REPRODUCTION AND PREGNANCY

A sure sign that your Doctor spends too much time online.
**PUBERTY**

- Hypothalamus
  - Releasing hormones
  - Stimulate the pituitary

- Gonadotrophin secretion
- FSH
- Ovary
  - Increase in number of growing follicles
  - Rise in oestrogen
  - Begining of growth of uterus, fallopian tubes, vagina, labia, breasts and endometrium
  - Secretion of oestrogen irregular
  - Irregular anovulatory menstruation
  - Oestrogen output becomes steady and rises to a critical level
  - LH secretion and ovulation
  - Adult cyclical menstruation

- Growth hormone
  - Skeletal growth
  - Retention of nitrogen, altered fat and CHO metabolism
  - Deposition of fat on shoulders, buttocks, thighs and pubic area

- Other endocrine organs stimulated
- ACTH
  - Adrenal
  - Androgen secretion
  - Pubic and axillary hair growth
  - ? Pigmentation of vulva

**Time-scale (years)**
- 13–14 Sexual hair appears.
- 10–14 Greatest spurt in skeletal growth.
- 11½–15 Developed feminine contours.
- 13–16 LH appears in blood → ovulation.

---

**Principal changes in serum hormone levels:**

<table>
<thead>
<tr>
<th></th>
<th>FSH (U/litre)</th>
<th>LH (U/litre)</th>
<th>Oestradiol (pmol/l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-menopausal</td>
<td>2–20</td>
<td>5–25</td>
<td>100–600</td>
</tr>
<tr>
<td>Post-menopausal</td>
<td>40–70</td>
<td>50–70</td>
<td>60</td>
</tr>
</tbody>
</table>
MENOPAUSE

Climacteric Signs and Symptoms

<table>
<thead>
<tr>
<th>ACUTE and/or early onset</th>
<th>CHRONIC and/or later onset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vasomotor Symptoms</td>
<td>Cardiovascular Disease</td>
</tr>
<tr>
<td>Hot flushes.</td>
<td>Ischaemic heart disease.</td>
</tr>
<tr>
<td>Psychological Symptoms</td>
<td>Skeletal Disease</td>
</tr>
<tr>
<td>Emotional lability.</td>
<td>Osteoporosis.</td>
</tr>
<tr>
<td>Anxiety.</td>
<td>Vertebral crush fractures with pain, deformity and loss of height.</td>
</tr>
<tr>
<td>Depressed mood.</td>
<td>Femoral neck fractures.</td>
</tr>
<tr>
<td>Poor memory and concentration.</td>
<td></td>
</tr>
<tr>
<td>Irritability.</td>
<td></td>
</tr>
<tr>
<td>Decreased libido.</td>
<td></td>
</tr>
<tr>
<td>Urogenital Tract Symptoms</td>
<td>Breast atrophy.</td>
</tr>
<tr>
<td>Genital tract atrophy.</td>
<td>Genital tract atrophy.</td>
</tr>
<tr>
<td>Dyspareunia.</td>
<td>Dyspareunia.</td>
</tr>
<tr>
<td>Urethral syndrome.</td>
<td>Urethral syndrome.</td>
</tr>
<tr>
<td>Trigonitis.</td>
<td>Trigonitis.</td>
</tr>
<tr>
<td>Urinary urgency and frequency.</td>
<td>Urinary urgency and frequency.</td>
</tr>
</tbody>
</table>

The Ovarian Cycle

- Primordial follicles in egg nest
- Primary follicles
- Secondary follicle
- Tertiary follicle

Figure 28.16
From fetal life to the menopause follicular growth is continuous. Oestrogen initiates the process. Three phases can be distinguished:

**FETAL**
- Primordial follicle
- Placental oestrogen
- Growth
- Induction of FSH receptor
- Continued growth
- Minimum FSH, large quantities of luteinising hCG
- Limited growth
- Atresia

**CHILDHOOD**
- Intra-ovarian oestrogen
- Growth
- Induction of FSH receptor
- Continued growth
- Pituitary FSH
- Lack of LH
- Growth limited; no ovulation
- Atresia

**ADULT**
- Intra-ovarian oestrogen
- Growth
- Induction of FSH receptor
- Continued growth
- Pituitary FSH
- Cyclical LH production
- Ovulation

hCG = Human Chorionic Gonadotrophin.
FSH = Follicle Stimulating Hormone.
LH = Luteinising Hormone.

**The Ovarian Cycle**

**STEP 4**
- Released secondary oocyte
- Corona radiata
- Ruptured tertiary follicle

**STEP 5**
- Follicular fluid
- Outer surface of ovary

**STEP 6**
- Corpus luteum
- Corpus albicans
Hormones of the female reproductive cycle

- Control the reproductive cycle
- Coordinate the ovarian and uterine cycles

Key hormones include:

- FSH
  - Stimulates follicular development
- LH
  - Maintains structure and secretory function of corpus luteum
- Estrogens
  - Have multiple functions
- Progesterones
  - Stimulate endometrial growth and secretion
The Hormonal Regulation of Ovarian Activity

Hormonal Interactions During the Ovarian Cycle

- Day 1 – GnRH stimulates the release of FSH and LH
- FSH and LH stimulate follicle growth and maturation, and low-level estrogen release
- Rising estrogen levels:
  - Inhibit the release of FSH and LH
  - Prod the pituitary to synthesize and accumulate these gonadotropins
Hormonal Interactions During the Ovarian Cycle

- Estrogen levels increase and high estrogen levels have a positive feedback effect on the pituitary, causing a sudden surge of LH.
- The LH spike stimulates the primary oocyte to complete meiosis I, and the secondary oocyte continues on to metaphase II.
- **Day 14 – LH triggers ovulation**
- **LH transforms the ruptured follicle into a corpus luteum, which produces inhibin, progesterone, and estrogen**

- These hormones shut off FSH and LH release and declining LH ends luteal activity.
- **Days 26-28 – decline of the ovarian hormones**
- Ends the blockade of FSH and LH
- The cycle starts a new
The Hormonal Regulation of the Female Reproductive Cycle

The Biological Events of Menstrual Cycle
(a) Levels of hormones produced by the pituitary

Plasma concentrations of pituitary hormones, arbitrary units

- LH
- FSH

The Hormonal Regulation of the Female Reproductive Cycle

<table>
<thead>
<tr>
<th>Phases of the Ovarian Cycle</th>
<th>Follicular Phase</th>
<th>Luteal Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>GnRH pulse frequency (pulses/day)</td>
<td>60</td>
<td>40</td>
</tr>
<tr>
<td>Gonadotrophic hormone levels (IU/L)</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>Follicular stages during the ovarian cycle</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Follicle development
- Ovulation
- Corpus luteum formation
- Mature corpus luteum
- Corpus albicans

Figure 28.26a-c
Luteal Secretion

Production of LH & FSH decreases

Corpus Luteum

Estrogen Feedback

Progesterone Feedback

Progesterone

Thickening Uterine Wall

Estrogen and Progesterone Feedback

Estrogen and Progesterone Feedback (decreasing)

Estrogen

Menstrual Flow
The Hormonal Regulation of the Female Reproductive Cycle

Phases of the Uterine Cycle

- Menses
- Proliferative Phase
- Secretory Phase

Endometrial changes during the uterine cycle

- Destruction of functional zone
- Repair and regeneration of functional zone
- Secretion of endometrial glands

Figure 28.26d-f

Basal body temperature (°C)

DAYS

Summary of the Menstrual Cycle

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pituitary Secretions</th>
<th>Ovarian Secretions</th>
<th>Resulting Action in Ovaries/Uterus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preovulatory preparation (follicular phase)</td>
<td>Increase in secretion of follicle-stimulating hormone (FSH)</td>
<td>Increased estrogen secretion</td>
<td>Ovum in one ovarian follicle ripens</td>
</tr>
<tr>
<td>Ovulation</td>
<td>Increased secretion of luteinizing hormone (LH)</td>
<td>Feedback Effect</td>
<td>Uterine lining (endometrium) thickens with enlargement of small glands and blood vessels</td>
</tr>
<tr>
<td></td>
<td>Feedback Effect</td>
<td></td>
<td>Mature ovum ruptures through ovarian wall, leaving follicular mass called corpus luteum</td>
</tr>
</tbody>
</table>
### Summary of the Menstrual Cycle

<table>
<thead>
<tr>
<th>Phase</th>
<th>Pituitary Secretions</th>
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<th>Resulting Action in Ovaries/Uterus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Luteal secretion</td>
<td>Continued secretion of LH</td>
<td>Feedback Effect</td>
<td>Corpus luteum secretes progesterone and estrogen</td>
</tr>
<tr>
<td></td>
<td>Hypothalamus signals pituitary to decrease production of FSH and LH</td>
<td>Feedback Effect</td>
<td>Uterine lining thickens further, begins secreting nutrient fluids that can nourish an embryo if pregnancy occurs</td>
</tr>
<tr>
<td>Menstruation</td>
<td>Decrease in estrogen production</td>
<td></td>
<td>Ovum moves through fallopian tube. If not fertilized, cycle advances to next phase.</td>
</tr>
<tr>
<td></td>
<td>Hypothalamus signals pituitary to increase secretion of FSH</td>
<td></td>
<td>Corpus luteum degenerates. Uterine lining degenerates. Fluids, blood, and some tissue flow out of uterus and through the vagina.</td>
</tr>
<tr>
<td></td>
<td>The cycle repeats itself</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A Basal Body Temperature Graph

- **Date of month**
  - Coitus
  - Menstruation

- **Days of cycle**
  - 1 to 40

- **Temperature (°F)**
  - 97.0 to 99.5
Hormone Levels Over Menstrual Cycle

Group 1: Nonpill women
- Estrogen
- Progesterone

Group 2: Combination pill

Group 3: Sequential pill

Semen
Semen

- Milky white, sticky mixture of sperm and accessory gland secretions
- Provides a transport medium and nutrients (fructose), protects and activates sperm, and facilitates their movement
- Prostaglandins in semen:
  - Decrease the viscosity of mucus in the cervix
  - Stimulate reverse peristalsis in the uterus
  - Facilitate the movement of sperm through the female reproductive tract

SEMEN

- The hormone **relaxin** enhances sperm motility
- The relative alkalinity of semen neutralizes the acid environment found in the male urethra and female vagina
- **Seminalplasmin** – antibiotic chemical that destroys certain bacteria
- Clotting factors coagulate semen immediately after ejaculation, then fibrinolysin liquefies the sticky mass
- Only 2-5 ml of semen are ejaculated, but it contains 50-130 million sperm/ml
Male Sexual Response

Male Sexual Response: Erection

- Enlargement and stiffening of the penis from engorgement of erectile tissue with blood
- During sexual arousal, a PNS reflex promotes the release of nitric oxide
- Nitric oxide causes erectile tissue to fill with blood
- Expansion of the corpora cavernosa:
- Compresses their drainage veins
- Retards blood outflow and maintains engorgement
The corpus spongiosum functions in keeping the urethra open during ejaculation.

Erection is initiated by sexual stimuli including:

- Touch and mechanical stimulation of the penis
- Erotic sights, sounds, and smells
- Erection can be induced or inhibited solely by emotional or higher mental activity
- Impotence – inability to attain erection

Ejaculation

- The propulsion of semen from the male duct system
- At ejaculation, sympathetic nerves serving the genital organs cause:
  - Reproductive ducts and accessory organs to contract and empty their contents
  - The bladder sphincter muscle to constrict, preventing the expulsion of urine
  - Bulbospongiosus muscles to undergo a rapid series of contractions
  - Propulsion of semen from the urethra
Ejaculation is when semen is pushed from the penis. It usually happens during an orgasm. Muscles push semen from the penis and into the vagina, possibly making the woman pregnant.

During orgasm, semen moves through the urethra and comes out of the hole at the tip of the penis. Ejaculation may happen during sleep (called a 'wet dream'). Men can ejaculate during sexual intercourse or by masturbation. In masturbation, men can excite their own penis and other sensitive areas of their body, such as the scrotum, by rubbing the genital area. A man must have gone through puberty before he can ejaculate.

Female Sexual Response

- The clitoris, vaginal mucosa, and breasts engorge with blood
- Activity of vestibular glands lubricates the vestibule and facilitates entry of the penis
- Orgasm – accompanied by muscle tension, increase in pulse rate and blood pressure, and rhythmical contractions of the uterus
- Females do not have a refractory period after orgasm and can experience multiple orgasms in a single sexual experience

Orgasm is not essential for conception
EXCITEMENT PHASE
This takes most of the time needed for coitus and, in the male, becomes longer with experience, while the female learns to respond in a shorter time.

Female:
Vasodilatation and vasocongestion of all erectile tissue. Breasts enlarge, the vaginal ostium opens and secretion from the vestibular glands and vaginal exudations cause ‘moistening’.

Male:
Penile erection occurs and may be transient and recur if this stage is prolonged. Scrotal skin and dartos muscle contract and draw testes towards the perineum.

INTROMISSION
The couple assume the chosen coital position and the penis is inserted into the open vagina. Although this is the irrevocable commitment to intercourse, it is still in the excitement phase until thrusting begins, and the male still has some control over the timing of orgasm.

PLATEAU PHASE
The pulse rate is doubled and blood pressure and respiratory rate are beginning to rise. Both partners make involuntary thrusting movements of the pelvis towards each other.

Female:
Vasocongestion increases, and contraction of the uterine ligaments (which contain muscle) lift the uterus and move it more into alignment with the axis of the pelvis. The cervix dilates. There is engorgement of the lower third of the vagina and ballooning of the upper two thirds.

Male:
The intensity of penile erection increases and the testes are enlarged by congestion. Seminal fluid arrives at the urethra as a result of sympathetic nervous stimulation of the vas deferens, seminal vesicles and prostate. There is some pre-ejaculatory penile discharge which may contain sperm.
ORGASM
Pulse and respiration rate are at double the resting rate and blood pressure may reach 180/110. Pelvic and genital sensations are completely dominating, and there is a noticeable reduction in sensory awareness in other parts of the body. The pelvic floor contracts involuntarily, with rhythmic contraction of vagina, urethra and anal sphincter.

**Female:**
Climactic sensations appear to be caused by spasmodic contractions of uterine muscle but orgasm is reported after hysterectomy. The female is potentially capable of repeated orgasm.

**Male:**
Strong contractions pass along the penis causing ejaculation of seminal fluid. The greater the volume of ejaculate (after several days’ continence) the more intense the sensations of orgasm.

**POSTCOITAL PHASE or RESOLUTION PHASE**
Pulse, respiratory rate and blood pressure rapidly return to normal and there is marked sweating. Vasocongestion recedes over about 5 minutes and there is complete relaxation of all muscles and detumescence of erectile tissue. In the male, but less so in the female, there occurs a refractory period which varies with individuals, from a few minutes to several hours when there is no response to further stimuli.
Copulation and Fertilization

- For fertilization to occur, sperm must be deposited in the vagina within a few days before or a day or two after ovulation.
- Sperm transfer is accomplished by copulation.
- Sexual excitation dilates the arterioles supplying blood to the penis.
- Blood accumulates in three cylindrical spongy sinuses that run lengthwise through the penis.
- The resulting pressure causes the penis to enlarge and erect and thus able to penetrate the vagina.
- Movement of the penis back and forth within the vagina causes sexual tension to increase to the point of ejaculation.
- Contraction of the walls of each vas deferens propels the sperm along. Fluid is added to the sperm by the seminal vesicles, Cowper’s glands, and the prostate gland.

- These fluids provide a source of energy (fructose)
- an alkaline environment to activate the sperm, and
- perhaps in other ways provide an optimum chemical environment for them.
Although sperm can swim several millimeters each second, their trip to and through the fallopian tubes may be assisted by muscular contraction of the walls of the uterus and the tubes.

There is also evidence that they respond to a chemical attractant produced by the egg or the tissues surrounding it.

In any case, sperm may reach the egg within 15 minutes of ejaculation. The trip is also fraught with heavy mortality.

An average human ejaculate contains over one hundred million sperm, but only a few dozen complete the journey.

And of these, only one will succeed in fertilizing the egg.

Fertilization begins with the binding of a sperm head to the outer coating of the egg (called the zona pellucida).

Exocytosis of the acrosome at the tip of the sperm head releases enzymes that digest a path through the zona and enable the sperm head to bind to the plasma membrane of the egg.

Fusion of their respective membranes allows the entire contents of the sperm to be drawn into the cytosol of the egg. (Even though the sperm’s mitochondria enter the egg, they are almost always destroyed and do not contribute their genes to the embryo.

So human mitochondrial DNA is almost always inherited from mothers only.)

Within moments, enzymes released from the egg cytosol act on the zona making it impermeable to the other sperm that arrive.
Within moments, enzymes released from the egg cytosol act on the zona making it impermeable to the other sperm that arrive.

Soon the nucleus of the successful sperm enlarges into the male pronucleus.

At the same time, the egg (secondary oocyte) completes meiosis II forming a second polar body and the female pronucleus.

The male and female pronuclei move toward each other while duplicating their DNA in S phase. Their nuclear envelopes disintegrate.

A spindle is formed (following replication of the sperm’s centriole), and a full set of dyads assembles on it.

The fertilized egg or zygote is now ready for its first mitosis.

When this is done, 2 cells — each with a diploid set of chromosomes — are formed.

In sea urchins, at least, the block to additional sperm entry and the fusion of the pronuclei are triggered by nitric oxide generated in the egg by the sperm acrosome.

---

Hormonal Factors That Stimulate Spermatogenesis

We shall discuss the role of hormones in reproduction later, but at this point, let us note that several hormones play essential roles in spermatogenesis. Some of these are as follows:

1. **Testosterone**, secreted by the Leydig cells located in the interstitium of the testis, is essential for growth and division of the testicular germinal cells, which is the first stage in forming sperm.
Maturation of Sperm in the Epididymis

After formation in the seminiferous tubules, the sperm require several days to pass through the 6-meter-long tubule of the epididymis.

Sperm removed from the seminiferous tubules and from the early portions of the epididymis are nonmotile, and they cannot fertilize an ovum.

However, after the sperm have been in the epididymis for some 18 to 24 hours, they develop the capability of motility, even though several inhibitory proteins in the epididymal fluid still prevent final motility until after ejaculation.

2. Luteinizing hormone, secreted by the anterior pituitary gland, stimulates the Leydig cells to secrete testosterone.

3. Follicle-stimulating hormone, also secreted by the anterior pituitary gland, stimulates the Sertoli cells; without this stimulation, the conversion of the spermatids to sperm (the process of spermiogenesis) will not occur.

4. Estrogens, formed from testosterone by the Sertoli cells when they are stimulated by follicle-stimulating hormone, are probably also essential for spermiogenesis.

5. Growth hormone (as well as most of the other body hormones) is necessary for controlling background metabolic functions of the testes.

Growth hormone specifically promotes early division of the spermatogonia themselves; in its absence, as in pituitary dwarfs, spermatogenesis is severely deficient or absent, thus causing infertility.
Fertilization
- acrosome reaction
- spermatozoon penetrates oocyte
- male and female pronuclei form

Immediate Transport
- retrograde loss
- phagocytosis
- entrance into cervix/uterus

Oviduct
- capacitation completed
- hyperactive motility

Uterus
- capacitation initiated
- phagocytosis

Cervix
- “privileged” pathways
- removal of non-motile sperm
- removal of some abnormalities
**The ascent of sperm**

Several barriers impede sperm in the female reproductive system

Vaginal bacteria secrete lactic acid so the pH of the vagina is < 5.0. Sperm become immobilized in an acidic environment

Those sperm that reach the **cervical canal** can become trapped within mucus

High estradiol present during estrus causes release of **sialomucin and sulfomucin**
Live sperm have been found:

in the **vagina**, only after 12 hours (too acidic);
in the **cervix**, after 10 days.

Fertilisation can occur 5 days after copulation.

> For sperm competition to occur, there must be a double mating with a maximum gap of ~ 5 days.

---

After masturbation, the male will ejaculate fewer sperm into the female (by ~228 million and recovering to baseline by some time after about 72 hours, still ~ 150 million short after 2 days)).

So why masturbate?

Masturbation will eject mainly older sperm; leaving younger sperm behind.

Conjecture: Male masturbation is a way of titrating sperm quality so that it is optimal for next copulation (Baker and Bellis).

In flow back studies, the number of sperm ejected by the female can be determined and hence the number retained by the female estimated:
WHEN DOES LIFE BEGIN?: EMBRYOGENESIS

1. MANY SPERMS BIND TO ZONA PELLUCIDA
2. SPERMS MOVE THROUGH THE ZONA PELLUCIDA
3. ONE SPERM BINDS TO THE OVUM
4. IT IS DRAWN INTO THE OVUM
5. OVUM RELESES VESICLE CONTENTS
6. OVUM COMPLETES II MEIOSIS
7. ENZYMES BLOCK POLYSPERMY
8. OVUM ENZYMES ACTIVATED
9. NUCLEI OF OVUM & SPERM UNITE
10. ZYGOTE FORMED

Ampulla-site of fertilization (sperm cell penetrates oocyte)
Figure 82-1

Figure 82-2
Migration of mammalian primordial germ cells

Embryo

Amniotic Cavity

Hindgut

Allantois

Foregut

Heart

Primordial germ cells

Yolk sac

Genital ridges

Mesonephros

Dorsal mesentery

Cloaca

Hindgut

(A) ~ day 7

(B) day 12
Seven Weeks

By seven weeks, your baby has grown into an embryo about the size of a raspberry and has a tiny beats heart. Head, mouth, liver, and intestines begin to take shape. Facial features are visible, including a mouth and tongue. The eyes have a retina and lens. The major muscle system is developed, and the unborn child practices moving. The child has its own blood type, distinct from the mother's. These blood cells are produced by the liver now instead of the yolk sac.
Placenta
- an organ formed on the wall of the uterus through which the fetus receives oxygen and nutrients and gets rid of waste products
- Human chorionic gonadotropin - a hormone secreted by the placenta; it is the substance detected in pregnancy tests

Umbilical cord
- the tube that connects the fetus to the placenta
- Amniotic fluid - the watery fluid surrounding a developing fetus in the uterus

FETO PLACENTAL UNIT

Placenta
- Cholesterol
- Pregnenolone
- Progesterone
- Estradiol
- Estriol

Fetal Adrenal
- DHEAS
- 16-OH-DHEAS
- Cortisol & Corticosterone
- DHEAS
- 16-OH-DHEAS
PLACENTA

- consists of fetal (majority) and maternal components.

- **Fetal Component** = composed of chorion (extraembryonic membrane), villi extend into endometrium where they become closely opposed to maternal blood spaces.

- **Anchoring Villi** = chorionic villi anchored to decidua (maternal component), **Free Villi** = don’t reach surface of decidua

- Villi with CT core containing capillary and **Hofbauer’s Cells** = tissue macrophages (large cells with spherical nuclei and vacuolated cytoplasm)

- Trophoblast epithelium covers each villus, consists of two layers until about week 10 of pregnancy when it is reduced to one (Syncitial trophoblast)

1) **Cytotrophoblast** = inner cell layer, pale cells with discrete borders; disappears after about week 10

2) **Syncitial Trophoblast** = outer layer containing numerous small dark nuclei, no apparent intercellular boundaries

Functions of the placenta:

1. Transfer gasses
2. Transport nutrients
3. Excretion of wastes
4. Hormone production — temporary endocrine organ — estrogen and progesterone
5. Formation of a barrier — incomplete, nonselective — alcohol, steroids, narcotics, anesthetics, some antibiotics and some organisms can cross
Guideline to hCG levels during pregnancy:

hCG levels in weeks from LMP (gestational age): 
- 3 weeks LMP: 5 - 50 mIU/ml
- 4 weeks LMP: 5 - 426 mIU/ml
- 5 weeks LMP: 18 - 7,340 mIU/ml
- 6 weeks LMP: 1,080 - 56,500 mIU/ml
- 7 - 8 weeks LMP: 7,650 - 229,000 mIU/ml
- 9 - 12 weeks LMP: 25,700 - 288,000 mIU/ml
- 13 - 16 weeks LMP: 13,300 - 254,000 mIU/ml
- 17 - 24 weeks LMP: 4,060 - 165,400 mIU/ml
- 25 - 40 weeks LMP: 3,640 - 117,000 mIU/ml
- Non-pregnant females: <5.0 mIU/ml
- Postmenopausal: <9.5 mIU/ml

Guideline to Progesterone levels during pregnancy:
- 1-28 ng/ml Mid Luteal Phase (Average is over 10 for un-medicated cycles and over 15 with medication use)
- 9-47 ng/ml First trimester
- 17-146 ng/ml Second Trimester
- 49-300 ng/ml Third Trimester
PREGNANCY: URINARY HORMONES

[Graph showing changes in urinary hormones during pregnancy, including ovulation, implantation, missed menstruation, and parturition.]
Quickening

- The first movement of the fetus felt by the mother, usually occurring during the fourth or fifth month of pregnancy
- By month seven the fetus is quite active
- During the last month the fetus becomes less active (usually due to space considerations.)
At the end of pregnancy both the mother and the uterus become “irritable”

The uterus undergoes Braxton-Hicks contractions: intermittent, painless contractions which can come 10 to 20 minutes apart.

Become more frequent as gestation progresses, and can be mistaken for onset of labor

Cervix begins to thin and dilate

Labor (parturition)

Stage one – the period from the onset of true labor contractions until the cervix is completely dilated at 10 cm.

The uterine contractions cause the cervix to dilate, and the amniotic sac may rupture.

Usually lasts 6 – 24 hours depending on the number of previous deliveries.
Stage 2

- Period from maximal cervical dilation until the birth of the baby
- Lasts minutes to an hour
- Contractions become more intense and frequent.
Stage 3

- The expulsion of the placenta
- Usually occurs within 15 minutes after the birth of the baby, but can range from 5 to 60 minutes.
Birth Process — Stage 3

- Uterus
- Placenta
- Umbilical cord
Changes in Hormones During Pregnancy

Improving the Chances of Conception
- Time intercourse so it occurs around time of ovulation
- Sperm live inside a woman's body for up to 5 days
- Egg is capable of being fertilized for about the first 12 to 24 hours after ovulation
- Position during and after intercourse is important

Symptoms of Pregnancy
- Missed menstrual period
- Breast tenderness
- Morning sickness
- More frequent urination
### Diagnostic Signs of Pregnancy

- **Presumptive Signs**: breast changes, amenorrhea, nausea, vomiting, fatigue, frequent urination
- **Probable Signs**: Positive pregnancy test, physical changes in the uterus
- **Positive Signs**: Ultrasound or X-ray of fetus, fetal heartbeat, fetal movement

### Pregnancy Tests

- **Physician tests**:
  - Immunologic test based on detection of hCG
  - Beta-hCG radioimmunoassay
- **Home pregnancy tests**

### Development of the Conceptus

- Nine months of pregnancy are divided into three equal periods of three months called trimesters:
  - First trimester - months 1 to 3
  - Second trimester - months 4 to 6
  - Third trimester - months 7 to 9

Develops into a fetus with most of the major organ systems present

- 4th to 8th week - external body parts develop

7th week - liver, lungs, pancreas, kidneys, and intestines have formed and begun limited functioning

- End of 12th week - 10 centimeters long; weighs 19 grams
Fetal Development During the Second Trimester

• Quickening occurs - women becomes aware of fetal movements
  – around the end of the 14th week
• Fetal heart beat can be detected
• Fetus opens its eyes

Fetal Development During the Third Trimester

• Fetus’s skin is wrinkled and covered with downlike hair
• Fetus turns in uterus to assume a head-down position
• Fetus experiences rapid growth

The Father’s Role in Pregnancy

• Couvade syndrome - male pregnancy symptoms
• The father-to-be - many choose to be actively involved
• Diversity in the contexts of pregnancy - there are lots of various family contexts that exist today

Nutrition Deficiencies

• Calcium – future risk of bone and tooth loss
• Folic acid – (folate) much higher risk of neural tube defects. (decreases risk by 50%)
• Zinc – malformations of the central nervous system

Effects of Drugs Taken During Pregnancy

• Teratogens - a substance that produces defects in a fetus
• Antibiotics - may damage fetus
• Alcohol - may cause fetal alcohol syndrome
• Cocaine - increased risk of premature birth
The First Trimester

Lasts from conception to the twelfth week of pregnancy

- 3 periods during the first trimester:
  - The Germinal Period
    - Fertilized egg travels and implants in wall of uterus
    - Implantation occurs 10-14 days after conception
  - The Period of the Embryo
    - Lasts from third through eighth week of pregnancy
    - Major organs and anatomical structures begin to form
  - The Period of the Fetus
    - Lasts from ninth week of pregnancy until birth
    - All major organs continue rapid growth and become interconnected
The Second Trimester

- Fetus assumes distinct human appearance
  - The nails harden and skin thickens, as well as the eye lashes, eye brows, and scalp hair appear during fifth and sixth months
  - Fetus’s visual and auditory senses are functional

The Third Trimester

- All organ systems mature rapidly
  - Fetus prepares for birth
  - Fetus reaches ‘age of viability’, the point at which the fetus can survive outside of the uterus
  - Fetus shows better-organized gross motor activity, and sleepiness/waking activity
  - Towards end of ninth month, fetus is positioned head-down with limbs curled up in ‘fetal position’
Teratogens

- External agents such as viruses, drugs, chemicals and radiation that can harm a developing embryo or fetus.
- Time when organ system or body part is at highest risk of effects from teratogens is known as ‘sensitive period’.
- Effects of teratogens on a body part or organ system are worst during the period when that structure is forming and growing most rapidly.
Teratogens

- The same defect can be caused by different teratogens.
- A variety of defects can be caused by a single teratogen.
- The longer the exposure or the higher the ‘dose’ of the teratogen, the more likely it is that serious harm will be done.
- The long-term effects of a teratogen often depend on the quality of the postnatal environment.
Subjective Assessment

- When pregnant female comes to you, the kinesiologist, you should ask:
  - Name
  - Age
  - Medical history
  - Genetic history
  - Previous surgeries
  - Current/past medications
  - If they have ever or are using “street drugs” or smoking
  - Alcohol/caffeine use
  - Occupation and current working status
  - Marital status and children

Objective Assessment

- When observing the client, evaluate:
  - Height
  - Weight
  - BMI
  - Blood Pressure
  - General alignment
  - Range painful movement
Conditions During Pregnancy

- **Constipation**
  - Affects half of pregnant women
  - Causes:
    - increase in progesterone
    - the colon absorbing more water
    - worse in first 13-14 weeks
  - Treatment:
    - Drink plenty of fluids
    - Eat high fiber foods
    - Take fiber supplements – psyllium husks, Metamucil, Ex-Lax
    - EXERCISE!

- **Fatigue**
  - Almost all women report increased fatigue in the 1st trimester.
  - Causes:
    - Body is working harder
    - More levels of progesterone,
  - Treatment:
    - Take naps
    - Drink plenty of fluids, but avoid fluids 2-3hr before bed.
    - Exercise
    - Gentle stretches before bedtime can help prevent nighttime cramping
    - Eat foods rich in protein
Conditions During Pregnancy

**Back Ache**
- Many women experience back aches during 2nd and 3rd trimesters
  - Causes:
    - Poor posture
    - Extra weight
    - Change in centre of gravity
    - Hormones
  - Treatment:
    - Pay attention to posture
    - Exercise
      - Swimming
    - Pillow support in bed
    - Ask for assistance when lifting heavy objects
    - Heat/cold
    - Massage
    - Support belt
    - Wear supportive low heel shoes

Benefits of Exercise During Pregnancy

- Maintenance/improvement of maternal fitness
- Control of excess weight gain
- Improved posture and appearance
- Increased energy
- Improved sleep
- Decreased incidence of back pain
- Improved self-esteem
- Decreased incidence of varicose veins
- Decreased water retention
- Decreased level of tension
- Possible decrease in complications during labour
- Shortened labour
- More rapid postpartum recovery
Disadvantages of Not Exercising

- Studies have shown that women who exercise do not experience an increase in:
  - Premature Rupture of Membranes (PROM)
    - When the membranes that hold the amniotic fluid break too early.
  - Congenital Abnormalities

Risk Reduction

- **Pre-Eclampsia (Toxemia)**
  - Occurs only during pregnancy and the postpartum period
  - Affects 5-8% of all pregnancies
  - Causes blood vessels to constrict resulting in high blood pressure and a decrease in blood flow to organs and uterus.
  - Having high blood pressure before pregnancy puts you at risk, also having a BMI of 30 or more
  - Characterized by high blood pressure and presence of protein in the urine
  - Symptoms: excess swelling of hands and feet, headaches, changes in visions, vomiting blood, ringing in the ears
  - Occurs in the 2nd or 3rd trimesters
Kinesiologist’s Role

Exercises During Pregnancy

- Low impact aerobics
- Water aerobics
- Walking
- Kegels
- Pilates
- Yoga
- Cycling
- Swimming
Kegels

- Help prepare body for labour
- Kegel exercises are easy to do - can be done anywhere
- Kegels help strengthen the pelvic floor muscles
- Many women do kegel exercises to prevent incontinence

Yoga (prenatal)

- Help with breathing and relaxation
- Promote feelings of well-being
- Energizing
- Stress relief
- Improve posture
- Meet others who are facing the same challenges
- Note: Avoid positions lying on the back
Walking

- Vary the intensity
- Less impact on the knees and ankles
- Easy way to start exercising
- Supportive shoes
- Water bottle
- Spray bottle
- Maintain good posture

Swimming

- Uses large muscle groups of the legs and arms
- No strain on ligaments
- Feeling of weightlessness
- Improved circulation
- Water Temp 18-25 °C
Exercises to Avoid During Pregnancy

- Ball sports
- Contact sports: ultimate fighting, wrestling, football
- Sports that involve bouncing, leaping, a sudden change of direction (increased joint laxity from hormones make joints susceptible to sprains)
- Exercises that put you at risk for falls: rollerblading, horseback riding, skiing
- After 1st trimester avoid exercise in the supine position
- Lying in the prone position
- Lifting heavy free weights

Contraindications to Exercise

- Pregnancy induced hypertension
- Premature rupture of membranes
- Preterm labor during the prior or current pregnancy
- Persistent 2nd or 3rd trimester bleeding
- There should be an evaluation to determine whether an exercise program is appropriate if the woman has conditions such as:
  - Cardiac disease, constrictive lung disease
  - Chronic hypertension
  - Severe anemia
  - Chronic bronchitis
  - Extreme obesity
  - Extreme underweight
  - History of an extremely sedentary lifestyle
  - Orthopedic limitations
  - Heavy smoker