# Physiology of Labor

***GUYTON & HALL, Chapter 82***


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# Objectives

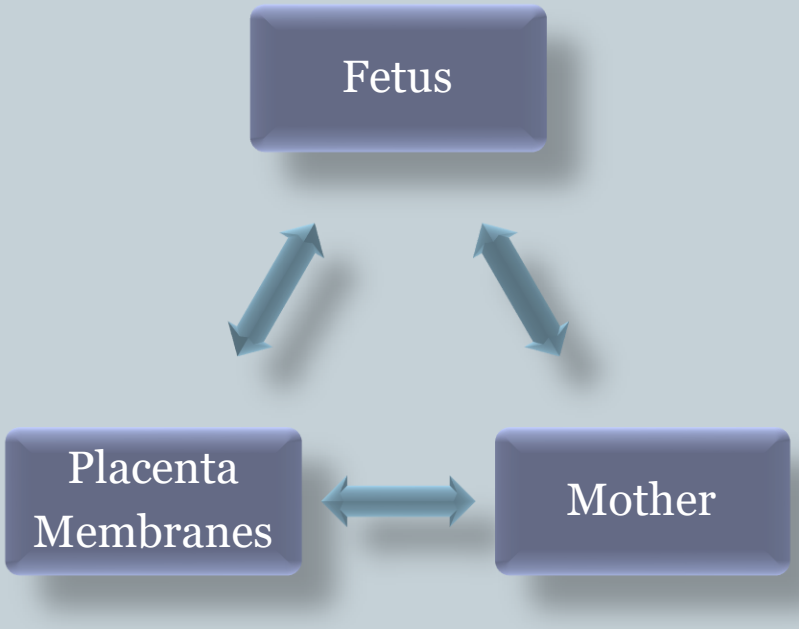
**By the end of this lecture, you should be able to:**

- Define labor/labour (parturition).
- Recognize the factors triggering the onset of labor.
- Describe the hormonal changes that occur before and during labor.
- Describe the phases of uterine activity during pregnancy and labor.
- Describe the clinical stages of human labor.

# Labor

- Normal Pregnancy
  - Uterine quiescence
  - Immature fetus
  - Closed cervix
- Labor
  - Coordinated uterine activity
  - Maturation of the fetus
  - Progressive cervical dilation

## Interactions

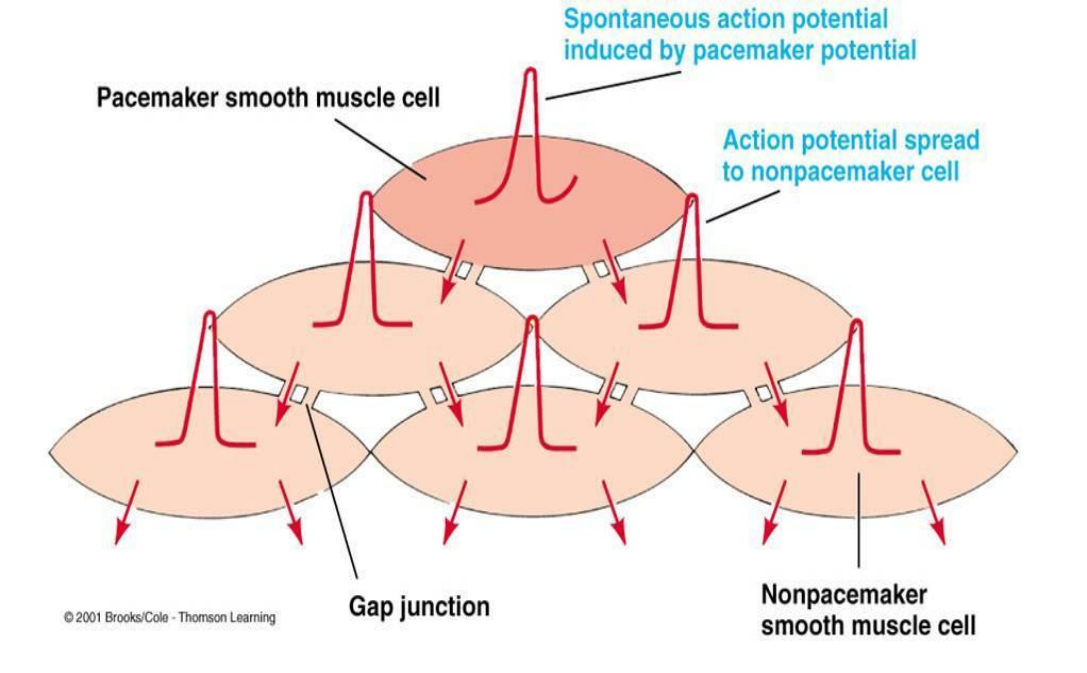


# Labor

- Definition
  - Uterine contractions that lead to expulsion of the fetus to the extrauterine environment.
  - Towards the end of pregnancy the uterus becomes progressively more excitable and develops strong rhythmic contractions that lead to expulsion of the fetus.

# Labor

- Uterus is spontaneously active.
- Spontaneous depolarization of pacemaker cells.
- Gap junctions spread depolarization.
- Exact trigger is unknown
  - Hormonal changes
  - Mechanical changes



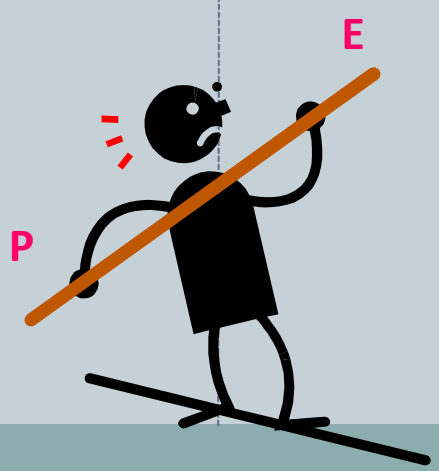
# Hormonal changes

**Increased ratio of estrogens to progesterone**

- Progesterone & Estrogen
  - Progesterone inhibits uterine contractility
  - Estrogen stimulates uterine contractility
- From 7$^{th}$ month till term
  - Progesterone secretion remains constant or decreases slightly
  - Estrogen secretion increases continuously
  - The estrogen/progesterone ratio increases sufficiently toward the end of pregnancy to be at least partly responsible for the increased contractility of the uterus

# Hormonal changes

- **Progesterone**
  - ▼ GAP junctions
  - ▼ Oxytocin receptors
  - ▼prostaglandins
  - ▲ resting mem. Potential
- **Estrogen**
  - ▲ GAP junctions with onset of labour
  - ▲ Oxytocin receptors
  - ▲ Prostaglandins



# Hormonal changes

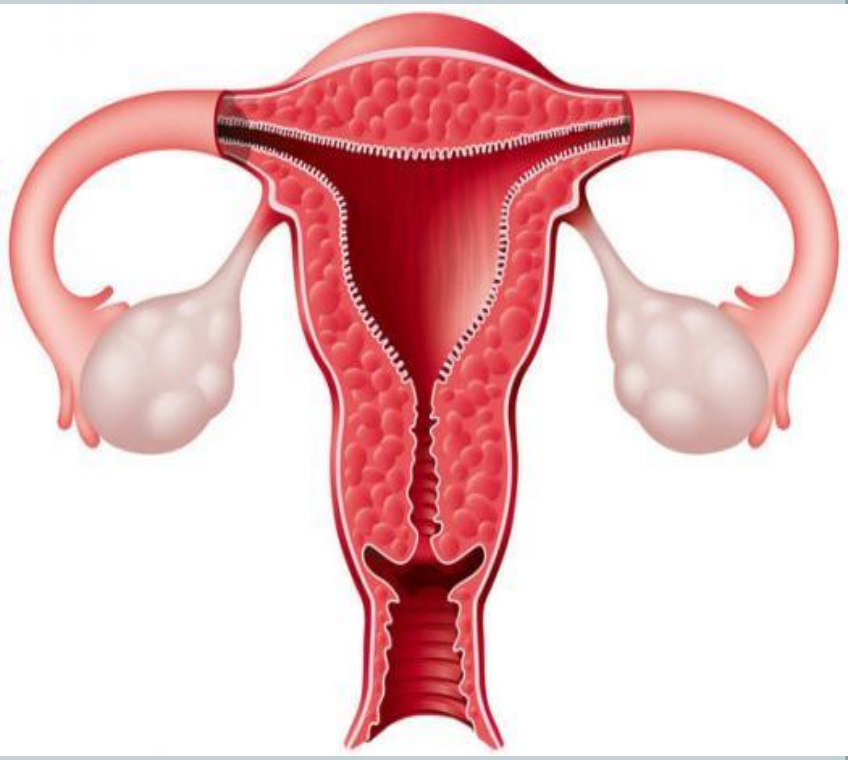
- **Oxytocin**
  - Dramatic ▲of oxytocin receptors at the last few months of pregnancy
    - gradual transition from passive relaxed to active excitatory muscle (↑ responsiveness).
  - Increase in oxytocin secretion at labor by posterior pituitary gland.
  - Oxytocin increases uterine contractions by
    - Directly on its receptors
    - Indirectly by stimulating prostaglandin production

# Hormonal changes

- **Prostaglandins**
  - Central role in initiation & progression of human labour
  - Locally produced (intrauterine)
  - Oxytocin and cytokines stimulate its production
  - Prostaglandin stimulates uterine contractions by:
    - Direct effect:
      - Through their own receptors
      - Upregulation of myometrial gap junctions
    - Indirect effect:
      - Upregulation of oxytocin receptors

# Mechanical changes

- **Stretch of the uterine muscle**
  - Increases contractility
    - Fetal movements
    - Multiple pregnancy
- **Stretch of the cervix**
  - Increases contractility (reflex)
    (Positive feedback mechanism)
  - Membrane sweeping & rupture
  - Fetal head



# Onset of labor

- During pregnancy
  - Periodic episodes of weak and slow rhythmical uterine contractions (Braxton Hicks) 2nd trimester
- Towards the end of pregnancy
  - Uterine contractions become progressively stronger.
  - Uerine contractions change suddenly, within hours, to become strong contractions leading to cervical stretching and force the baby through the birth canal.

# Onset of Labor

## Positive feedback mechanisms

Labor contractions obey all the principles of ***positive feedback:***

1. Stretching of the cervix causes the entire body of the uterus to contract.

2. Stretching of the cervix also causes the pituitary gland to secrete oxytocin

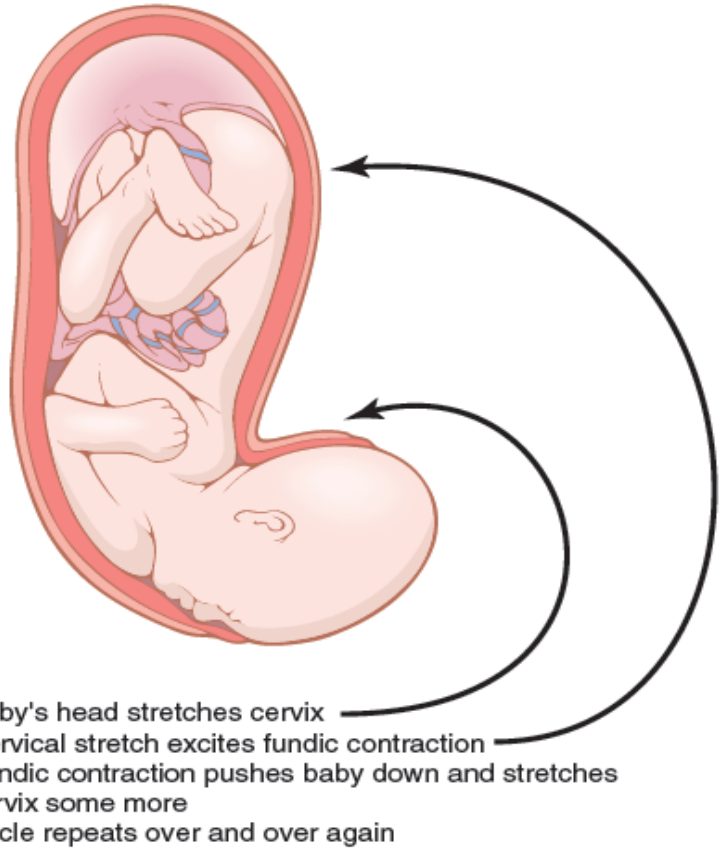
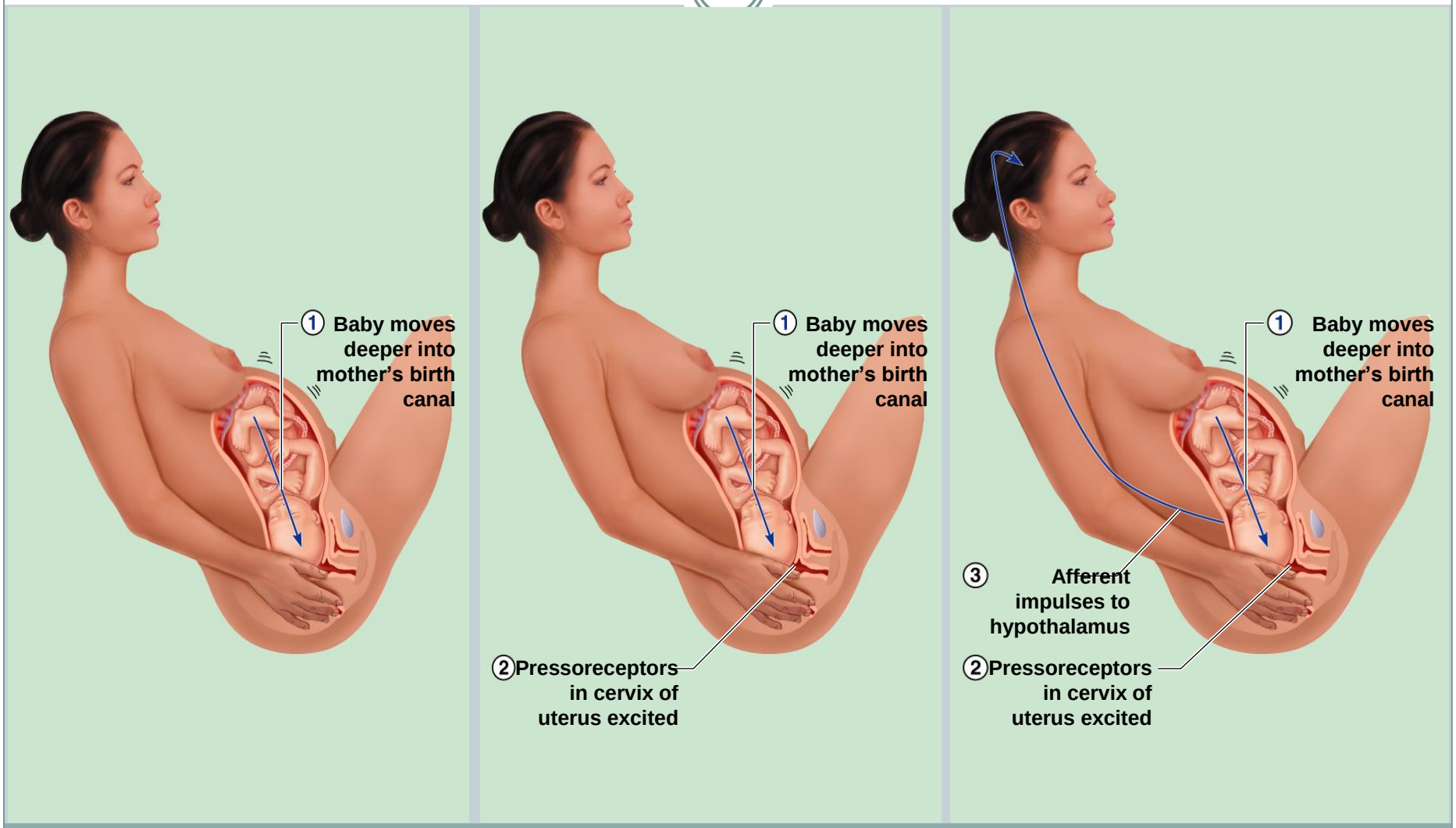
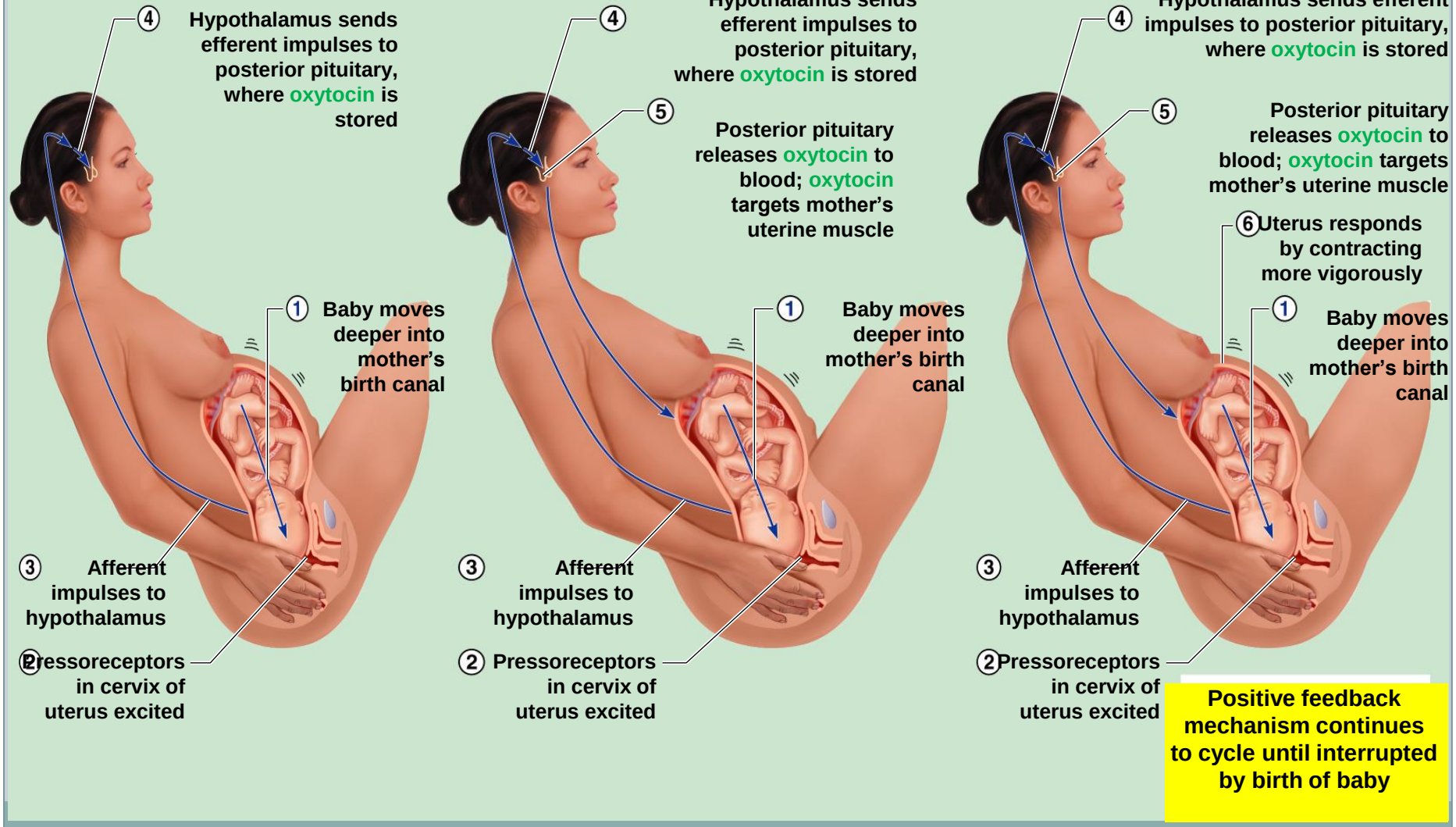



**Figure 83-9.** Theory for the onset of intensely strong contractions during labor.

# Onset of Labor



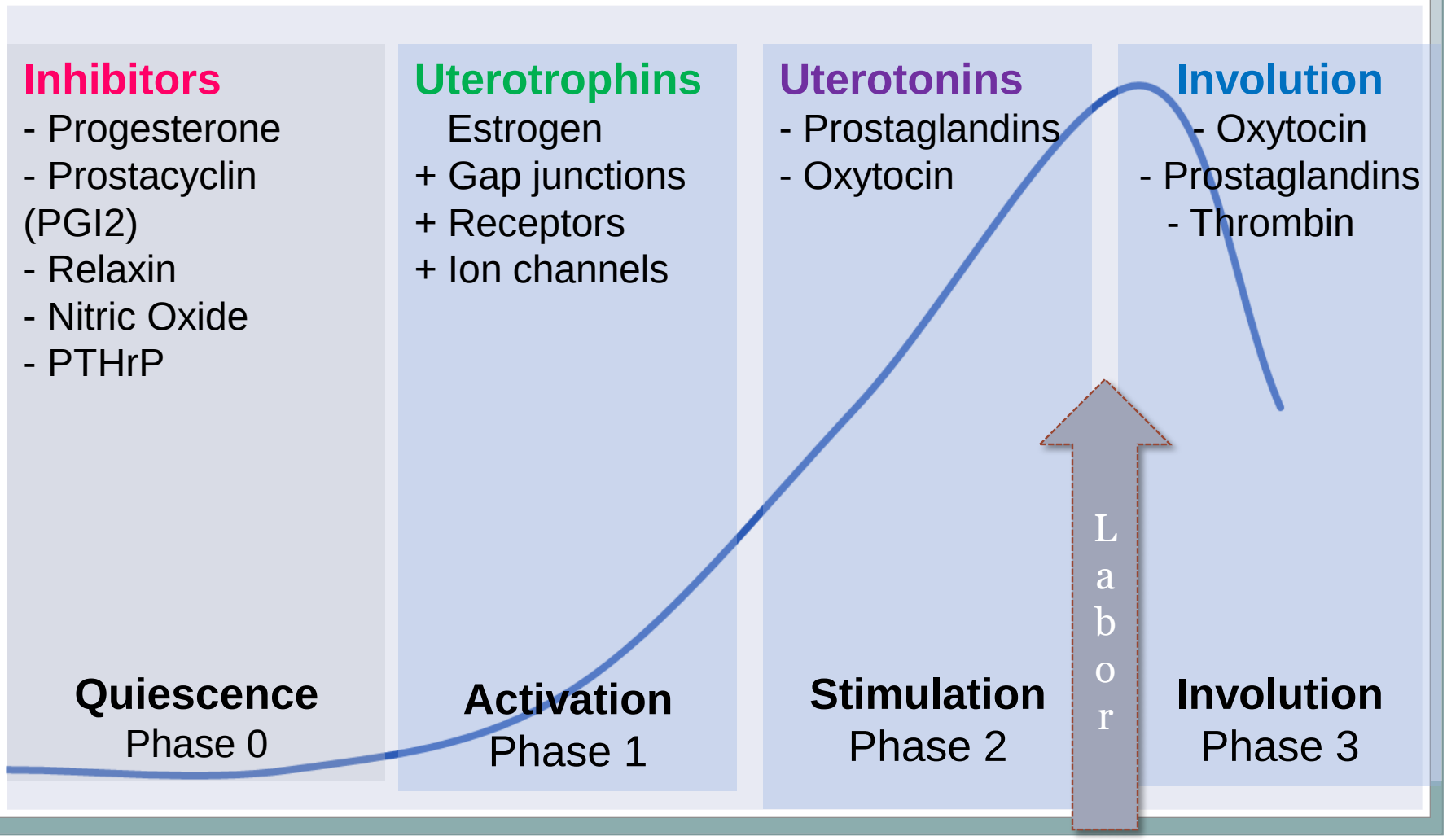
# Onset of Labor



# Mechanism of Labor

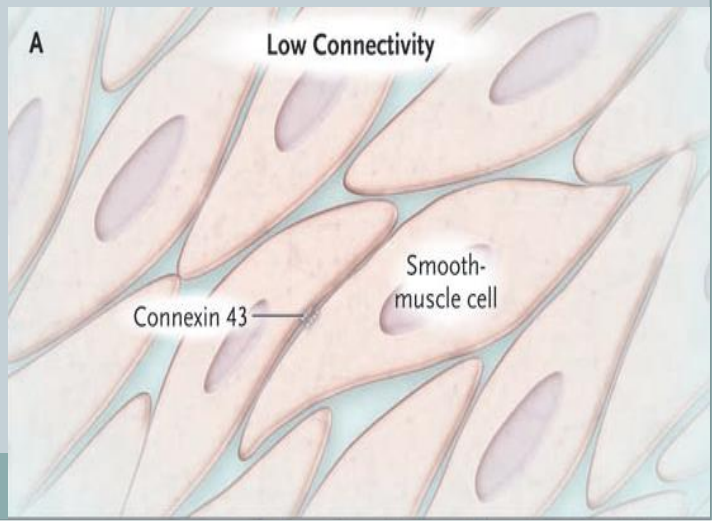
- Contractions start at the fundus and spread to the lower segment
- The intensity of contractions is strong at the fundus but weak at the lower segment
- In early stages: 1 contraction/ 30 minuets
- As labor progresses:  1 contraction/ 1-3 minutes
- Abdominal wall muscles contract
- Rhythmical contractions allow blood flow

# Phases of uterine activity



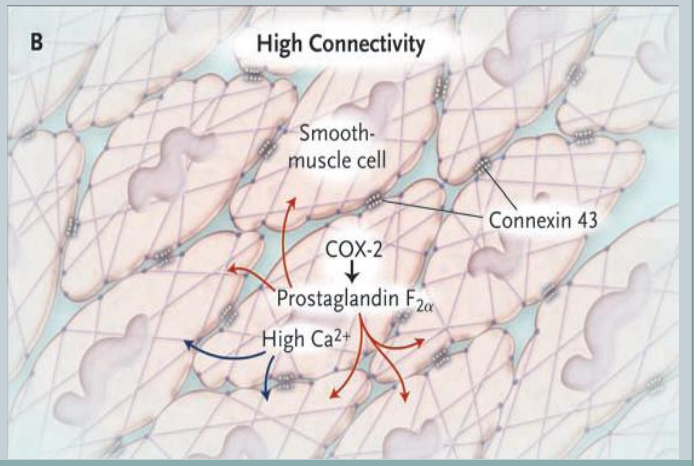
# Phases of uterine activity

- **Phase 0 (quiescence)**
  - Occurs during early pregnancy.
  - Increase cAMP level.
  - Increase production of:
    - Prostacyclin ($PGI_2$) causes uterine relaxation
    - Nitric oxide (NO) causes uterine relaxation
    - PTHrP inhibits uterine contraction



# Phases of uterine activity

- **Phase 1 (activation)**
  - Occurs in third trimester
  - Promotes a switch from quiescent to active uterus
  - Increase excitability & responsiveness to stimulators by
    - Increasing expression of gap junctions
    - Increasing receptors and ion channels
      - Oxytocin receptors
      - PG  receptors

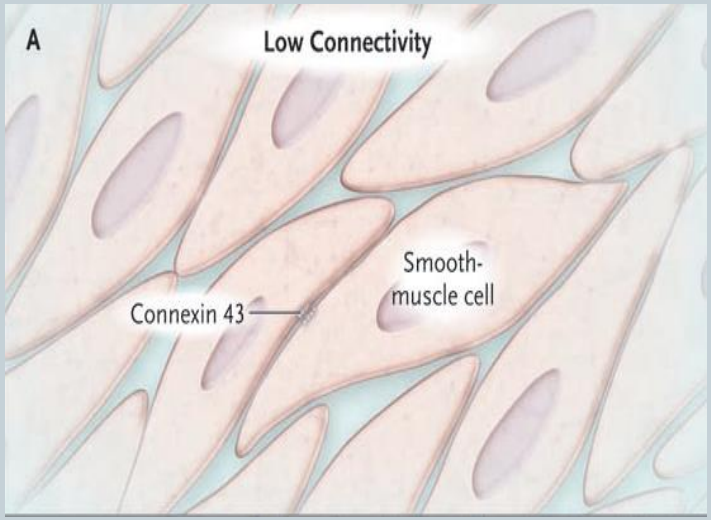


# Phases of uterine activity

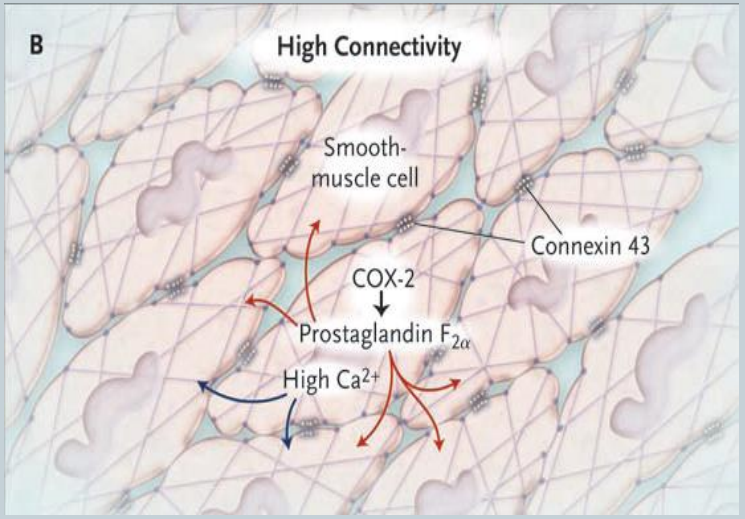
- **Phase 2 (stimulation)**
  - Occurs in the last 2-3 gestational weeks
  - Increase in synthesis of uterotonins
    - Oxytocin
    - Prostaglandins
- **Phase 3 (uterine involution)**
  - Pulsatile release of oxytocin
  - Delivery of the placenta
  - Involution of the uterus
    - Occurs in 4-5 weeks after delivery
    - Lactation helps in complete involution

# Phases of uterine activity (summary)

**Phase 0 (quiescence)**



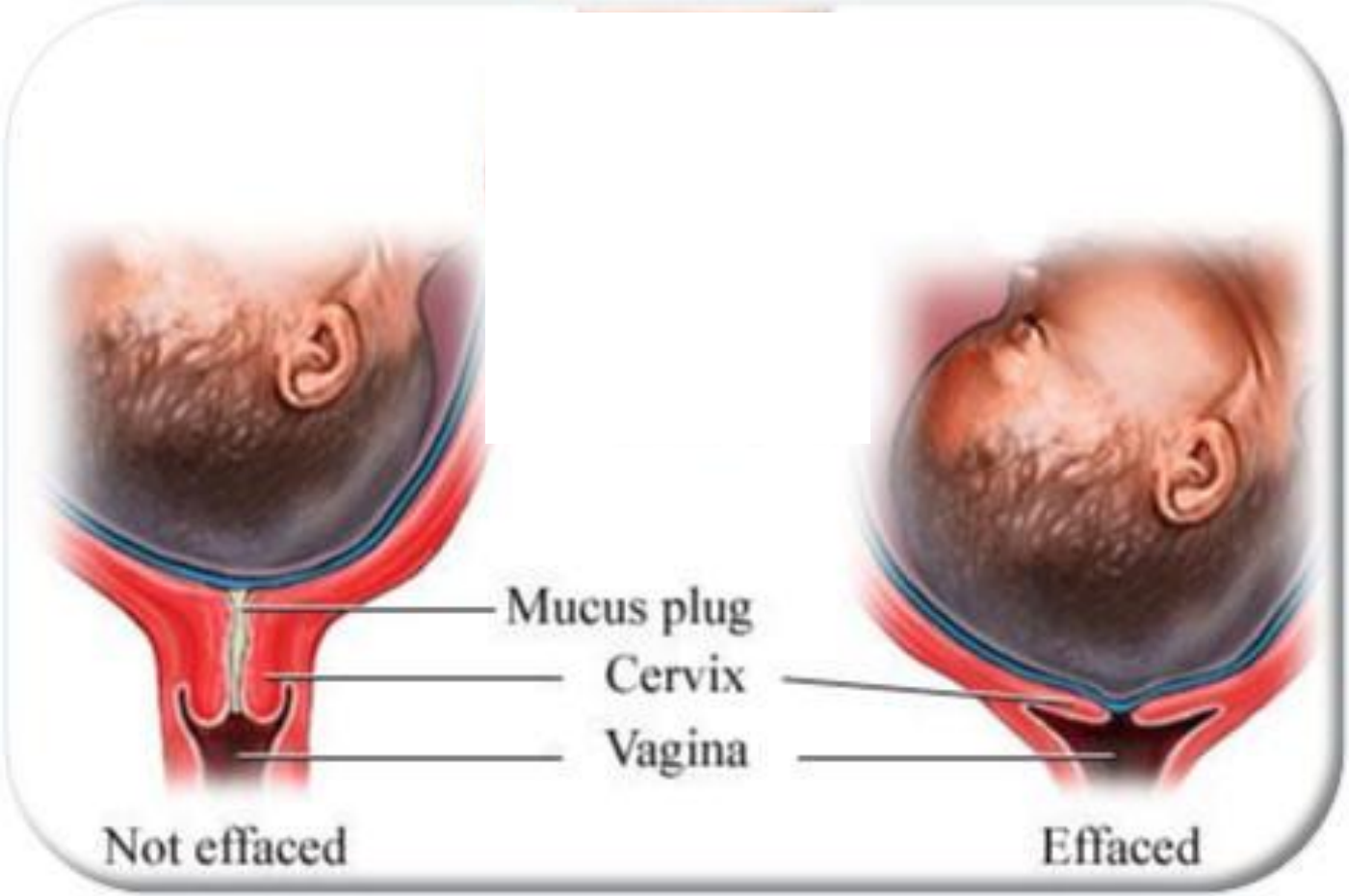

**Phase 1 (uterotrophins)**




**Phase 3 (involution)**

**Phase 2 (uterotonins)**

# Clinical Stages of Labor

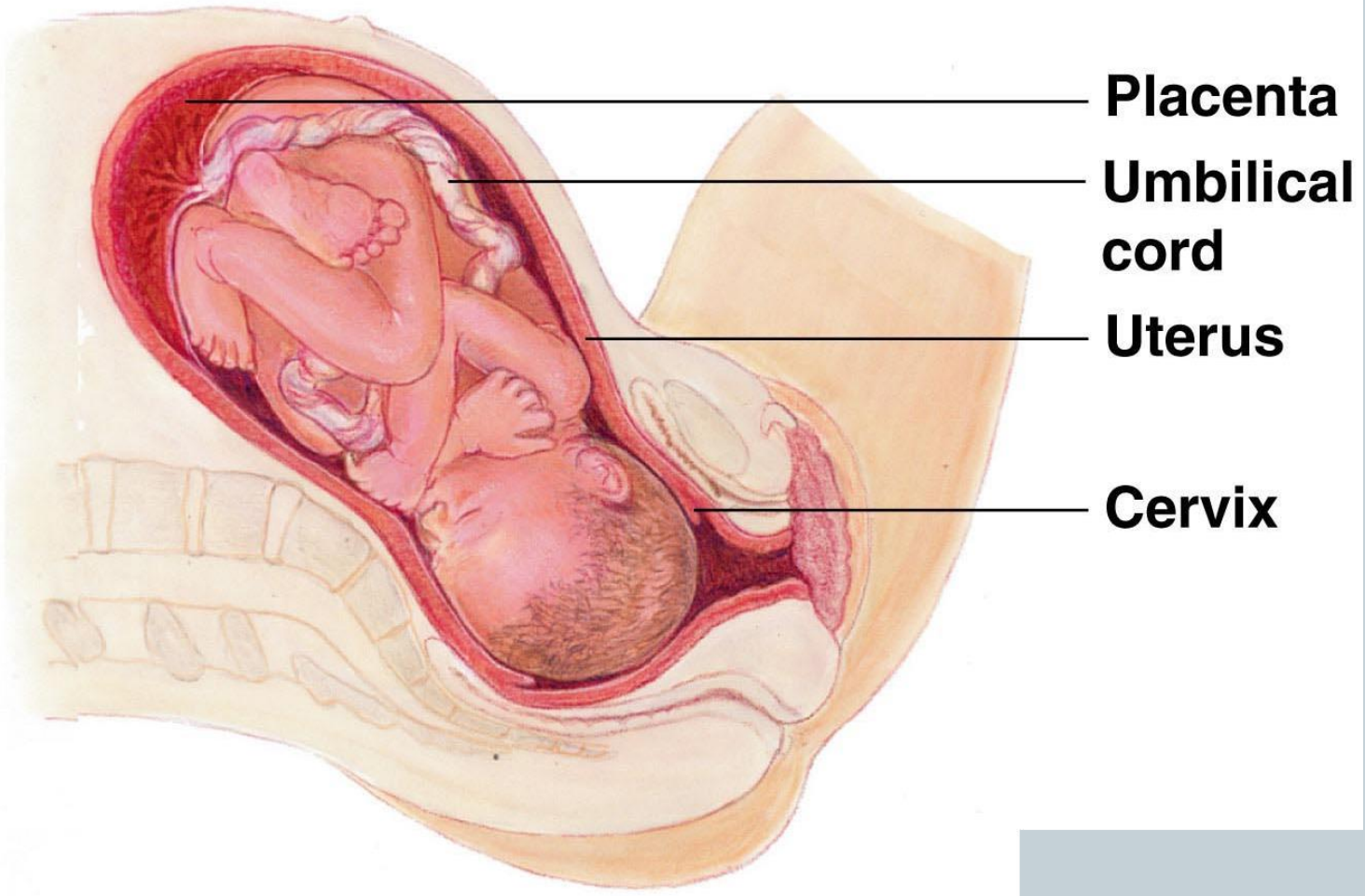


# Clinical Stages of Labor

**1) Dilation**

- Cervix becomes dilated
- Full dilation is 10 cm
- Uterine contractions begin and increase
- Cervix softens and effaces (thins)
- The amnion ruptures (“breaking the water”)
- Longest stage at 6–12 hours

# Clinical Stages of Labor



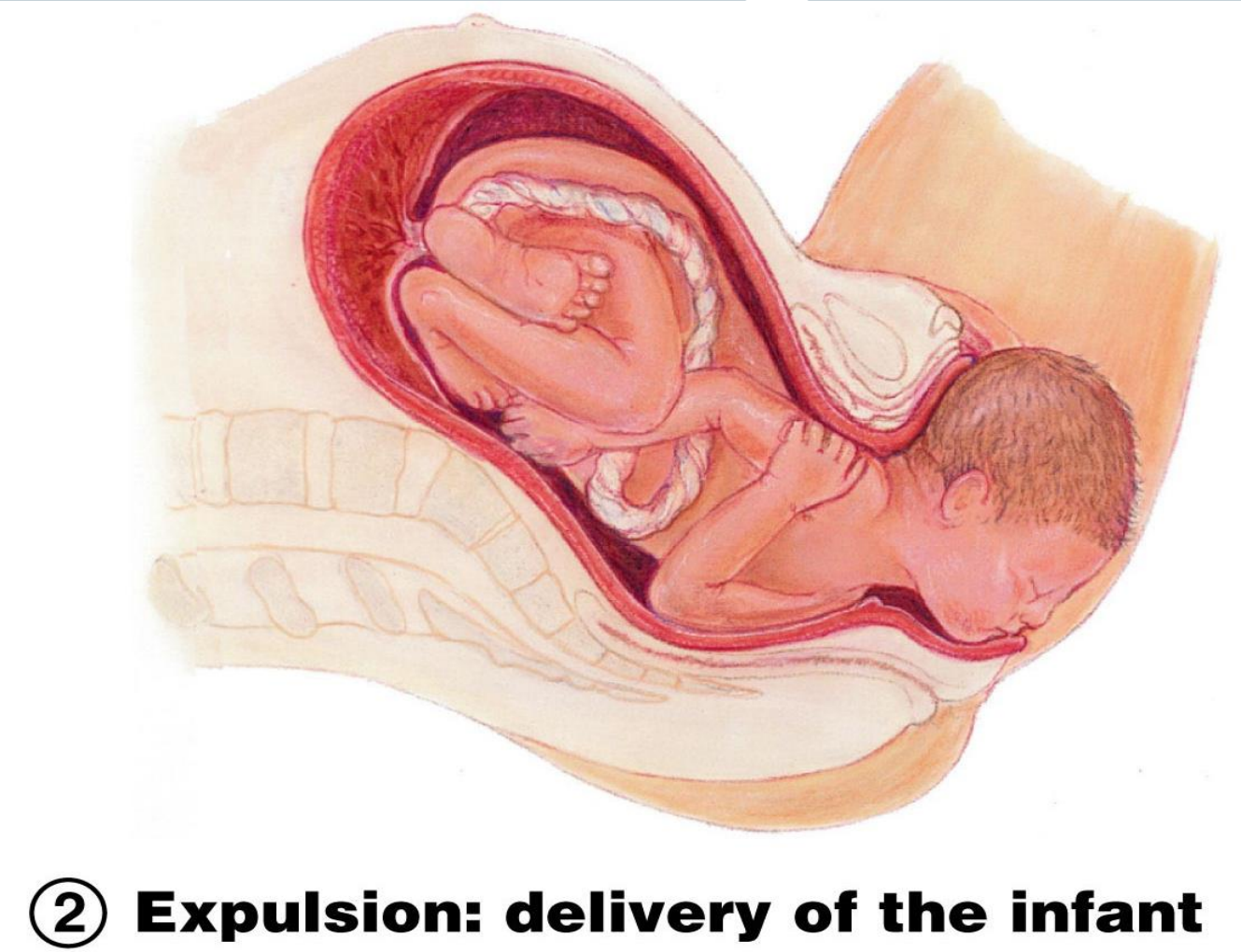

① **Dilation of the cervix**

# Stages of Labor

## 2) Expulsion

- Infant passes through the cervix and vagina
- Can lasts as long as 2 hours, but typically is 50 minutes in the first birth and 20 minutes in subsequent births
- Normal delivery is head first (vertex position)
- Breech presentation is buttocks-first

# Clinical Stages of Labor



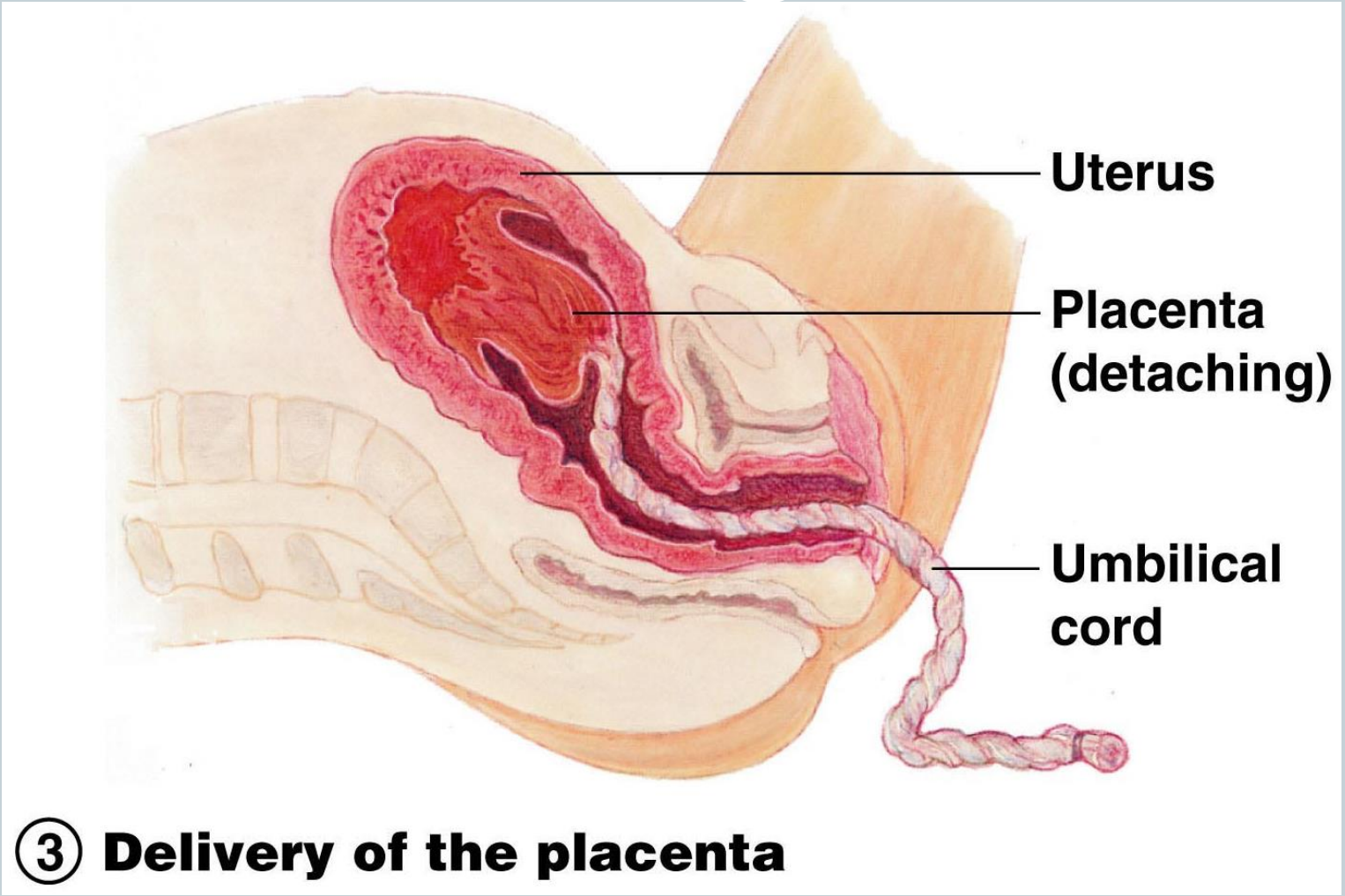
② **Expulsion: delivery of the infant**

# Clinical Stages of Labor

**3) Placental stage**

- Delivery of the placenta
- Usually accomplished within 15 minutes after birth of infant
- After birth—placenta attached to the fetal membranes are delivered
- All placental fragments should be removed to avoid postpartum bleeding

# Clinical Stages of Labor



# New arrival

# The End

# Thank You