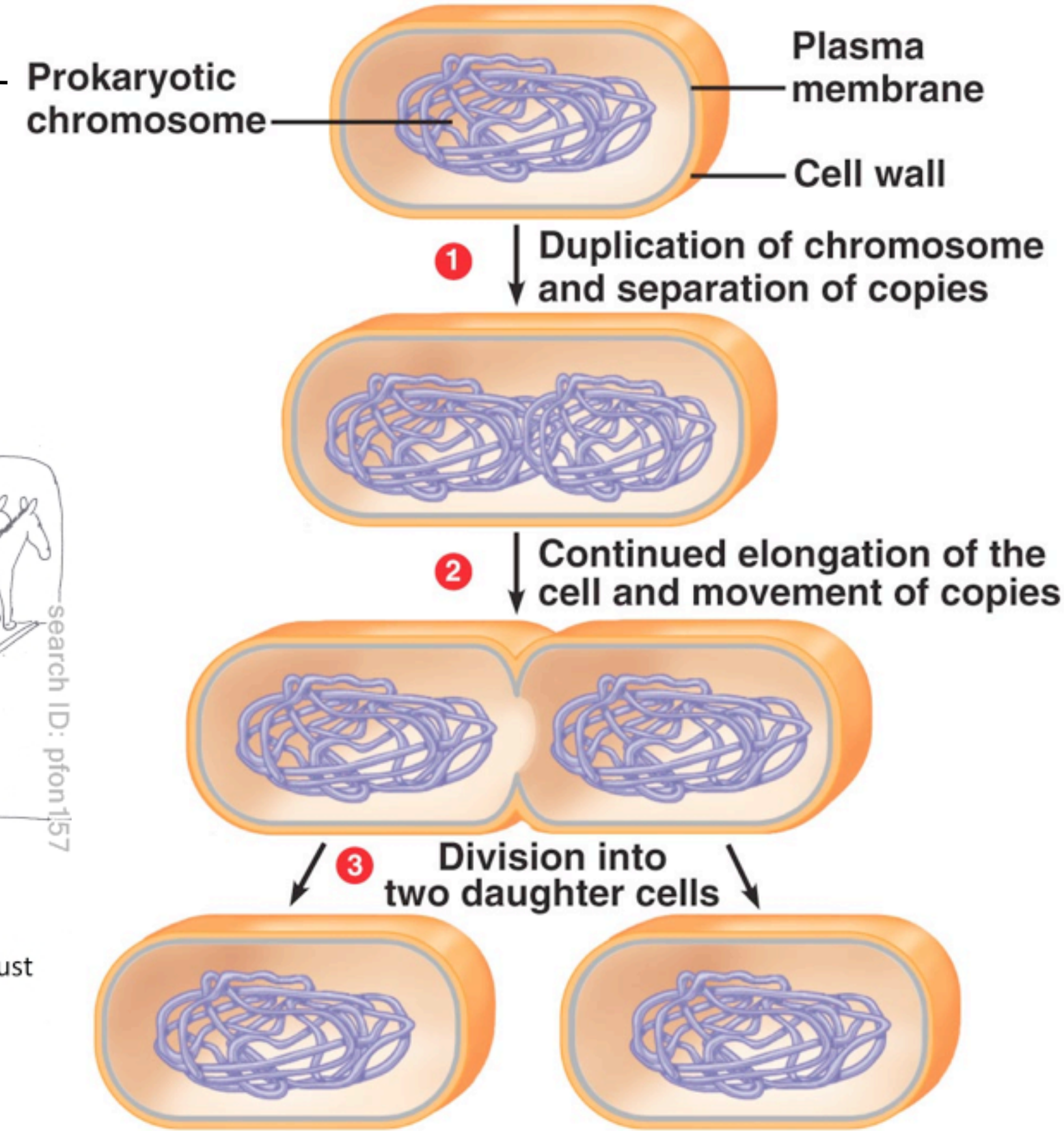
# General Points Regarding

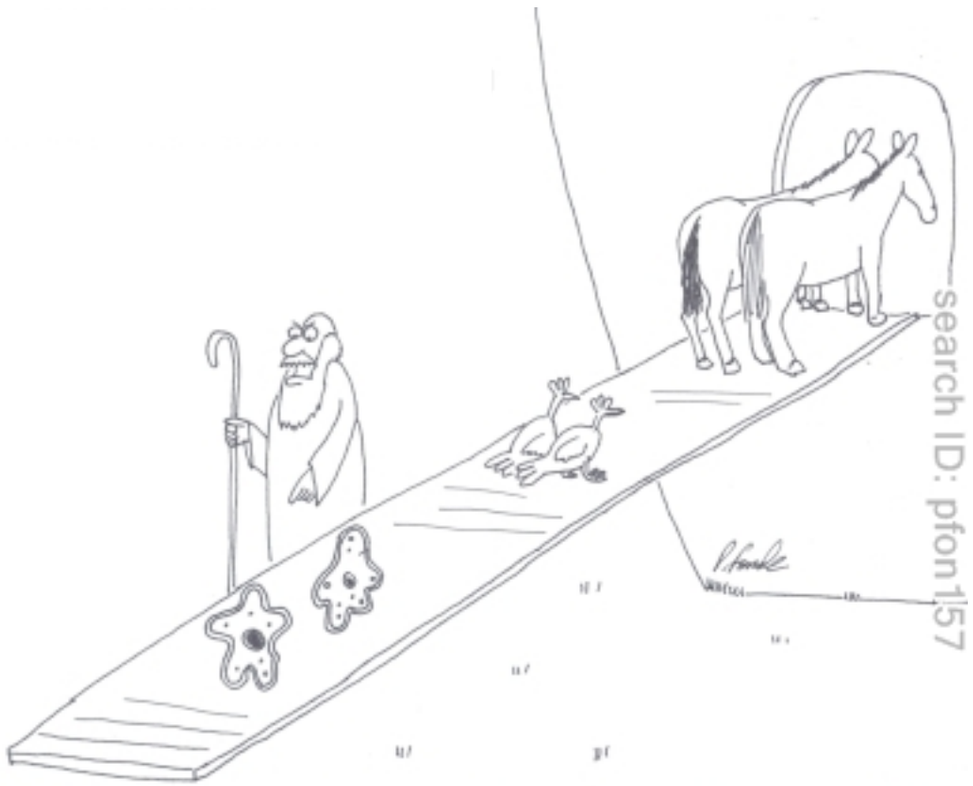
- "Life begets life"... more or less organisms reproduce their own kind.
  - Oak trees give rise to Oak trees, euglenas produce euglenas, humans produce humans, etc
  - some offspring are identical to their parent(s) while others are very similar to their parent(s)

- All cells arise from preexisting cells.
- Cell division underlies All reproduction.
  - It is necessary for unicellular reproduction and multicellular reproduction, for asexual reproduction and sexual reproduction.

# Cellular Division-Prokaryotes (Binary Fission)

A single Circular chromosome that contains genetic instructions

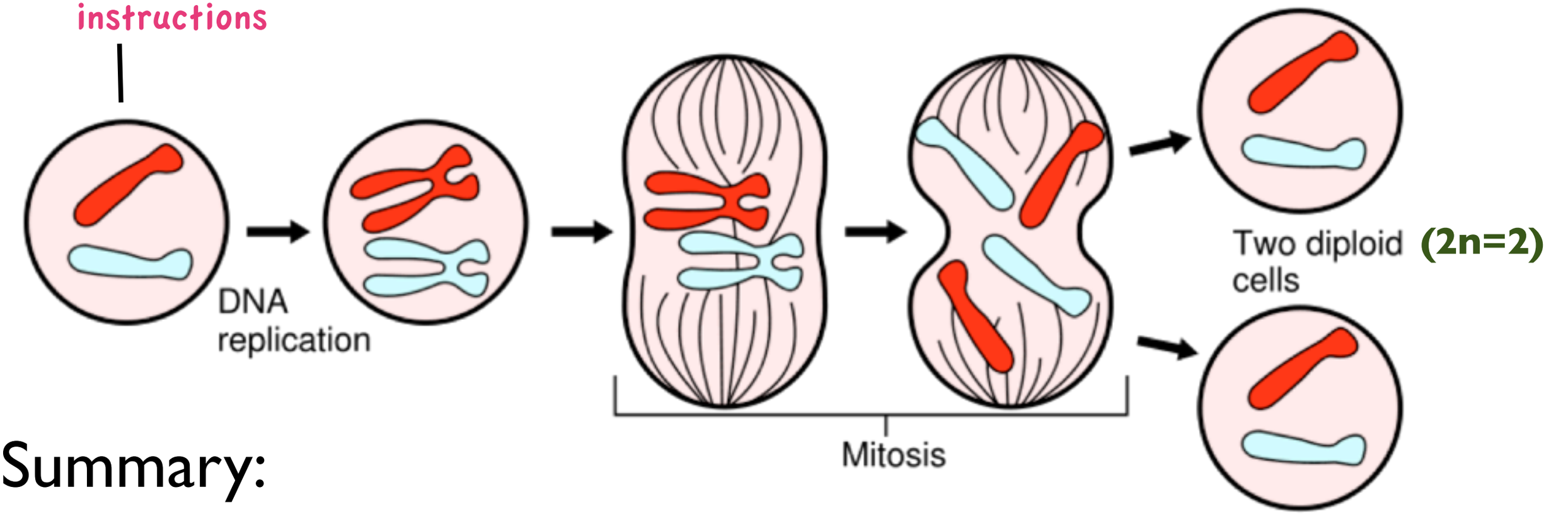



"Nice try! We only need *one* of you. You can just turn around and be on your way, buddy."

# Cellular Division- Eukaryotes (Mitosis)

Two or more linear chromosomes that contain genetic instructions




Summary:

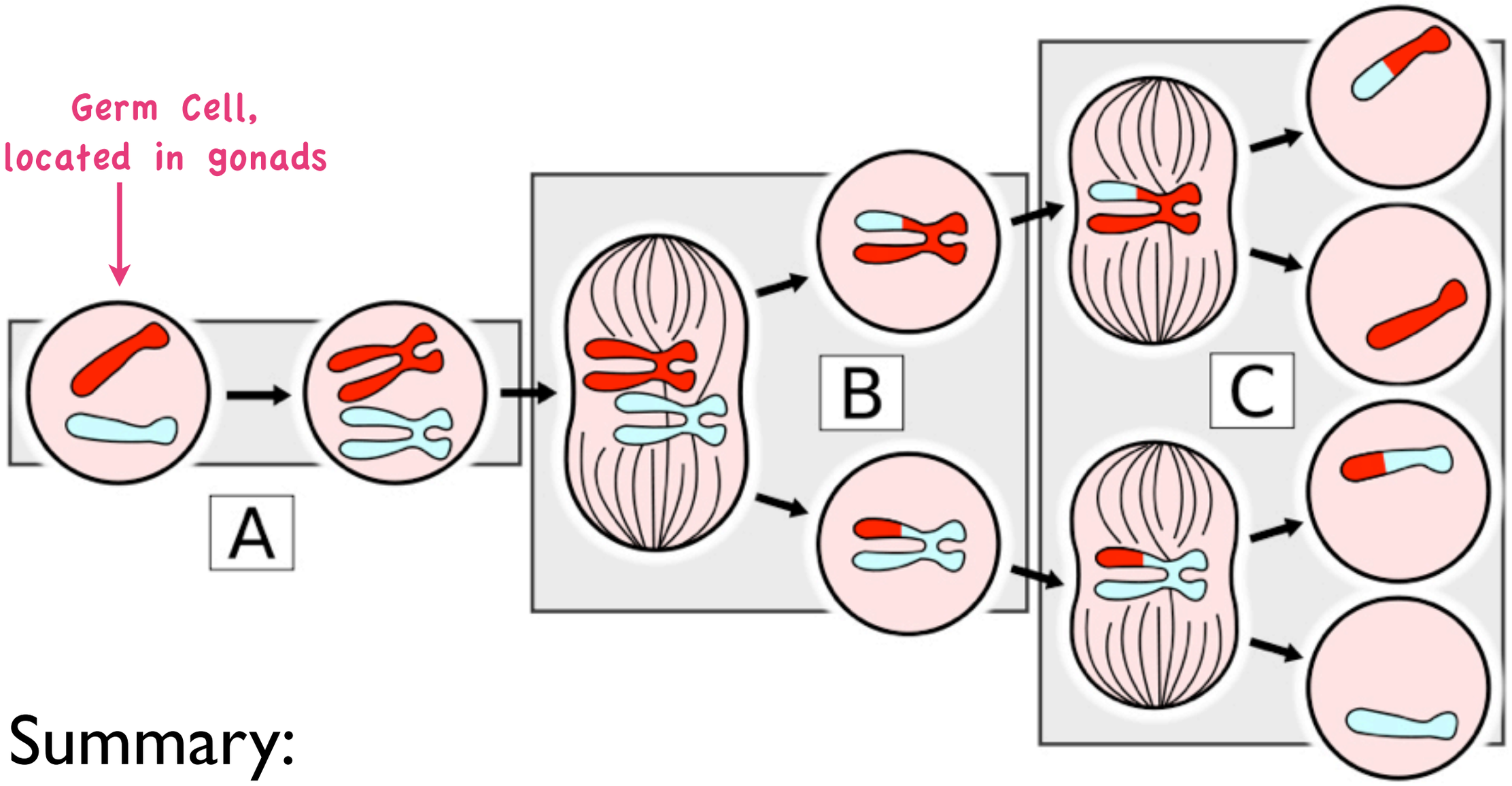
-2 diploid cells produced

-identical to parent & each other

-same # of chromosomes as parent cell

-used in growth, repair and development of a multicellular organism

# Cellular Division- Eukaryotes (Meiosis)




Summary:

-4 haploid cells produced

-unique to parent & each other

-half the # of chromosomes as parent cell

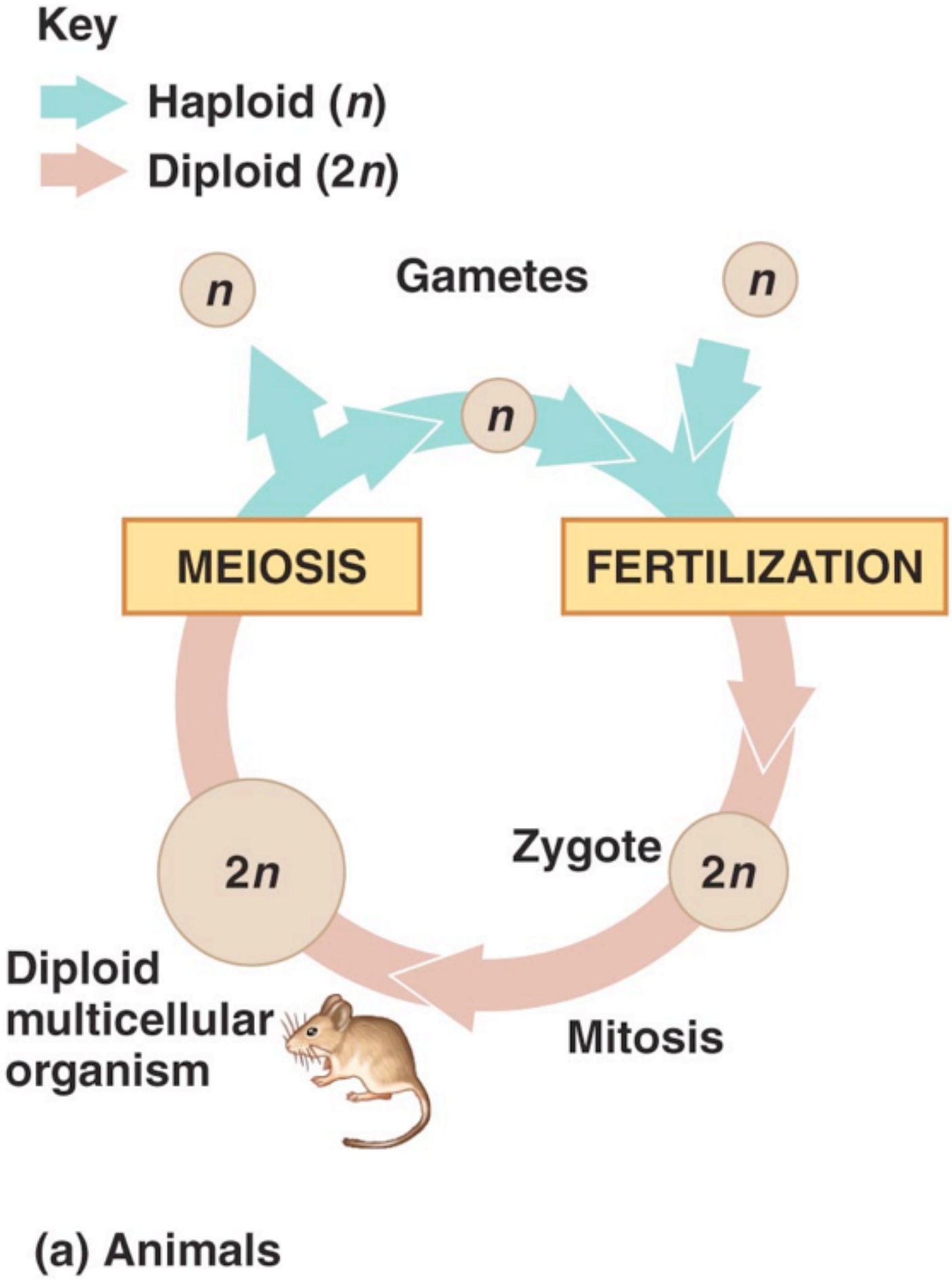
-produces sperm and eggs (gametes)

# There are Two Types of Reproduction

- ASEXUAL REPRODUCTION.
  - the parent/cell passes exact copies of its genetic instructions to its offspring/daughter cells
  - the offspring or daughter cells are called *clones*
    - any difference that does happen to show up in the offspring is a result of a genetic mistake (mutation)
- SEXUAL REPRODUCTION.
  - two parents give rise to offspring that have unique combinations of genetic instructions inherited from the two parents
  - in contrast sexually produced offspring are vary from parents and siblings, they are not exact replicas

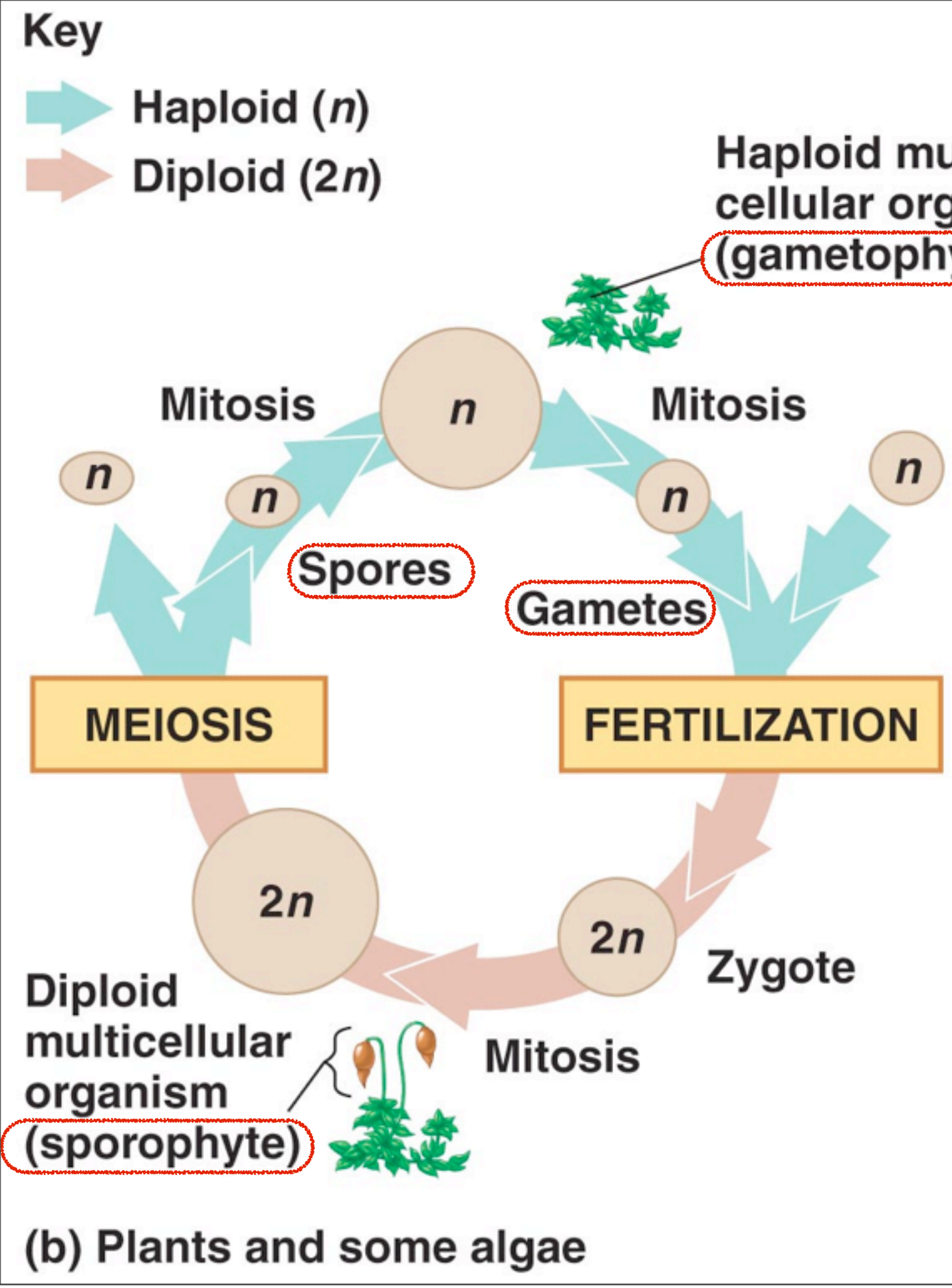
# *Reproductive Strategies have*

- ASEXUAL REPRODUCTION.
  - (+)Energetically Inexpensive
  - (+)Faster and more offspring produced
  - (-)Generates *No Variation
- SEXUAL REPRODUCTION.
  - (-)Energetically Expensive
  - (-)Slower and less offspring produced
  - (+)Generates Much Variation



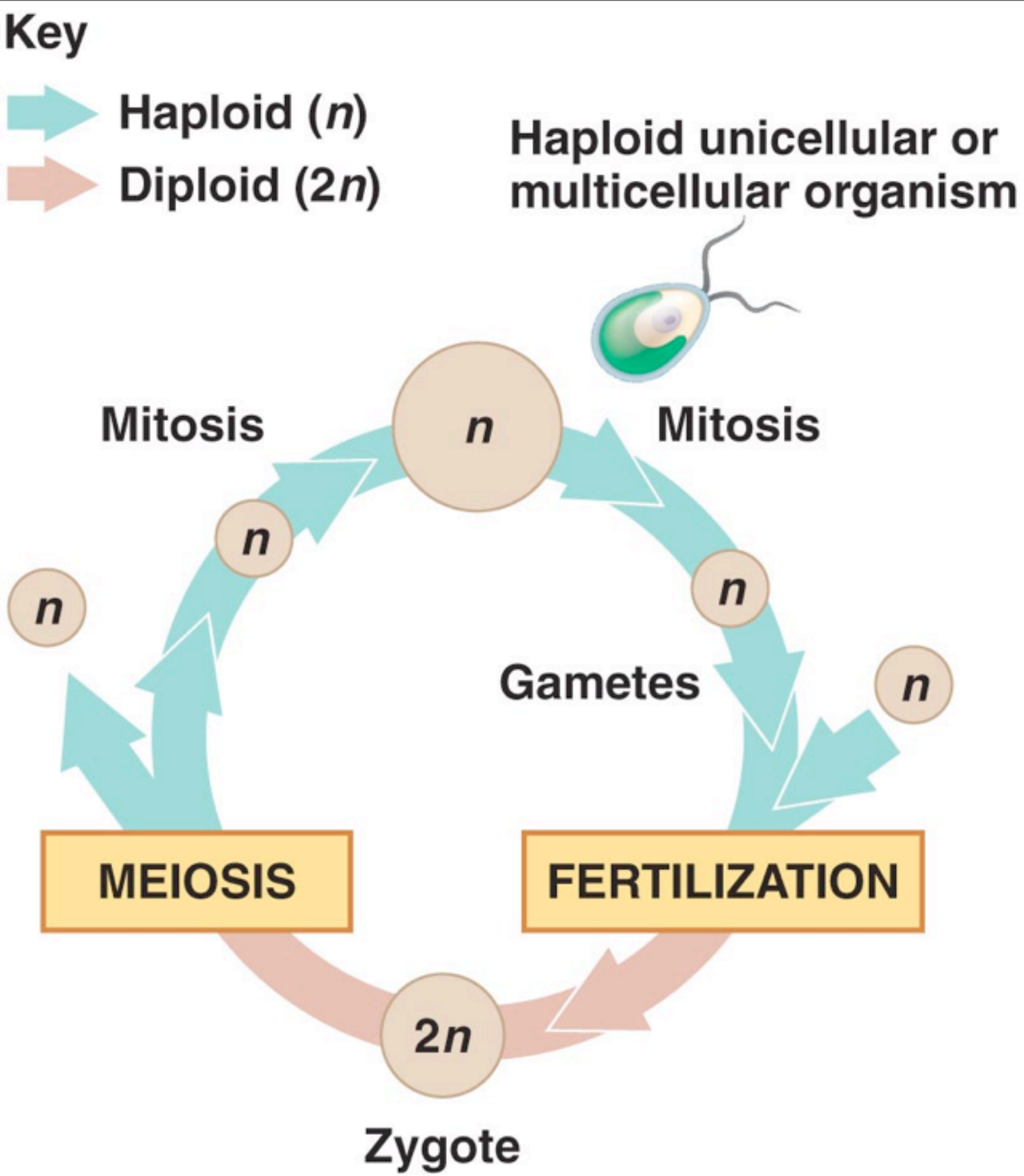

# Variation in Sexual Life Cycles

The alternation of meiosis and fertilization is common to all sexually reproducing organisms...BUT the timing of these two events vary from species to species




# Alternation of Generations

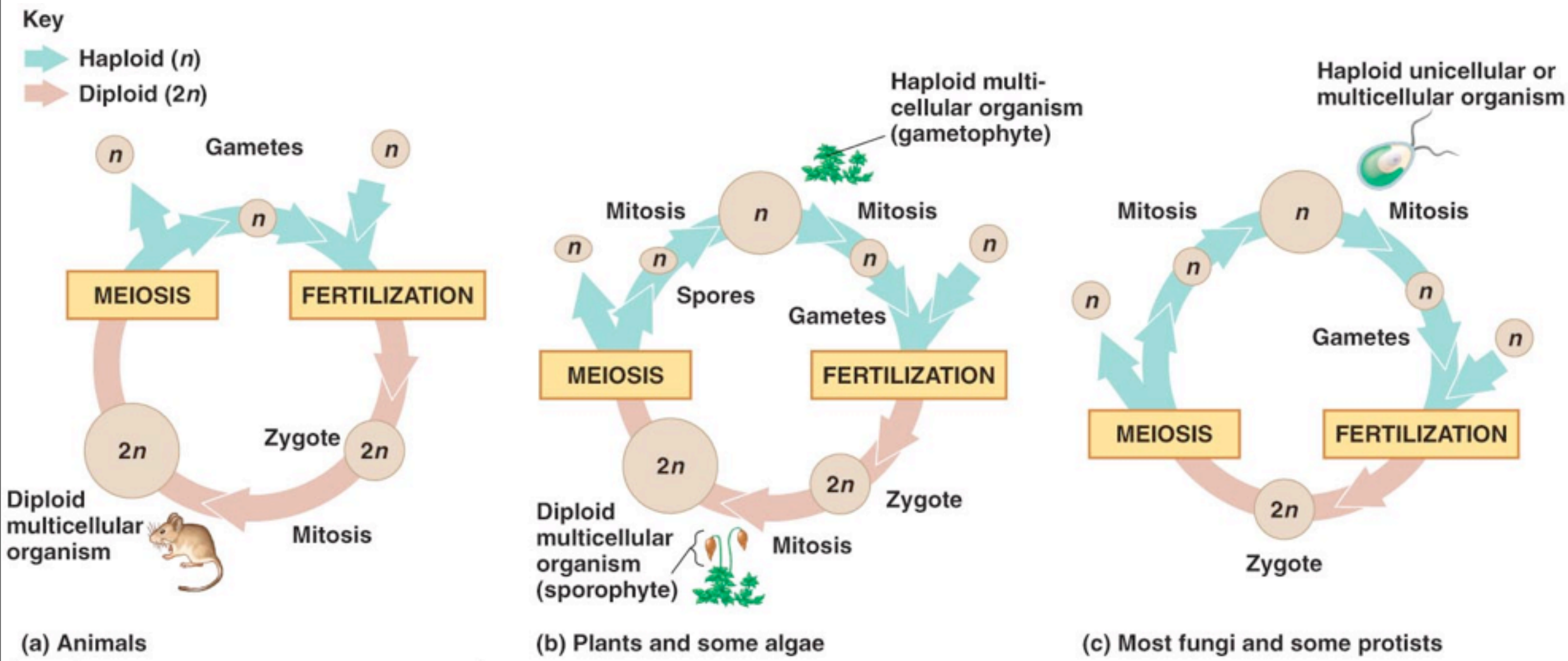
This type includes both diploid and haploid stages that are multicellular!




# Variation in Sexual Life Cycles

This type has only one diploid stage...the single celled zygote

# Variation in Sexual Life Cycles Comparisons






NOTE: that either haploid or diploid cells can divide by mitosis, depending on the cycle.

NOTE: however only diploid cells can divide by meiosis, because haploid cells have only one set of chromosomes and can not be further reduced.

# Animals

## Reproduction

# Animal Reproduction Intro

- Most animals reproduce sexually.
- The diploid stage dominates the life cycle
- *Gametes* (sperm & eggs) are produce via meiosis
- In most species a small flagellated sperm swims to and fertilizes a large immobile egg
- The fusion of sperm and egg produces a single celled *zygote*
- The zygote proceeds to divide via mitosis over and over again and the new cells then grow and develop into a multicellular (*adult) organism

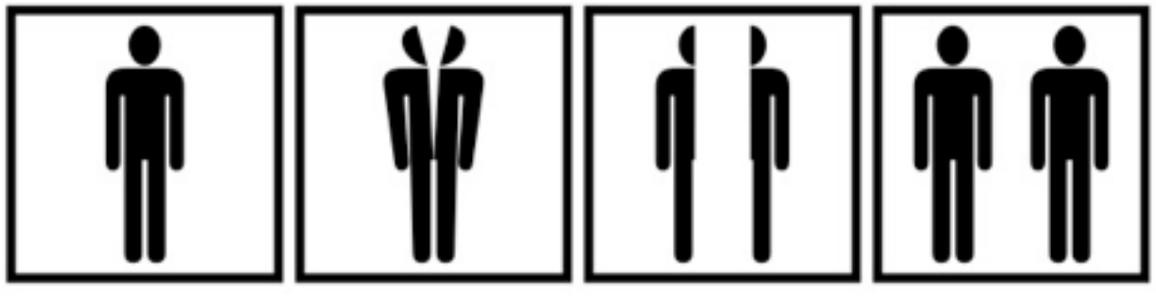
# Animal Reproduction Intro

- Some animals develop directly into adults, like humans.
- Most animal life cycles include at least one larval stage.
- *Larva*- is a sexually immature form of an animal
  - Larva have: 1. distinct morphology 2. eats different food 3. may live in different habitats

- Animal larva will eventually undergo metamorphosis
- *Metamorphosis*- a developmental transformation that turns the animal in a juvenile which resembles the adult but is still sexually immature

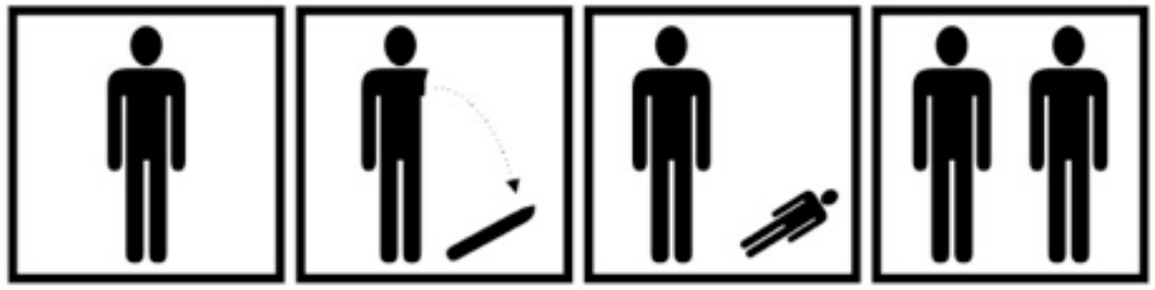
# Animal Reproduction (Asexual)

- Most animals reproduce primarily or exclusively sexually.
- Some animals reproduce primarily asexually.
- Their are several forms of asexual reproduction
  - Fission



  - Budding

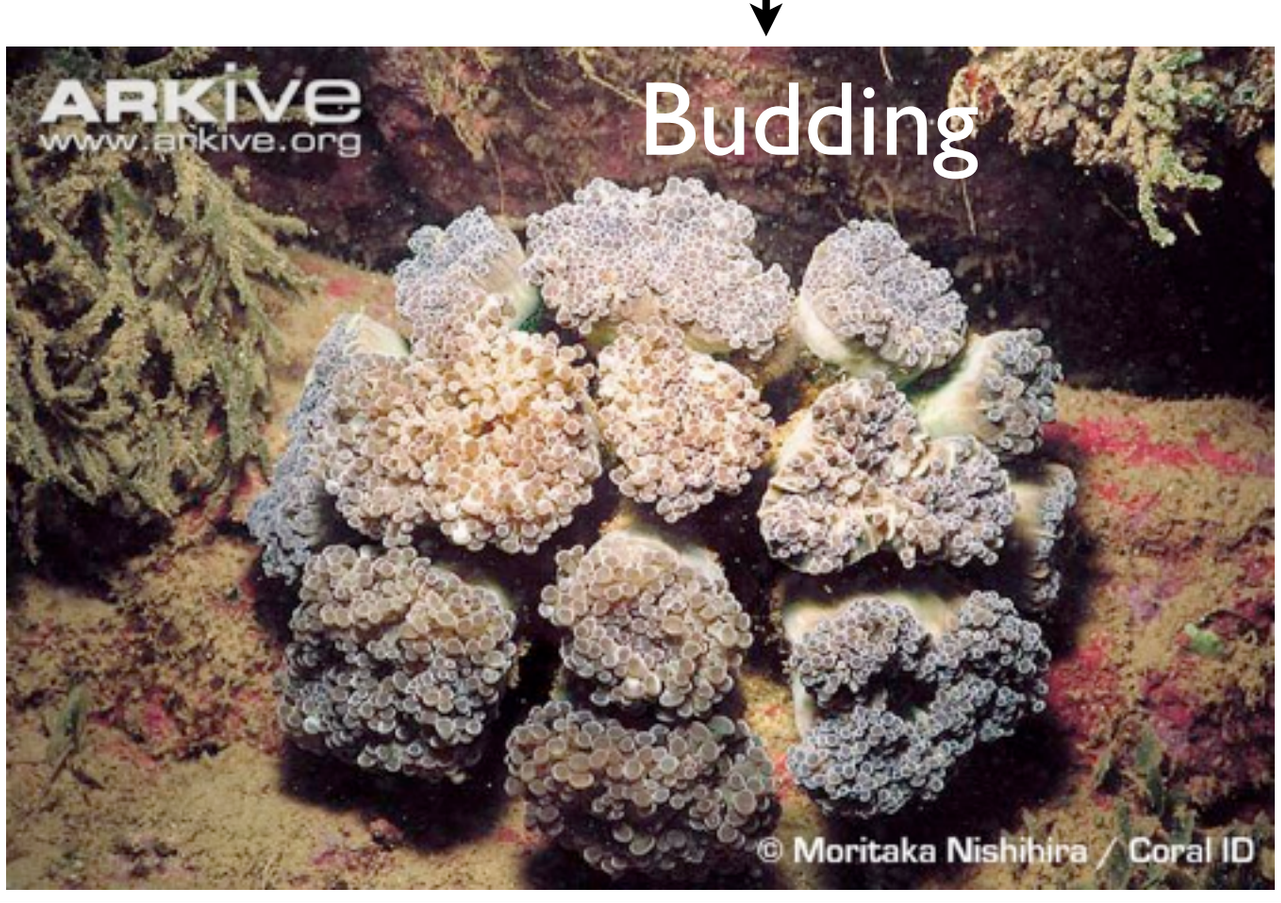
  - Fragmentation, Regeneration



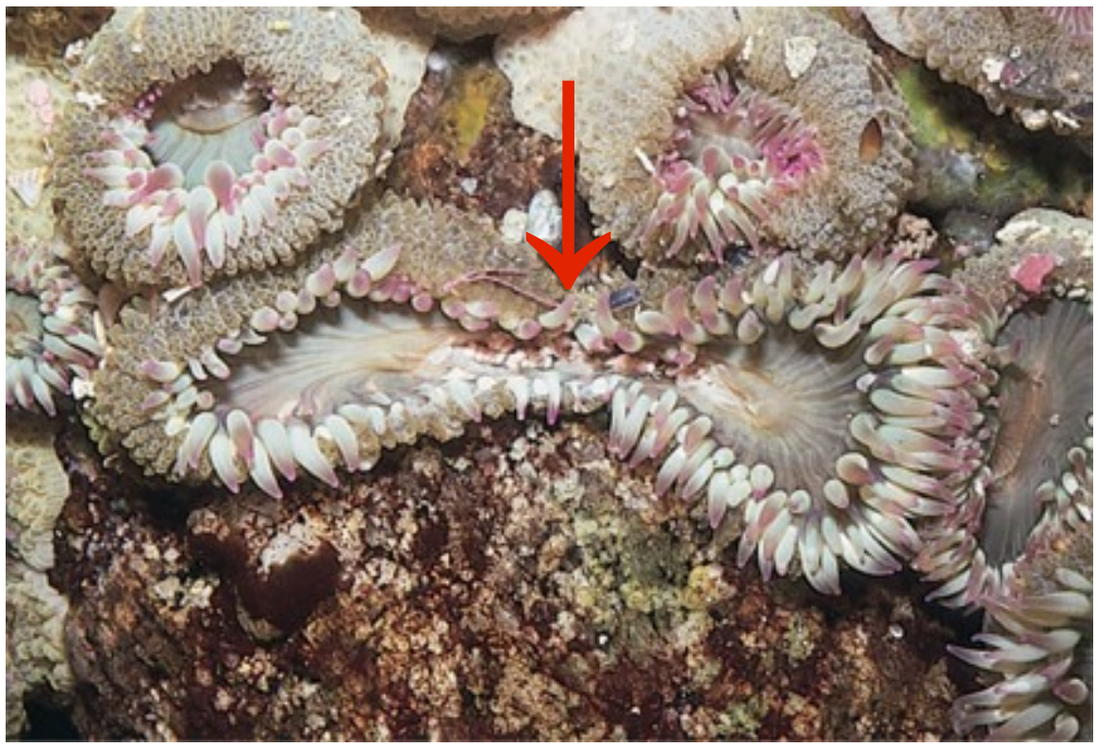
  - Parthenogenesis

# Fission & Budding

- *Fission*- separation of parent organism into two individuals of equal size.
  - ex. Sea Anemones
- *Budding*- new individuals arise from outgrowths of existing ones
  - ex. stony corals



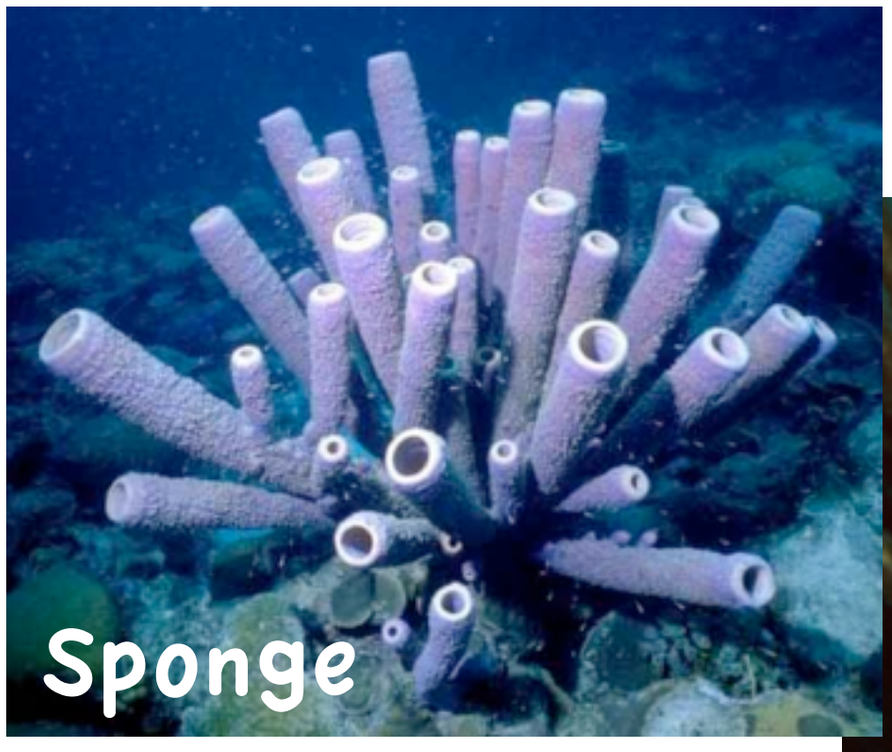

Fission



# Fragmentation-Regeneration

- This mode of reproduction involves two steps.
- *Fragmentation*- the breaking of the body into several pieces
- *Regeneration*- regrowth of the lost body parts
  - If one piece regrows into a complete organism then it is considered reproduction

Bristle Worm



Sponge

Sea Squirt

# Parthenogenesis

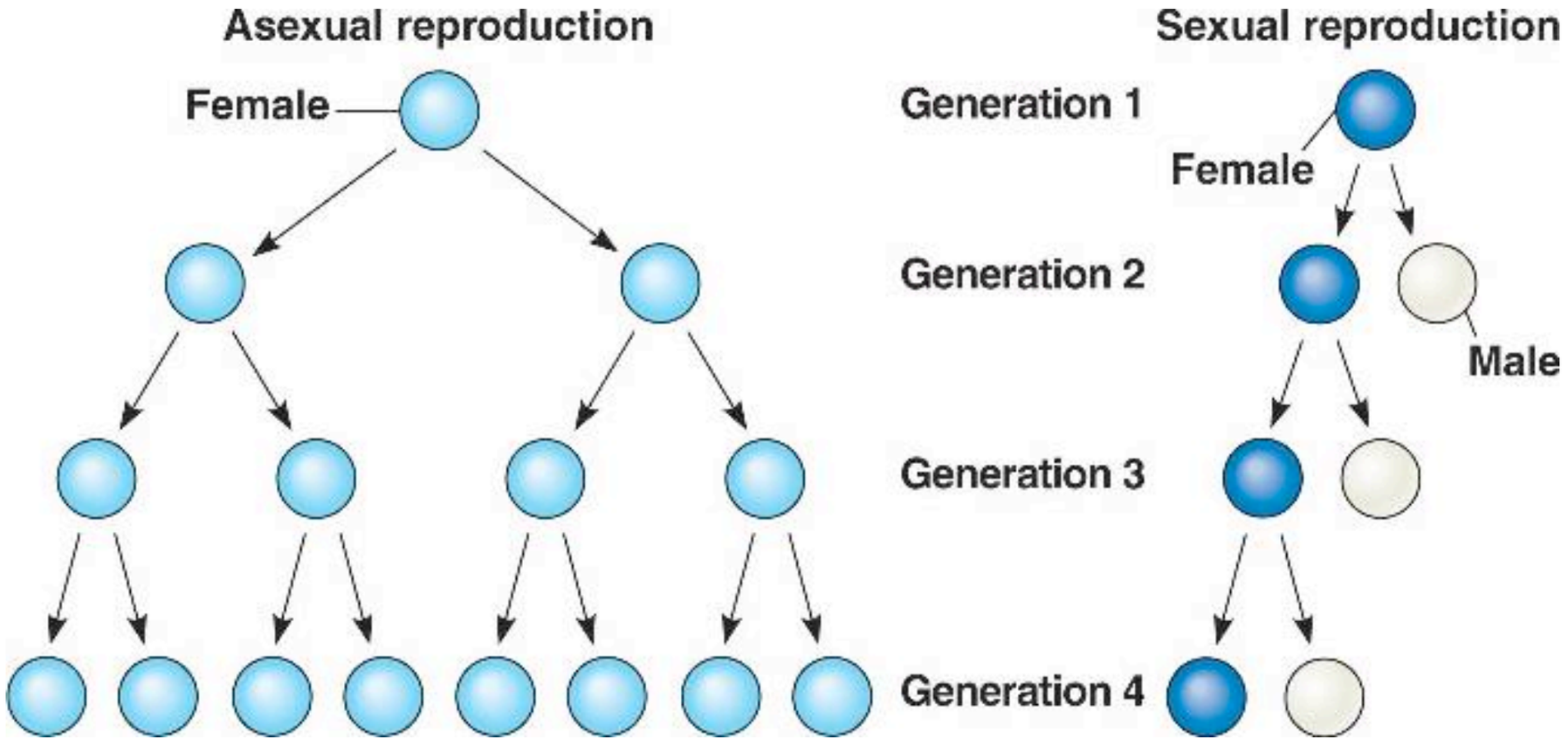
- *Parthenogenesis*- an egg develops into organism without being fertilized.
  - *ex. bees, wasps, ants, recently discovered Komodo Dragon and certain species of hammerhead sharks!*
- The progeny can be haploid or diploid
- Male honeybees (drones) are fertile haploid adults, they produce sperm and eggs without meiosis
- Female honeybees are sterile diploid adults (except queen is fertile diploid adult) that develop from fertilized eggs

# Animal Reproduction (Sexual)

## Sex...An Evolutionary Enigma

- Sex must enhance reproductive success or survival because it would otherwise disappear...but HOW

Clearly asexual reproduction can produce far more offspring and sexual organisms only pass 50% of their genes into the future



# Sex...An Evolutionary Enigma

## ...possible explanations

- Sexual reproduction may enhance the reproductive success of parents when environmental factors change rapidly.
    - Variation generated through sex might speed up the rate of adaptations.
        - Another idea is that shuffling genes helps a population to get rid of harmful genes
- Asexual reproduction is expected to be most advantageous in stable, favorable environments because it perpetuates successful genes faithfully and precisely

# Animal Reproduction (Sexual)

## Reproductive Cycles

- Most animals exhibit cycles in reproductive activity
- Cycles are often seasonal
  - reproduction takes place when resources are most available and environmental conditions most favorable
  - Ex. Sheep
    - Ewes (females) are fertile for two weeks in the fall
    - sheep gestation period is 5 months
    - lambs are born in the spring
- Cycles are controlled by hormones
- Regulated by environmental cues: light, temp, rainfall, etc

# Reproductive Cycles & Climate Change

- Because reproductive cycles are often seasonal, climate change can decrease reproductive success
- Danish scientists have shown a 75% decline in Caribou reproduction compared 1993
  - Caribou migrate to calving grounds using daylight length as their cue
  - Since 1993 the average spring temps have rise by 4 degrees C.
  - As a result tundra thaws earlier, plants sprout earlier and the timing has resulted in less nutrition for nursing females and a higher mortality rate among calfs

# A Very Different Reproductive Cycle

- Whiptail lizard video clip...

# Variation in Patterns of Sexual Reproduction

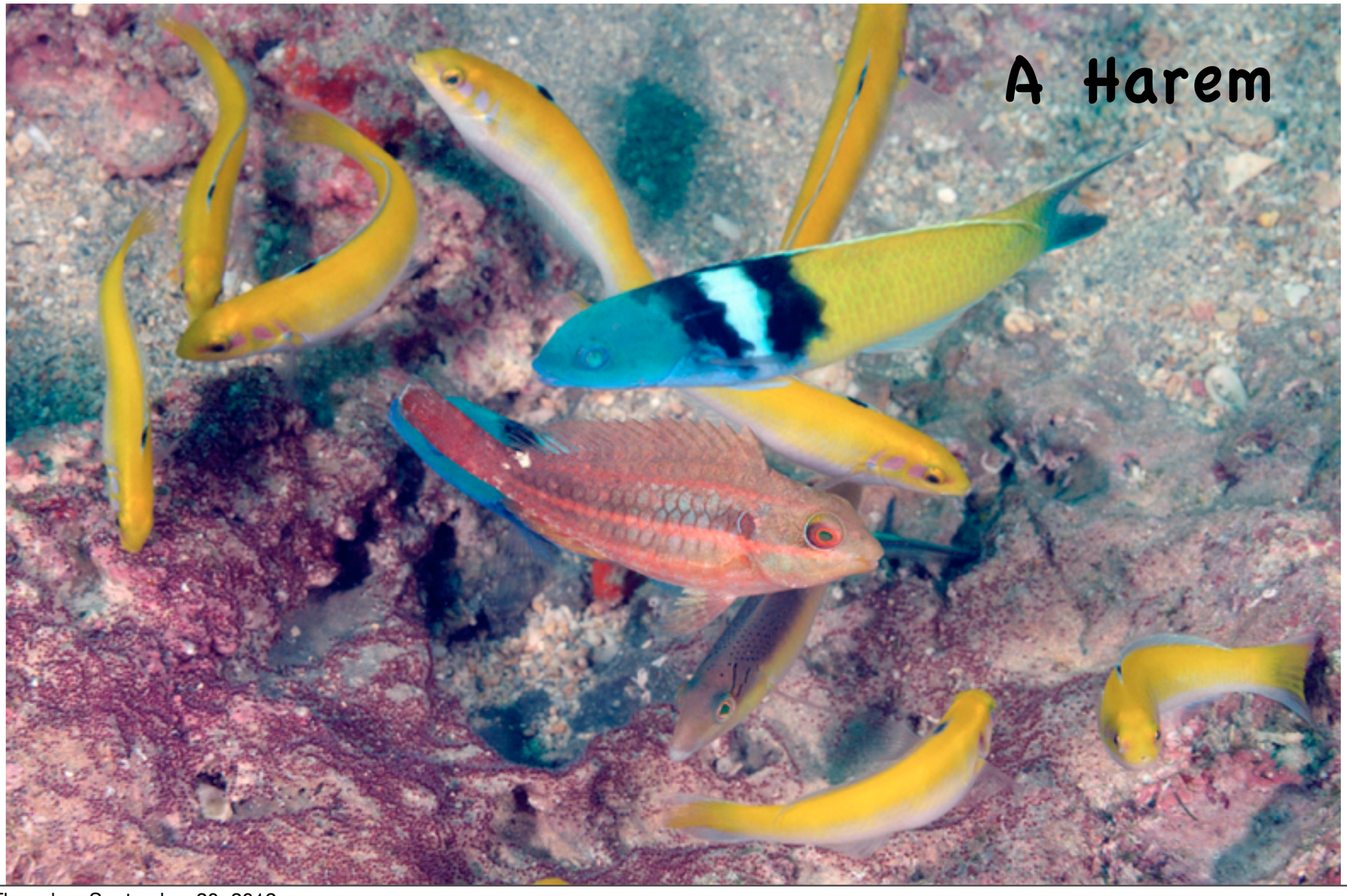
- Finding a partner for sexual reproduction can be challenging.
- Adaptations have arose to meet this challenge.
- Some species meet this challenge in a novel way- to blur the distinction between male and female
- *Hermaphroditism*- individuals are born with male and female reproductive systems.
    - finding a mate is now easier because any two individuals can mate
        - each animal donates and receives sperm
- Some hermaphrodites are capable of self-fertilization, which does not require any partners!

- *Hermaphroditism*- arose in sessile organisms, whose lack of locomotion challenged their ability to reproduce

- ex. barnacles, clams, sea slugs

# Another Novel Adaptation of Sexual Reproduction

- Sex Reversal; organisms can transform into the opposite sex.
  - Bluehead Wrasse, Oysters




A single, Large Male

Numerous, Small Females

# Females ⟶ Males

- Bluehead Wrasse live in harems, a single male and numerous females
- When male dies, the largest female turns into a male
- In one the new male is producing sperm
- Large males are needed to defend the harem

# Males ⟶ Females

- Oysters are born male and grow
- When male grows large enough it becomes female
- The larger the female the more eggs it produces
  - males' sperm production is similar in all sizes
- The increased number of gametes increases the odds of fertilization in the open ocean

# Fertilization Depends on Mechanisms that Bring Together Sperm and Eggs of the Same Species

- *Fertilization*- the union of sperm and egg, it can occur internally or externally.
- *Internal Fertilization*- sperm are deposited in or near female's reproductive tract and fertilization occurs inside this tract.
  - moist external environments are not required
  - parents do make contact with each other
  - it requires cooperative behavior on each behalf
  - it requires sophisticated and compatible reproductive systems
  - males require copulatory organ to deliver sperm and females require receptacle organ to receive and store sperm

- *External Fertilization*- females release eggs into the environment and males then fertilize them.
- moist environments are required so gametes do not dry out and it provides a medium for sperm to swim to the egg
- parents do not even make contact with each other
- timing of gamete release by both sexes is critical (spawning)
- location is important the closer males and females, the better
- Gamete release is controlled by hormones, environmental cues or if it is not synchronized it requires courtship behaviors (ex. frog).
    - Courtship behaviors have additional advantages: 1. it allows mate choice and 2. it triggers gamete release at the same time

- No matter how fertilization occurs, the mating organisms make use of *pheromones*.
- *Pheromones*- are chemicals released by one organism that can influence the the physiology and behavior of others of the same species
  - they are small volatile or water soluble
  - they require only tiny amounts exert their effects
  - many act as male attractants

External Fertilization in Frogs

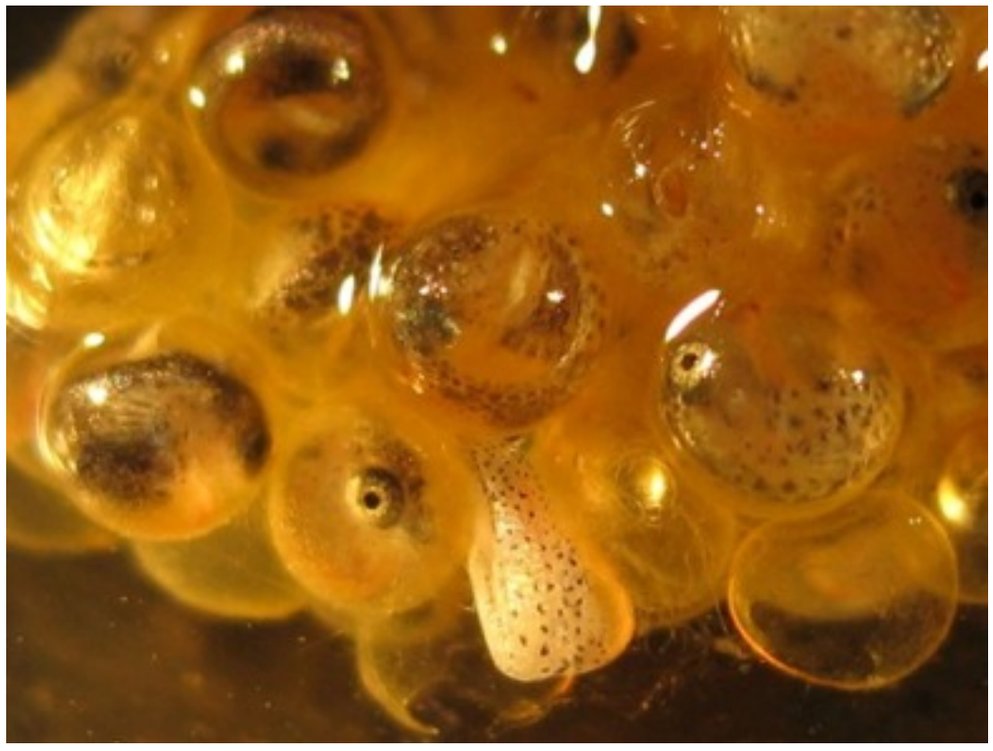
- T-shirt pheromone video clip...

# Ensuring the Survival of Offspring

- External Fertilization typically produces far more gametes but a lower fraction of zygotes survive
- Internal Fertilization typically produces far less gametes but a higher fraction of zygote survival
  - embryos are better protected and furthermore organisms with internal fertilization most often provide greater parental care of young

Internally Fertilized Bird Eggs

Which egg type provides greater protection?



Externally Fertilized Fish Eggs

- Rather than protecting embryos in eggs some animals retain the embryo for part or all of its development inside the female reproductive tract
  - Marsupials mammals (kangaroos and opossums) spend a only a short period of development in mother's *uterus*, crawl out and complete development in a pouch receive nourishment from a mammary gland
  - Eutherian (placental) mammals (humans) complete their development in the mother's *uterus*, they receive nourishment from mother's blood supplied through a temporary organ called the *placenta*.

What do you call a baby kangaroo?

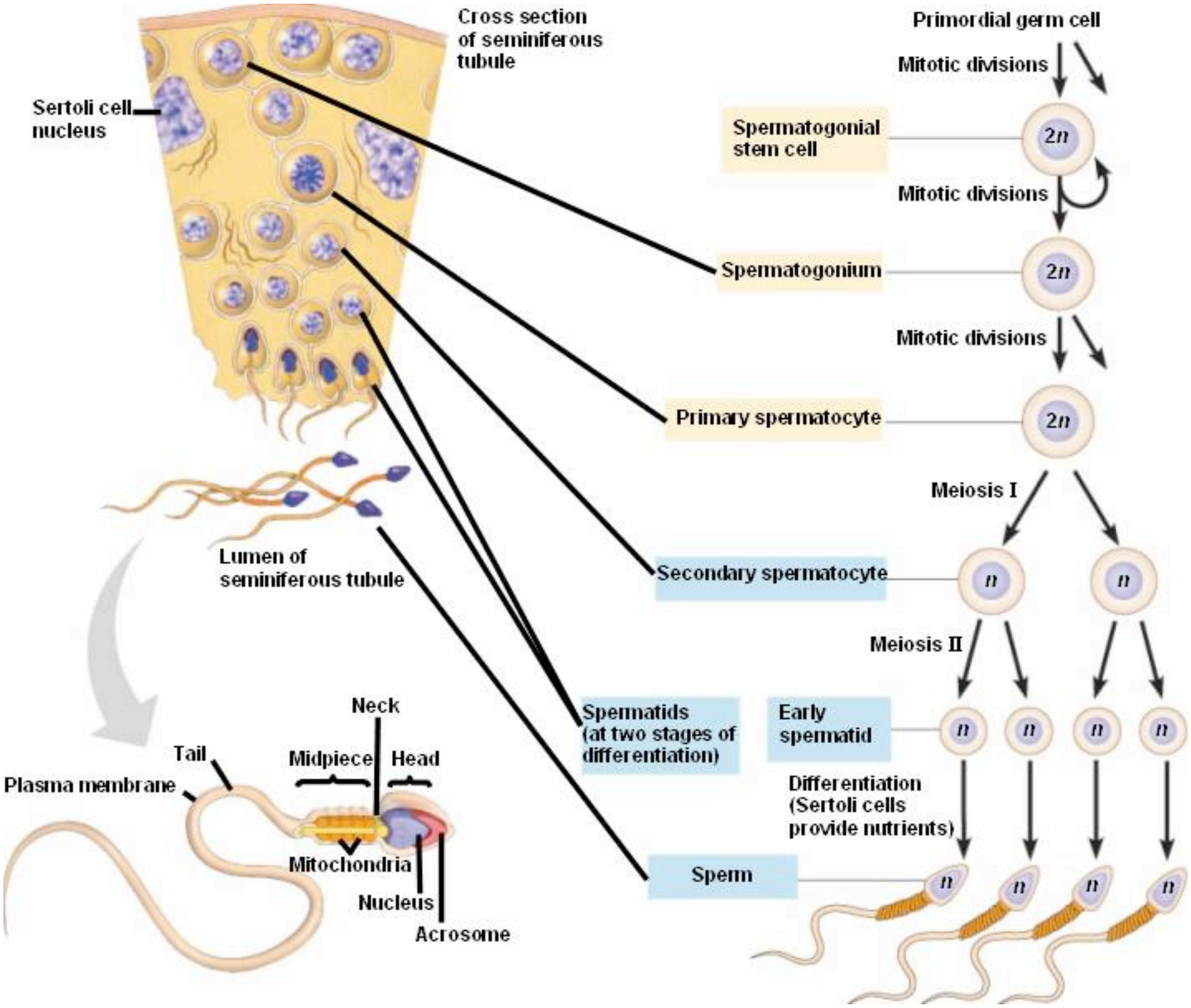
**...a JOEY**


BBC

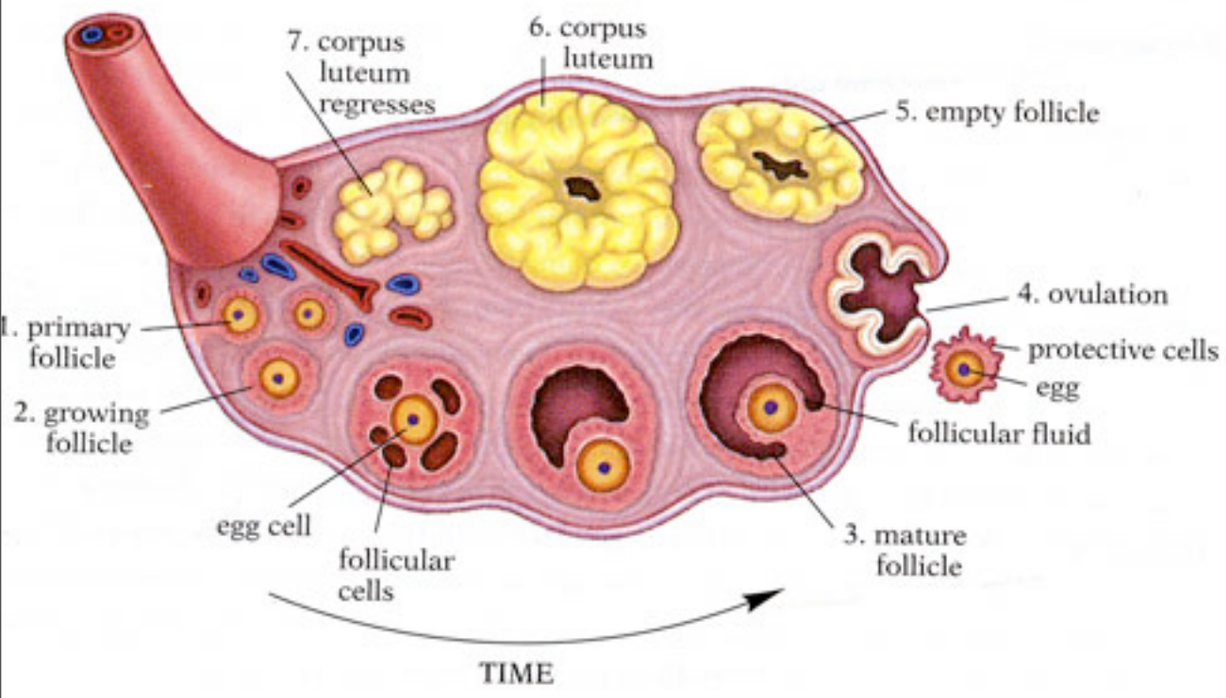
# Gamete Production

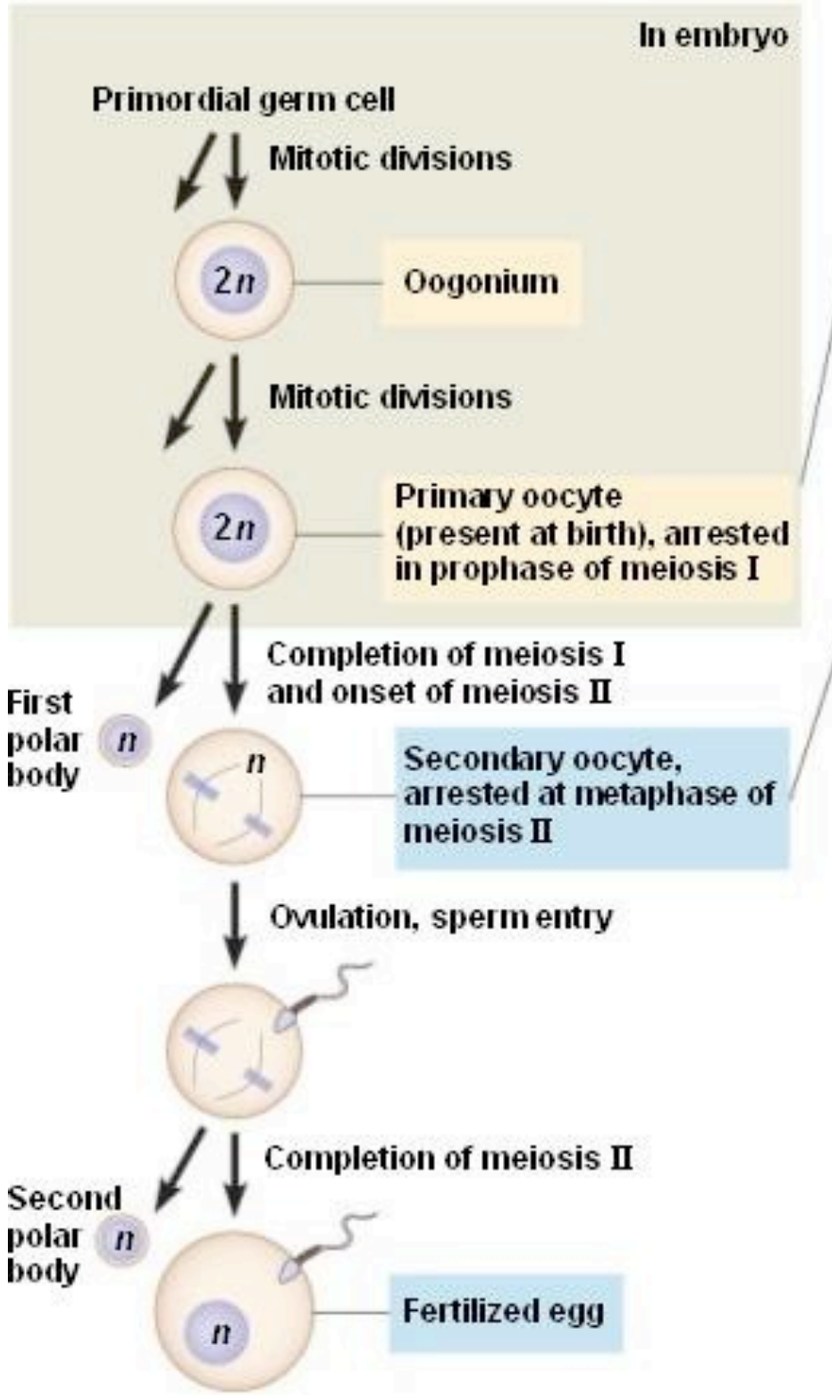
- Sexual reproduction in animals relies on special cells..... (germ cells) that give rise to sperm and eggs
- In some simple reproductive systems special cells in animal's body cavity (coelom) give rise to sperm and eggs
- In most and more elaborate reproductive systems special organs are used to produce gametes, *gonads*
  - *Male Gonads are Testes*
  - *Female Gonads are Ovaries*

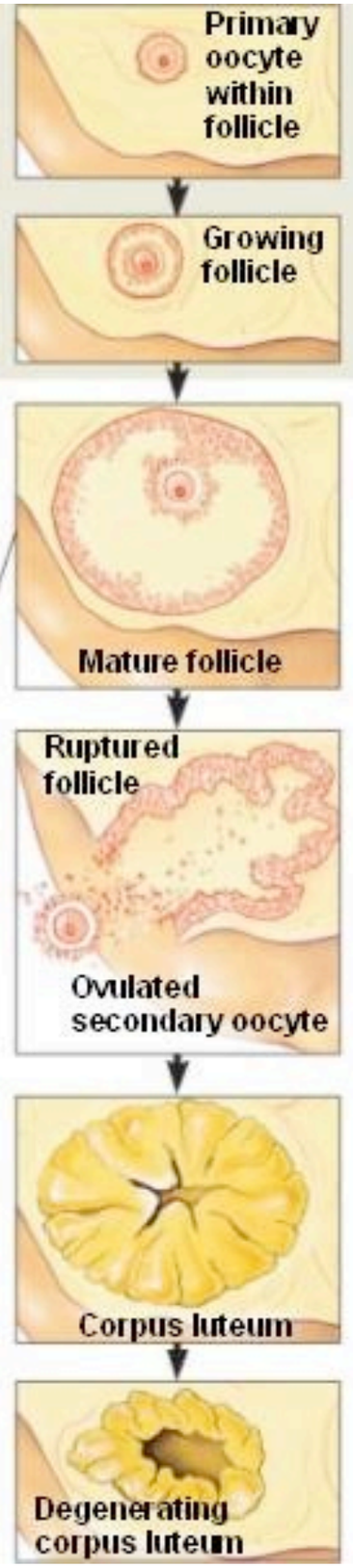
# Spermatogenesis



# Oogenesis


7. corpus luteum regresses
6. corpus luteum
5. empty follicle
4. ovulation
protective cells
egg
follicular fluid
1. primary follicle
2. growing follicle
egg cell
follicular cells
3. mature follicle
TIME


In embryo
Primordial germ cell
Mitotic divisions
2n
Oogonium
Mitotic divisions
2n
Primary oocyte (present at birth), arrested in prophase of meiosis I
Completion of meiosis I and onset of meiosis II
First polar body
n
n
Secondary oocyte, arrested at metaphase of meiosis II
Ovulation, sperm entry
Completion of meiosis II
Second polar body
n
n
Fertilized egg


Primary oocyte within follicle
Growing follicle
Mature follicle
Ruptured follicle
Ovulated secondary oocyte
Corpus luteum
Degenerating corpus luteum

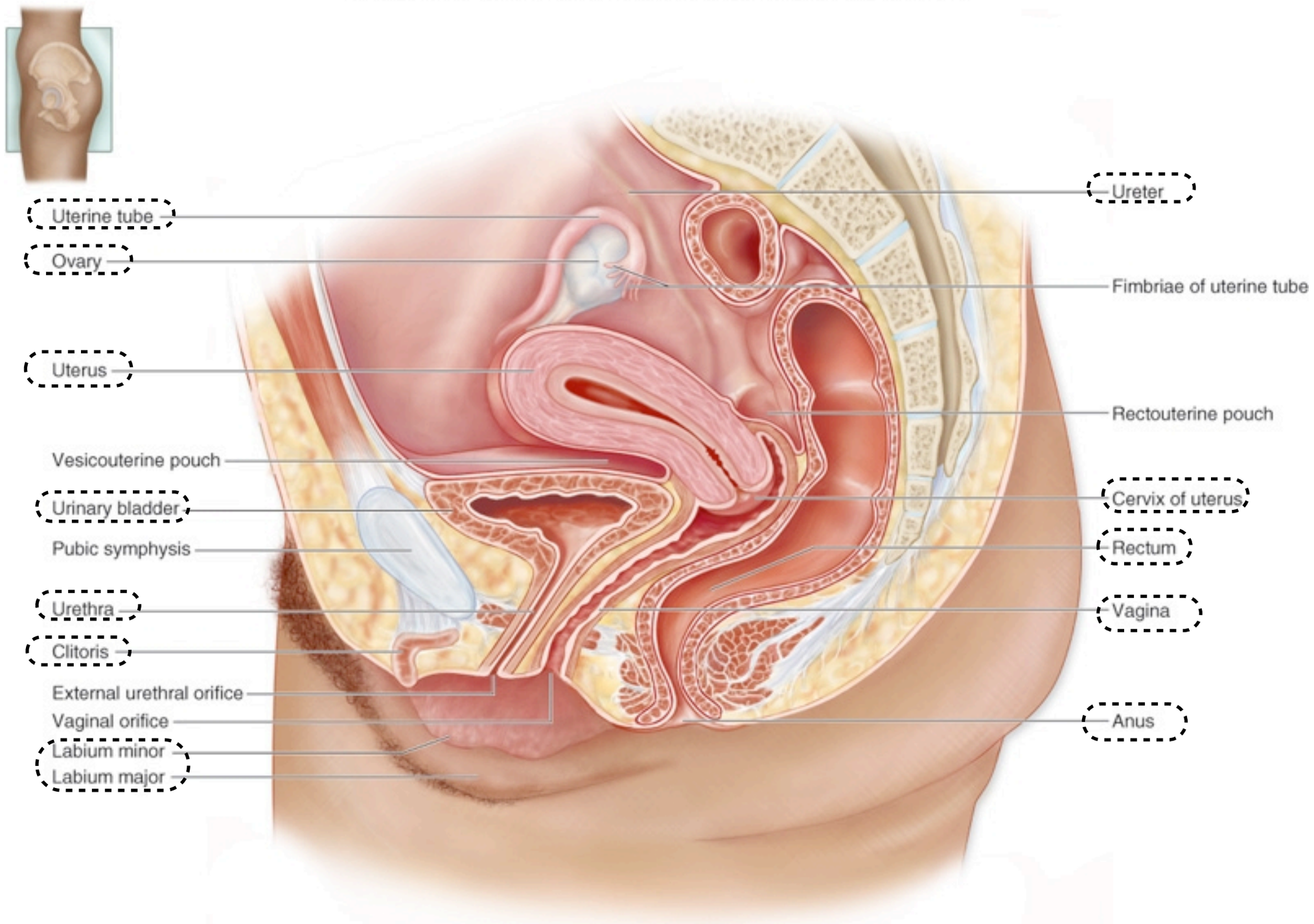
# Comparison of Gamete Production

## 3 Significant Differences

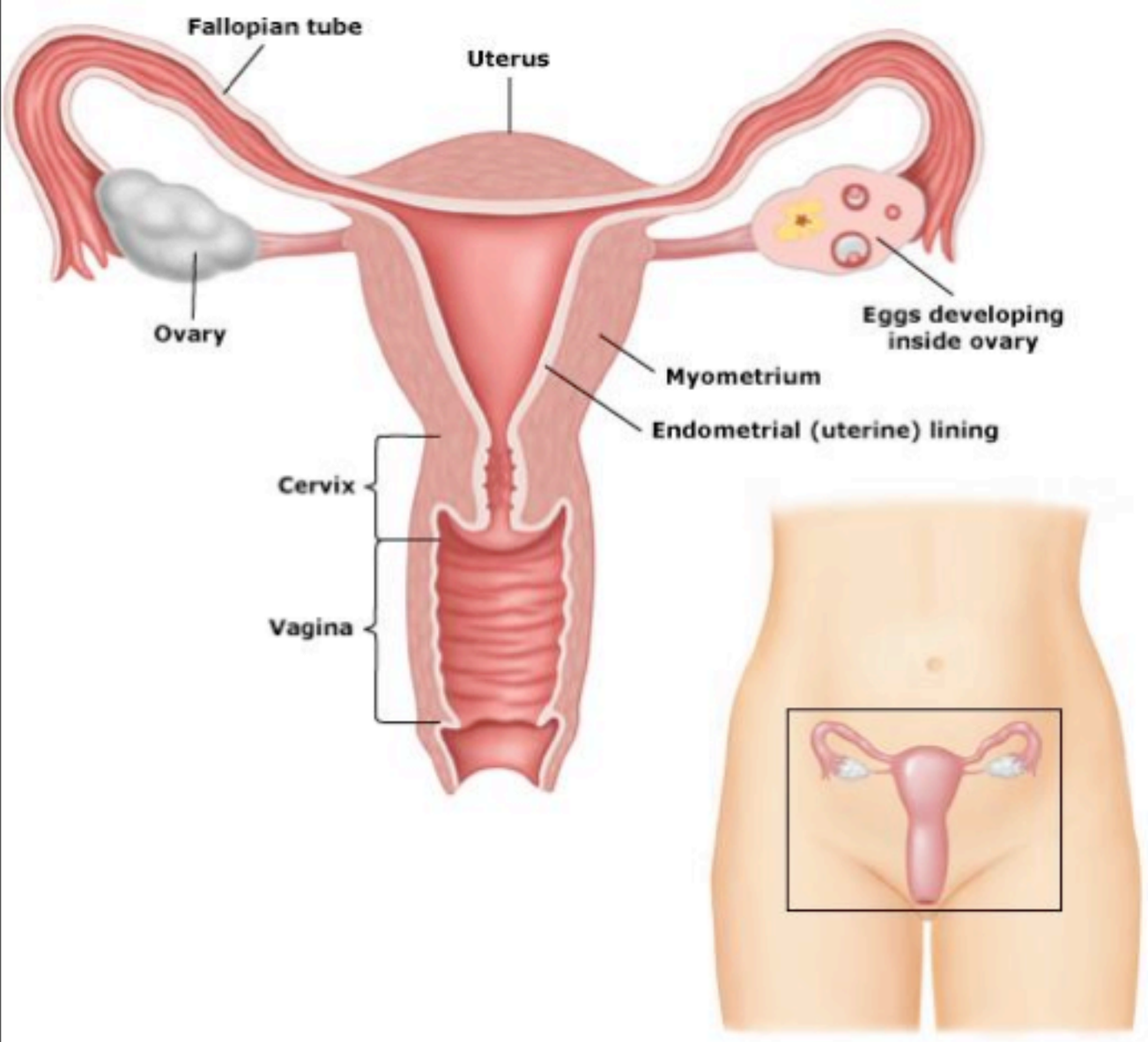
- First; Spermatogenesis produces 4 functioning gametes, oogenesis only produces 1
- Second; Spermatogenesis occurs throughout adolescence and adult, oogenesis begins before birth and stops completely at menopause (~50 years of age)
- Third; Spermatogenesis produces gametes in a continuous sequence, oogenesis produces gametes with long interuptions

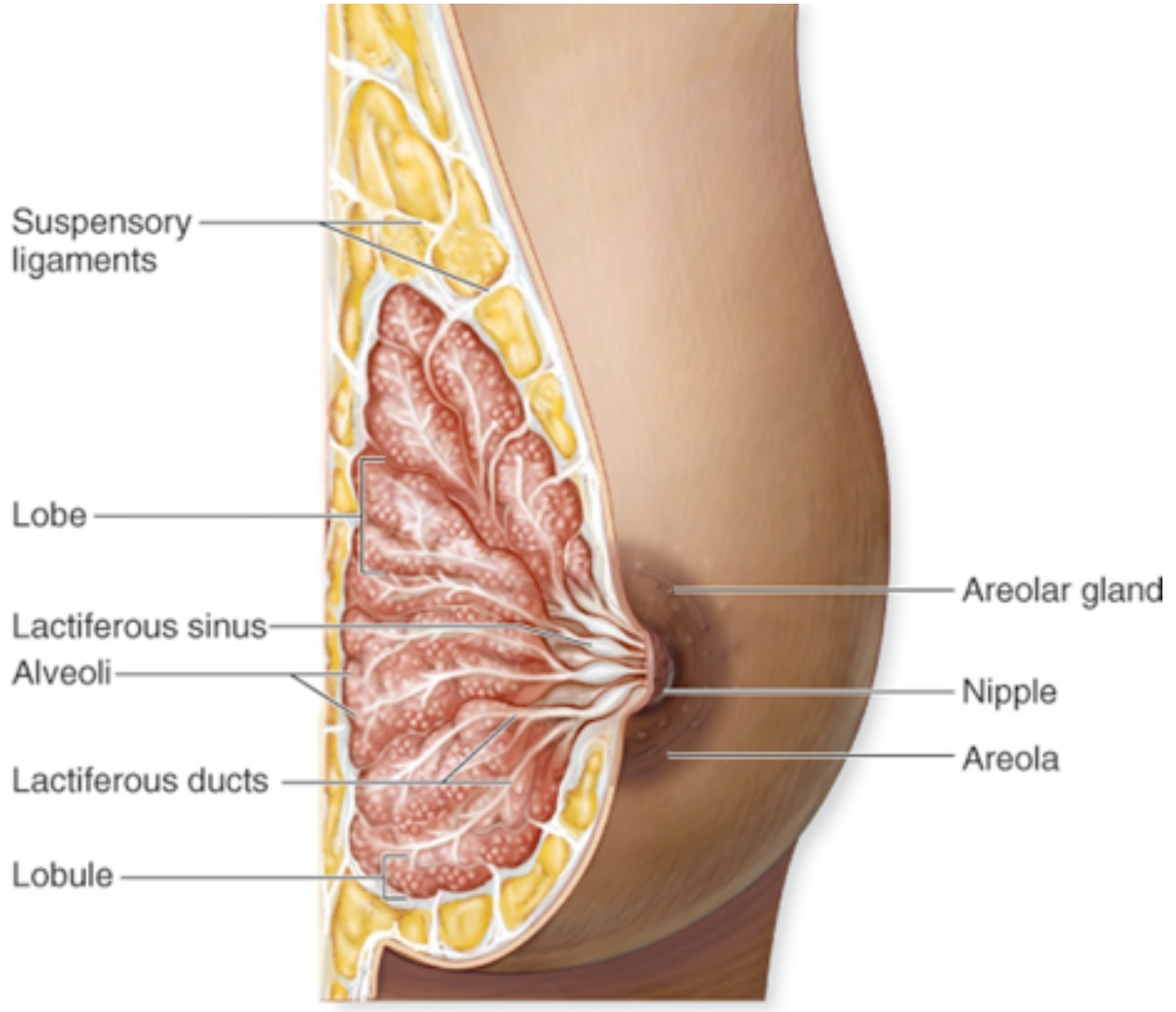
# Human Reproductive System

## Female Anatomy



# Female Anatomy




Not apart of the reproductive system BUT important in reproduction.

Both males and females have breasts but generally only females excrete milk

# Ovaries

- The female gonads, the ovaries
  - Lie in the abdominal cavity
- Each ovary is enclosed in a tough protective capsule and contains many follicles
- A follicle consists of one egg cell surrounded by one or more layers of follicle cells
  - Cells of the follicle produce estrogen
  - Most of the 400,00 + follicles formed before birth

# Ovulation


- The process of ovulation
  - Expels an egg cell from the follicle
    - occasionally more than egg is ovulated (fraternal twins!)
  - Starting at puberty and ending at menopause
  - A ripened egg lives for ~ 24 hours
- The remaining follicular tissue then grows within the ovary
  - To form a solid mass called the corpus luteum, which secretes estrogen and progesterone, depending on whether or not pregnancy occurs

# Oviducts & Uterus

- The egg cell is released into the abdominal cavity
  - Near the opening of the oviduct, or fallopian tube
- Cilia in the tube
  - Convey the egg to the uterus

# Vagina & Vulva (external genetalia)

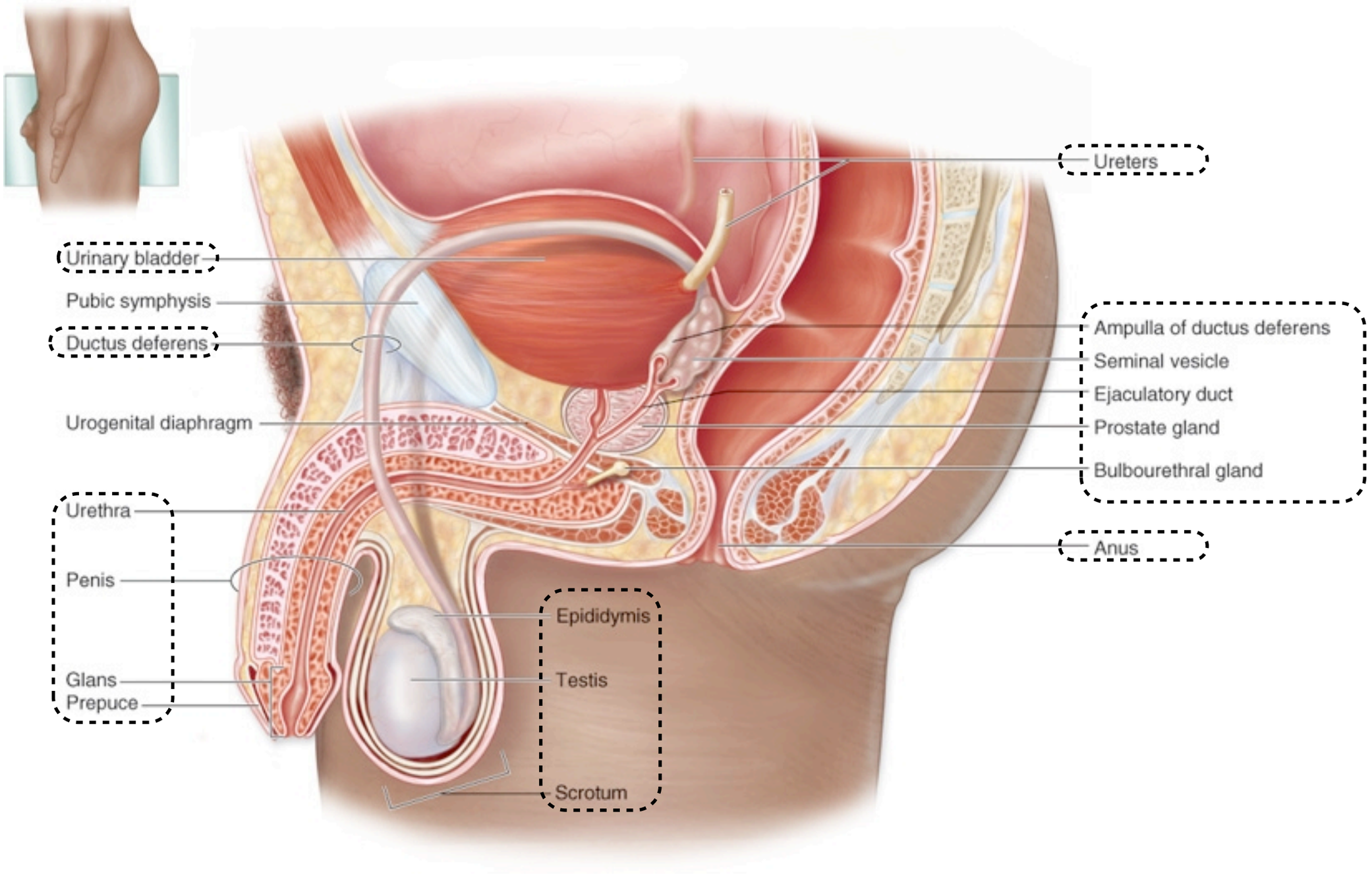
- The vagina is a thin-walled chamber
  - That is the repository for sperm during copulation
  - That serves as the birth canal through which a baby is born
- The vagina opens to the outside at the vulva
  - Which includes the hymen, vestibule, labia minora, labia majora, and clitoris

# Mammary Glands

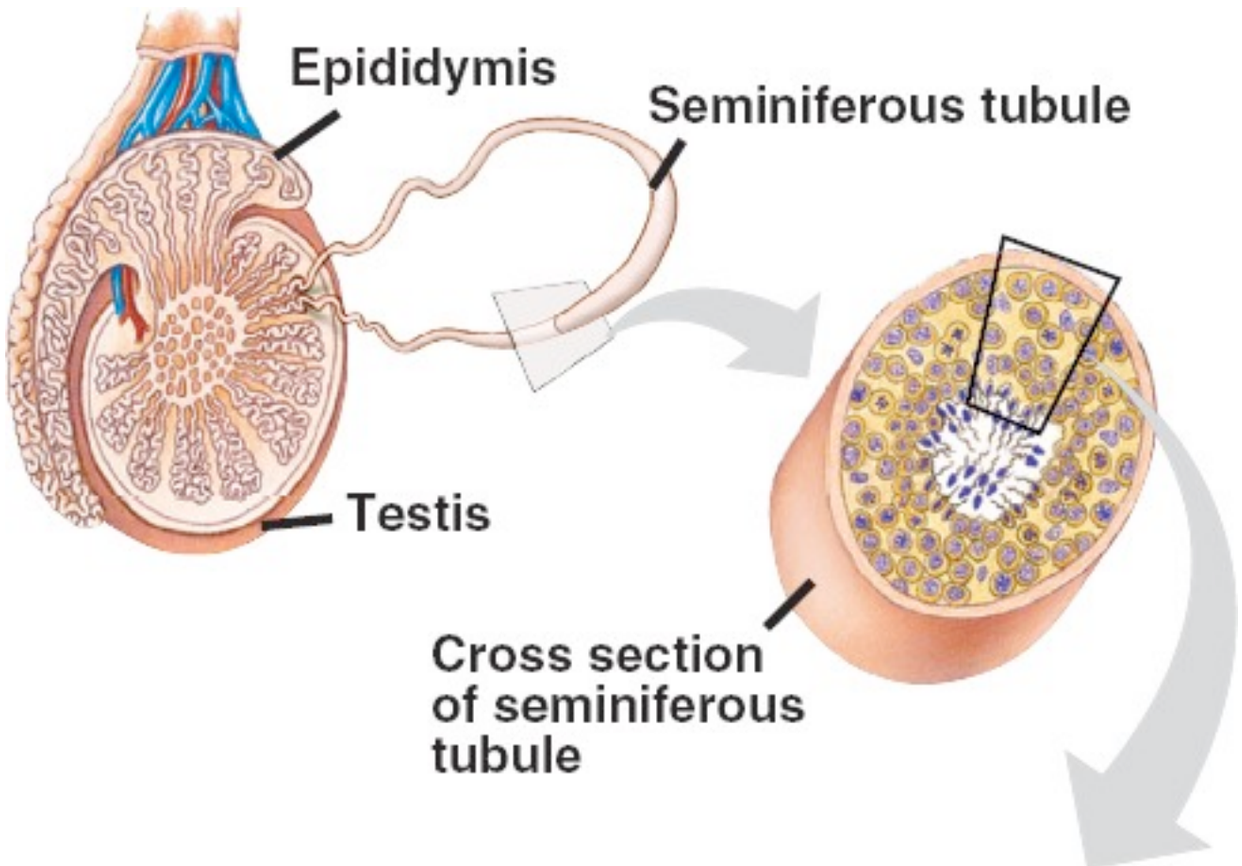
- The mammary glands are not part of the reproductive system
  - But are important to mammalian reproduction
- Within the glands
  - Small sacs of epithelial tissue secrete milk
  - Low estrogen keeps male breasts small and keeps the nipples from connecting to the ducts

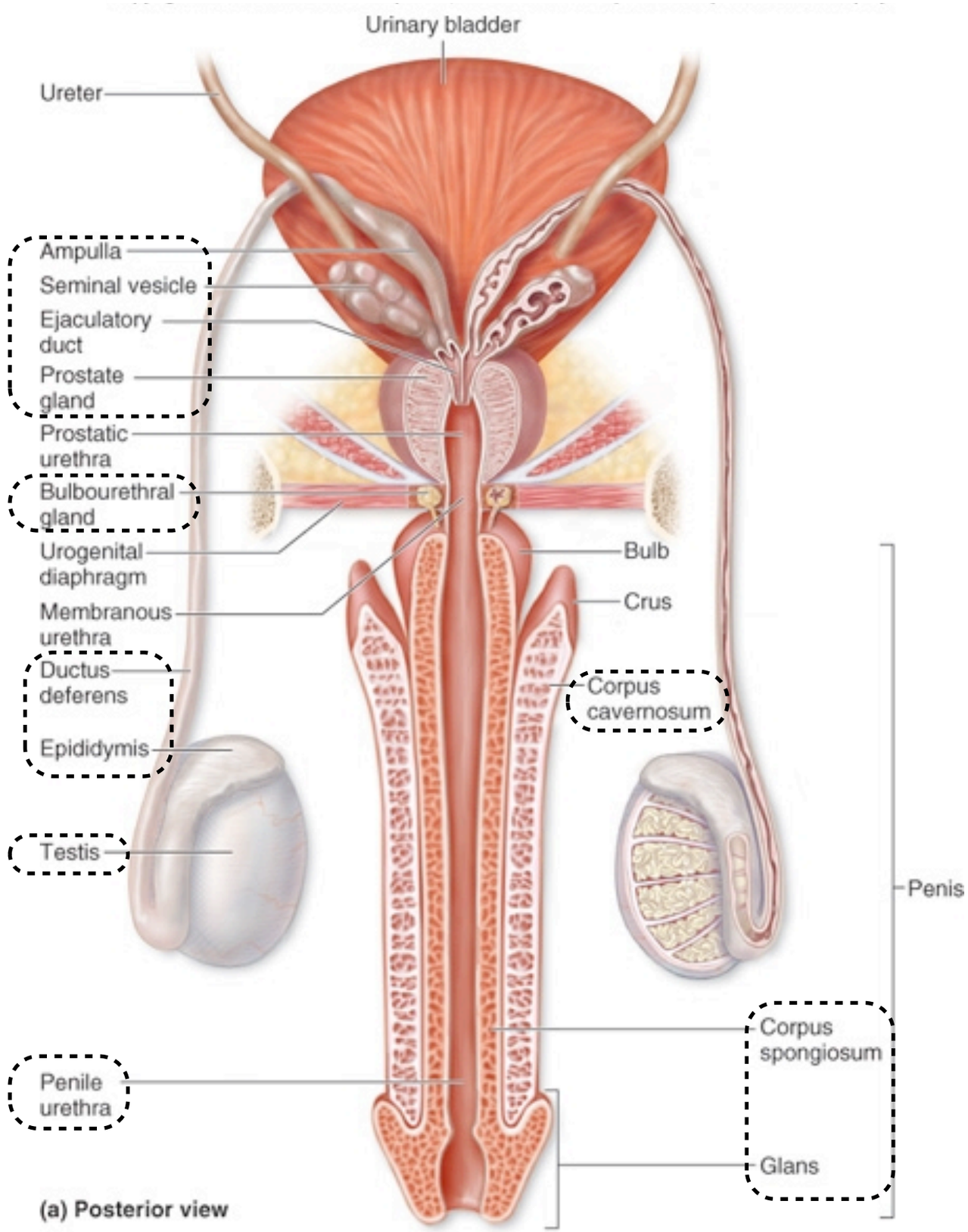
# Human Reproductive System

## Male Anatomy



# Male Anatomy



# Testes

- The male gonads, testes
  - Consist of many highly coiled tubes surrounded by several layers of connective tissue
- The tubes are seminiferous tubules
  - Where sperm form
  - Leydig cells scattered between tubes produce testosterone and other androgens (male steroid hormone)

# Testes/Sperm Production

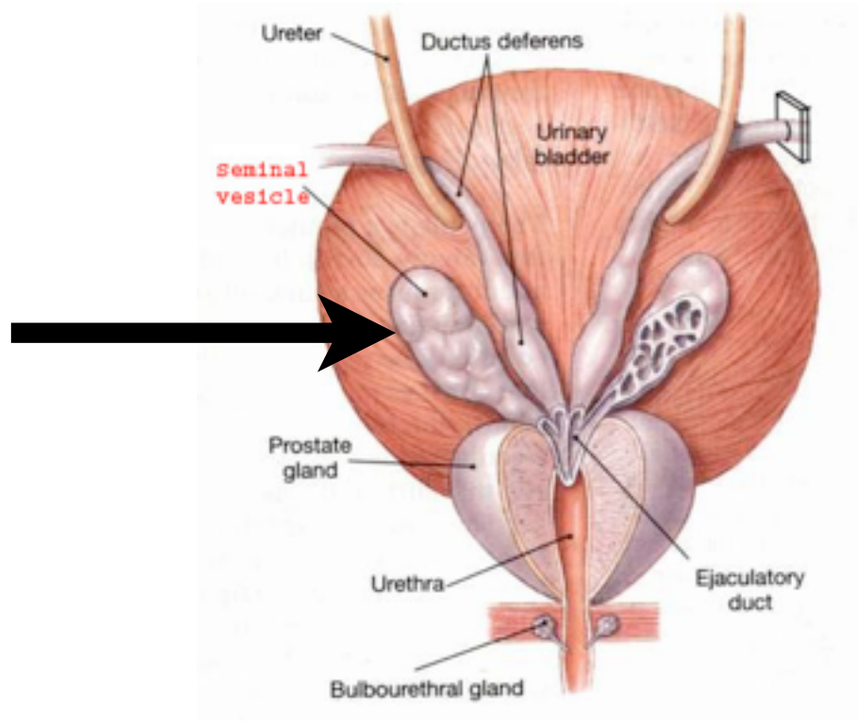
- Production of normal sperm
  - Cannot occur at the body temperatures of most mammals
- The lifespan of human sperm
  - Outside the body on the order of minutes to hours and inside female reproductive tract 5 days or more
- The testes of humans and many mammals
  - Are held outside the abdominal cavity in the scrotum, where the temperature is lower than in the abdominal cavity
  - Rodents move them in and out accordingly and whales and elephants retain theirs

# Ducts

- From the seminiferous tubules of a testis
  - The sperm mature as they pass into the coiled tubules of the epididymis (6 meters in length-takes about 20 days for sperm to get through)
- During ejaculation
  - Sperm are propelled through the muscular vas deferens, the ejaculatory duct, and exit the penis through the urethra
  - Urethra serves both excretory and reproductive functions in males
  - Human copulation transfers 2-5ml of sperm with 70-130 million sperm per ml
  - semen coagulates until it reaches the cervix

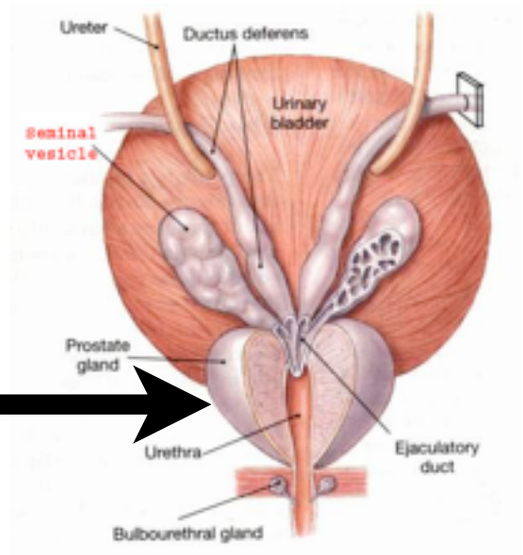
# Glands

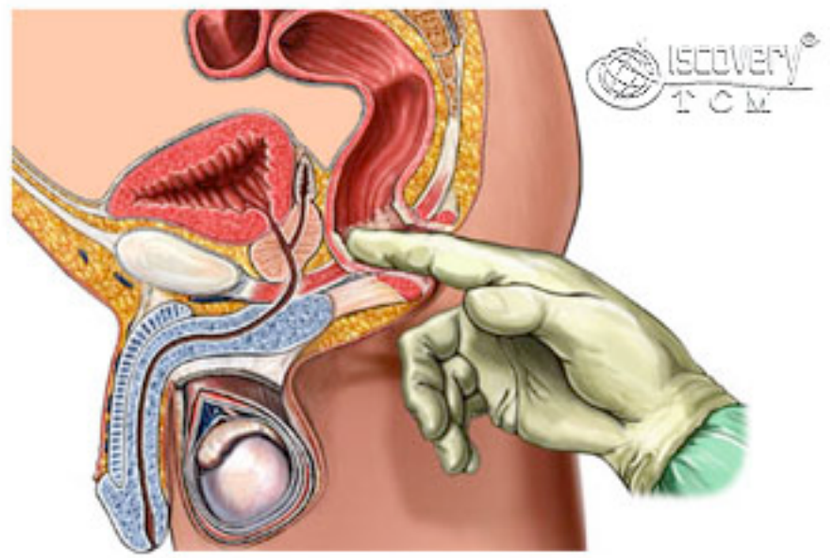
- Three sets of accessory glands
  - Add secretions to the semen, the fluid that is ejaculated
- A pair of seminal vesicles
  - Contributes about 60% of the total volume of semen
  - Thick, yellowish, alkaline fluid
- Contains: mucus, sugar, coagulating enzymes, ascorbic acid and prostaglandins (local regulators)



# Glands

- The prostate gland
  - Largest of three, it secretes its products directly into the urethra through several small ducts
  - Thin and milky fluid
  - Contains: anticoagulant enzymes and citrate

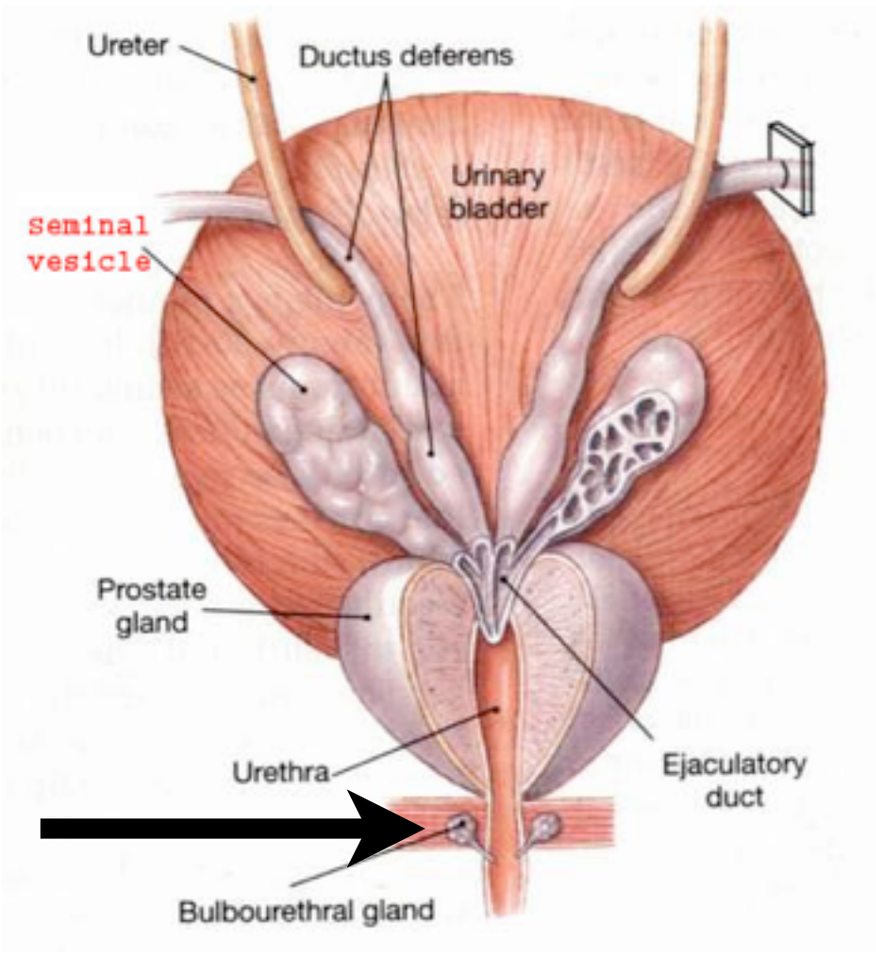



- The prostate gland
  - One of the most common cancers in men
  - 50% of males over the age of 40 have an enlarged prostrate

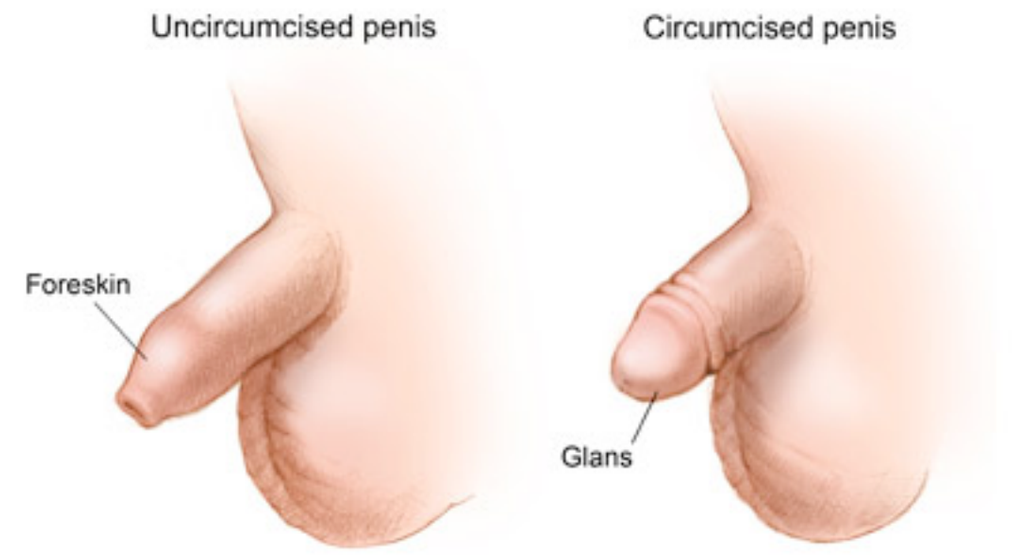
# Glands

- The bulbourethral gland
  - secretes a clear mucus before ejaculation that neutralizes acidic urine remaining in the urethra
  - carries some sperm prior to ejaculation, one reason for low success rate of withdrawal method of birth control



# Penis

- The human penis
  - Is composed of three cylinders of spongy erectile tissue
  - Glans penis thin skin and dense nerve endings
  - Prepuce (foreskin) is a fold of skin that covers the Glans penis
    - Circumcision removes this foreskin; the act arose from religious traditions and has no basis in health or hygiene

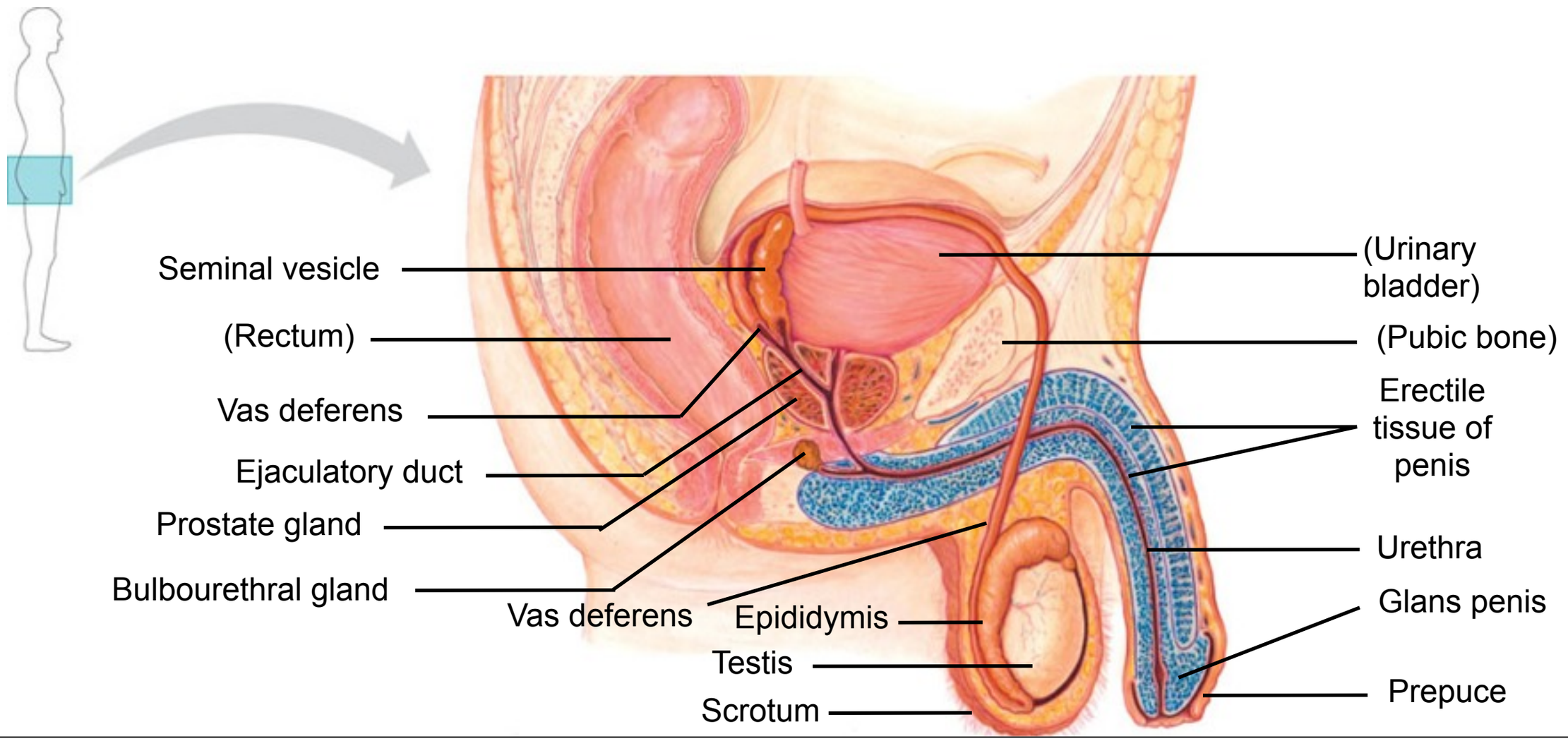


# Erection

- During sexual arousal
  - The erectile tissue fills with blood from the arteries, causing an erection
    - Increase pressure in arteries seals the veins that drain the penis
    - Some animals (rodents, racoons, walruses, whales) have *baculum*, a bone that helps stiffen the penis

# Pathway of Sperm in Ejaculation

- Seminiferous tubules →Epididymus →Vas Deferens →Ejaculatory Duct →Urethra
- As sperm travels through the tract 3 glands (seminal vesicle, prostrate and bulbourethral) secrete fluid that along with sperm produce what we call semen



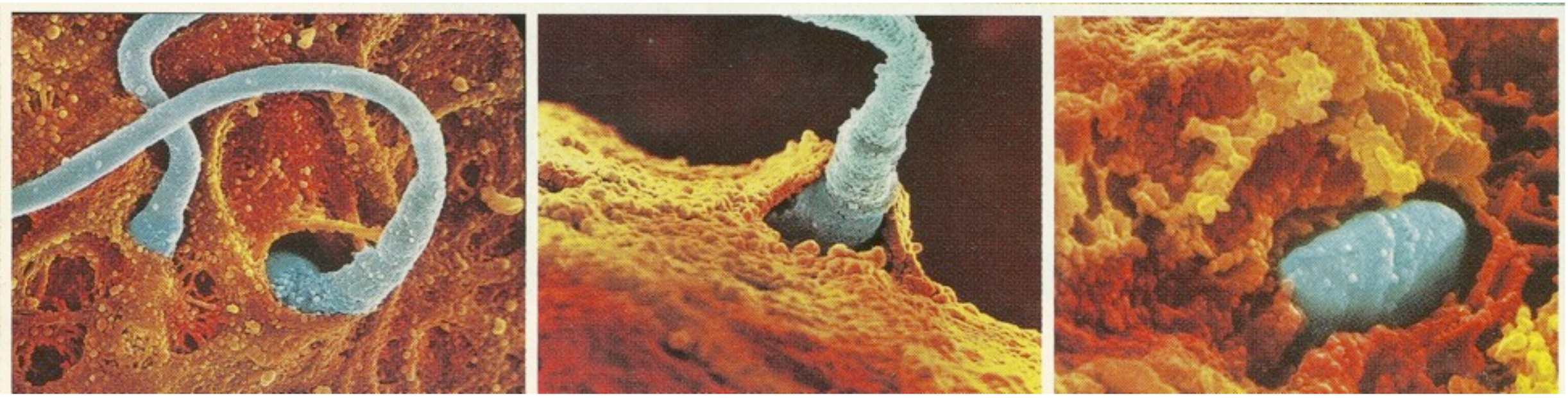
# Semen in the Female Reproductive Tract

- Once in the female reproductive tract
  - A number of processes, including contractions of the uterus, help move the sperm up the uterus
    - Males ejaculate 50 -650 million sperm each time
- Secretions in the female reproductive tract bring about "changes" in sperm motility and structure
  - These "changes" (called *capacitation*) take place about 6 hours after sperm enters female and they are required for sperm to fertilize the egg

# Conception & Fetal Development

- In humans and other placental mammals, an embryo grows into a newborn in the mother's uterus
  - Conception = Fertilization
  - Gestation = Pregnancy
    - Human gestation is 40 weeks (countdown begins from your first day of your last menstrual period)
  - Divided into three trimesters
    - Gestation period directly correlates with animal size. Example rats (21 days), dogs (60 days), cows (270 days), giraffes (420 days), elephants (600 days)

# Fertilization/Conception



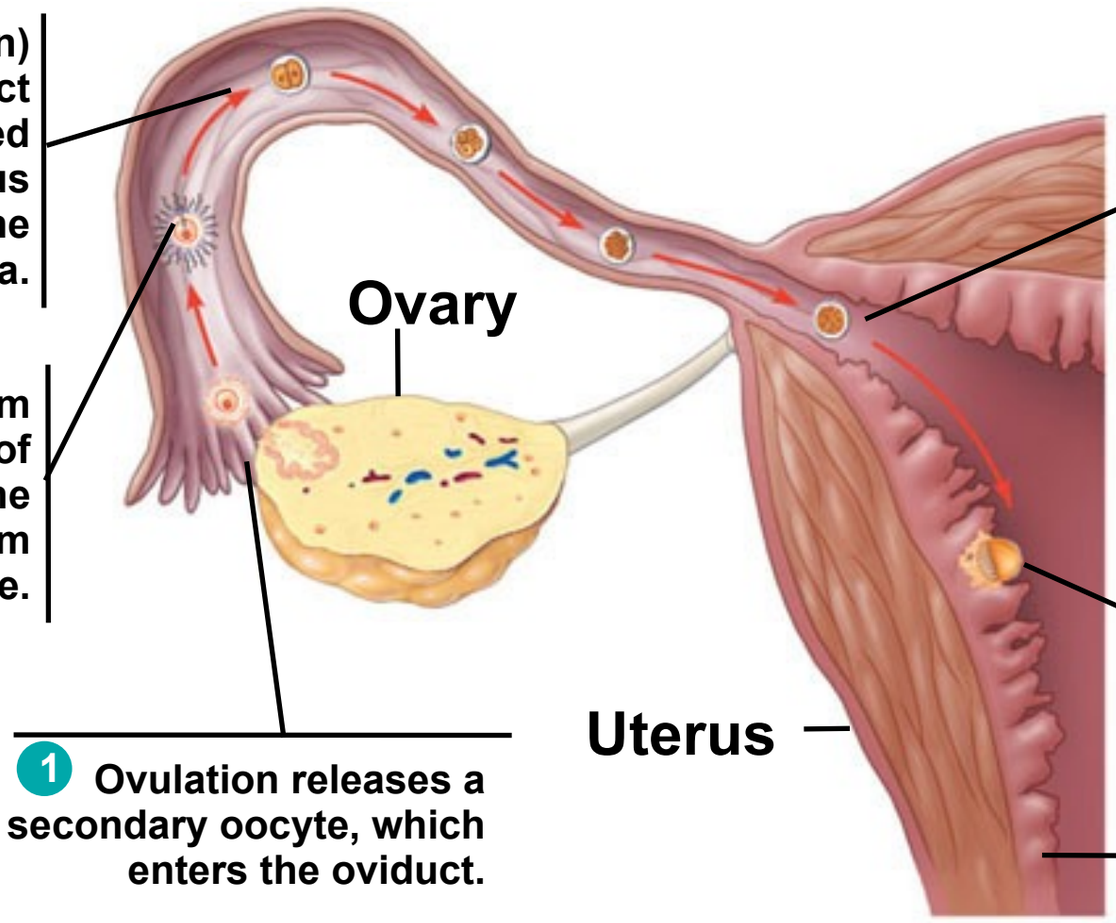
- Fertilization of an egg by a sperm, conception
  - Occurs in the oviduct

# A Closer Look-Fertilization

From ovulation to implantation

3 Cleavage (cell division) begins in the oviduct as the embryo is moved toward the uterus by peristalsis and the movements of cilia.

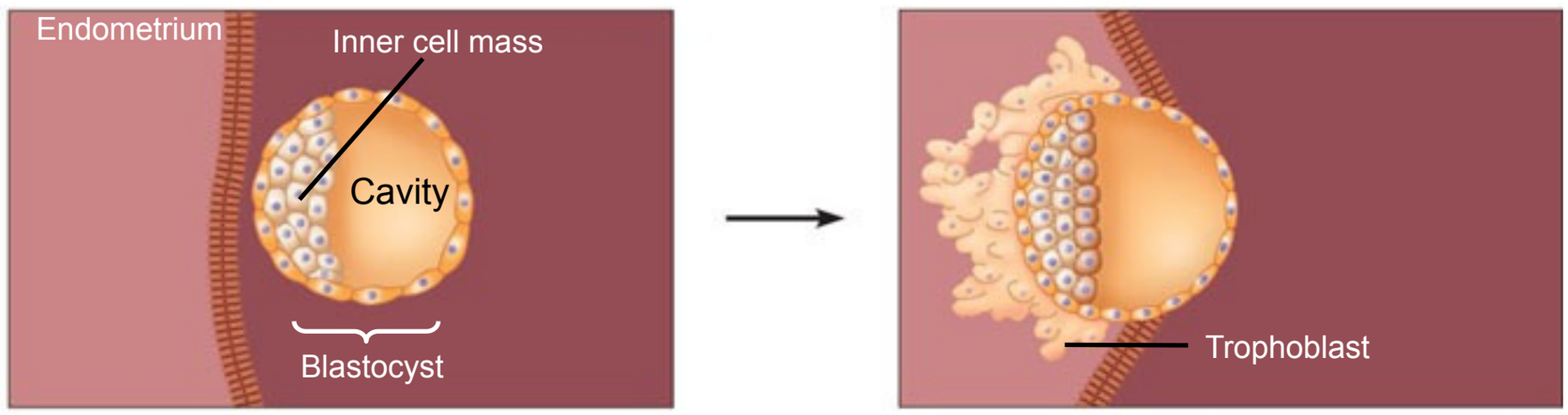
2 Fertilization occurs. A sperm enters the oocyte; meiosis of the oocyte finishes; and the nuclei of the ovum and sperm fuse, producing a zygote.




1 Ovulation releases a secondary oocyte, which enters the oviduct.

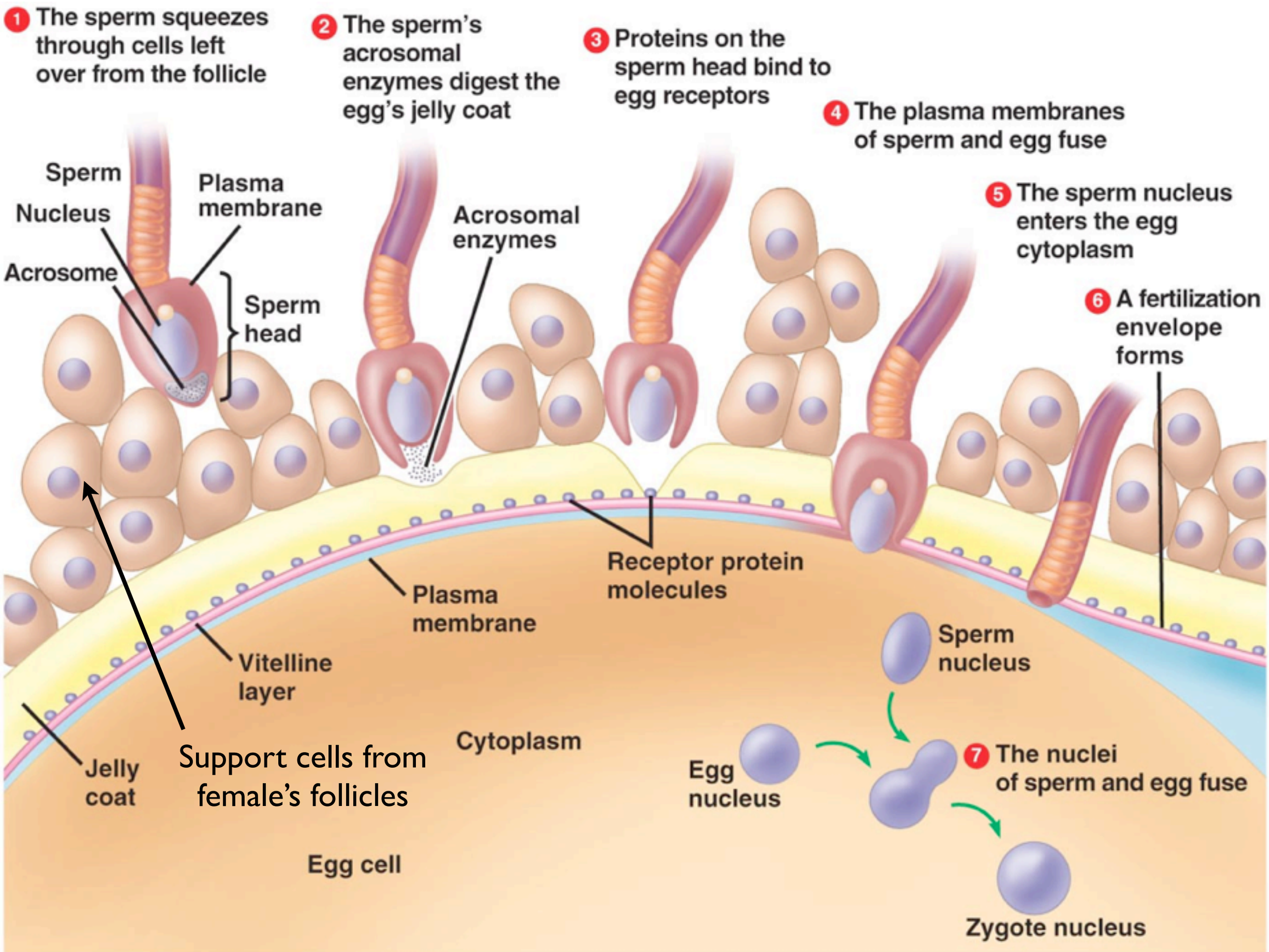
4 Cleavage continues. By the time the embryo reaches the uterus, it is a ball of cells. It floats in the uterus for several days, nourished by endometrial secretions. It becomes a blastocyst.

5 The blastocyst implants in the endometrium about 7 days after conceptio




Implantation of blastocyst

# Fertilization/Conception



# Embryonic Development

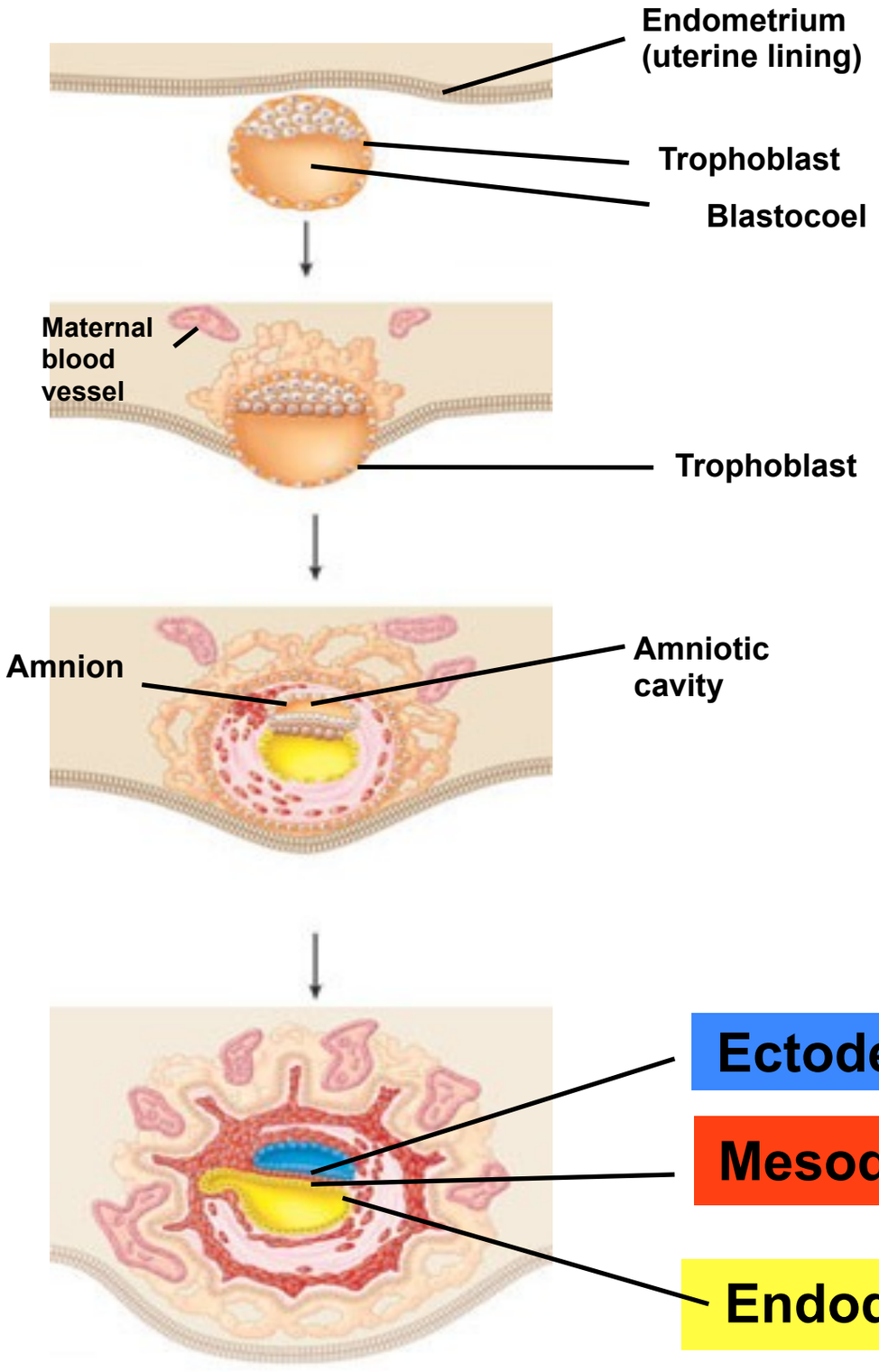
- Early embryonic development in a human
  - Occurs in 4 stages...

Blastocyst reaches uterus.

Blastocyst implants.

Extra embryonic membranes start to form and gastrulation begins.

Gastrulation has produced a three-layered embryo with four extra embryonic membranes.



# Embryonic Development

- Many different structures
  - Are derived from the three embryonic germ

| ECTODERM | MESODERM | ENDODERM |
| --- | --- | --- |
| • Epidermis of skin and its derivatives (including sweat glands, hair follicles)<br>• Epithelial lining of mouth and rectum<br>• Sense receptors in epidermis<br>• Cornea and lens of eye<br>• Nervous system<br>• Adrenal medulla<br>• Tooth enamel<br>• Epithelium or pineal and pituitary glands | • Notochord<br>• Skeletal system<br>• Muscular system<br>• Muscular layer of stomach, intestine, etc.<br>• Excretory system<br>• Circulatory and lymphatic systems<br>• Reproductive system (except germ cells)<br>• Dermis of skin<br>• Lining of body cavity<br>• Adrenal cortex | • Epithelial lining of digestive tract<br>• Epithelial lining of respiratory system<br>• Lining of urethra, urinary bladder, and reproductive system<br>• Liver<br>• Pancreas<br>• Thymus<br>• Thyroid and parathyroid glands |

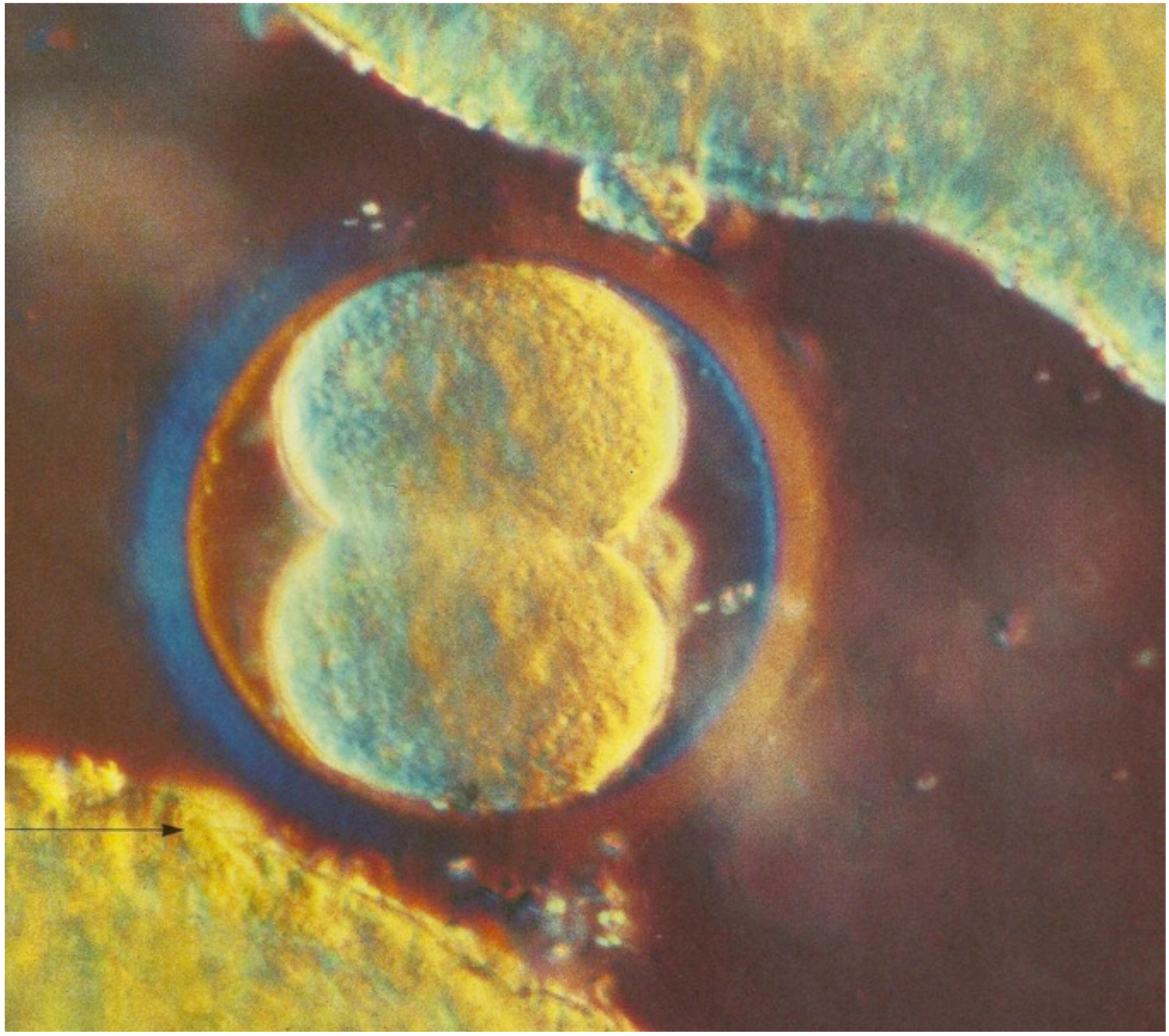
# Development (First Trimester)

- After fertilization
  - The zygote undergoes cleavage (~24 hours after fertilization)
  - Takes 3-4 days to get to the uterus; it continues divide the while it travels
  - Develops into a blastocyst (by 7 days)
  - Takes another 5 days before implantation in the endometrium
  - Differentiation (cell specialization) now begins in earnest

# Conception

Single cell zygote divides into two cells; occurs on route to the uterus

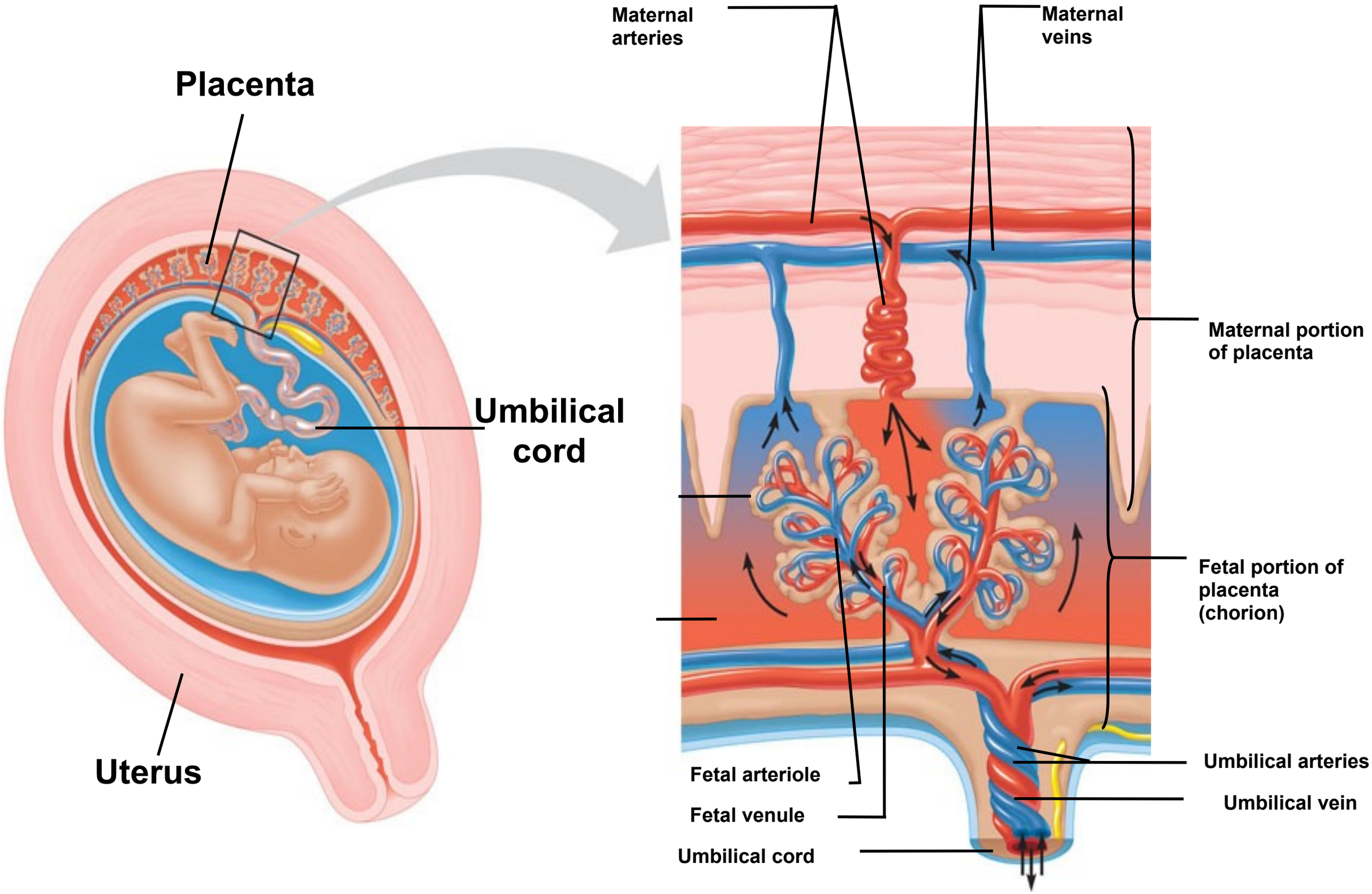
12-36 hours after sperm binds to egg



# Development (First Trimester)

- Embryo obtains nutrients from endometrium for the first 2-4 weeks
  - Tissues grow out from embryo and mingle with endometrium-forming the disc shaped placenta
    - Placenta is a mixture of maternal and embryonic blood vessels
    - The site where gas, nutrient and waste exchange occur
    - The umbilical cord (and its arteries/veins) connects embryo to placenta

# First Trimester



# First Trimester

- Human gestation
  - Can be divided into three trimesters of about three months each
- The first trimester
  - Is the time of most radical change for both the mother and the embryo
  - Embryo secretes HCG (acts like LH) to maintain corpus luteum for the first 3 months
  - No HCG would result in menstruation and a spontaneous abortion
  - Home pregnancy tests detect HCG in Urine
  - Other Changes include: cessation of ovulation and menstruation, enlargement of breasts and uterus and development of protective cervical plug

# Development (First Trimester)

- The first trimester is the main period of organogenesis
  - The development of the body organs

**5 weeks.** Limb buds, eyes, the heart, the liver, and rudiments of all other organs have started to develop in the embryo, which is only about 1 cm long.

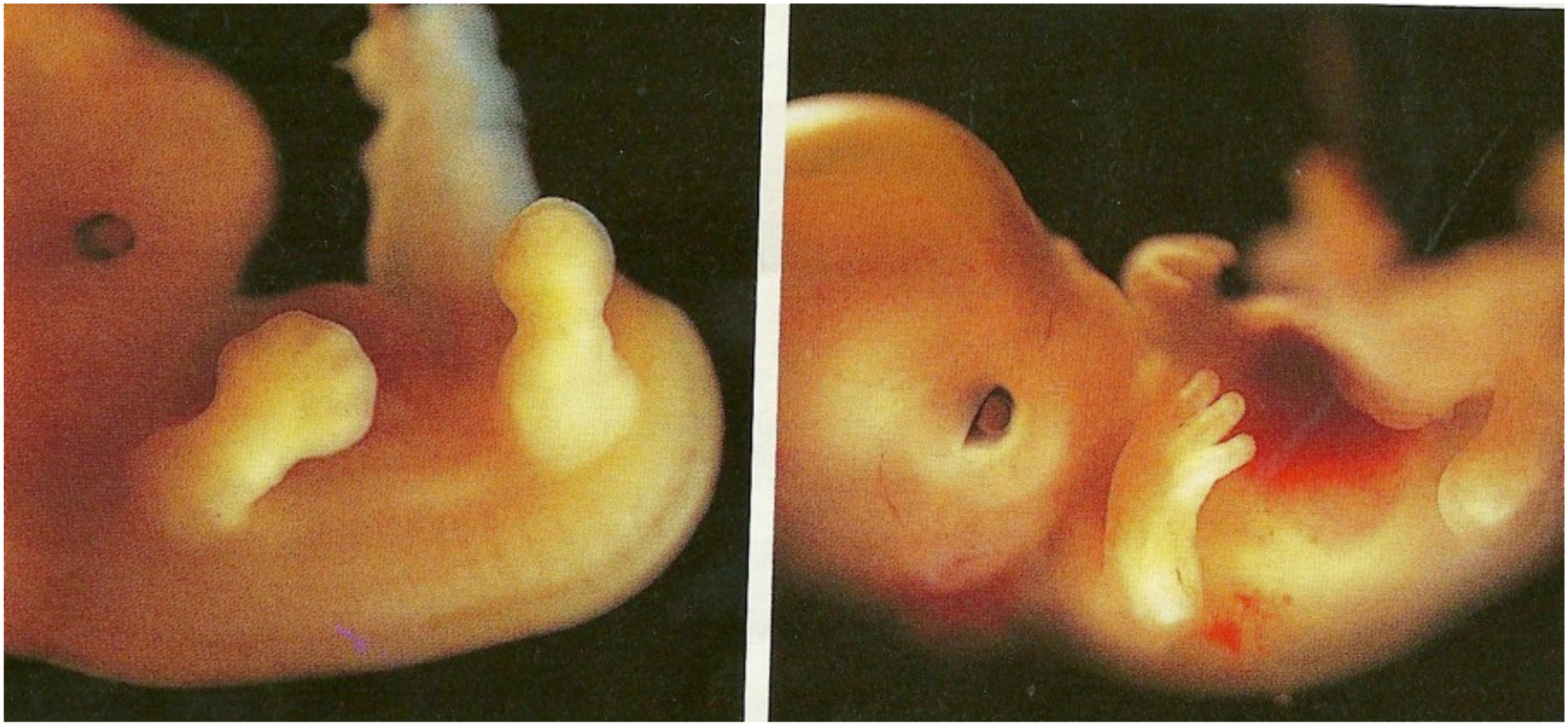
**14 weeks.** Growth and development of the offspring, now called a fetus, continue during the second trimester. This fetus is about 6 cm long.

**20 weeks.** By the end of the second trimester (at 24 weeks), the fetus grows to about 30 cm in length.

# a week

a ball of
several
hundred
cells

# 4-10 weeks



# 8 weeks

now called an embryo

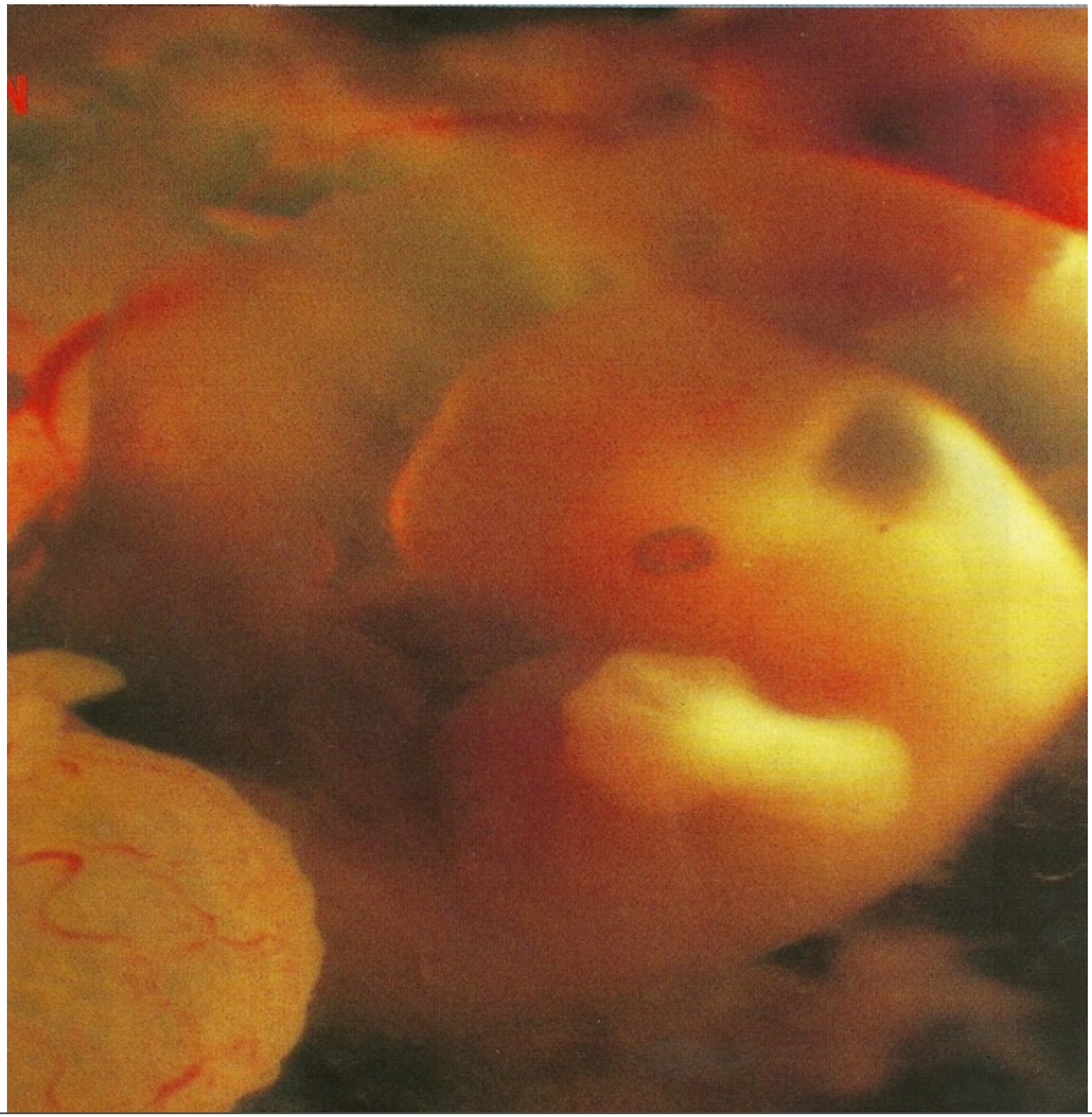
has limbs

# 8 weeks

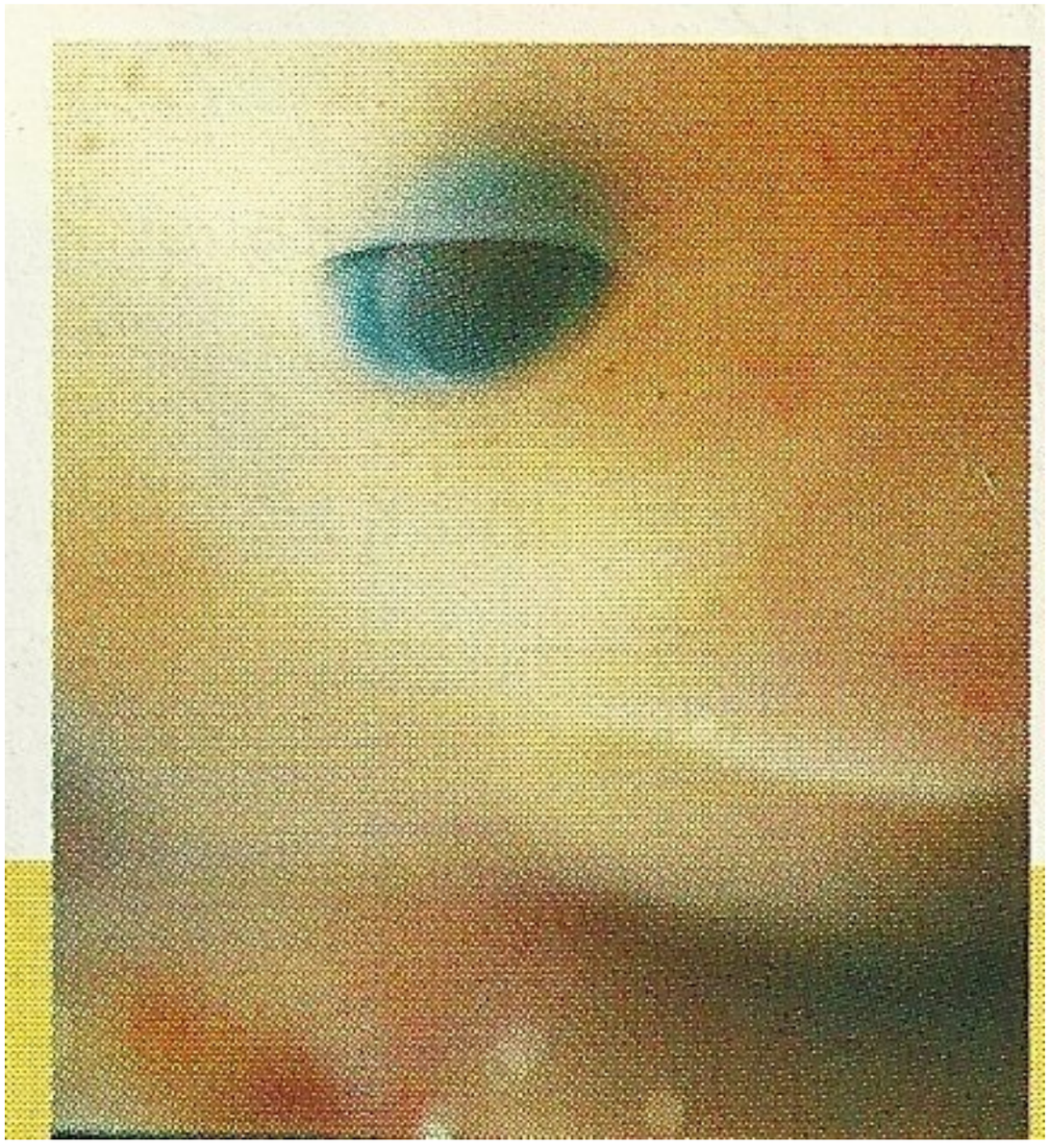
hands and feet have weblike look as fingers and toes develop

# 8 weeks

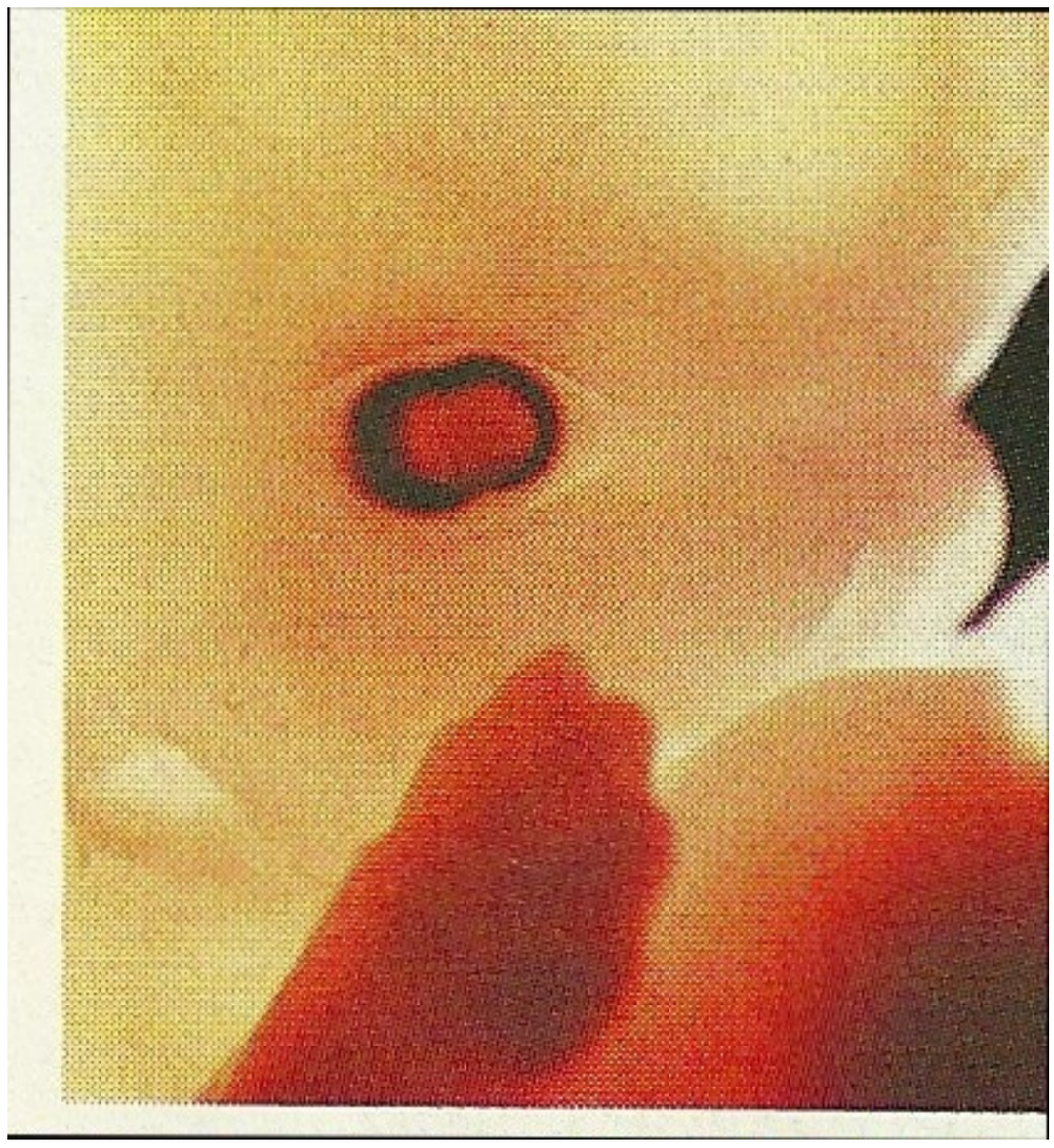
most internal organs are formed but do not yet function



# 8 weeks



eyes and
lenses are
forming



1/2 inch
in size on
average

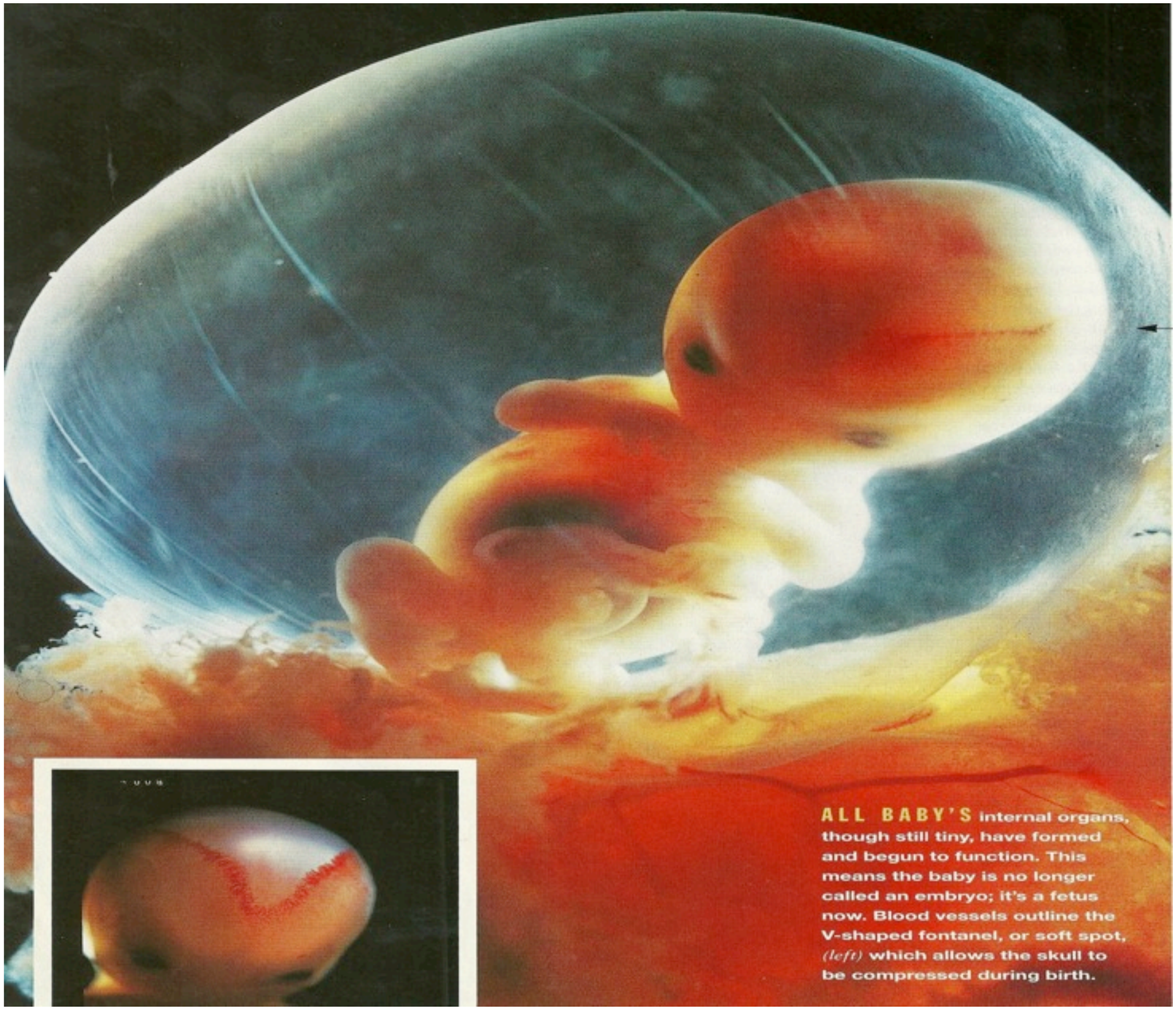
# 12 weeks

all internal parts are present

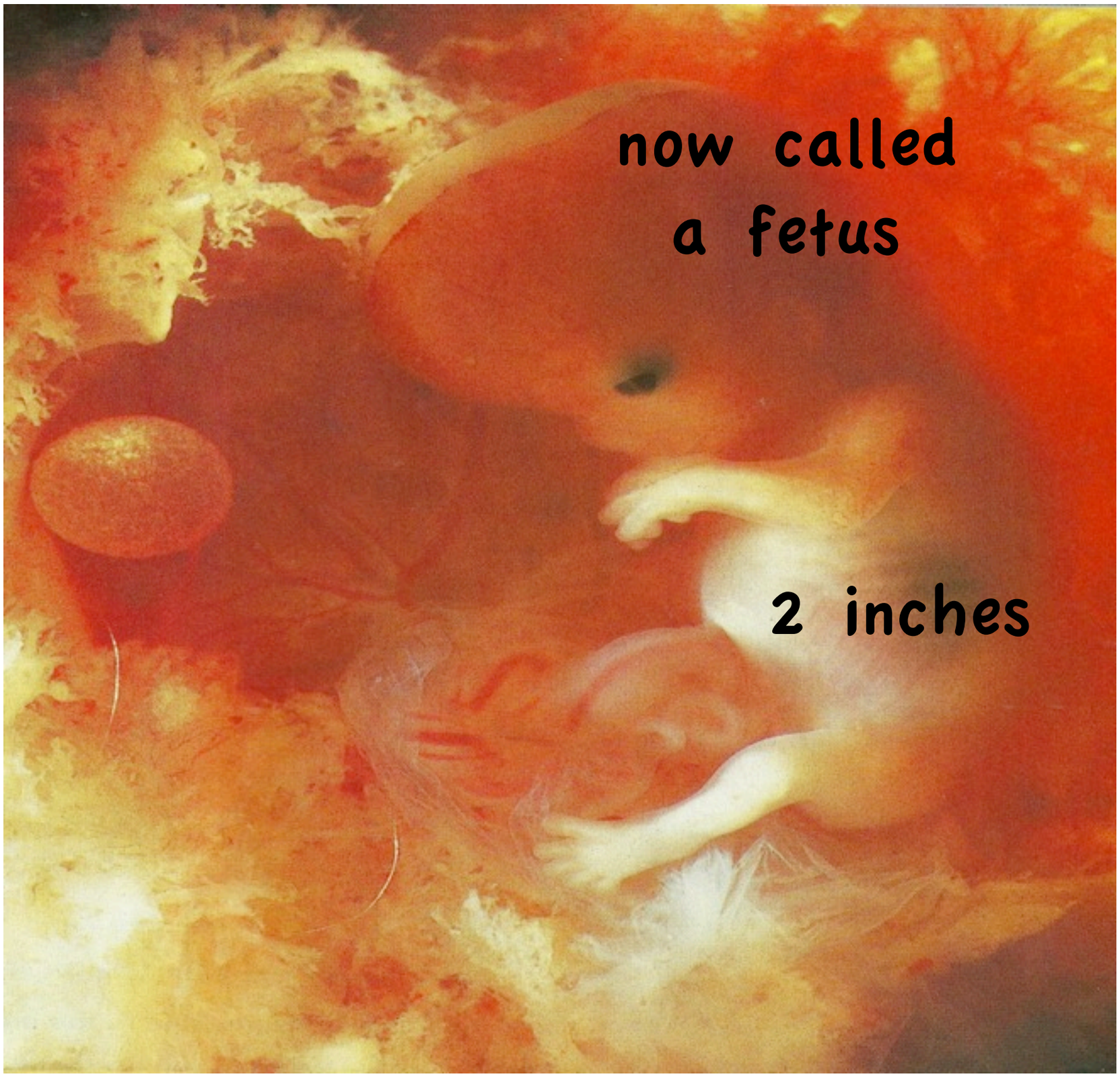
kidneys are producing urine

↓

later most of the amniotic fluid is fetal urine



# 12 weeks




muscles and
bones are
starting to grow

mouth can
open & close

arms & legs
can bend

gonads are
formed

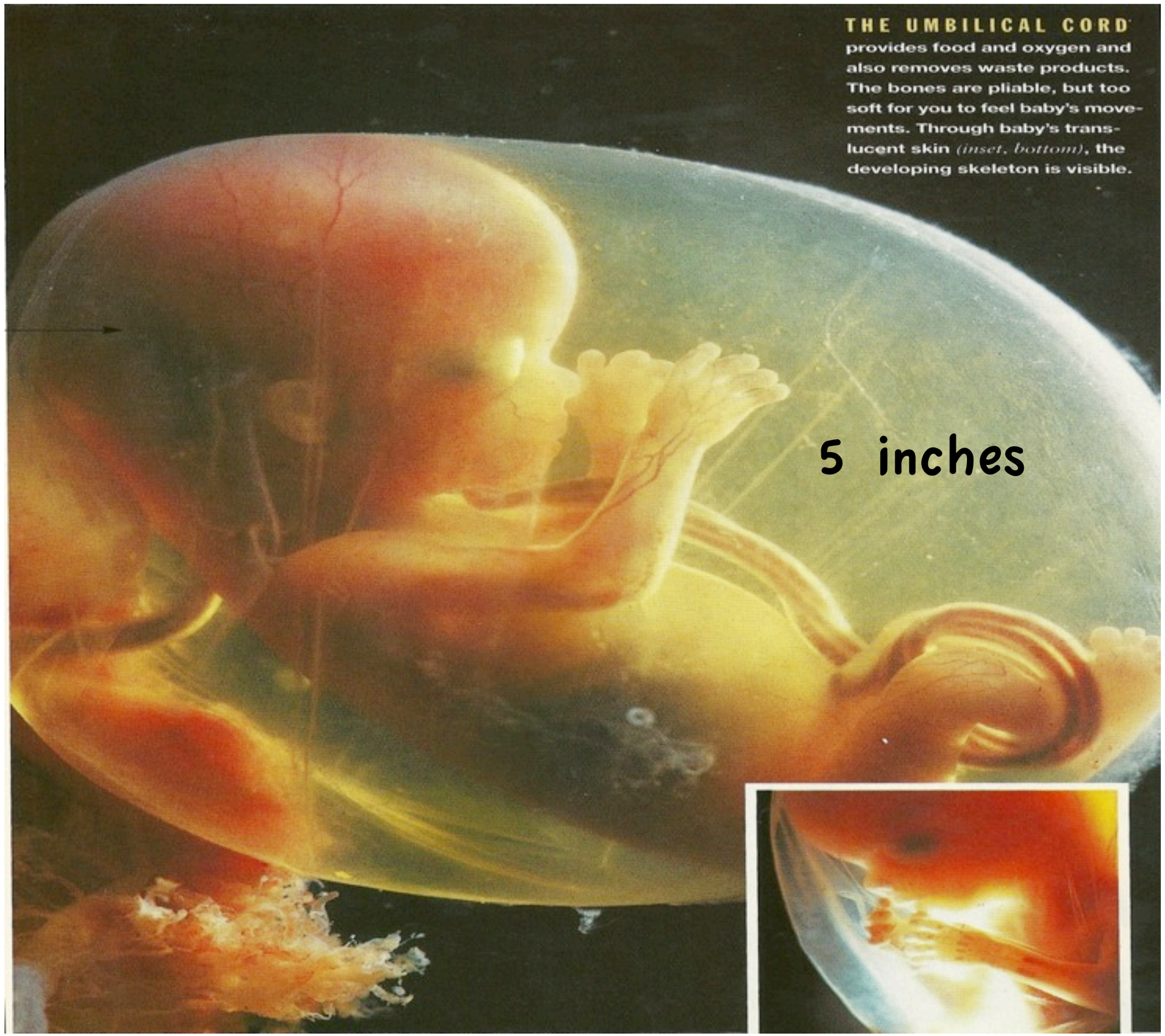
# Second Trimester

- During the second trimester
  - The fetus grows and is very active
  - The mother may feel fetal movements
  - The uterus grows enough for the pregnancy to become obvious
  - HCG declines, corpus luteum deteriorates, and placenta secretes its own progesterone, which maintains pregnancy through birth

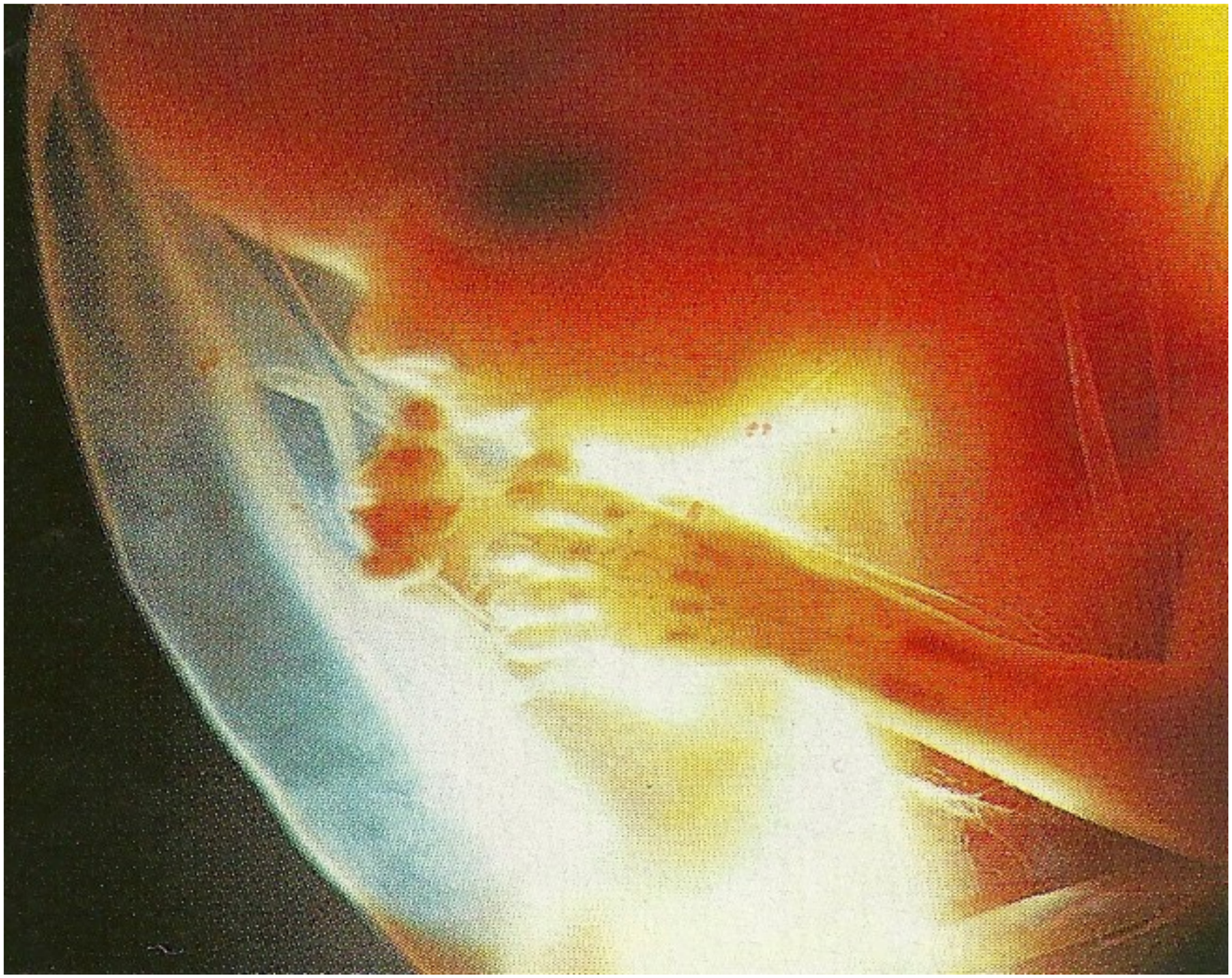
# 16 weeks

fingerprints and nails are formed

hair begins to grow



# 16 weeks



bones are
making red
blood cells

sex organs
are distinct

# 16 weeks

baby starts to show in females

female can feel baby move

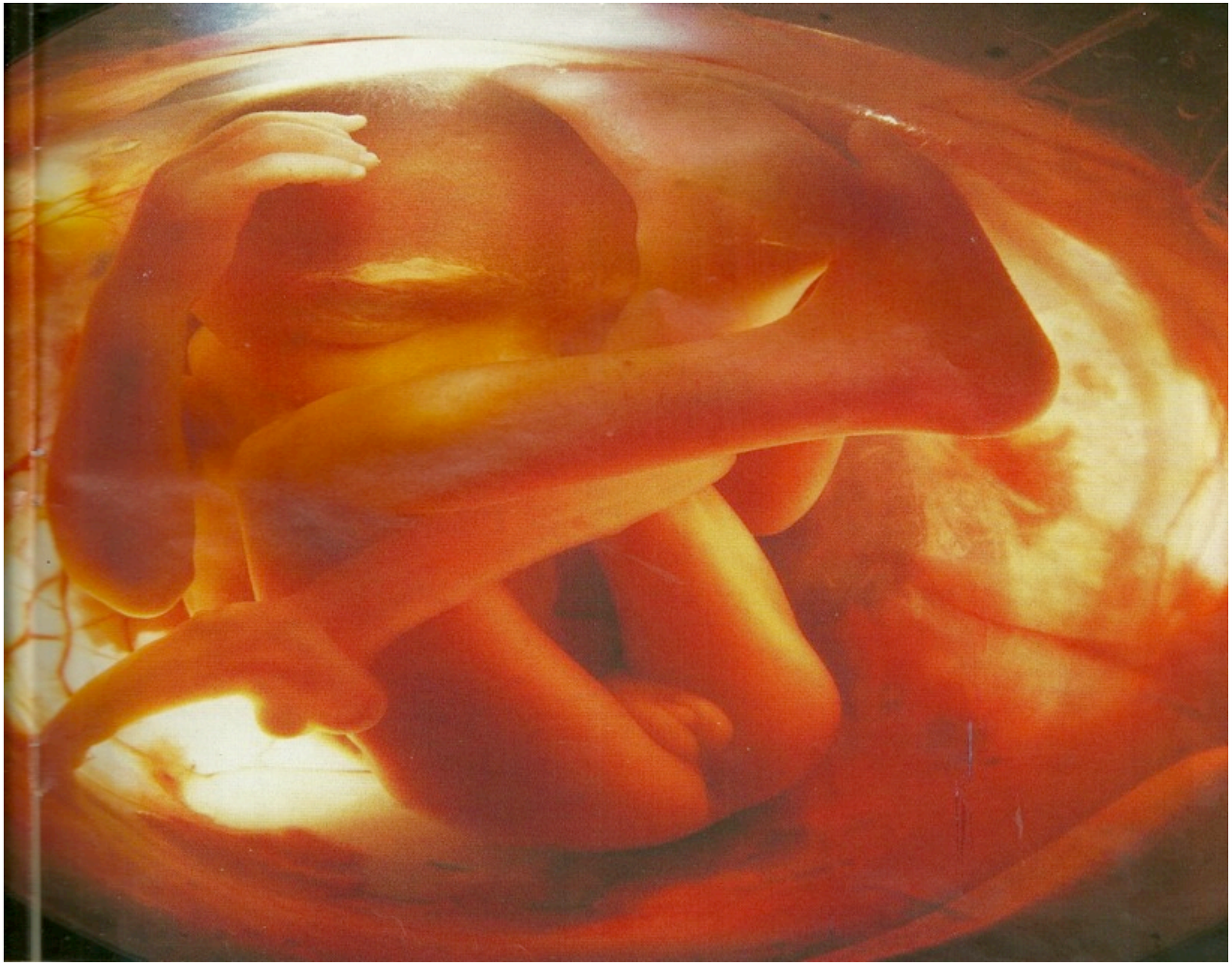
# 20 weeks


nerve cells increase rapidly

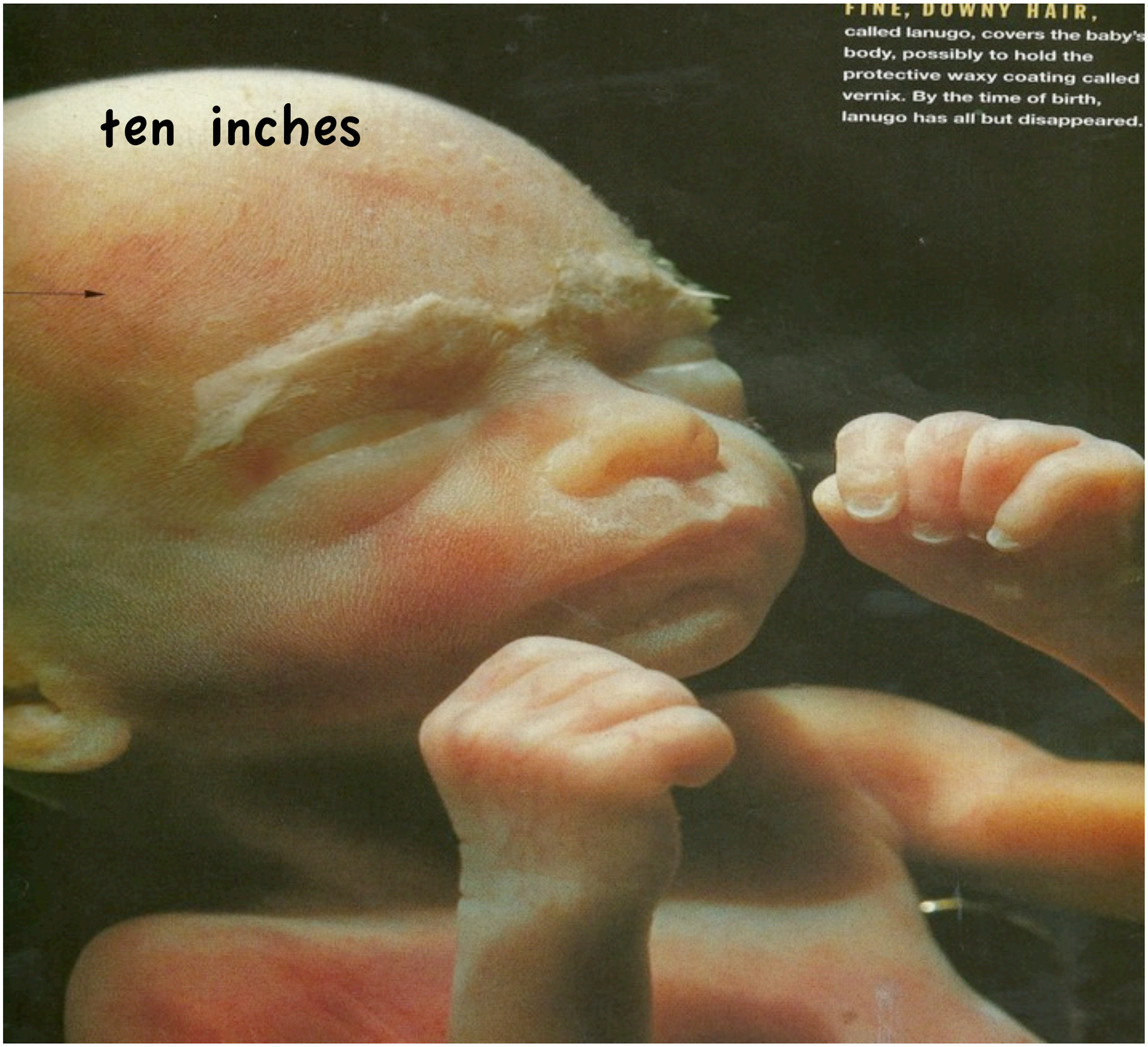
baby's first stool (meconium) begins to form

# 20 weeks

amniotic fluid is swallowed and urinated, completely replaced every 24 hours



# 24 weeks




fine hair
called
lanugo holds
vernix in
place

"cheesy"
covering
called vernix
covers skin
to protect
from fluid

# 24 weeks

rapid growth occurs now

baby can hear

air sacs begin
to inflate

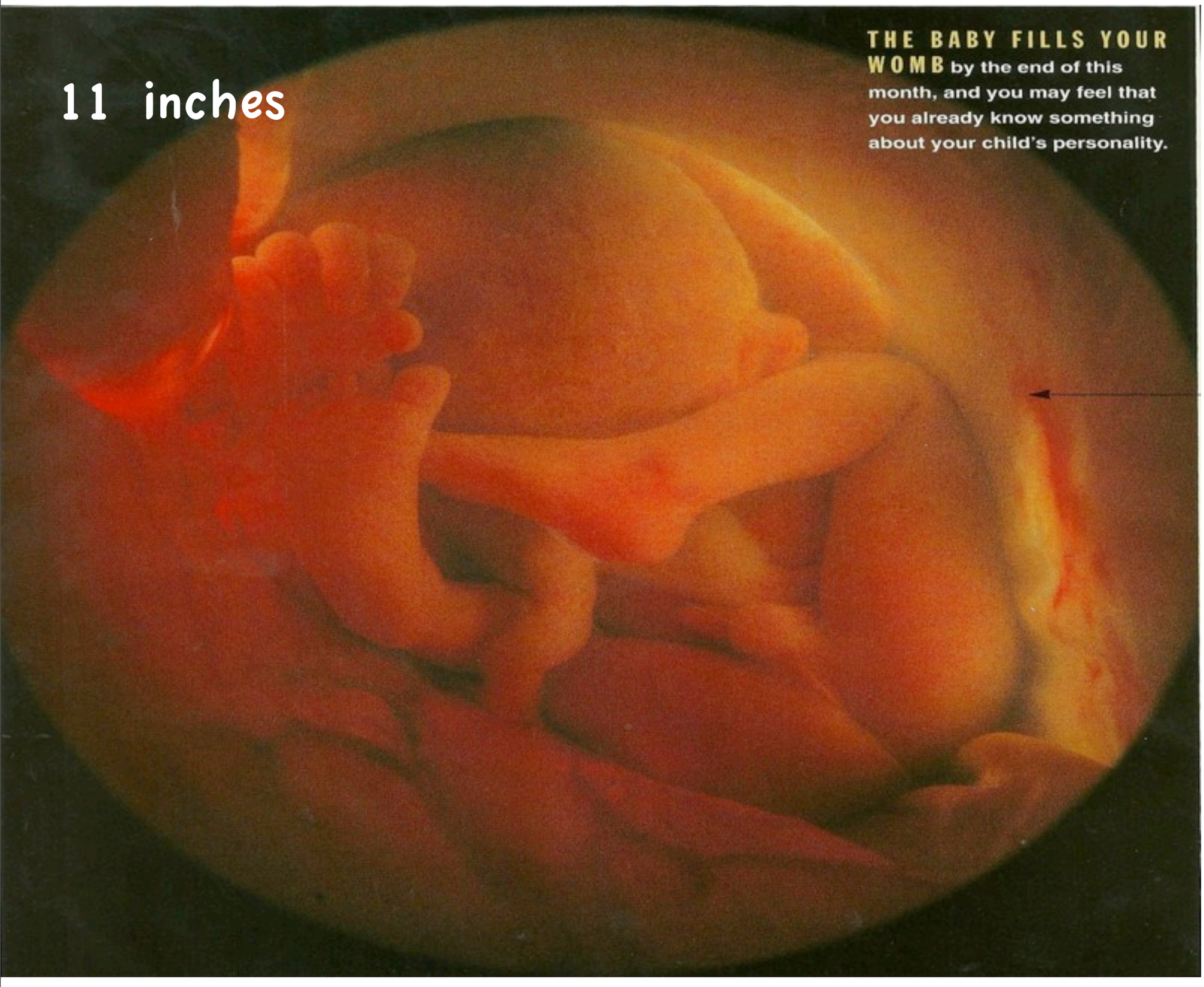
bones are
hardening

heart beat
can be heard

# Third Trimester

- During the third trimester
  - The fetus continues to grow rapidly and fills the available space within the embryonic membranes
  - Fetus expands compressing maternal organs resulting in shortness of breath, frequent urination, constipation and lower back aches
  - Complex interplay of hormones begin that prepare for, regulate and induce labor
    - Estrogen is at its highest level during the final weeks of pregnancy

# 28 weeks




11 inches

eyelids can open

fat begins to fill in contours

brain begins to fold and wrinkle

# 32 weeks

mom passes some antibodies to baby

vernix and lanugo are falling off

baby very likely to survive if born now

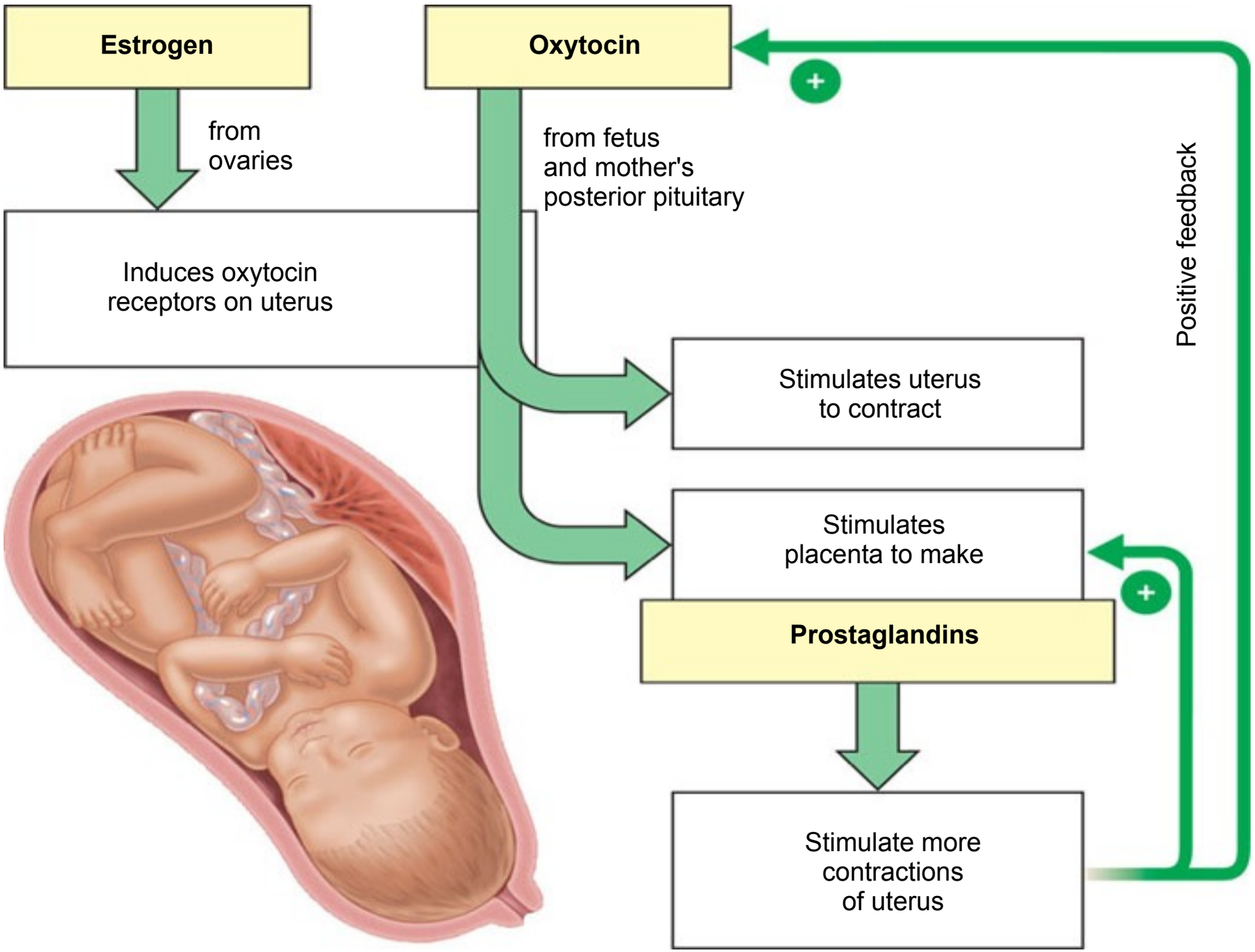
# 40 weeks (birth)


baby's head faces down (most)

baby's head slips down into the basket of the pelvis "lightening"

# Labor/Birth

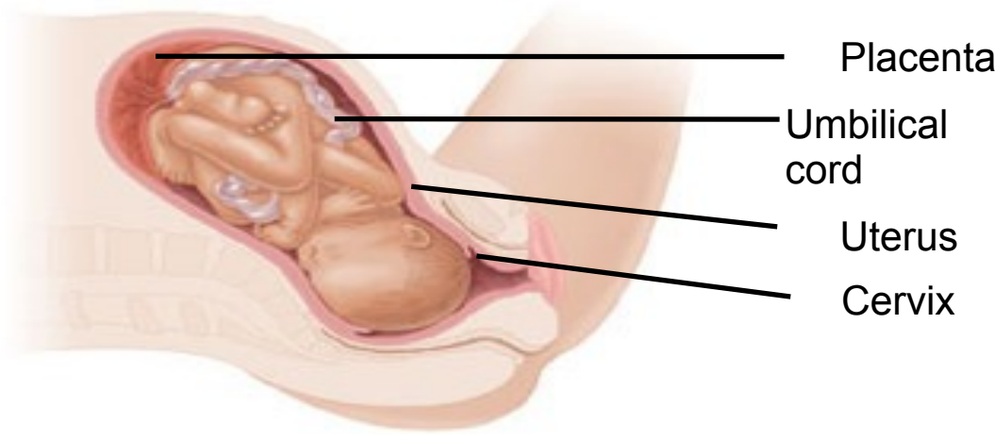
- Childbirth begins with ***labor***, a series of strong, rhythmic uterine contractions that push the fetus and placenta out of the body.



# Birth (parturition)

- The process of labor has three stages:

**Dilation- the opening and thinning of the cervix**

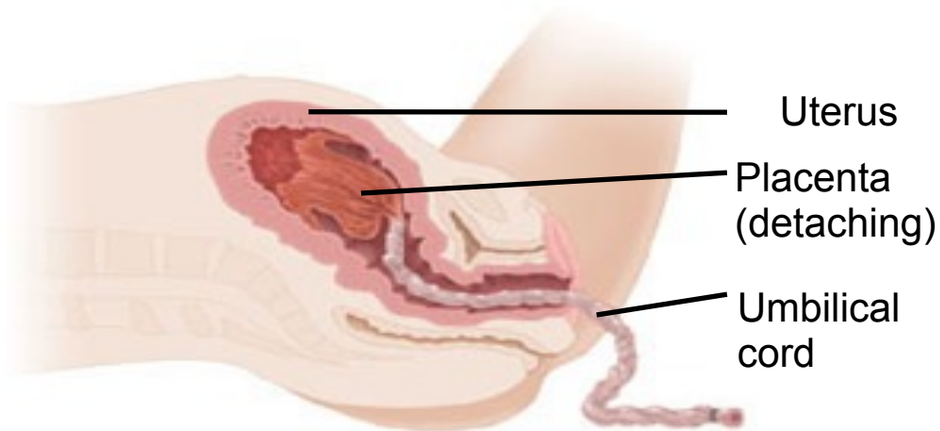



1 Dilation of the cervix

**Expulsion- the delivery of the baby and the umbilical cord is cut**

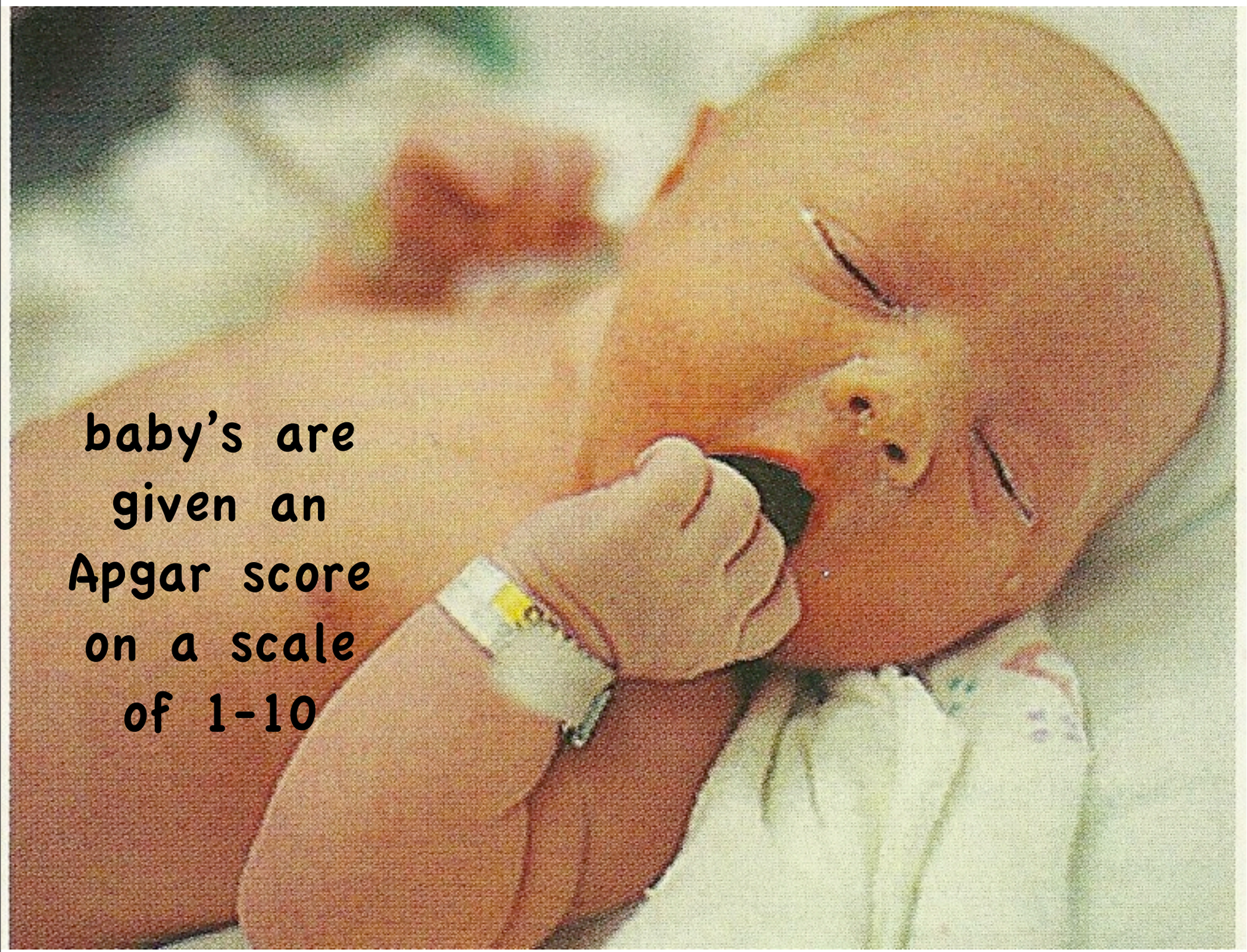
2 Expulsion: delivery of the infant

**Delivery- the placenta is removed**




3 Delivery of the placenta

# 40 weeks (birth)




umbilical cord cut, treated with antiseptic and clamped

baby's eyes are medicated to prevent veneral infection

# 40 weeks (birth)

## APGAR SCORING SYSTEM

| | 0 Points | 1 Point | 2 Points | Points totaled |
|---|---|---|---|---|
| Activity (muscle tone) | Absent | Arms and legs flexed | Active movement | |
| Pulse | Absent | Below 100 bpm | Over 100 bpm | |
| Grimace (reflex irritability) | Flaccid | Some flexion of Extremities | Active motion (sneeze, cough, pull away) | |
| Appearance (skin color) | Blue, pale | Body pink, Extremities blue | Completely pink | |
| Respiration | Absent | Slow, irregular | Vigorous cry | |

| | |
|---|---|
| Severely depressed | 0-3 |
| Moderately depressed | 4-6 |
| Excellent condition | 7-10 |

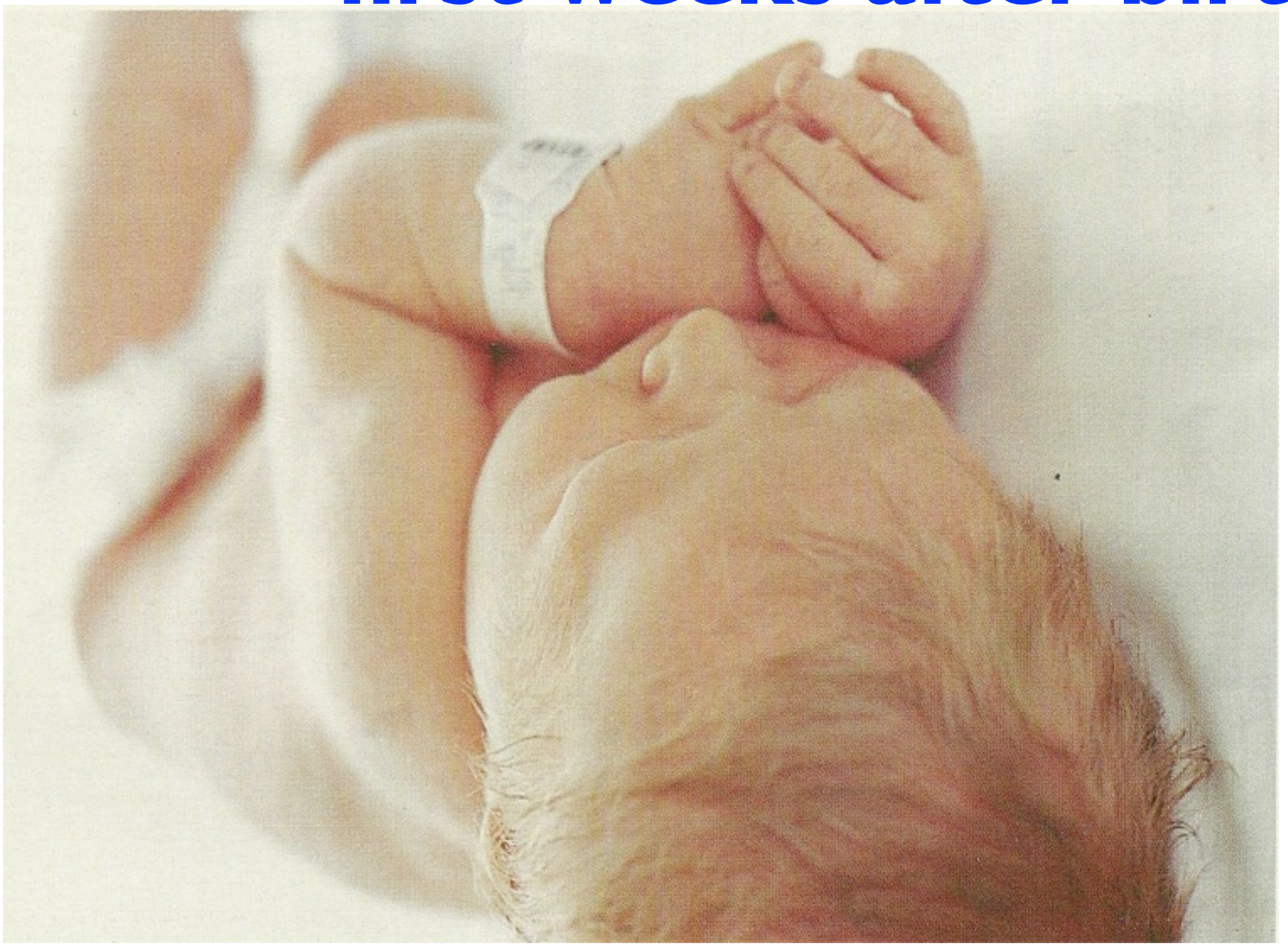
# 40 weeks (birth)

first cry fills lungs with air

eyes are usually brown or blue

baby's head may be elongated if a vaginal birth

# first weeks after birth



sense of smell is sharp

hearing is acute but lacks directionality

eyes focus best on close objects

# Plants

## Reproduction

# Plant Reproduction Intro

- ALL *Plants can be placed into one of four main groups.*
  - 1. Bryophytes: moss and other nonvascular plants
  - 2. Pterophytes & Lycophytes: ferns and other seedless vascular plants
  - 3. Gymnosperms (Conifers; seeds but no fruit)
  - 4. Angiosperms (90% of all plants; seeds and fruit)

As MYP students will focus only on angiosperm reproduction

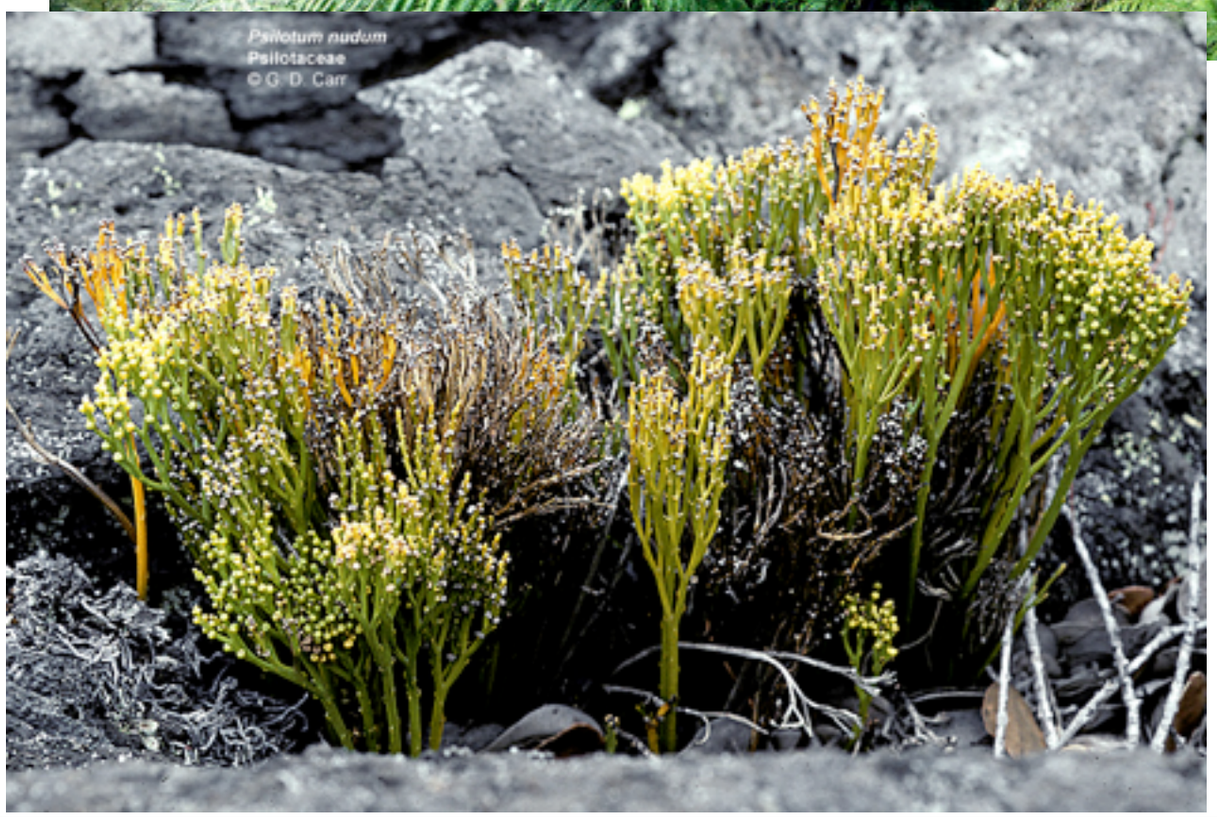
# BRYOPHYTES



# PTEROPHYTES & LYCOPHYTES

## Horsetails

## Ferns




## Whisk Ferns

# GYMNOSPERMS





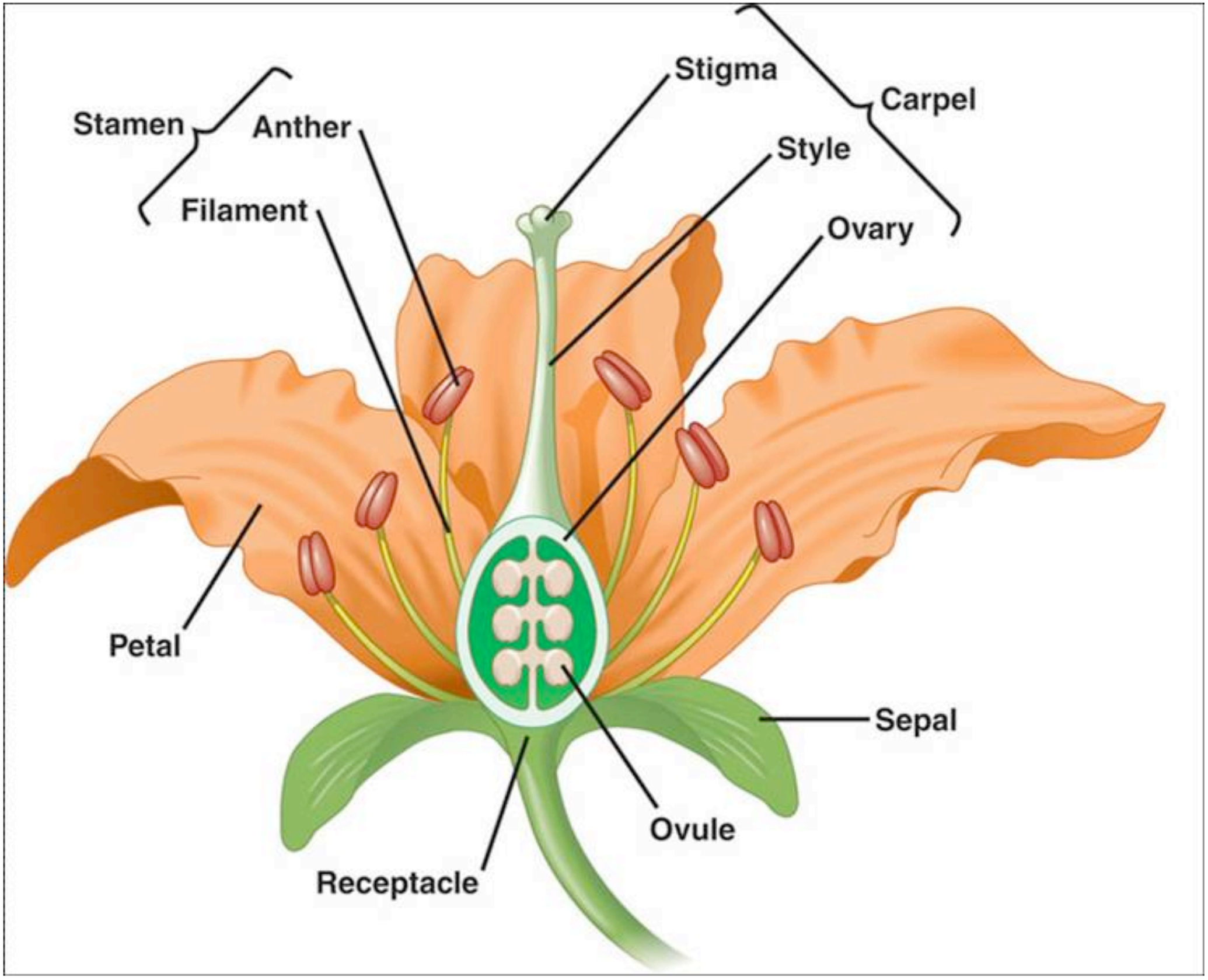
# Plant Reproduction Intro

- *Gametes* (sperm & eggs) are produce via meiosis
- The fusion of sperm and egg (fertilization) produces a single celled *zygote*
- The zygote proceeds to divide via mitosis over and over again and the new cells then grow and develop into a multicellular (*adult) organism

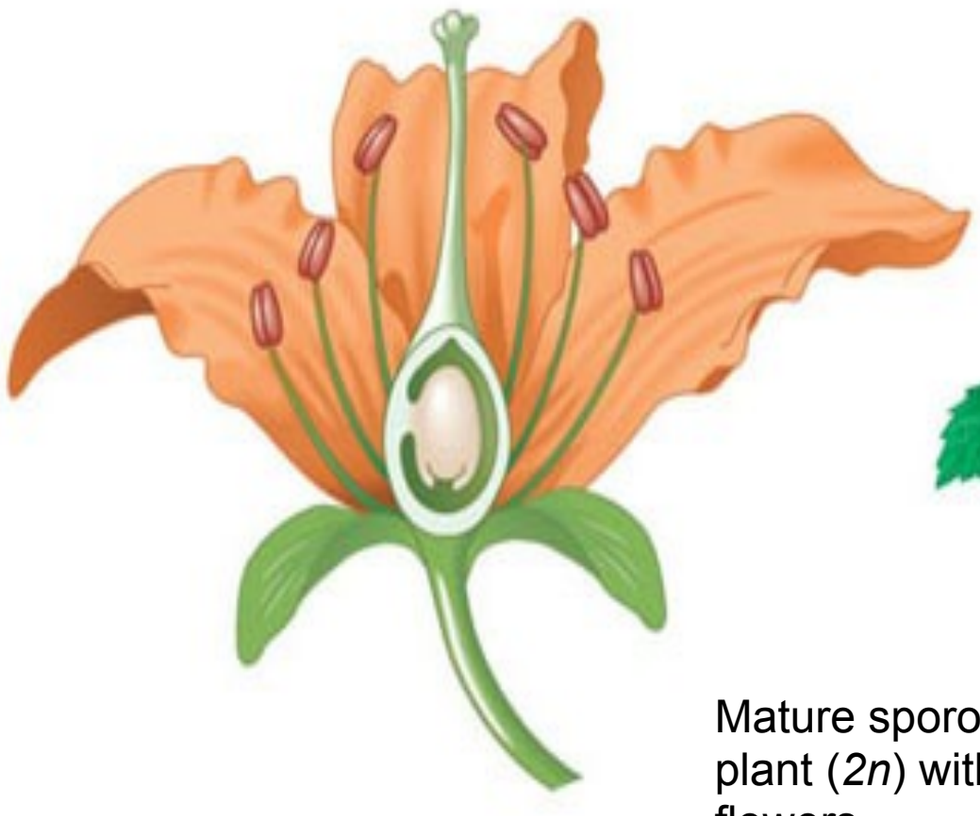
# Plant Reproduction Intro

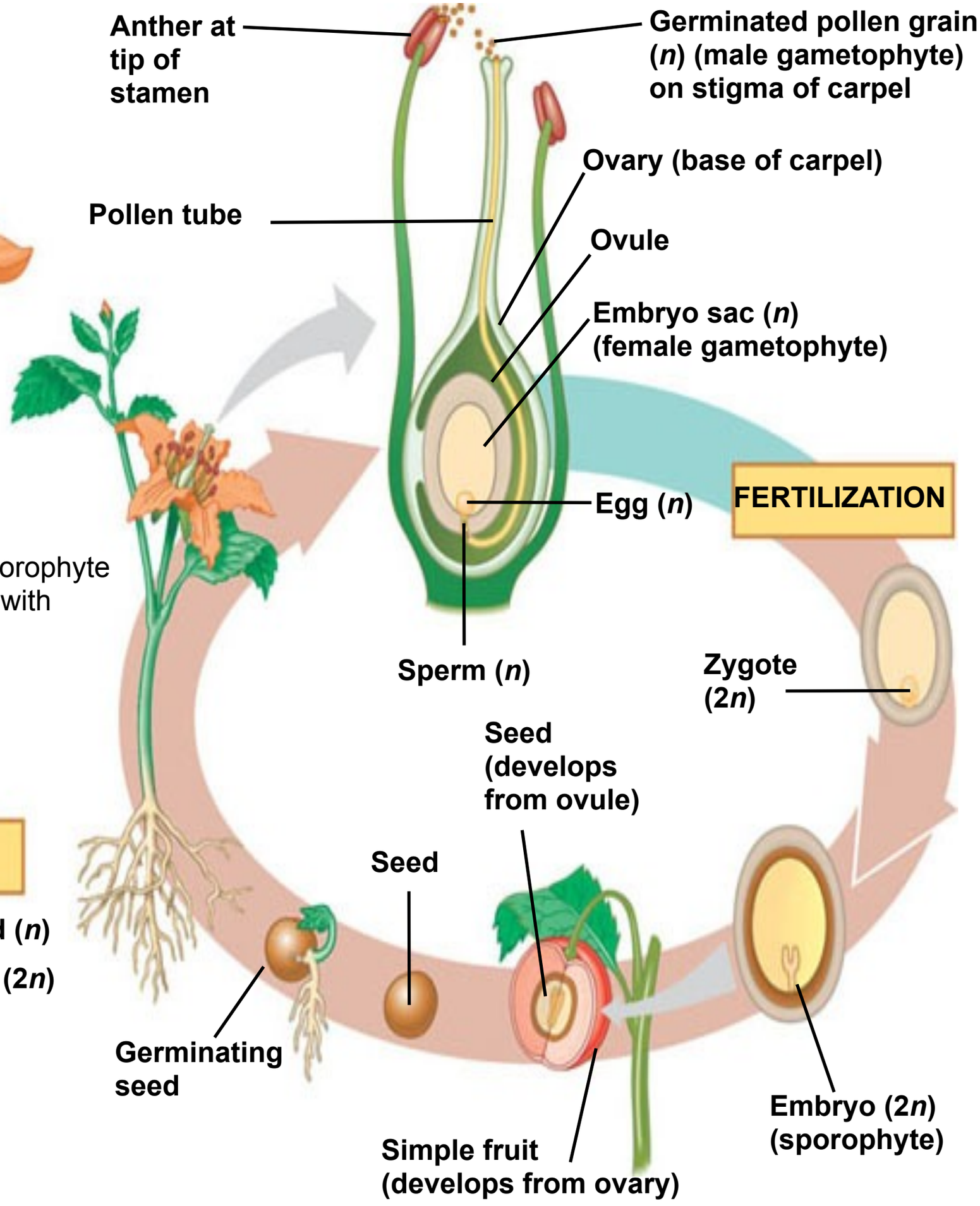
- The life cycle of ALL plants is characterized by an Alteration of Generations.
    - The gametophyte (multi-cell, haploid generation) and the sporophyte (multi-cell, diploid generation) take turns producing each other
- The diploid stage (sporophyte) dominates (larger, lives longer and more conspicuous) the life cycle in most plants
- The key traits of angiosperm (flowering plants) reproduction are the "3F's"- ***Flowers, Fertilization, Fruits, Seeds***
- A knowledge of ***Seed*** structure and function will also be helpful to fully understand (most) plant life cycles

# FLOWERS: Structure & Function

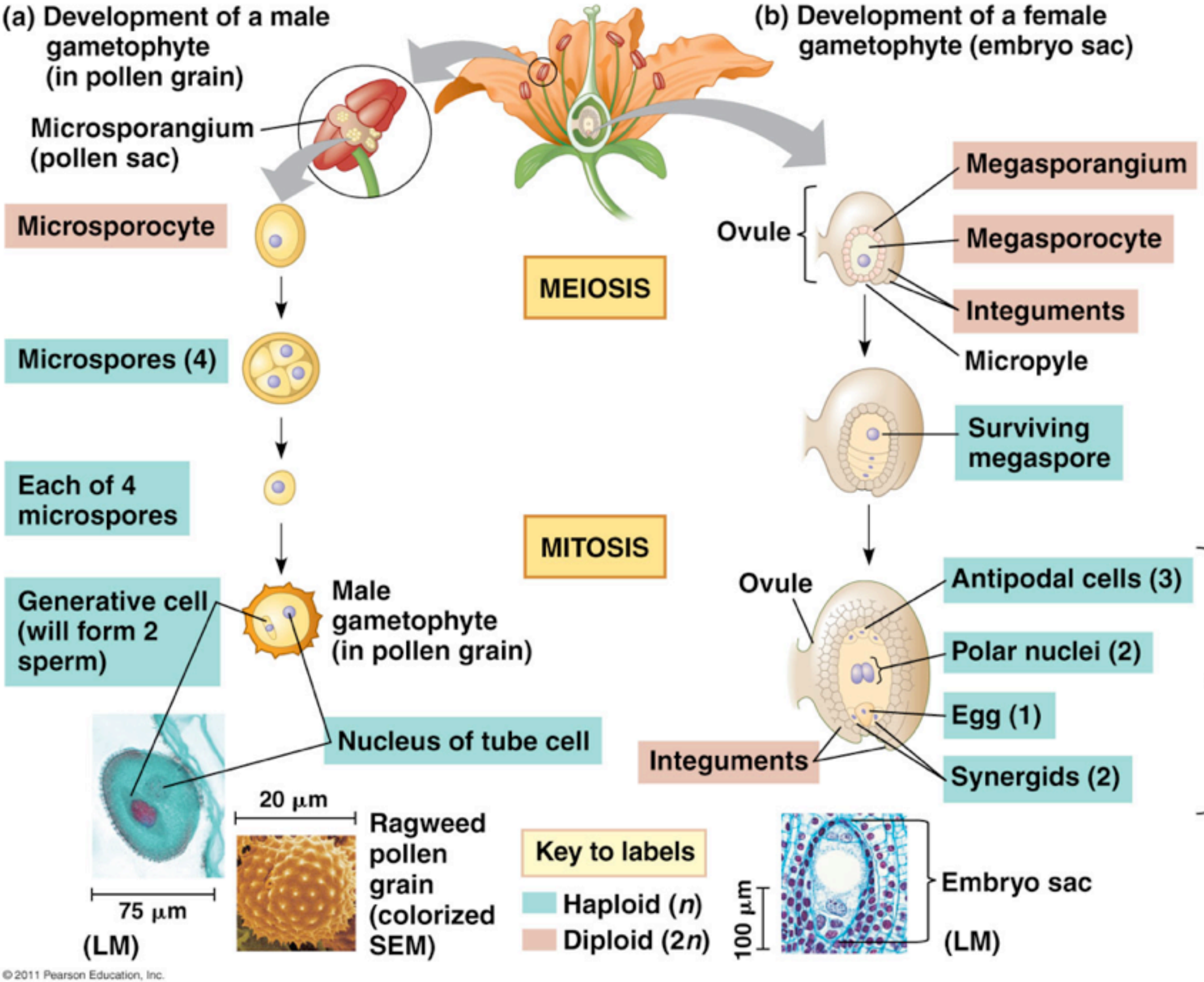


# Simplified Angiosperm Life Cycle.





# Development of Male & Female Gametophytes



# Pollination

- Pollination the transfer of pollen from an anther to stigma.
  - Most angiosperms rely on biotic and abiotic pollinating agents. (the others self fertilize)
  - 80% of all pollination is biotic
  - most abiotic pollination relies on wind(98%) or water(2%)

# Wind Pollination

nearly 20 % of all angiosperms

most temperate trees and grasses

inefficient so lots of pollen is produced

does not have to attract pollinators so usually small, lack color and scent

appear early in spring before leaves get in the way

# Bee Pollination


flowers attract bees bright yellows and blues along with sweet scents

bees use flower nectar for food

flowers have UV markings called “nectar guides”

bees are the most important pollinators

bee populations are declining, this concerns scientists because bees pollinate most of our food crops

# Bird Pollination

birds use flower nectar for food

these flowers have little to no scent

usually large bright yellow or red flowers

petals often fuse to produce long tubes

# Fly Pollination

fly's lay their eggs on it and get dusted with pollen doing so

usually red fleshy flowers

these flowers smell like dead, rotting corpses

# Moth & Bat Pollination

these flowers
smell sweet

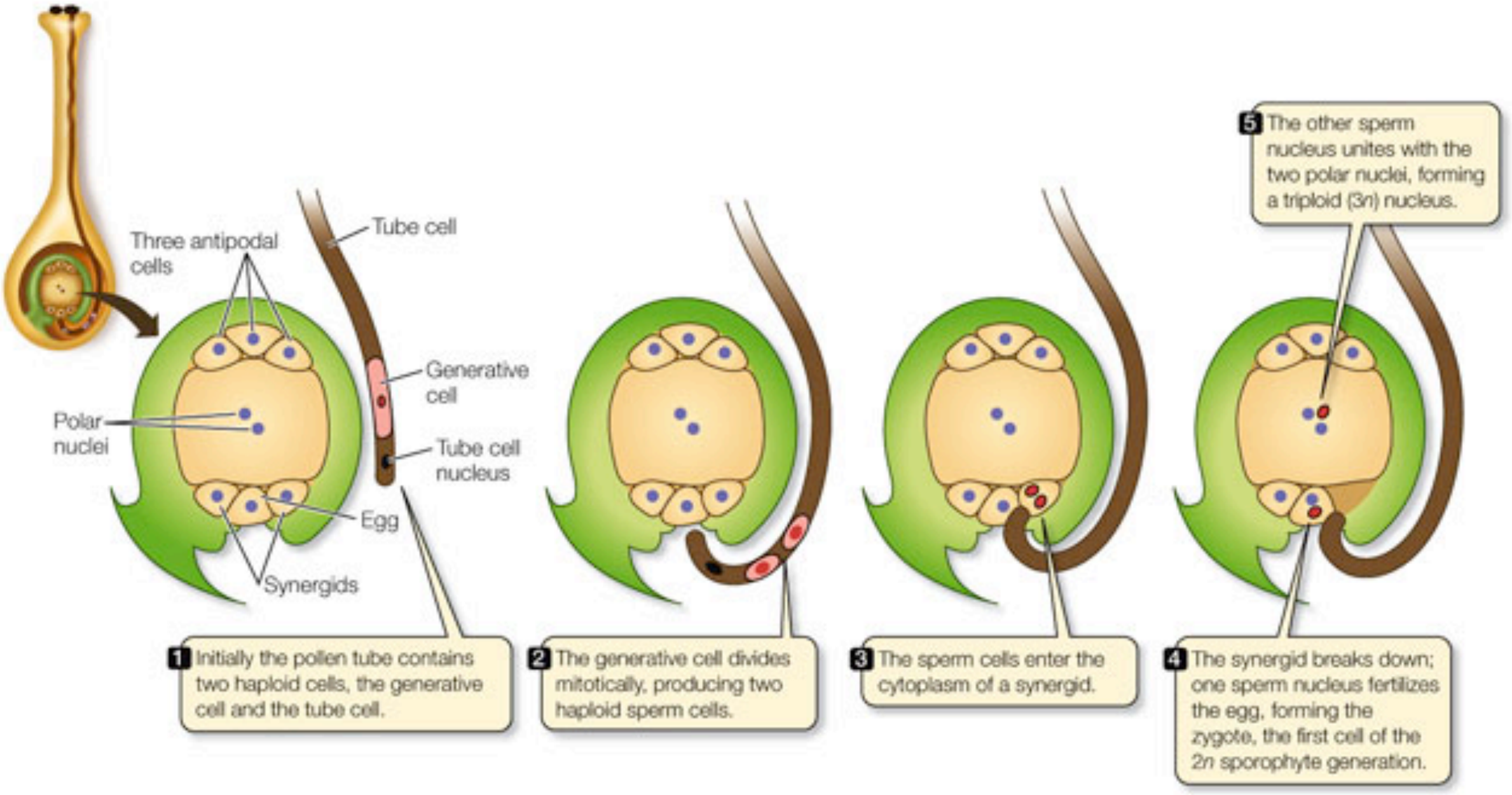
usually white or
light colored flowers
because pollinators
are often nocturnal

bats feed on nectar, moths lay
eggs on the flower's ovaries

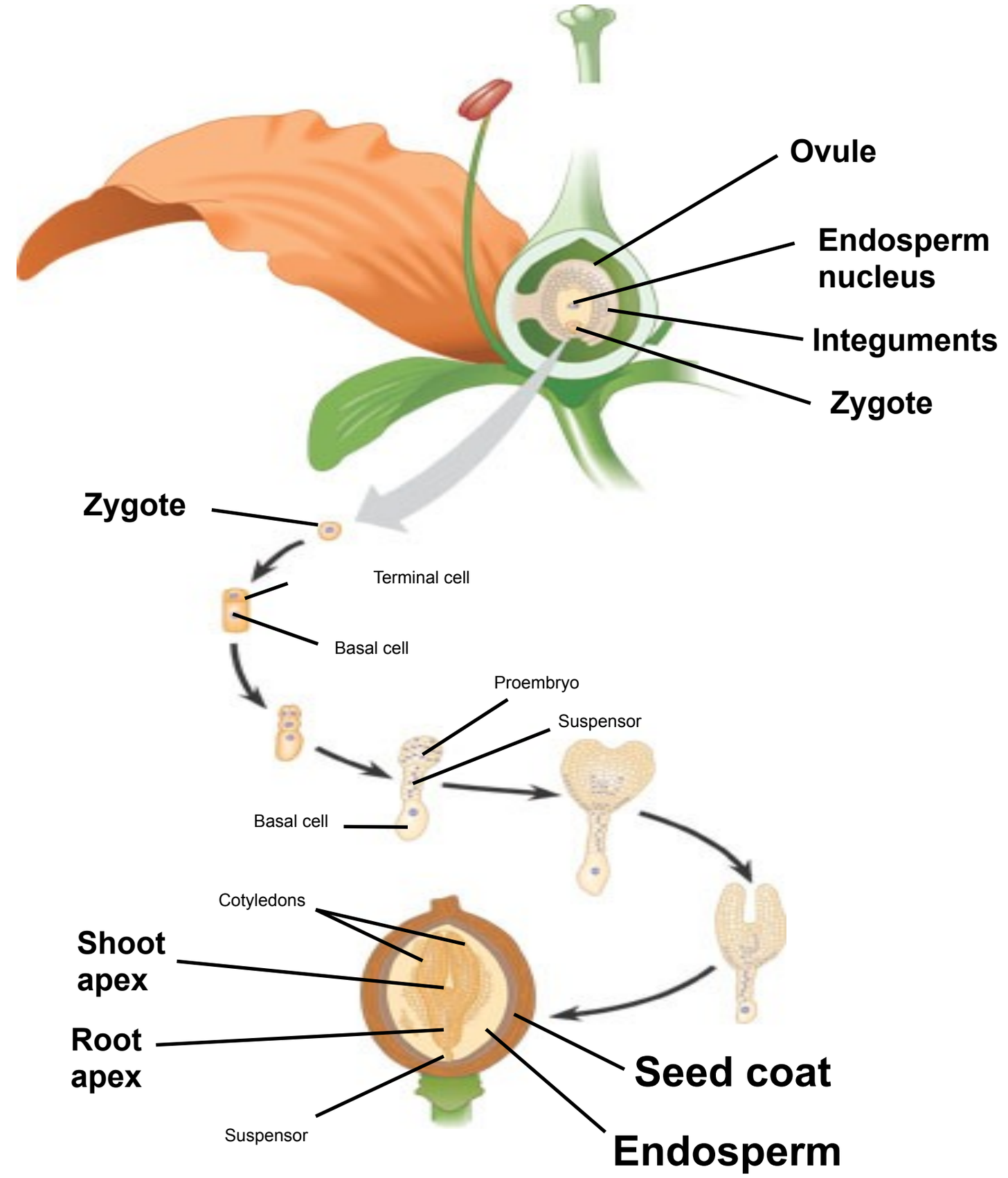
***Xanthopan morgani***
**(WALKER, 1856)**

# Coevolution of Flower & Pollinator

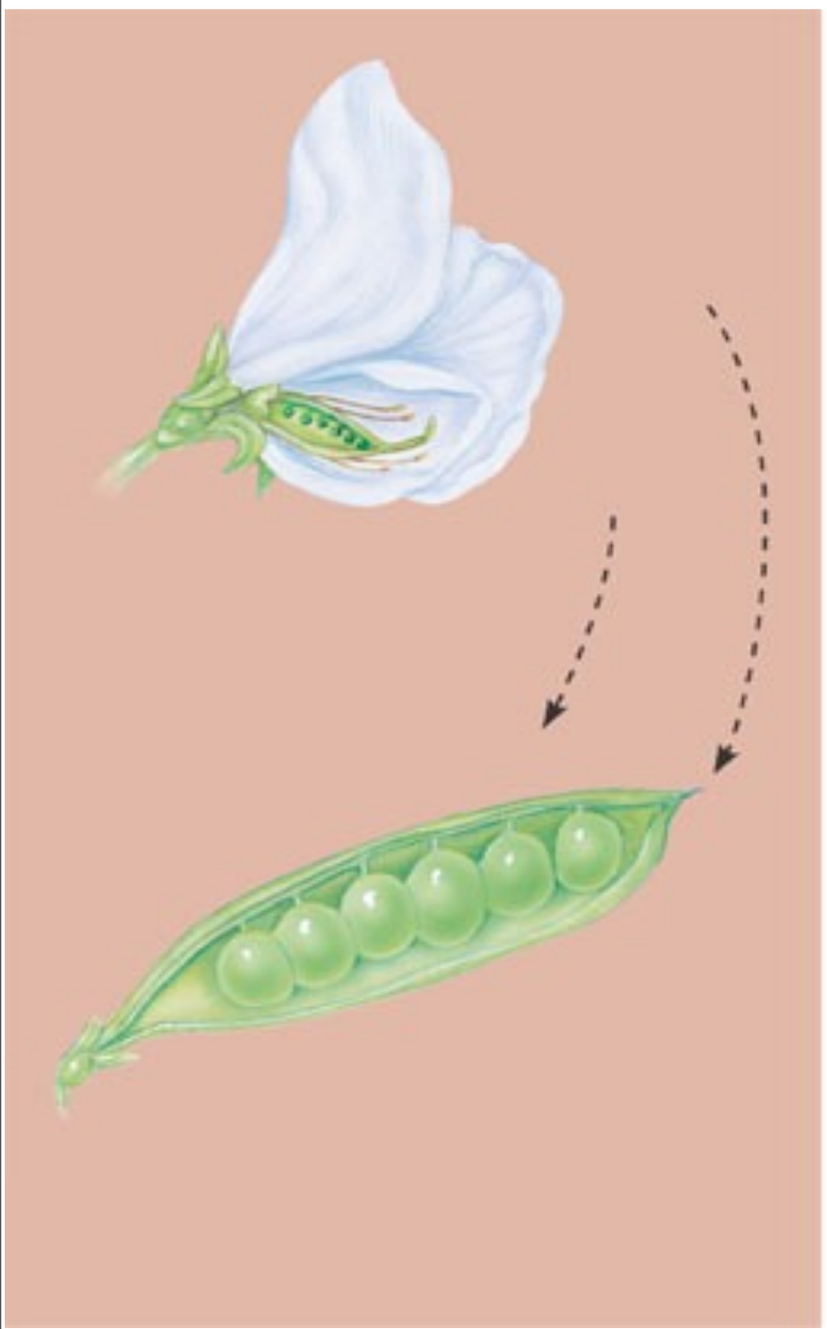
# Double Fertilization



# Embryo & Seeds



# Fruits

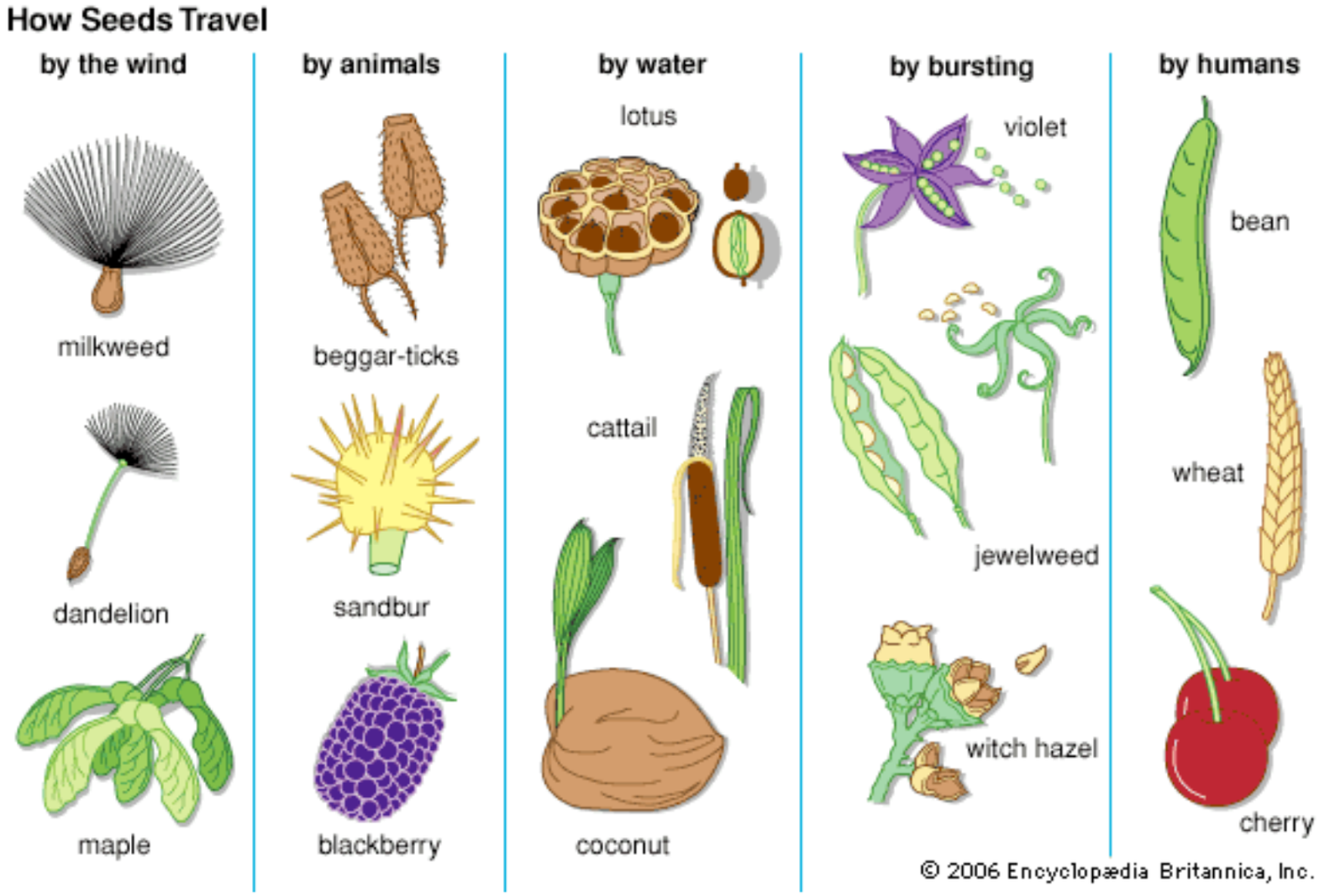


**Simple fruit.** A simple fruit develops from a single carpel (or several fused carpels) of one flower (examples: pea, lemon, peanut).

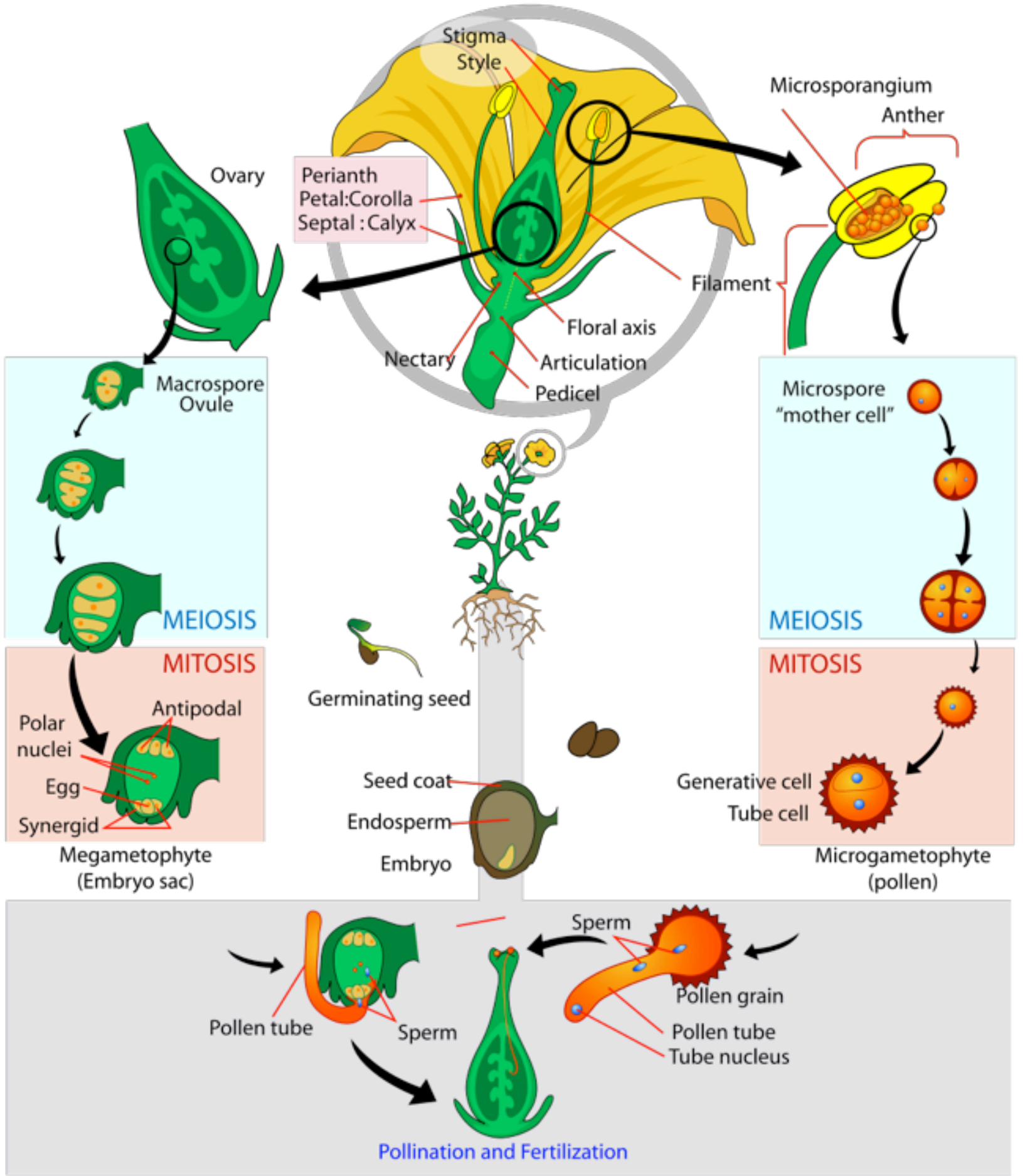
**Aggregate fruit.** An aggregate fruit develops from many separate carpels of one flower (examples: raspberry, blackberry, strawberry).

**Multiple fruit.** A multiple fruit develops from many carpels of many flowers (examples: pineapple, fig).

# Seed & Fruit Dispersal



# Angiosperm Life Cycle



# Asexual Reproduction in Plants

add next year

# Fungi

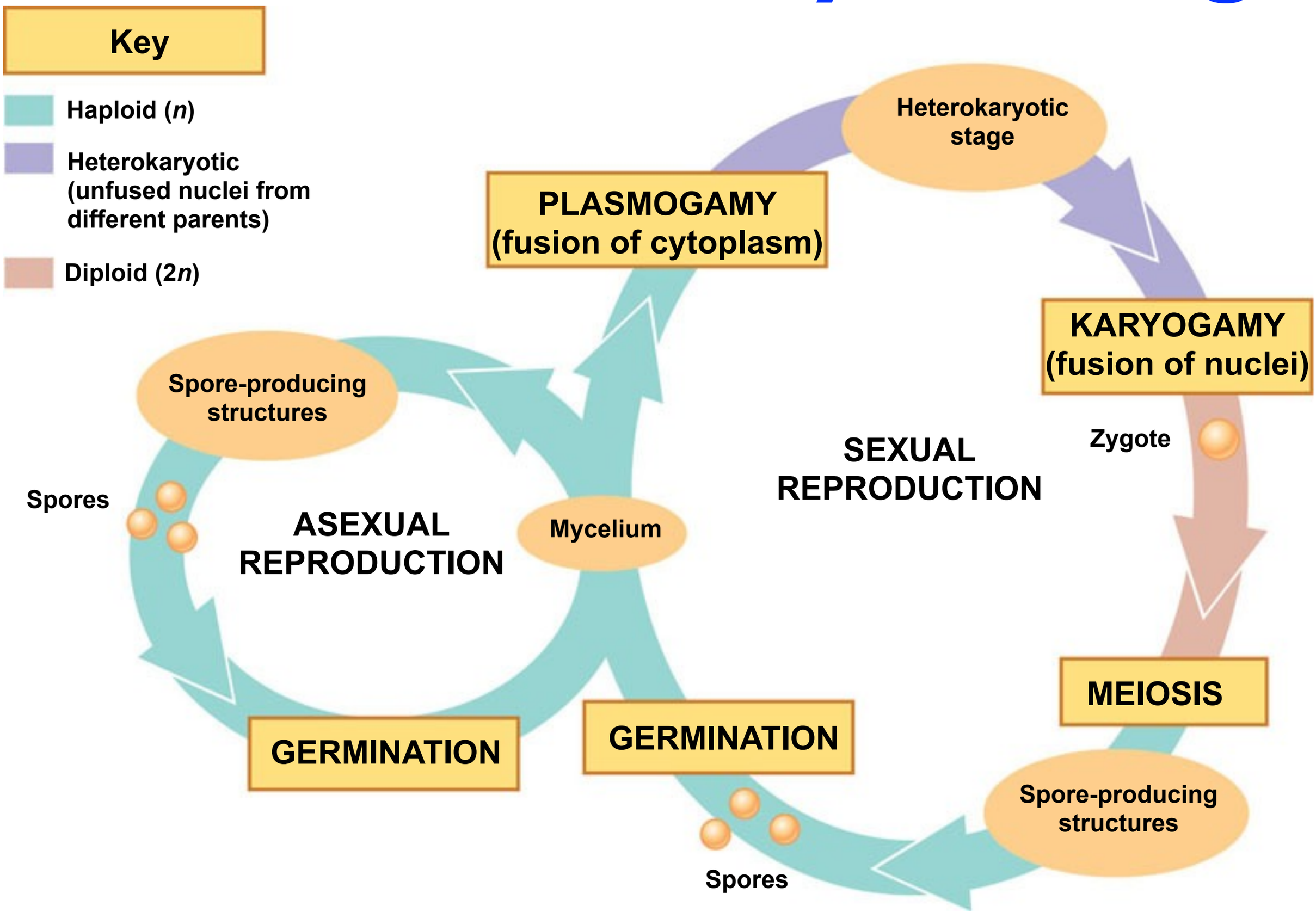
## Reproduction

# Reproduction in Fungi

- Fungi produce spores through sexual or asexual life cycles.
  - Fungi can produce a vast number of spores
  - Spores are carried by wind or water and can travel long distances
  - Spores can germinate when they find a suitable environment, usually a moist one
  - Spores are everywhere...just leave some bread on the counter and return days later to find black bread mold consuming the bread

We will try generalize fungal reproduction and also introduce some familiar fungal groups but the truth is fungal reproduction is very diverse, in fact mycologists classify fungi according to their reproductive means.

# Generalized Life Cycle: Fungi



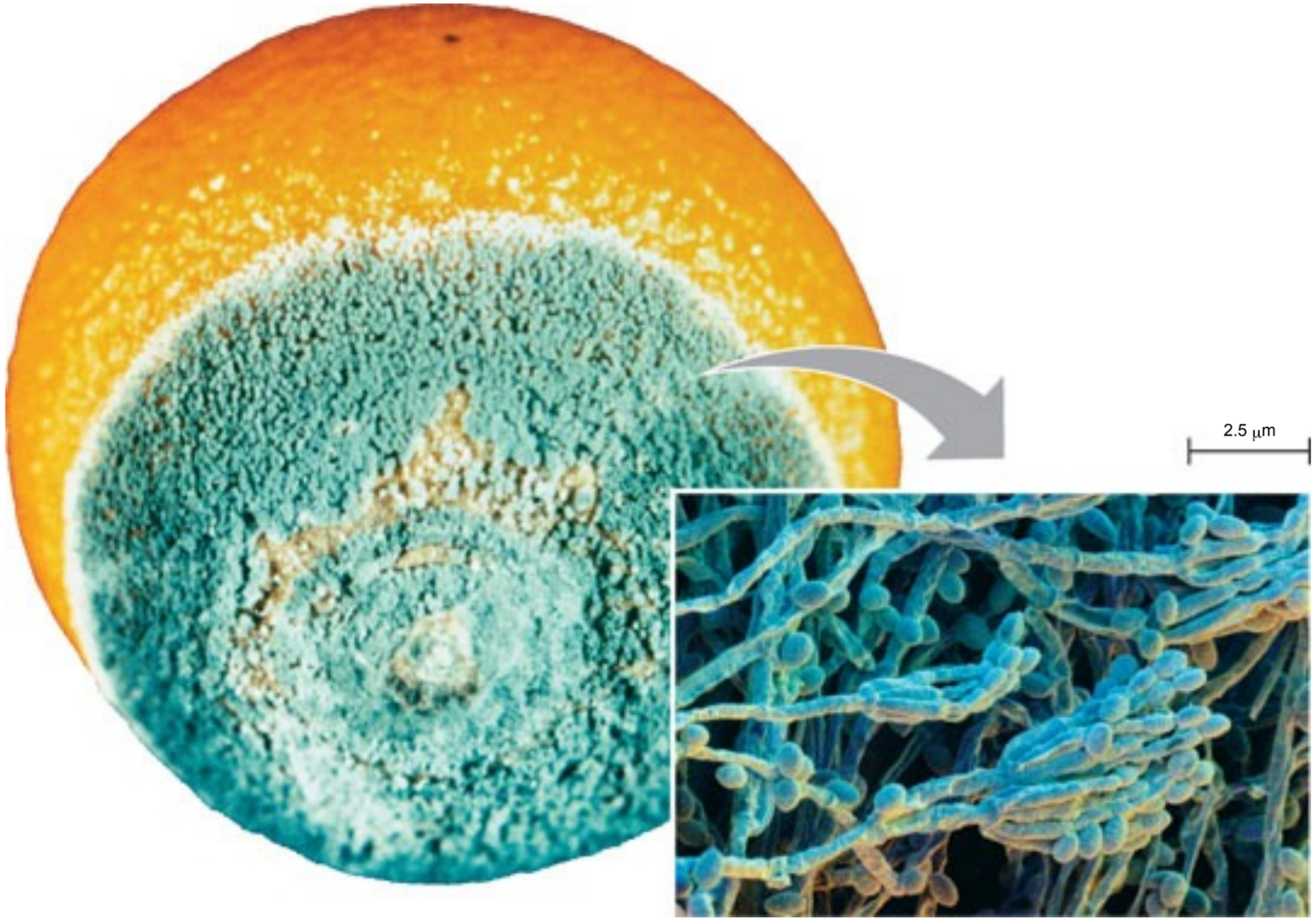
# Sexual Reproduction

- Most fungal spores are haploid.
- Fungal hyphae of different "mating types" (instead of male or female) seek each other using pheromones.
- The two cytoplasms of hyphae/mycelia will fuse (plasmogamy) but the nuclei do not initially fuse
  - The hyphae/mycelia remain dikaryotic anywhere from a few days to a couple centuries
- When the two nuclei do fuse (karyogamy) the short lived diploid zygote undergoes meiosis to restore the haploid condition, followed by the release of more haploid spores

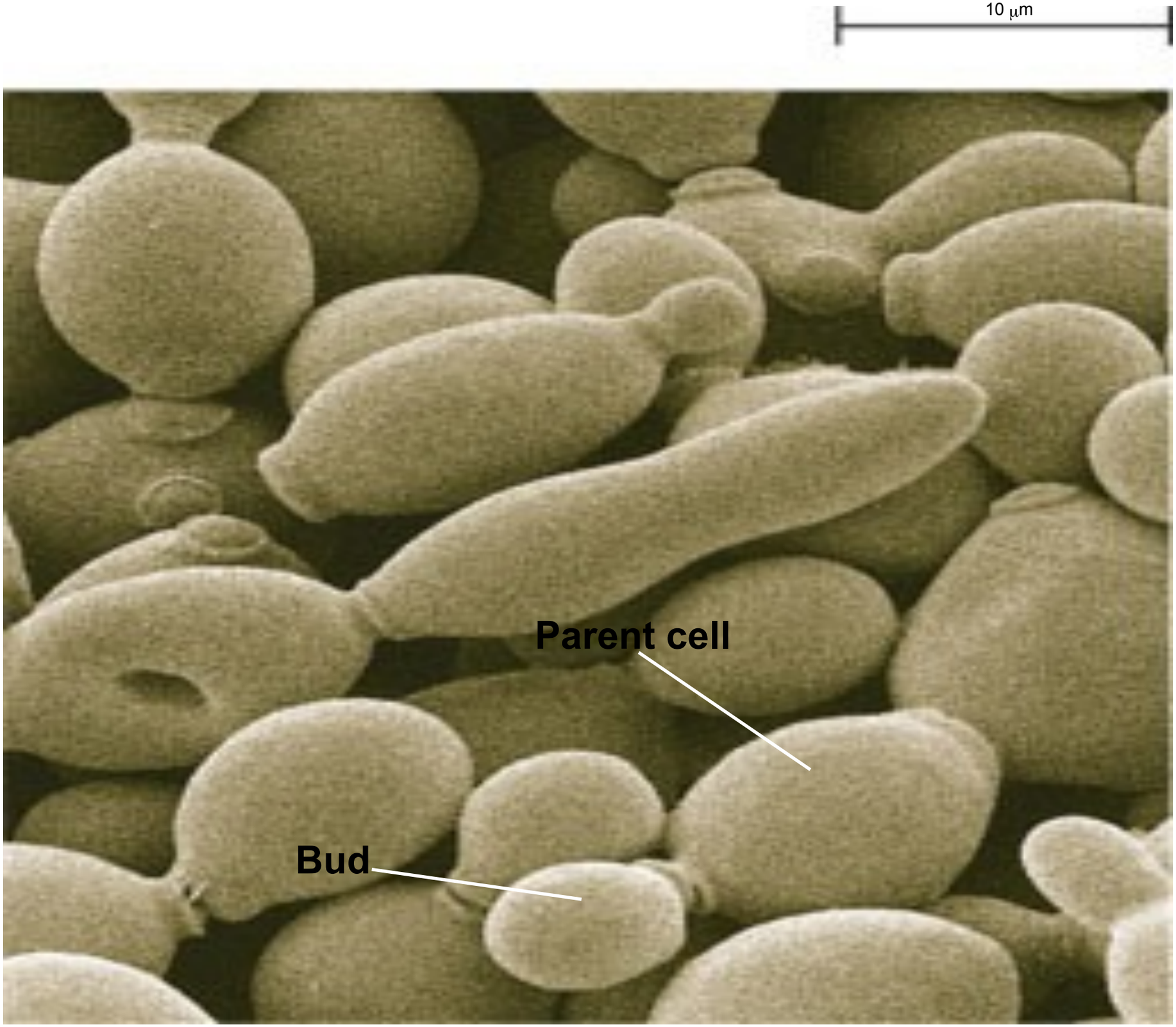
# Asexual Reproduction

- Many fungi reproduce both sexually and asexually but some 20,000+ species do reproduce solely by asexual means.
  - either way fungal reproduction is extremely diverse
- *Molds* produce haploid filaments that give rise to spores
- *Yeasts* reproduce in a more traditional way, ordinary cellular division that resembles budding or binary fission
  - The hyphae/mycelia remain dikaryotic anywhere from a few days to a couple centuries
- When the two nuclei do fuse (karyogamy) the short lived diploid zygote undergoes meiosis to restore the haploid condition, followed by the release of more haploid spores

# Mold



# Yeasts



# Basidiomycetes

- When most think of mushrooms, they likely visualize mushrooms on pizza, or on their salad, or perhaps mushroom caps that spring up from the ground.
- In any case basidiomycetes is a group of familiar mushrooms and by examining their life cycle we can see and review common principles of fungal reproduction

# Basidiomycetes

(a) Fly agaric (*Amanita muscaria*), a common species in conifer forests in the northern hemisphere

(b) Maiden veil fungus (*Dictyphora*), a fungus with an odor like rotting

(c) Shelf fungi, important decomposers of wood

(d) Puffballs emitting spores

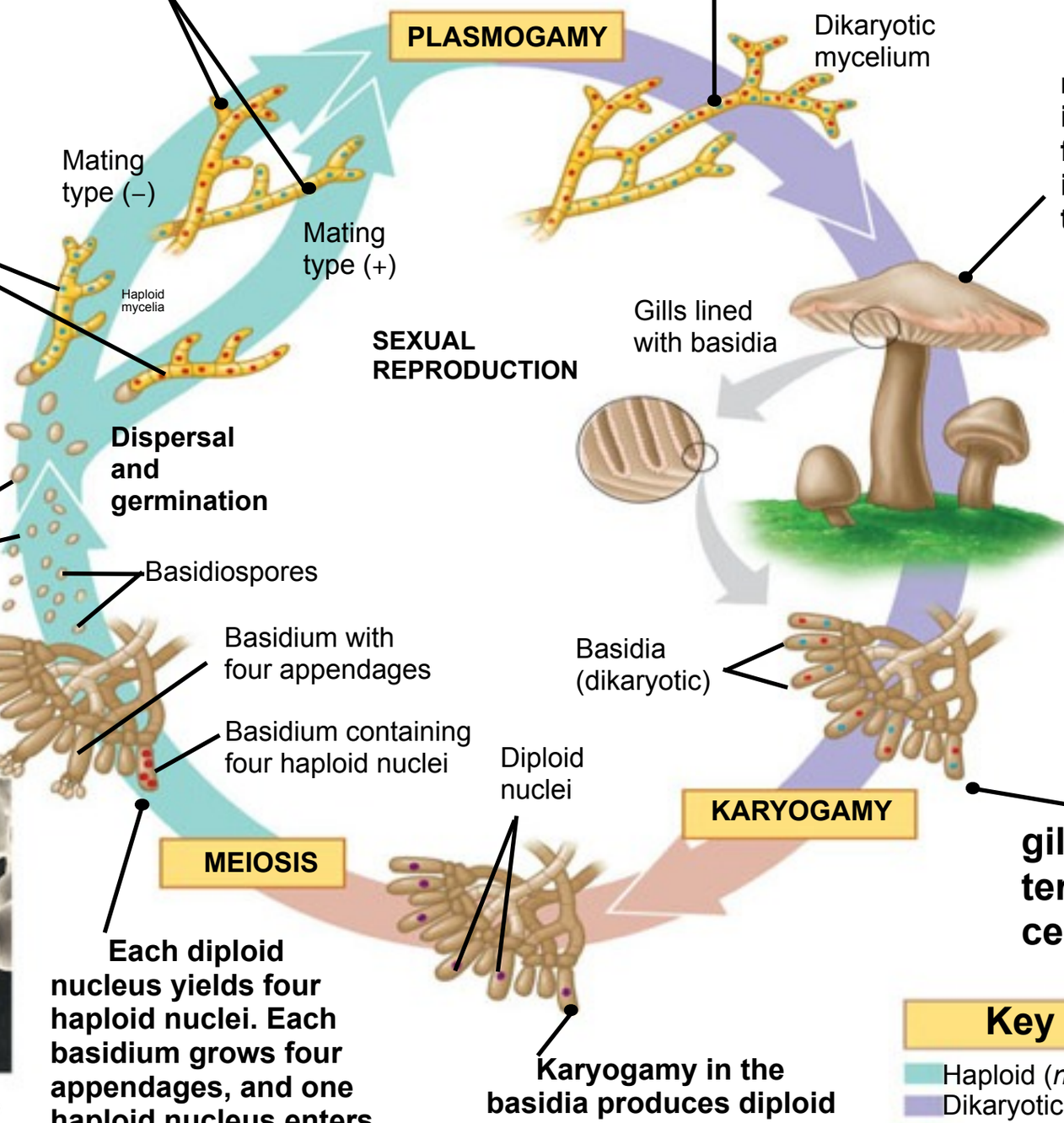
Thursday, September 20, 2012

# Basidiomycetes

**A dikaryotic mycelium forms, growing faster then, and ultimately crowding out, the haploid parental mycelia.**

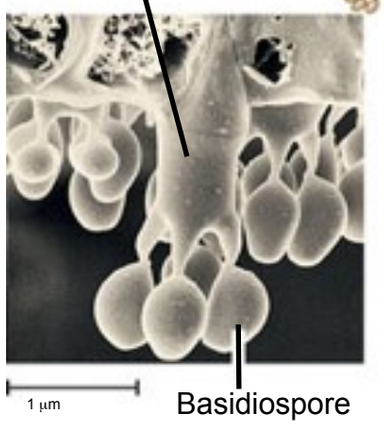
**Two haploid mycelia of different mating types undergo plasmogamy.**

**In a suitable environment, the basidiospores germinate and grow into short-lived haploid mycelia.**




**Environmental cues such as rain or temperature changes induce the dikaryotic mycelium to form compact masses that develop into basidiocarps (mushrooms, in this case).**

**When mature, the basidiospores are ejected, fall from the cap, and are dispersed by the wind.**




**Each diploid nucleus yields four haploid nuclei. Each basidium grows four appendages, and one haploid nucleus enters each appendage and develops into a basidiospore (SEM).**

**Karyogamy in the basidia produces diploid nuclei, which then undergo meiosis.**

**The basidiocarp gills are lined with terminal dikaryotic cells called basidia.**

**Key**

- Haploid ($n$)
- Dikaryotic ($n + n$)
- Diploid ($2n$)

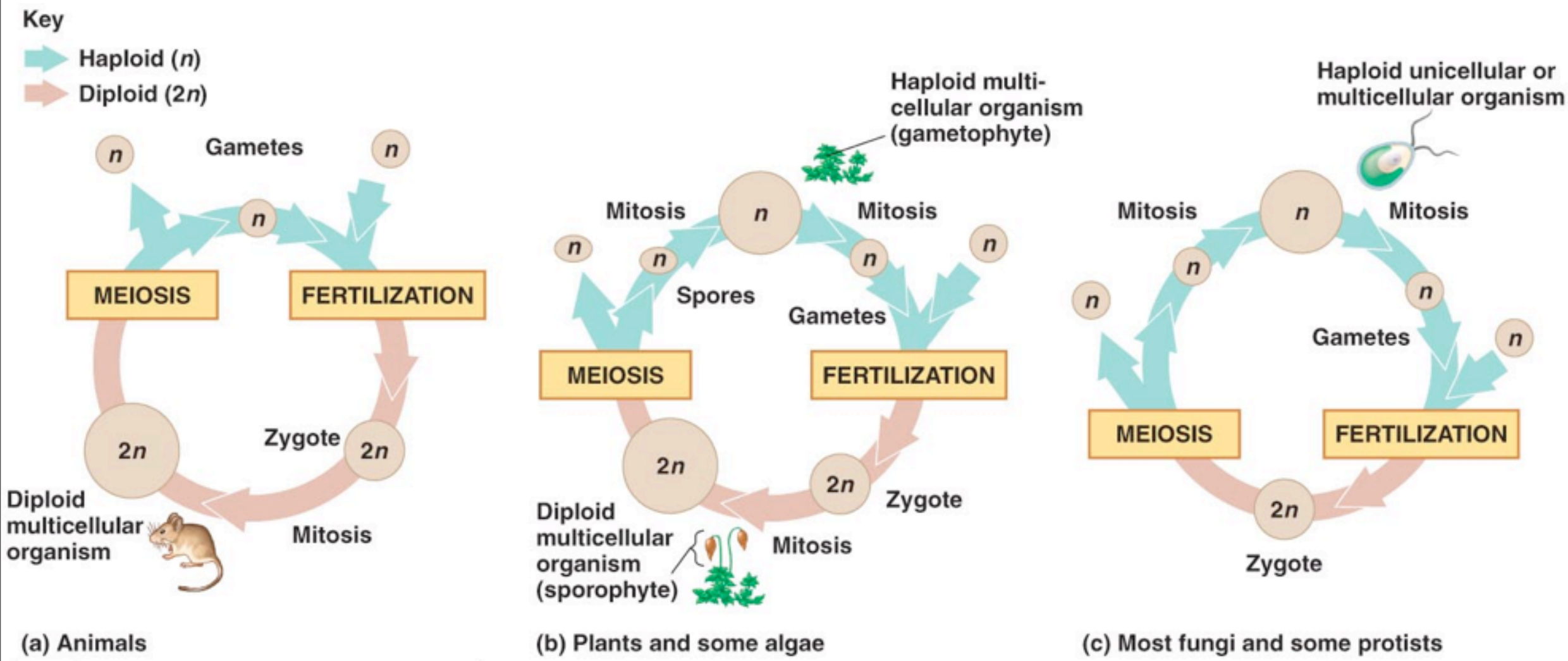
# Protists

## Reproduction

# Reproduction in Protists

- Reproduction in protists are highly varied.
- Some reproduce sexually, some asexually and yet others can reproduce either way.
- All 3 General life cycles are represented in protists, along with variations that do not quite fit any of the these three.

# REVIEW: Variation in Sexual Life Cycles



# Bacteria

## Reproduction

# Reproduction in Bacteria

- Prokaryotes reproduce asexually and very quickly in favorable environments.
- Ideal conditions bacteria can reproduce every 1-3 hours.
    - some as fast as every 20 minutes and others slower every few days.
- If ideal conditions were unlimited, a single bacteria could produce a colony that outweighed the earth in two days.

In reality reproduction is limited...nutrients limited, waste becomes toxic, they are consumed, competition increases, etc

# Reproduction in Bacteria

- Prokaryotes are small, they have short generations and reproduce by binary fission.
- As a result bacterial colonies can approach the trillions, they reproduce at incredible rates and adapt quickly to environmental challenges.

# Binary Fission



1. A young cell at early phase of cycle

2. A parent cell prepares for division by enlarging its cell wall, cell membrane, and overall volume. Midway in the cell, the wall develops notches that will eventually form the transverse septum, and the duplicated chromosome becomes affixed to a special membrane site.

3. The septum wall grows inward, and the chromosomes are pulled toward opposite cell ends as the membrane enlarges. Other cytoplasmic components are distributed (randomly) to the two developing cells.

4. The septum is synthesized completely through the cell center, and the cell membrane patches itself so that there are two separate cell chambers.

5. At this point, the daughter cells are divided. Some species will separate completely as shown here, while others will remain attached, forming chains or doublets, for example.