

BOOKLET 3

Fetus Development and Birth

Learner outcomes...

What you need to know!

- trace the processes of fertilization, implantation and extra-embryonic membrane formation, i.e., placenta, amnion, chorion, allantois, followed by embryonic and fetal development, parturition and lactation, and describe the control mechanisms of these events, i.e., progesterone, LH, human chorionic gonadotropin (hCG), prostaglandins, oxytocin, prolactin
- describe development from fertilization to parturition in the context of the main physiological events that occur in the development of organ systems during each major stage (trimester); i.e., zygote, blastocyst, gastrulation, general morphogenesis

Learner outcomes...

What you need to know!

- describe the influence of environmental factors on embryonic and fetal development; *e.g., maternal lifestyle, teratogens such as alcohol, drugs, viral infections and radiation*

Terms you need to know

Morphogenesis

Embryo

Fetus

1st Trimester

2nd Trimester

3rd Trimester

Organogenesis

Teratogen

Sexually Undifferentiated Stage

Sex determining Chromosome

Parturition

Prostaglandin

Terms you need to know

Relaxin

Oxytocin

Prolactin

Episiotomy

Caesarean

Epidural

Lactation

Chorionic Villi Sampling

Amniocentesis

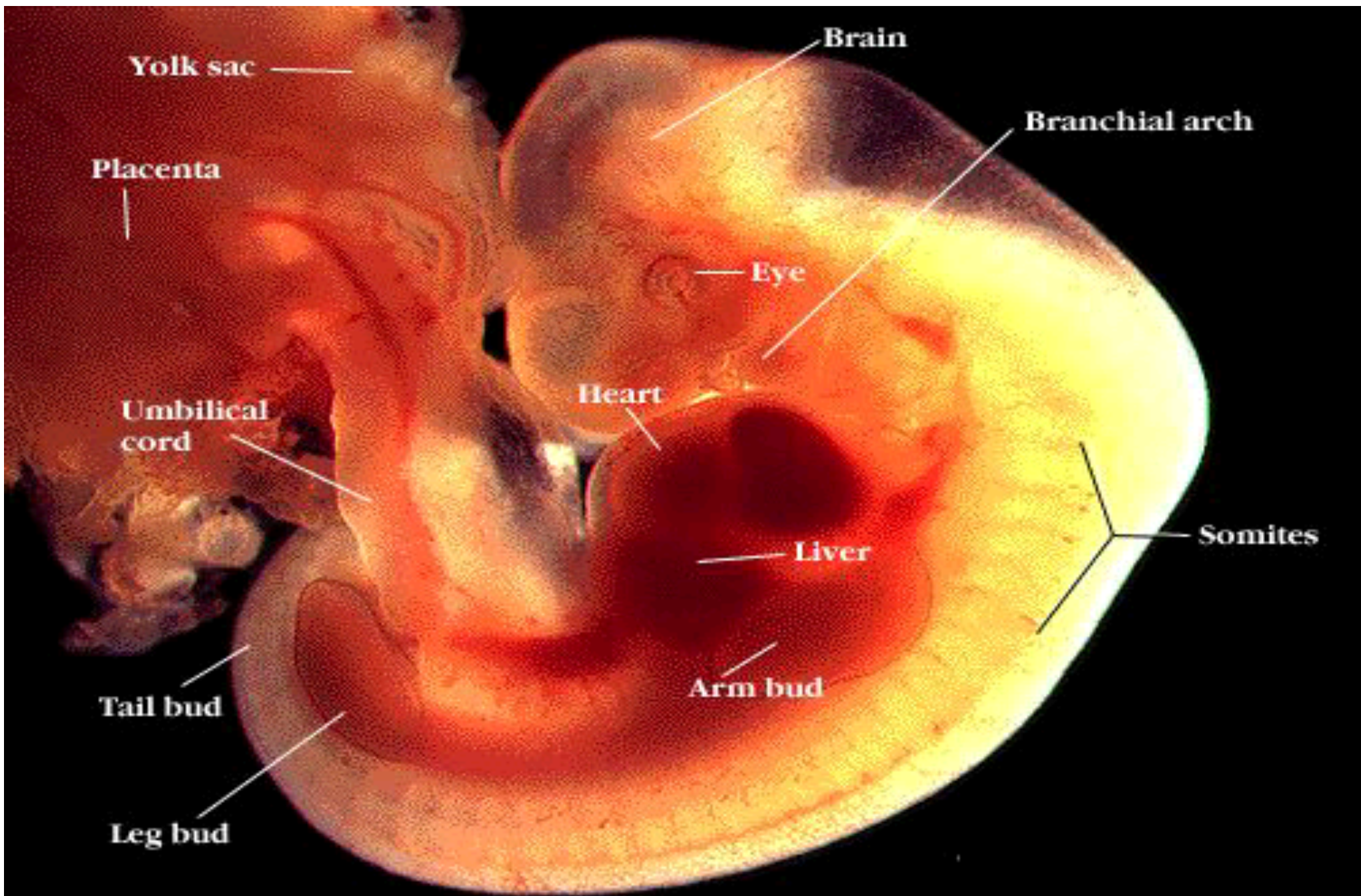
Karyotype

Gene Mapping

Ultrasound Imaging

Embryonic - Fetal Development

- Following gastrulation, the embryo begins a process called **morphogenesis**. This is when the embryo begins to develop specific organs and begins to take on a more human shape
- After the 9th week of development, we enter the **fetal** stage and the term **fetus** replaces **embryo**.



Embryo at four weeks of age. The beginnings of all major structures are present.

Embryonic to Fetal Development

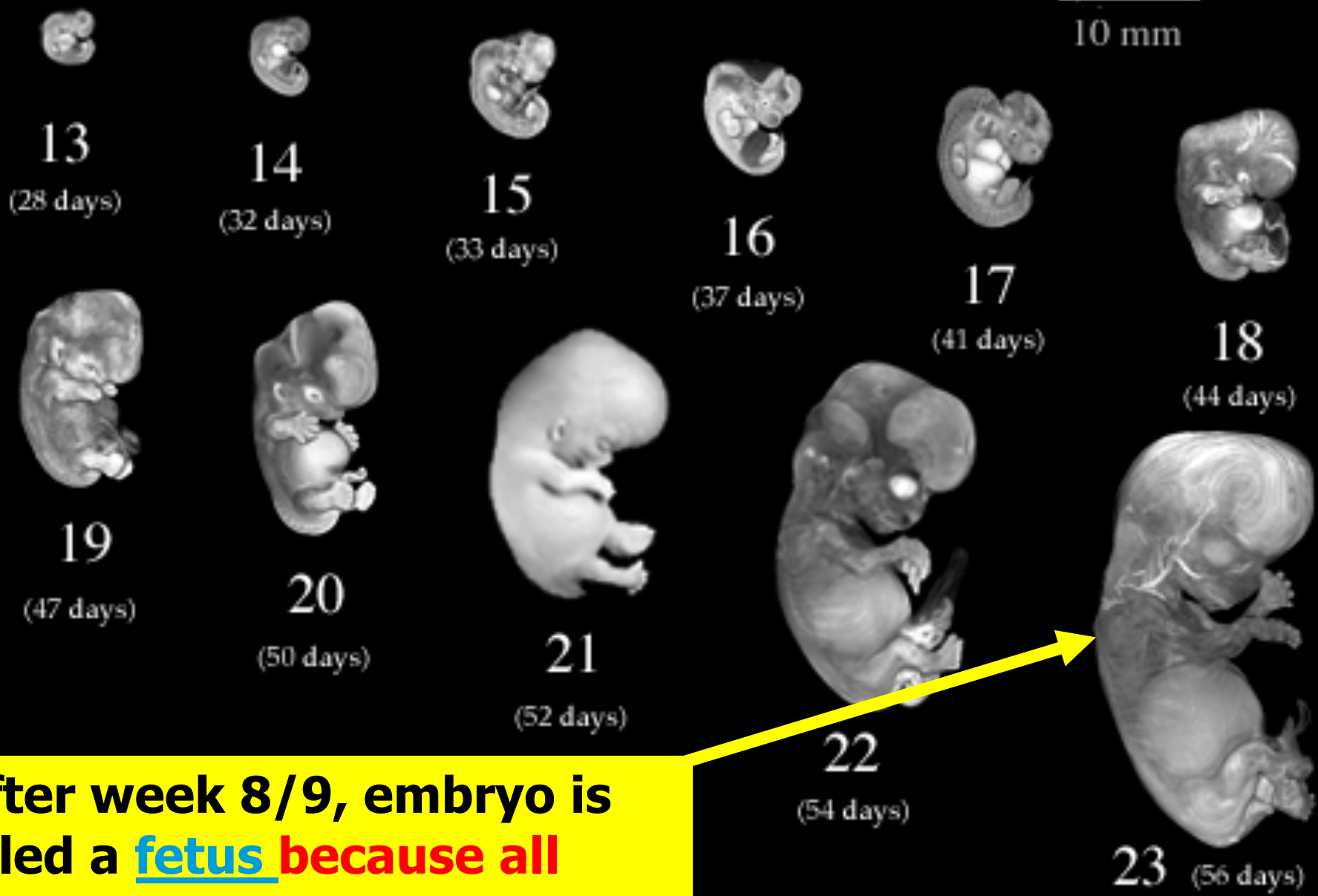
Embryonic Development

- first 9 weeks
- most of the organs are taking shape
- time of morphogenesis

Fetal Development

- organs are present and continue to develop
- time of growth and refinement of existing structures

10 mm



•After week 8/9, embryo is called a **fetus** because all organs have started to develop

1st trimester

fertilization → end of 3rd month

- by 9th week: embryo = fetus
- mainly **organogenesis**, (development of organs)
- **Sex** develops
- most susceptible to environmental factors
 - **teratogens** – substances that increase chance of birth defects
- chorion secretes **hCG** → corpus luteum continues to secrete progesterone/estrogen

Human Embryonic Development



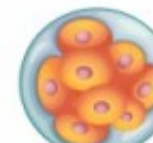
Fertilized egg



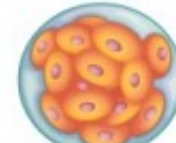
2-cell stage



4-cell stage



8-cell stage



16-cell stage



Blastocyst



1st month (4 weeks)



Ted talk video on embryo development (show 2:05 – end)

https://www.youtube.com/watch?v=fKyljukBE70&feature=player_embedded

Critical Phases of Prenatal Development

Severe congenital abnormalities						Less severe abnormalities and functional disorders			
Embryonic period (weeks)						Fetal period (weeks)			
3	4	5	6	7	8	9	16	32	38
abnormalities of the neural tube								CNS abnormalities	
heart abnormalities			heart abnormalities						
	abnormalities of the extremities		upper extremities						
	abnormalities of the extremities		lower extremities						
		cleft lip		upper lip					
	abnormalities of the ears (lower ear location, hearing impairment)					ears			
	eye disorders (abnormally small eyes, glaucoma, cataracts)				eyes				
			tooth enamel, discoloration			teeth			
			cleft palate			gums			
			genital abnormalities			external sex organs			

Legend: highly sensitive phase less sensitive phase

Examples of Teratogens

Alcohol – can cause Fetal Alcohol Effects or fetal alcohol spectrum disorder (FASD)

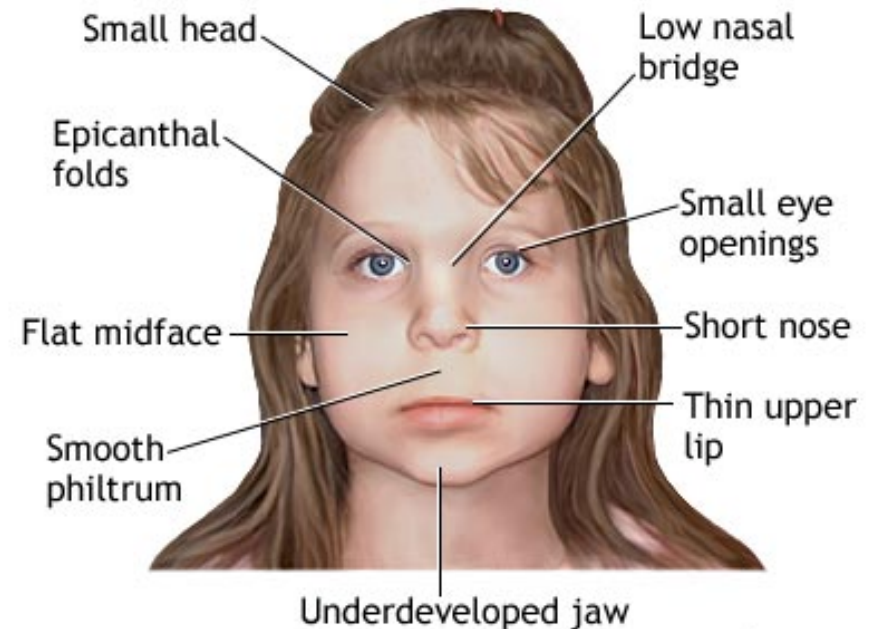
- FASD is 100% preventable. If you are pregnant or plan to become pregnant, don't drink any alcoholic beverage. There is no known safe level.

Tobacco

- Smoking during pregnancy appears to raise the risk of miscarriage or premature labor. But the primary danger is **hindered fetal growth**.

Fetal Alcohol Spectrum Disorder

- Fetal Alcohol Spectrum (FAS) is used to describe a broad range of effects associated with alcohol use during pregnancy
- The spectrum can include **physical effects** as well as **effects on the brain** that may result in problems with **learning, emotions and behavior.**



Sometimes you can tell, sometimes you can't!

Lack of folic acid in the mother's diet can cause spina bifida

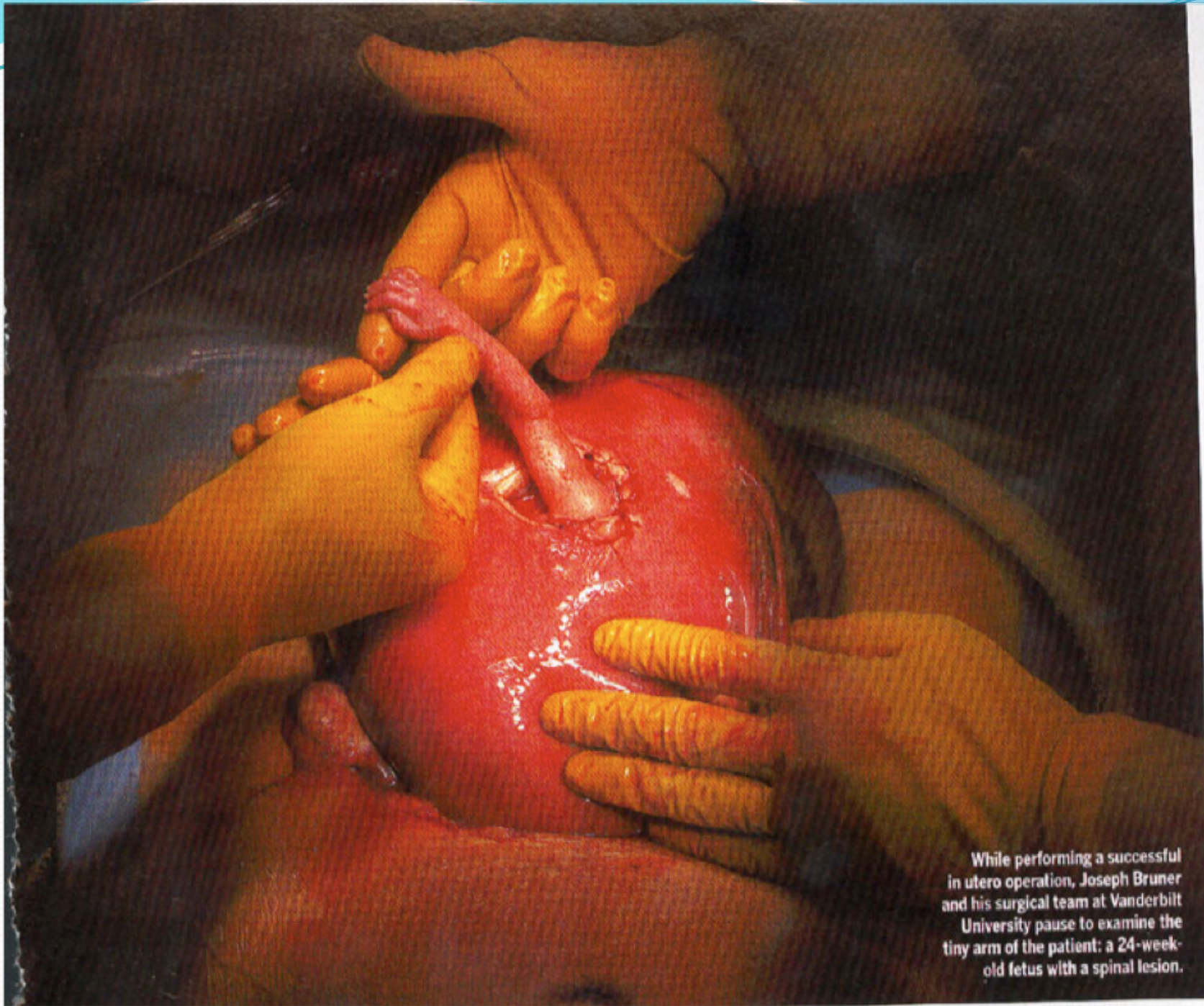
- Spina bifida is a birth defect that involves the incomplete development of the spinal cord or its coverings.
- Spina bifida occurs at the end of the first month of pregnancy when the two sides of the embryo's spine fail to join together, leaving an open area. In some cases, the spinal cord or other membranes may push through this opening in the back. The condition usually is detected before a baby is born and treated right away.



Folic Acid

- Folic acid, sometimes called folate, is a B vitamin (B9) found mostly in leafy green vegetables like kale and spinach, orange juice, and enriched grains.
- Many studies have shown that women who get 400 micrograms (0.4 milligrams) daily *prior* to conception and during early pregnancy reduce the risk that their baby will be born with a serious neural tube defect (a birth defect involving incomplete development of the brain and spinal cord) by up to 70%.





While performing a successful in utero operation, Joseph Bruner and his surgical team at Vanderbilt University pause to examine the tiny arm of the patient: a 24-week-old fetus with a spinal lesion.

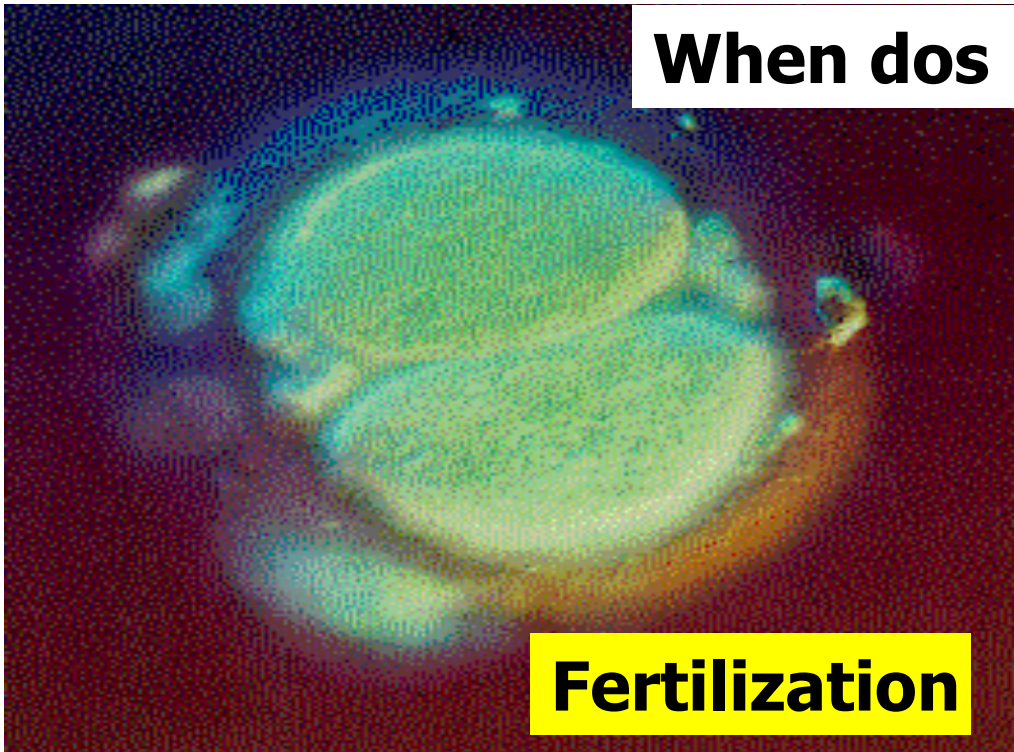
Examples of Teratogens

Viral infections

ex. Rubella (german measles)
-causes cataracts, heart damage, blindness, deafness if mom contracts the virus before week 13. After week 13, the baby may show few effects



When does Life Begin?



Fertilization



6 weeks



6-7 weeks



8 weeks

Sexual Development

Physically undifferentiated stage
till 6th or 7th week

Males

Females

Glans penis

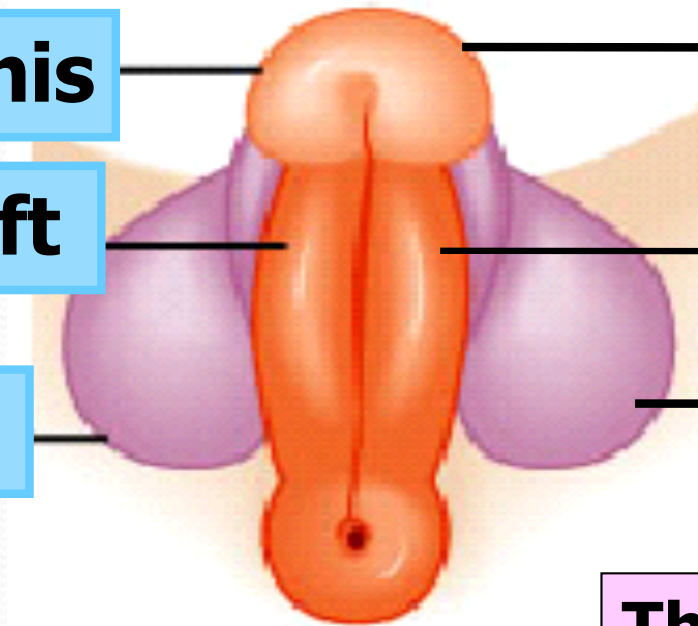
Clitoris

Penis shaft

**Labia
minor**

Scrotum

**Labia
major**

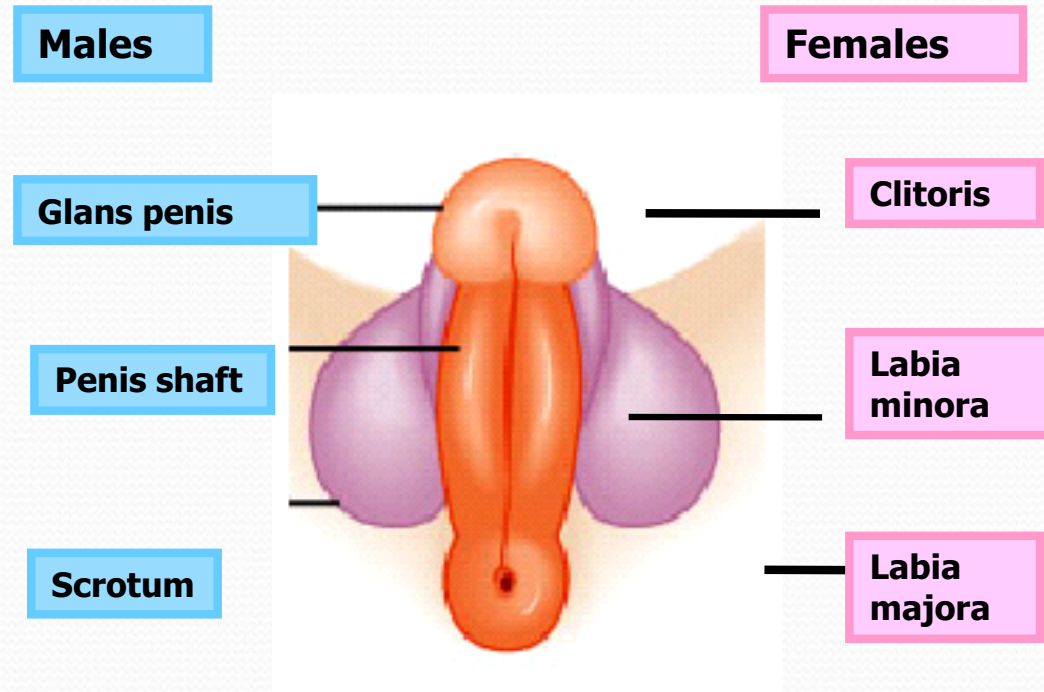


The labia are folds that surround the urethral and vaginal opening

Male and Female Sexual Development

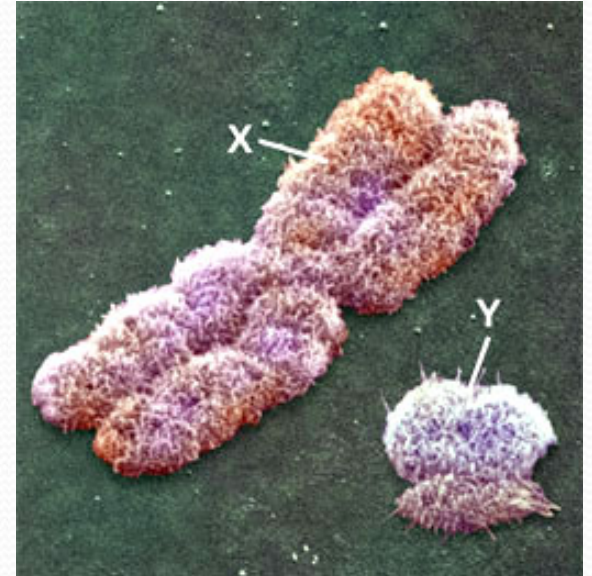
The male and female sex organs originate in the **abdominal cavity**.

By the third month of embryonic development the genes on the **sex chromosomes** cause gonad tissue to specialize into **testes or ovaries**.



What makes a boy a boy?

- The Y chromosome carries a gene called the *sex-determining region Y (SRY)* that triggers the production of male hormones known as androgens (**testosterone**).
- The presence of androgens starts the development of male sex organs in the fetus



3 Trimesters of Pregnancy

2nd Trimester: 4th month → 6th month

- **growth** (mitosis!!) and refinement of tissues
- organs continue to form, cartilage skeleton replaced by bone
- fetus can survive outside womb at end of 6th month (with medical support)
- placenta secretes **progesterone/estrogen**





8 weeks



10 weeks

11 weeks



3 Trimesters of Pregnancy

3rd Trimester: 7th month → 9th month

- fetus grows **rapidly**
- organ systems increase in size
- **fat** is deposited
- respiratory & circulatory systems allow for air breathing
- **Testes** descends into scrotum

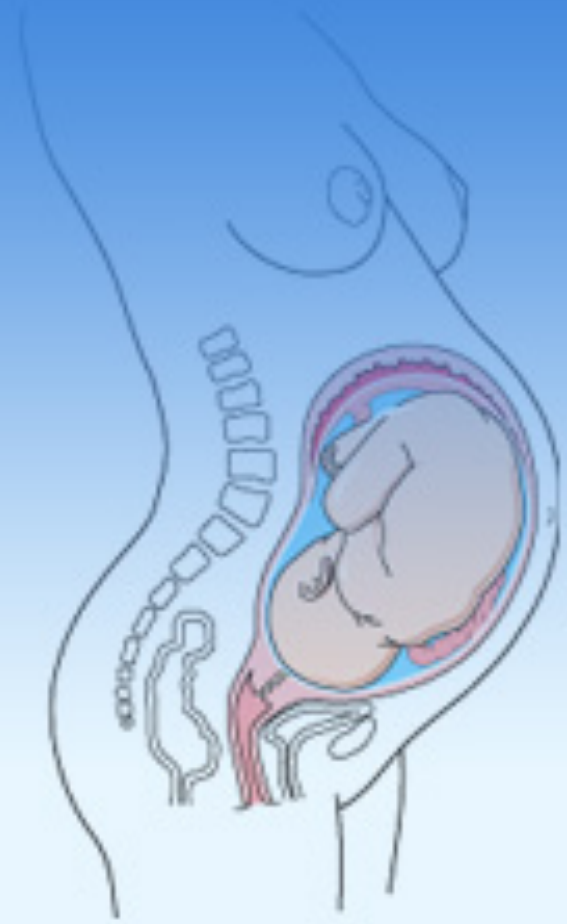




First Trimester

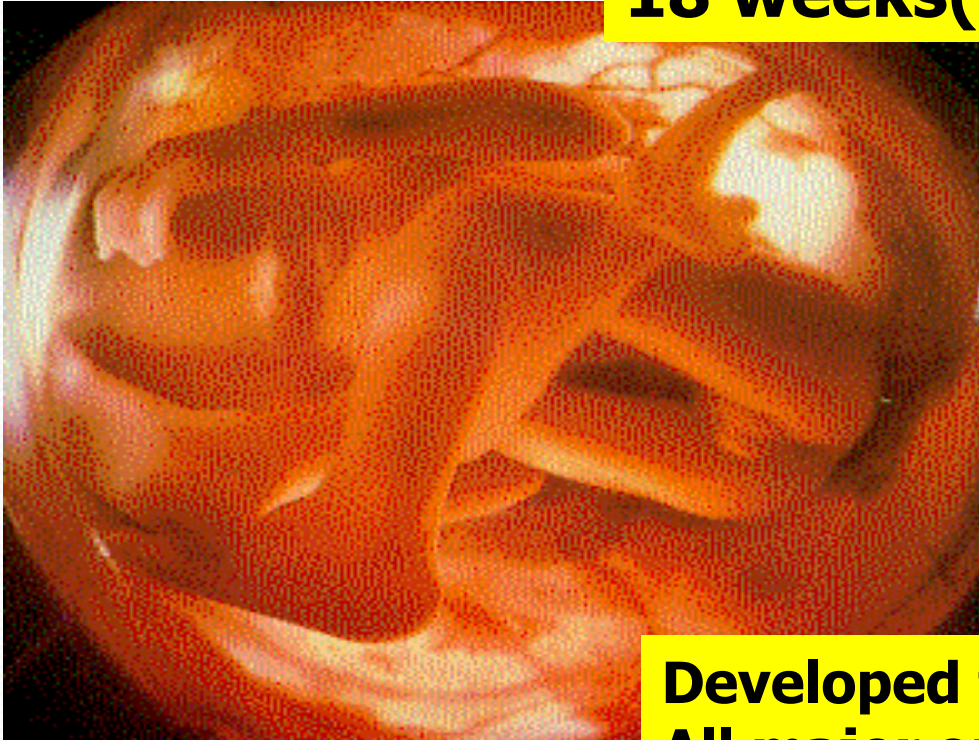


Second Trimester



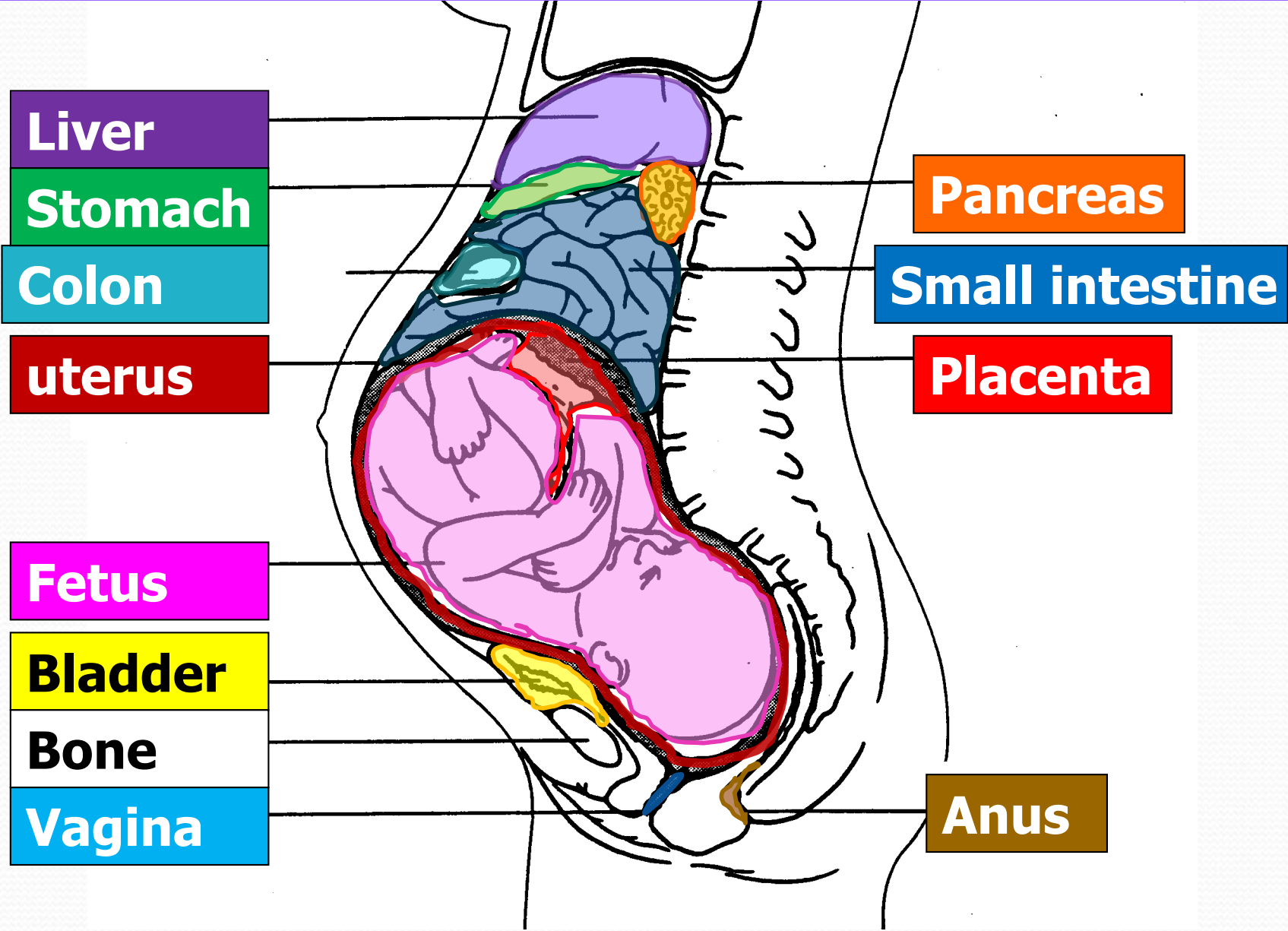
Third Trimester

18 weeks(4.5 months)



**Developed fetus.
All major organs are
functioning except for
the lungs.**

Label the Diagram



I'm so pregnant

<https://www.youtube.com/watch?v=eVuittFyM34>

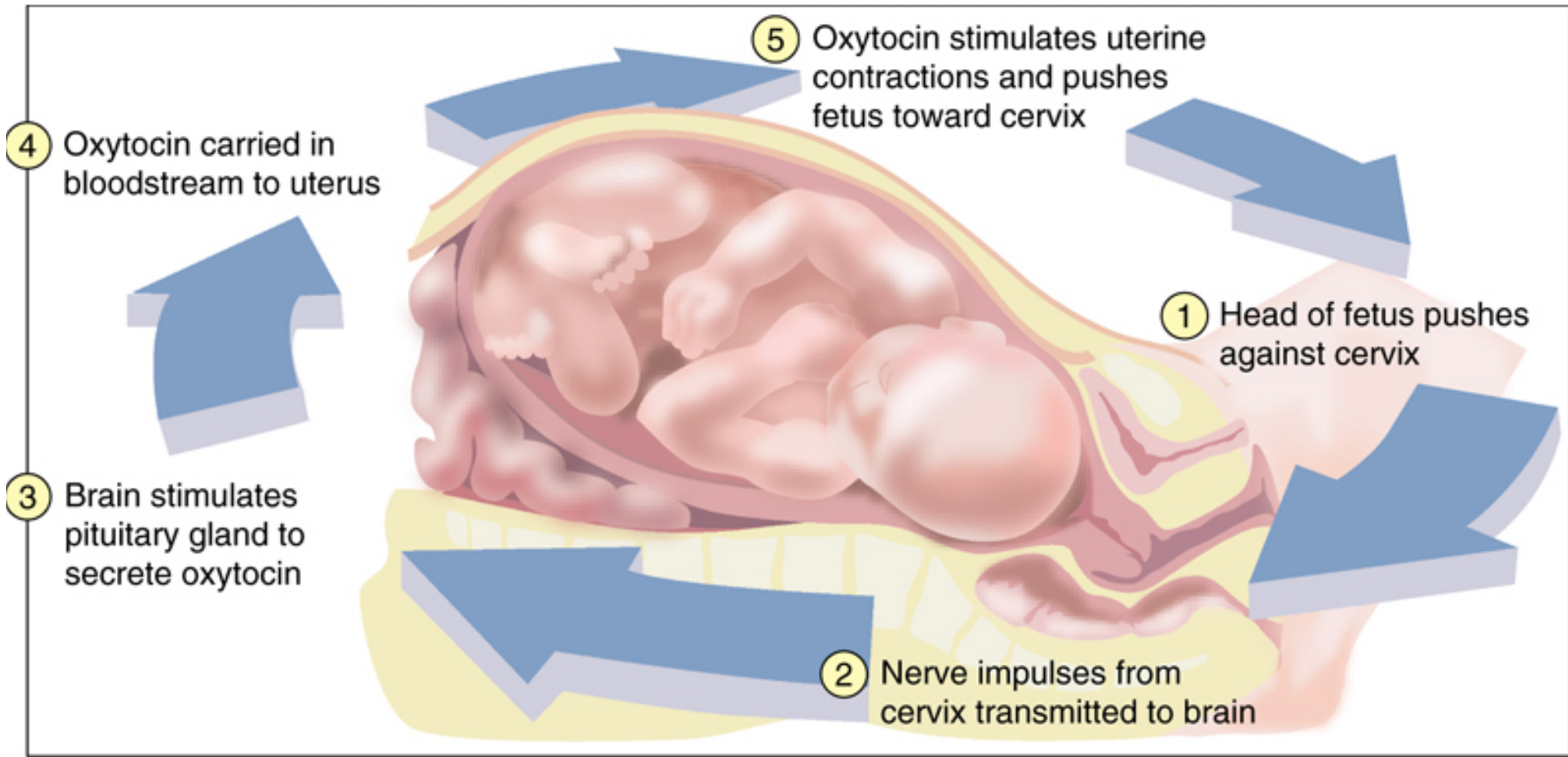


Birth “**parturition**”: Delivery of the Baby

- 38-42 weeks from conception
- rhythmic **uterine contractions** signal labor
- Cervix begins to dilate
- Amniotic membrane gets forced down and often bursts (water breaks)
- Uterine contractions move baby through birth canal
- After the baby is delivered soon after the placenta is also delivered

Parturition

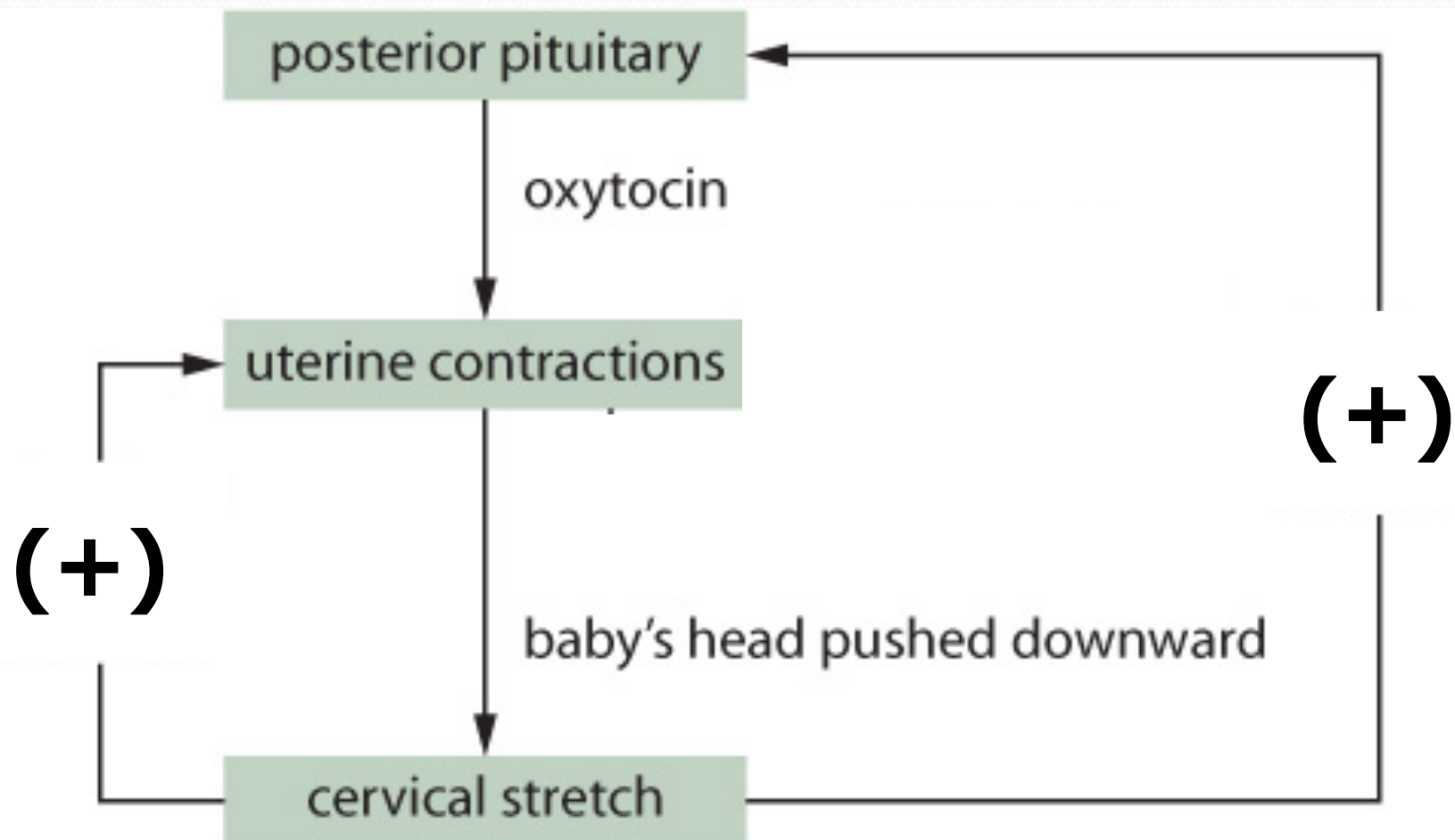
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Labour Hormones (PROP)

1. **Prostaglandins**: local area hormone (produced by **uterus**) that works with oxytocin causing uterine **contractions**
2. **Relaxin**: produced by placenta, **relaxes ligaments** in pelvis → ease passage of baby
3. **Oxytocin**: produced by hypothalamus and stored in posterior pituitary, **positive feedback** causes uterine **contractions**
4. **Prolactin**: produced by anterior pituitary, causes mammary glands to **produce and maintain milk production**

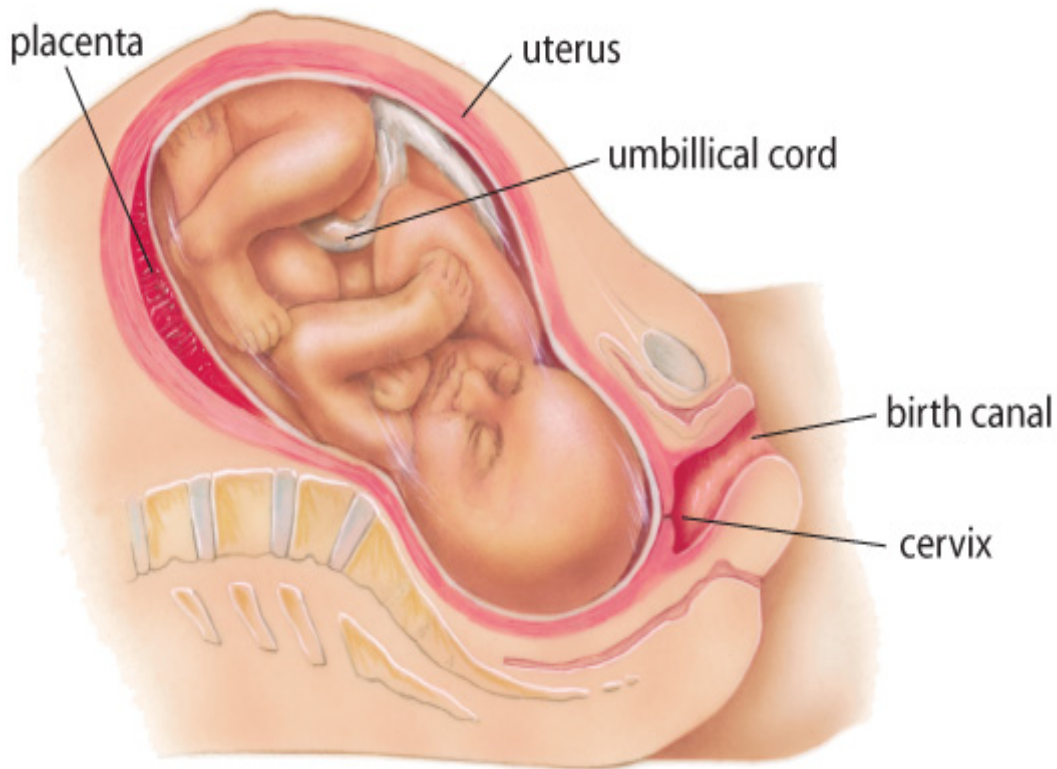
Labour Hormones feedback loop



The Three Stages of Birth

1. Dilation (**Labour**) (the longest stage)

Figure 15.15 Three stages of parturition (birth)

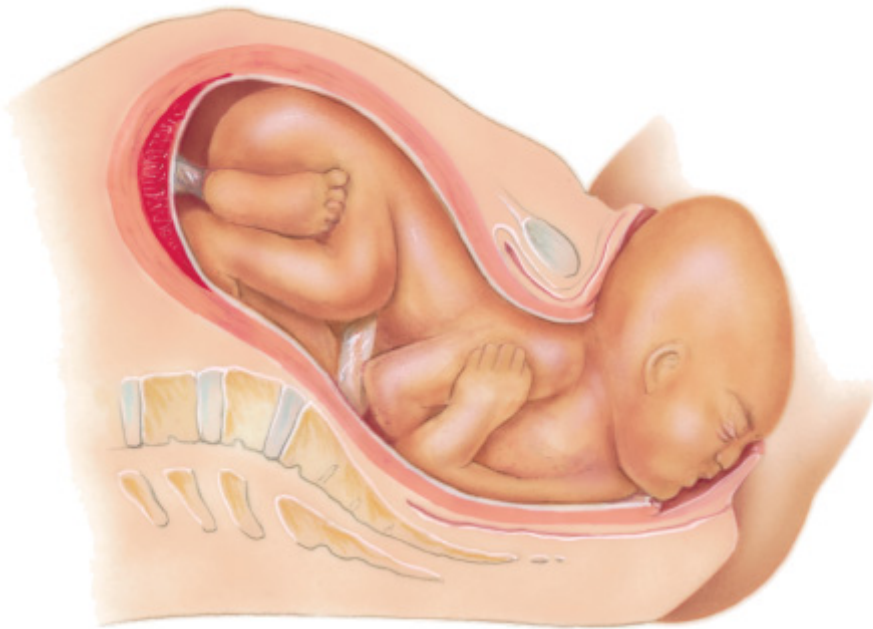


A **Dilation stage** Uterine contractions and oxytocin cause the cervix to open, or dilate. During this stage, the amniotic sac breaks and the amniotic fluid is released through the vagina. The dilation stage usually lasts from 2 to 20 hours.

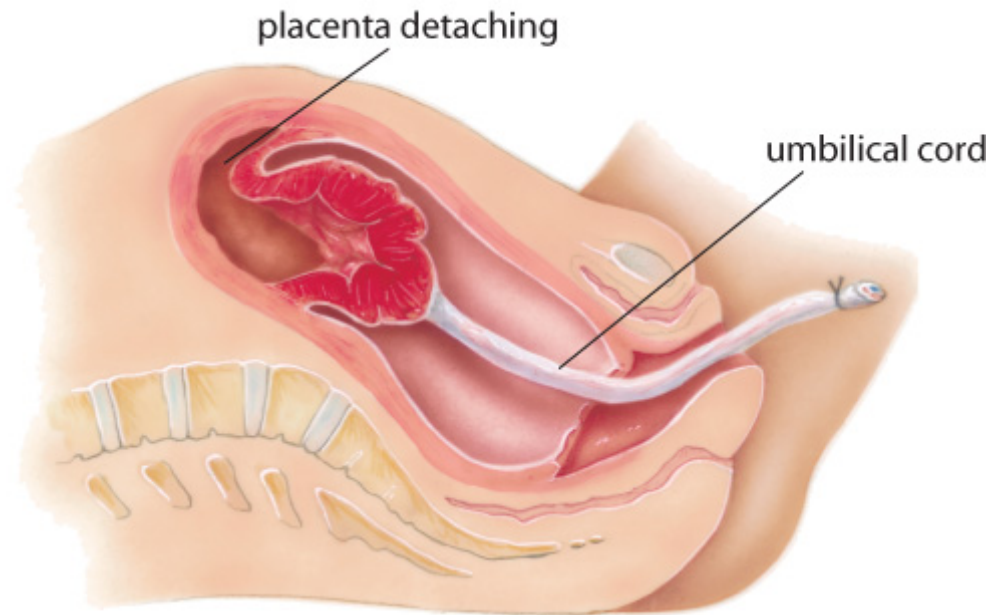
The Three Stages of Birth

2. Expulsion (**Delivery**)

3. Placental Delivery (**Afterbirth**)



B **Expulsion stage** Forceful contractions push the baby through the cervix to the birth canal. As the baby moves through the canal, the head rotates, making it easier for the body to pass through the birth canal. This stage usually lasts from 0.5 to 2 hours.



C **Placental stage** About 10 to 15 minutes after the baby is born, the placenta and umbilical cord are expelled from the uterus. The expelled placenta is called the afterbirth.

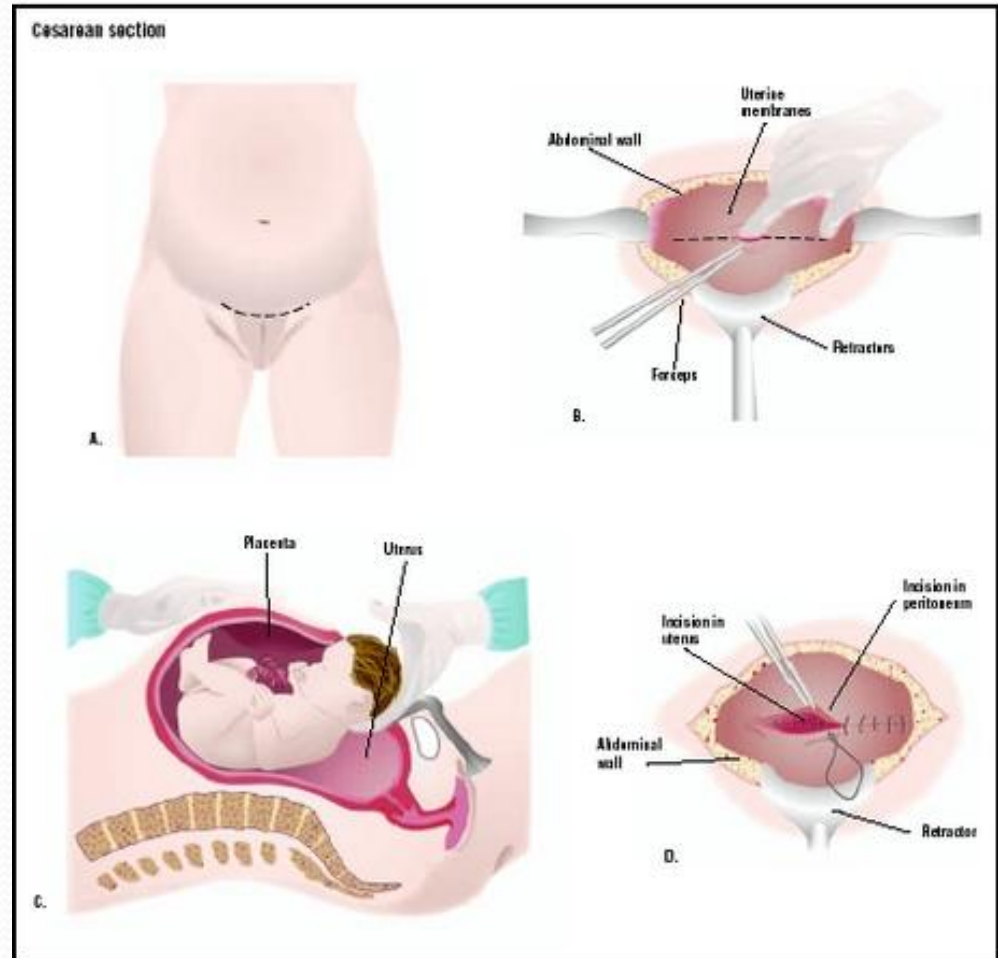
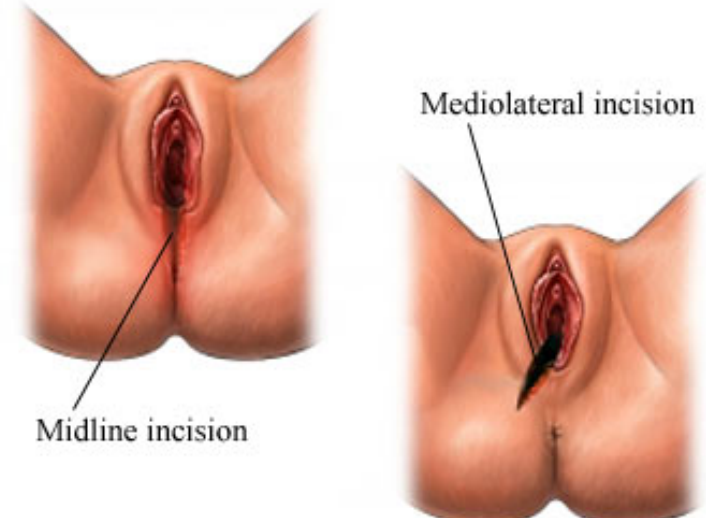
Delivery Methods

1. Natural (vaginal) birth

▣ **Episiotomy** – incision is made with a scalpel to increase size of vaginal opening

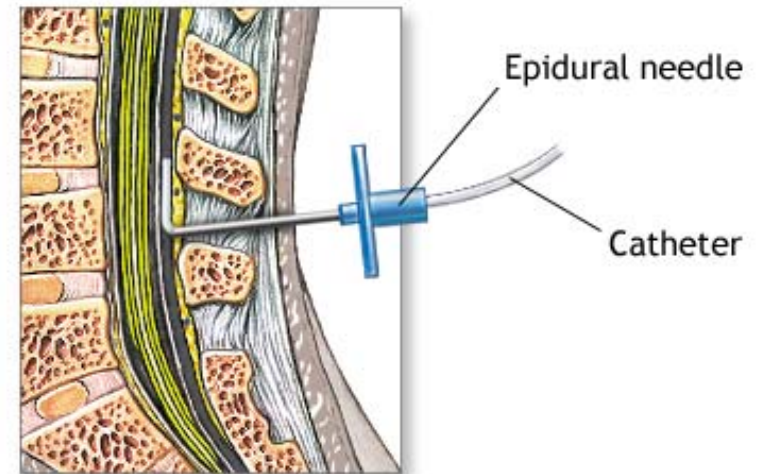
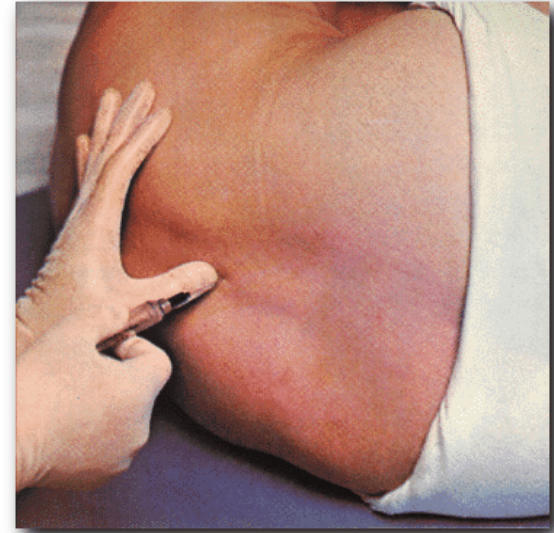
2. Caesarean section – incision in abdomen and uterus

▣ Useful for babies in the rump-first position (breech birth) and for mom's with STI's



Epidural Analgesia

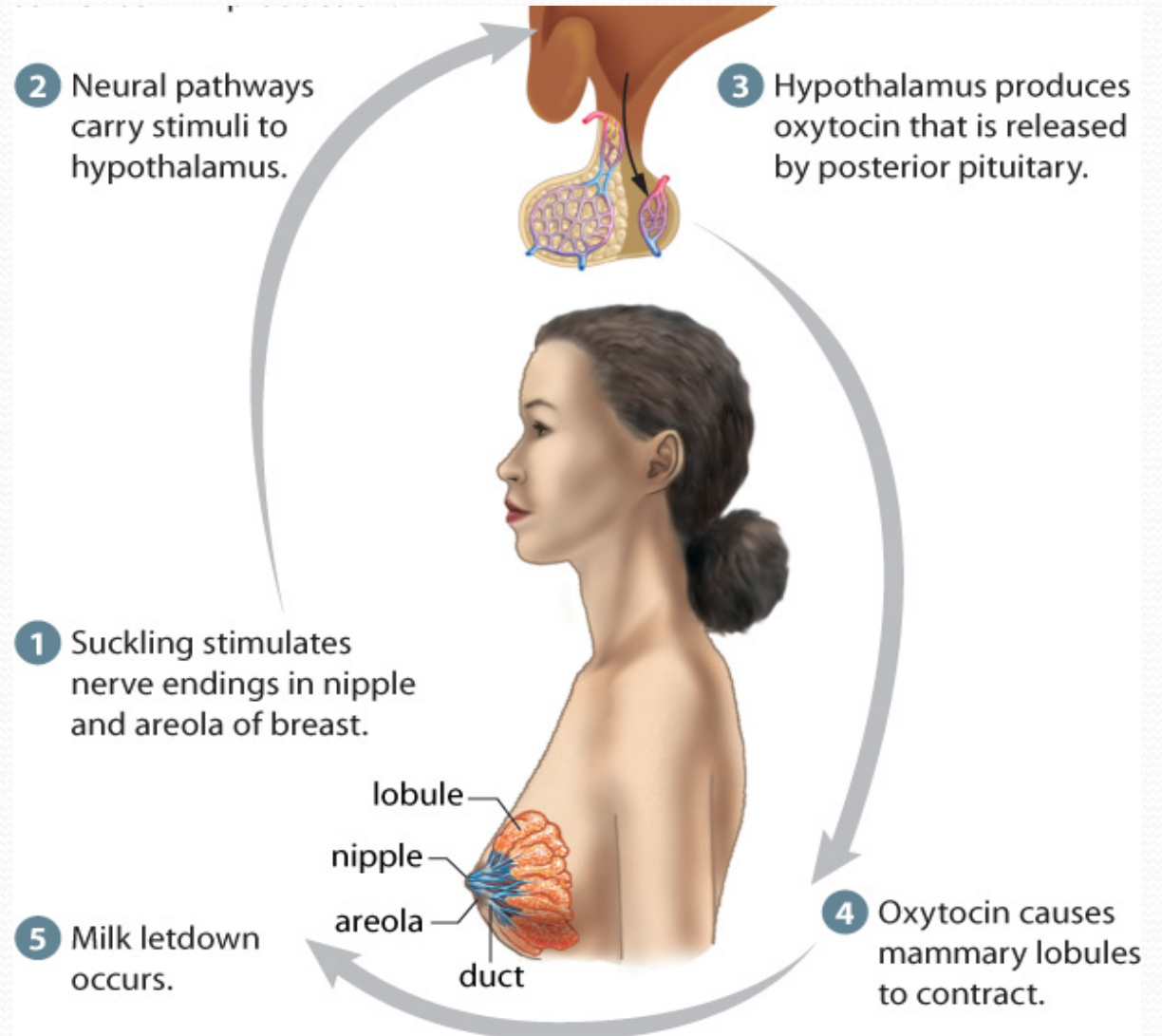
- Needle inserted into the epidural space **in the spine**
- PROS: Provides **pain relief** during labor by **blocking sensory pain receptors (neural pathway)** (numb from the waist down)
- CONS: **slowed heart rate of baby and mom** (which can be dangerous)
- Use remains **controversial**



Lactation (**Breast Feeding**)

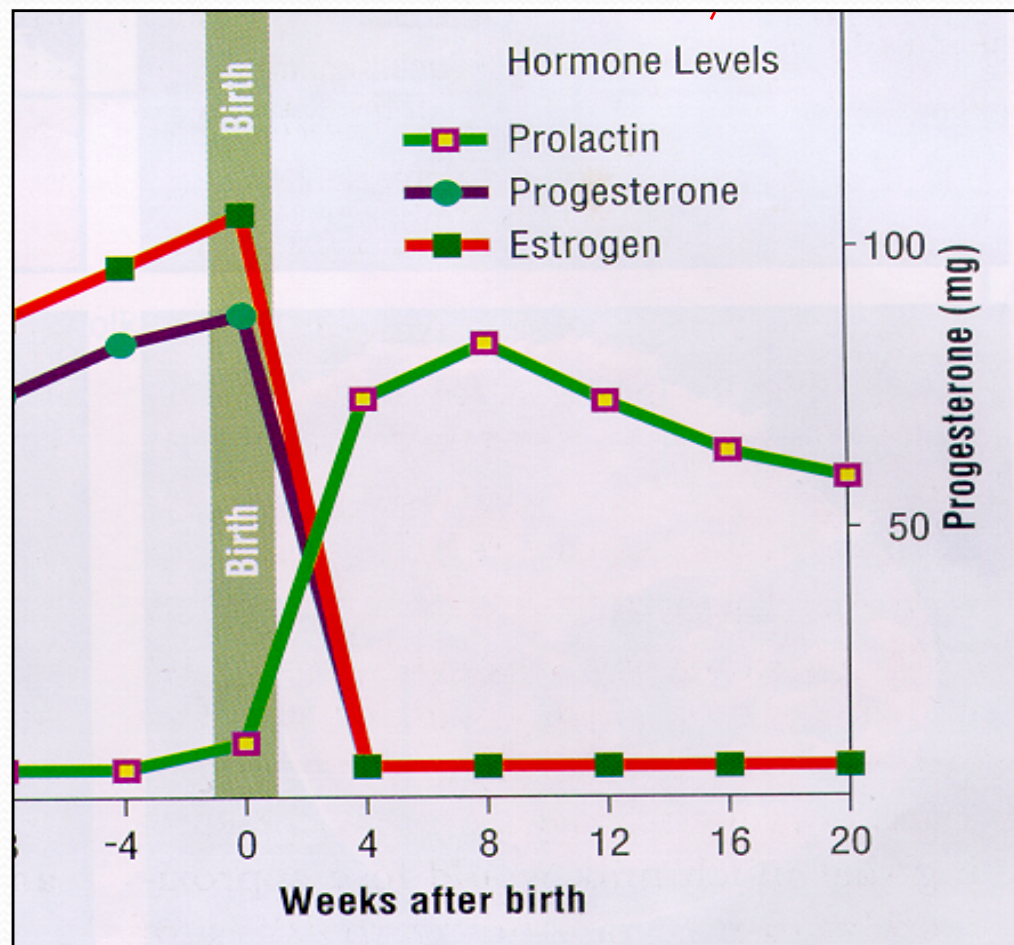
Colostrum: yellowish fluid produced by mammary glands during first days after birth

- high in **protein** & **antibodies** to protect baby



Lactation (**Breast Feeding**)

Prolactin is produced (anterior pituitary) after birth when levels of **progesterone and estrogen** drop. It initiates and maintains milk production.



Lactation (Breast Feeding)

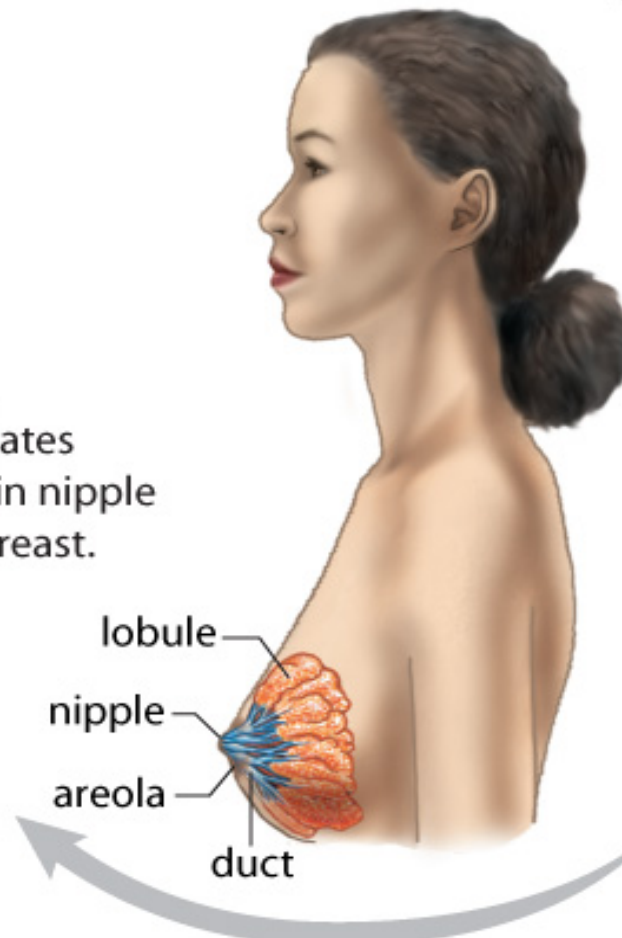
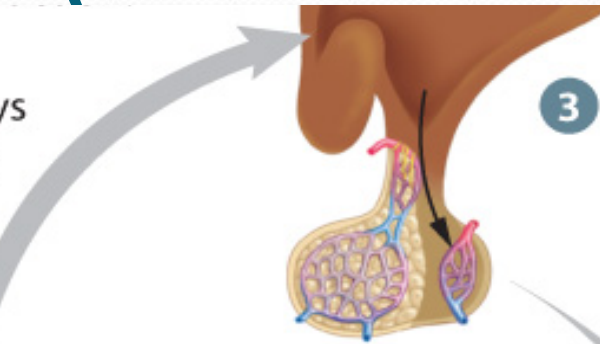
2 Neural pathways carry stimuli to hypothalamus.

3 Hypothalamus produces oxytocin that is released by posterior pituitary.

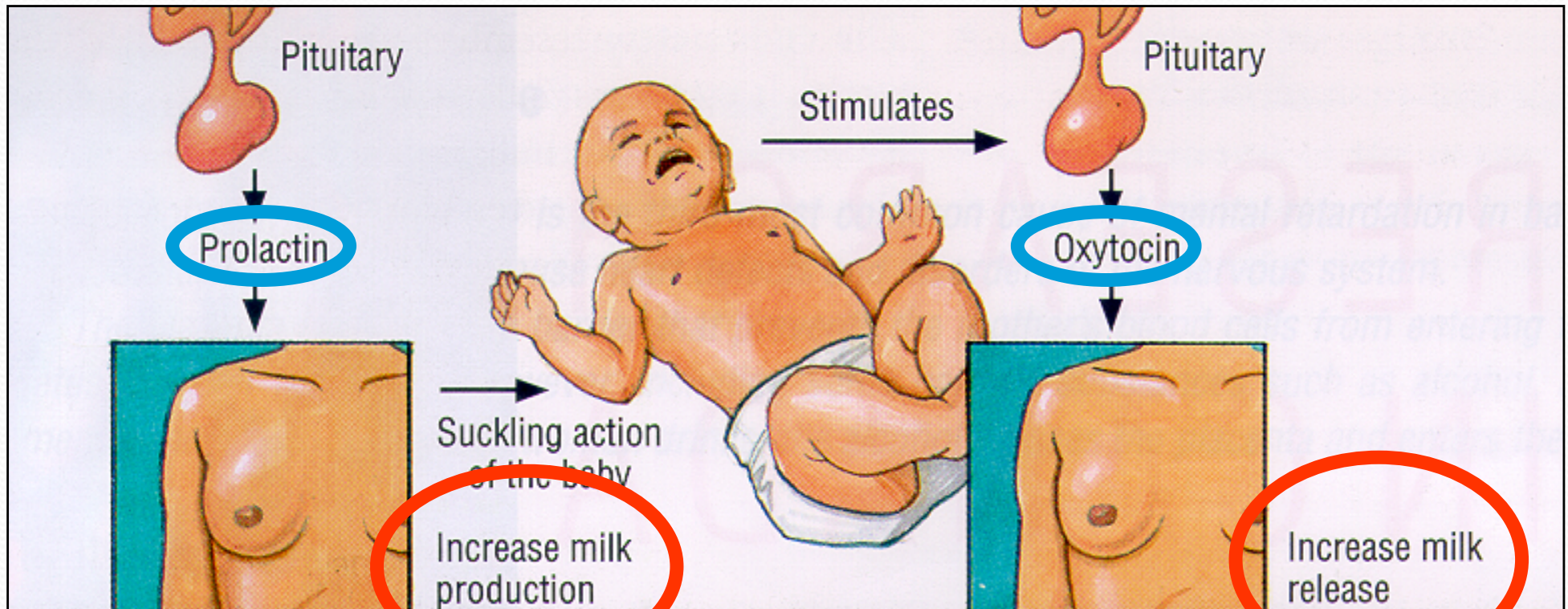
1 Suckling stimulates nerve endings in nipple and areola of breast.

5 Milk letdown occurs.

4 Oxytocin causes mammary lobules to contract.



Prolactin/Oxytocin & Milk Production



PROLACTIN maintains and increases milk production induced by suckling action

OXYTOCIN initiates milk release

BREAST MILK

THE CHOICE FOR A NEW GENERATION



THIS PSA WAS BROUGHT TO YOU BY...

BREASTFEEDING **O**UR **O**WN **B**ABIES **I**N **E**VERY **S**ITUATION .ORG

Prenatal Screening Technologies

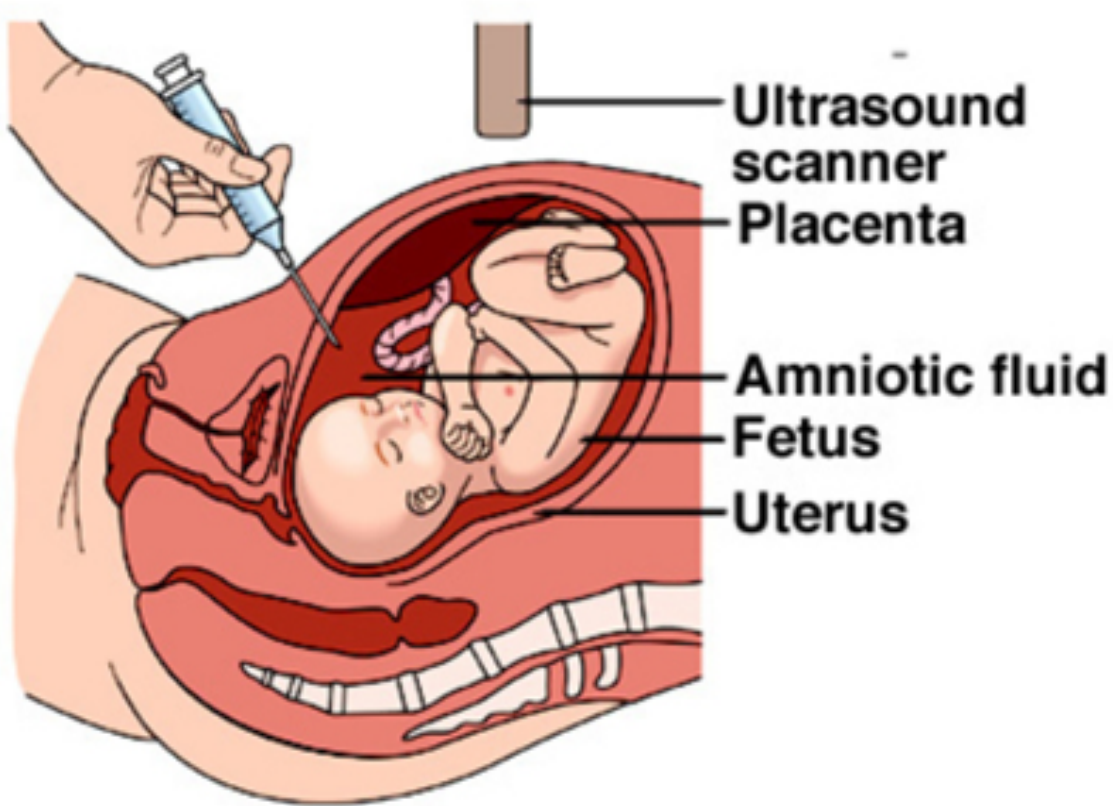
1. **Chorionic Villi Sampling:** needle removes fetal cells from **chorion/placenta** → genetic testing
 - detects Downs' Syndrome, Cystic Fibrosis etc.
 - can be performed after 9th week

PLAY ME!

2. **Amniocentesis:** needle withdraws **amniotic fluid** sample containing fetal cells → genetic/karyotyping(chromosome abnormalities)/hormone tests
 - can be performed after 14th week

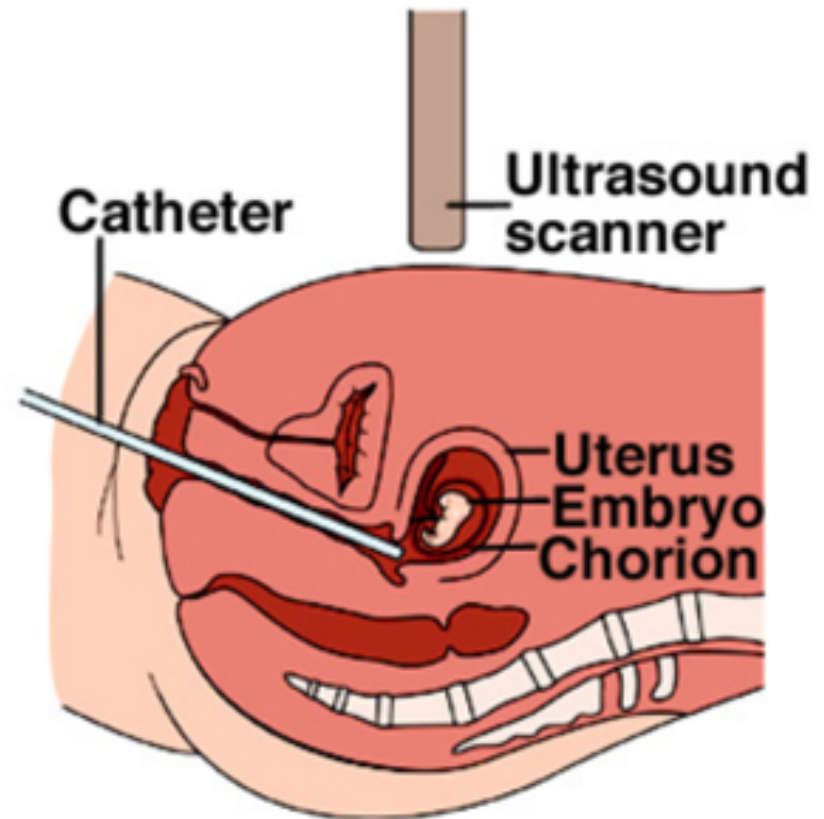
PLAY ME!!

Amniocentesis & Chorionic Villus Sampling



(a) Amniocentesis

**Cells selected from
AMNIOTIC FLUID
14th week**

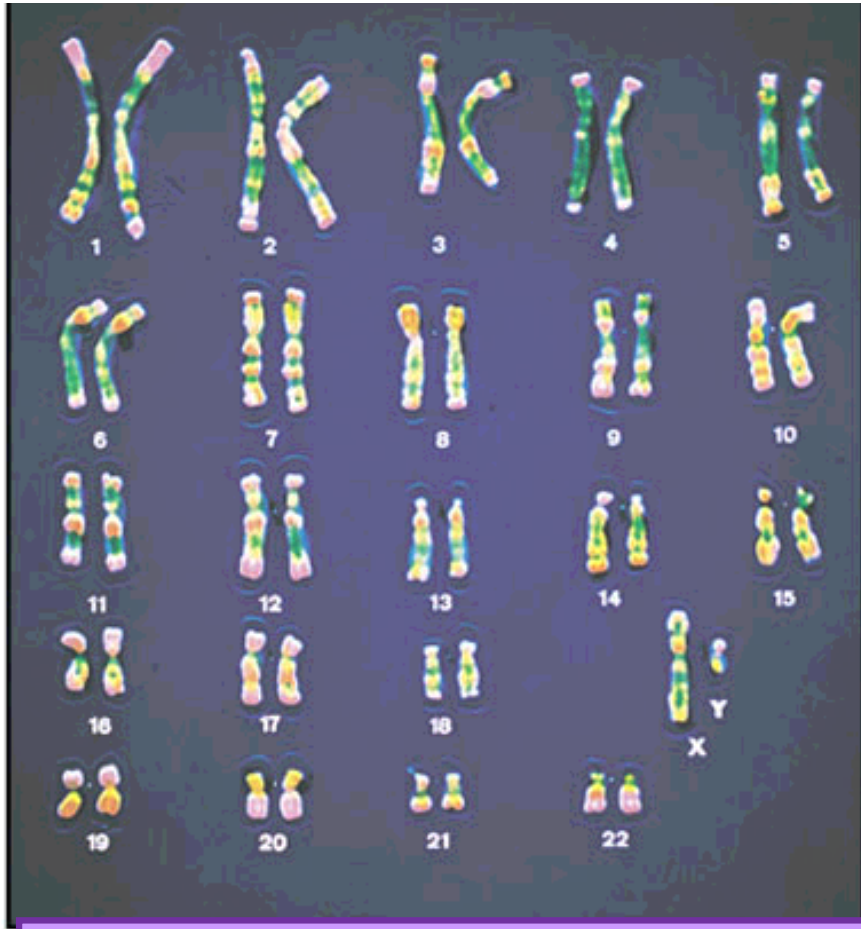


(b) Chorionic villus sampling

**Cells selected from
CHORION/PLACENTA
9th week**

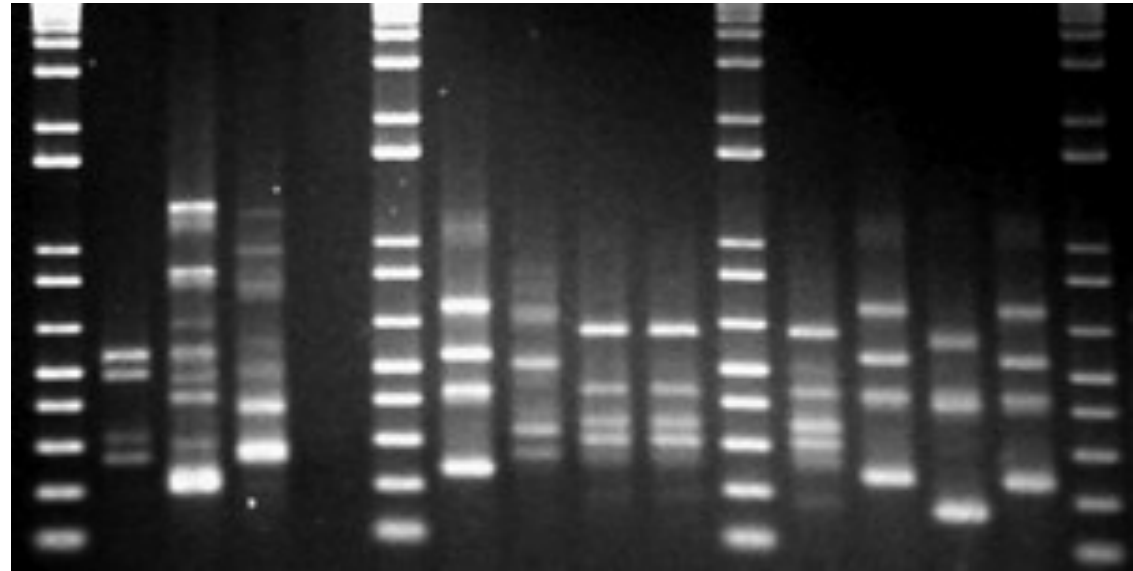
Karyotype

-Identifying Pairs of Chromosomes



Gene Mapping

-Identifying specific genes
(20,000 of them in humans)



Gene Mapping-
detect abnormalities
in DNA

Chromosome Map

Detects disorders like
Down's Syndrome



**Set #21 has an extra
chromosome**

Prenatal Screening Technologies...con't

3. Ultrasound imaging:
high frequency sound waves sent through body are used to visualize internal structures

