INTRODUCTION

As long as human beings have existed, women have become pregnant and given birth. In the overwhelming majority of these instances, the "cause" of pregnancy was a particular act of sexual intercourse between a man and woman. In your case, it involved your particular mom and dad (assuming you weren't conceived in a test tube or Petri dish). While most of us would rather not think about it too much, your beginning probably took place in one of your mother's fallopian tubes when one of her ova "hooked up" with one of your father's sperm. While this is hardly news to you, the particular mechanical details of how this happens have only been known for a relatively short period of time. For instance, someone as recent as the eminent Charles Darwin never knew that "fertilization was accomplished by a single sperm" (Tannahill, 1980, p. 42). So if you keep reading, at least in this area, you will know more than Charles Darwin did, and presumably everyone else prior to 1882, the year Darwin died.

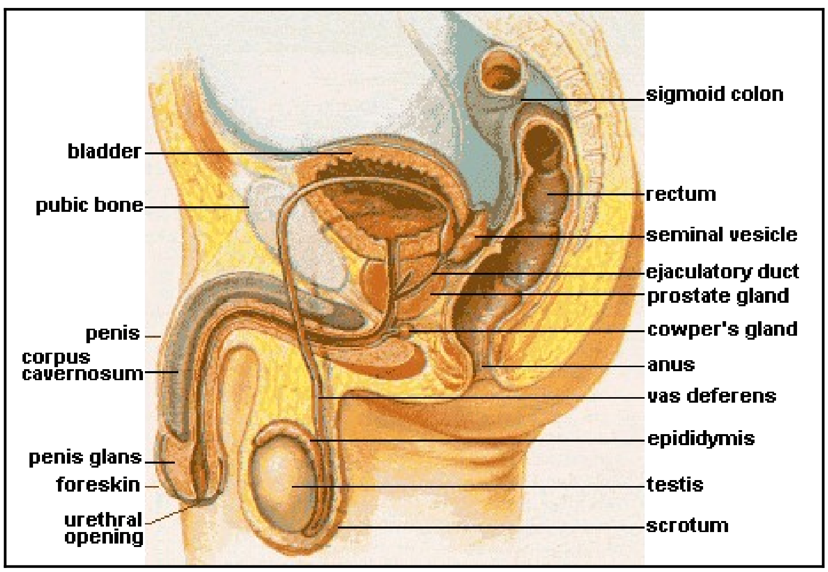
For fertilization to even have a chance of taking place, hundreds of other events must have already taken place. The sperm and ovum must be healthy and on time, the temperature must be just right, the environment of the fallopian tube has to be near perfect, and so on. The entire process has often been referred to as miraculous, and rightly so. Further, the "production" (called gametogenesis) of sperm and ova are subject to their own vagaries and difficulties. Your mother's ova were produced (called oogensis) and stored in her ovaries before she was even born and once she hits menarche, she "releases" just one every 28 days or so. Your father's sperm began their lives (called spermatogenesis) approximately 70 days earlier in the seminiferous tubules of one of his testicles and between 200 and 500 million were "released". If all goes right, just one of these sperm will penetrate the ovum, beginning the process of fertilization. Talk about competition!

Further, both sperm and ova are produced and stored and released within different "environments" and involving different organs, the structure and function of each requires understanding before we proceed. We will then examine the processes leading up to fertilization, and finally implantation.

MALE STRUCTURES AND PROCESSES

External Genital Structures

Penis



The penis is the primary male sex organ, cylindrical in shape and composed primarily of sponge-like erectile tissue which engorges with blood during sexual arousal. This process allows for erection, which in turn makes sexual intercourse feasible. The shaft of the penis terminates in the acorn-shaped glans (which comes from the Latin word for acorn) and is packed with neural receptors which make it very sensitive. The ridge of the glans is called the corona and is even more responsive than the rest of the glans. During sexual intercourse, the friction on the glans and coronal ridge serve to stimulate ongoing arousal and lead to orgasm and ejaculation. Thus, the erect penis serves as the conduit to "deliver" sperm from the testicles, where they develop, to the vagina, allowing for the possibility of fertilization. During orgasm, the sperm join together with seminal fluid to constitute semen. In men who are uncircumcised, the foreskin covers the glans in an unaroused state. Arousal causes the foreskins to pull back and expose the glans to the stimulation of sexual intercourse. In males, the shaft and glans of the penis are homologous with the shaft and glans of the clitoris in females. The underside of the penis in males is homologous with the labia minora in females. There is a line running down the center of the underside of the penis where the tissue was fused together during prenatal development.

Scrotum and Testicles

The scrotum is the sac that loosely holds the testes in 2 separate chambers, allowing the testicles to hang down from the body. This allows the temperature of the scrotum to be a few degrees below body temperature necessary for healthy sperm production. But if the temperature in the scrotum falls too much below 95 degrees (for example, if someone was swimming in the ocean), the muscles in the scrotal sac contract and reflexively pull the testicles up toward the body, so they can be warmed and the developing sperm within protected. In males, the scrotum is homologous with the labia majora in females.

The main functions of the testicles are to produce and subsequently to store sperm, so that they are ready for possible fertilization. The word testis is derived from the Latin word for "witness" or "testify" because in ancient times men would cover their genitals with their hands when taking an oath (McAnulty & Burnette, 2001, p. 94). Contained within the scrotum, the testes are avocado-shaped (but not sized; the word avocado comes from the Spanish word *aguacate* which is derived from the Aztec word *ahuacati* which means testicle (Sex trivia, 2006) and measure approximately 1 X 1.5 inches. They are homologous with the female's ovaries. Each testis is subdivided into lobes, and within the lobes are the masses) of coiled snake-like seminiferous tubules (about 850 feet in each testis) where sperm are first produced. Interspersed among the tubules are interstitial cells (Leydig and Sertoli) which produce male hormones and protect and nurture the sperm. Like an assembly line, the sperm move from the seminiferous tubules to rete testes, another network of tubes and finally to the epididymous, where they continue their gradual development and attain motility. The epididymous, located on the top of the testes, is another bunched- up and coiled tube, which if stretched out, would be around 20 feet in length. It is here that the mature sperm are stored for up to 2 weeks until used. The testicles are connected to the man's body by means of a spermatic cord, which contains nerves and blood vessels which insure the survival and function of the testes.

Internal Genital Structures

Vas Deferens and Ejaculatory Duct

The testes are connected to the penis by means of the vas deferens, two long curving ducts which begins at the termination end of the epididymous and also store mature sperm. The vas deferens snakes up within the spermatic cords over the top of the bladder and continues on to the seminal vesicles and enters the prostate gland where it becomes a single ejaculatory duct. This duct connects in turn with the urethra, the tube which runs down the center of the penis and terminates in a small slit in the glans. The urethra is also connected with the bladder and allows for the expulsion of urine. Muscular sphincters control which of two processes (ejaculation or urination) occur at any given point, automatically prohibiting the other.

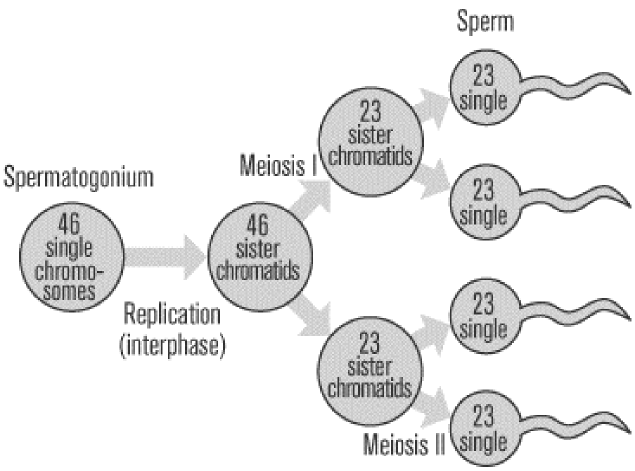
Seminal Vesicles

The seminal vesicles are small elongated pouches located directly behind the bladder which produce seminal fluid. During ejaculation, the sperm travel through the vas deferens to the seminal vesicles where seminal fluid is mixed in. This fluid, which constitutes about 70% of semen, is chemically alkaline and functions to neutralize the highly acidic environment of the vagina, insuring the survival of some (but not all) of the sperm. Seminal fluid is also rich in nutrients and includes fructose, and citric and amino acids, which all provide energy for the sperm and increase motility.

Sperm Production

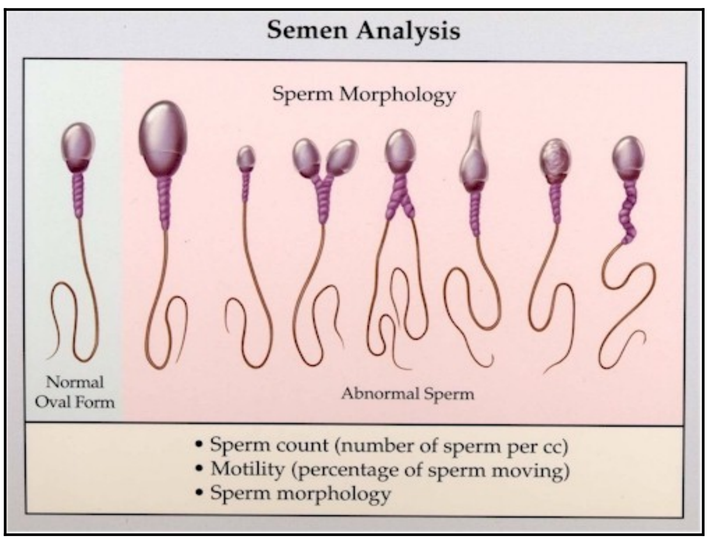
Spermatogenesis begins in the seminiferous tubules of the testicles when germ cells, called spermatogenia, are generated. Each has the 46 chromosomes normal for human cells. In a process called mitosis, the 46 chromosomes replicate and each half of the resulting 92 chromosomes split into 2 separate cells called primary spermatocyctes. Each cell retains half (46) of the chromosomes) and then, in a process called meiosis, divide again, resulting in secondary spermatocytes containing just 23 chromosomes. One last division occurs in which the secondary spermatocyctes becomes spermatids, or immature sperm. The maturation process continues, eventually resulting in a mature sperm (about 0.05 milliliters in length) containing 23 chromosomes. Theses 23 join together with the 23 chromosomes of the ovum, allowing for a new person to eventually result, sharing half of her genetic material with her father and half with her mother. The testes are prodigiously productive, taking approximately 70 days to produce sperm from beginning to end and doing it at the astounding rate of 1000 sperm a second (Macdonald, 2005), or 300 million or so per day. That works out to about 12 trillion (12,000,000,000,000) sperm that a typical man will produce over his lifetime (Sex trivia, 2006).

Three elements comprise the mature sperm; the tail, the body (or connecting piece) and the all-important head containing the nucleus with the chromosomal material. The crown of the head is covered by an acrosome, containing enzymes to be released if and when the sperm comes in contact with an ovum. These enzymes allow penetration of the membrane covering the ovum. On top of these enzymes are a layer of enzyme inhibitors (Nilsson, 1986), to prevent the enzymes from being used too early, or before the sperm reaches the ovum. The acrosome and rest of the sperm are also covered by a membrane.



Immediately below the head is the connecting piece, made up energy-supplying mitochondria. Finally, protein fibers make up the tail. These fibers contract on alternating sides, producing a wave-like action which propels the sperm forward at an approximate rate of about 3mm (0.12 inches) per minute. Sperm work hard, needing to whip their tales over 2000 times to swim an inch. It is still a mystery, but some sperm are better “swimmers” than others.

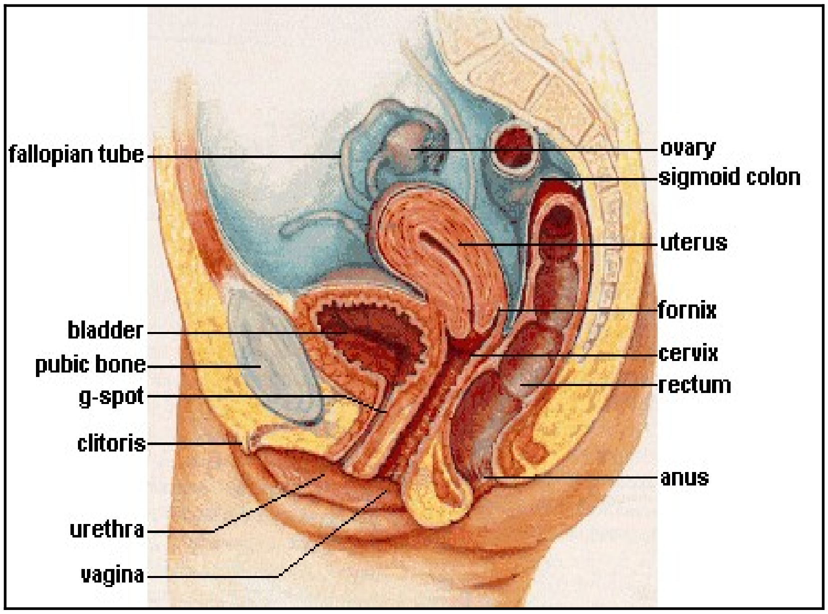
As noted earlier, ideal sperm production requires a temperature of 3-5 degrees below body temperature. The scrotum has a built-in “thermostat” which pulls the testis up toward the body if the temperature is too low to preserve heat and allow the sperm to develop. But if the scrotal temperature is too high, sperm development is also adversely affected. One of the queries that fertility specialists often have for men who are having difficulty conceiving is what type of underwear they typically wear. Briefs and other tight clothing effectively pull up the scrotal sac closer to the body, thereby elevating scrotal temperature and causing a greater proportion of the sperm to develop abnormally and have lower motility. The same result can be produced by taking too many hot baths (Macdonald, 2005) or having a job which a man to repeated exposure to high temperatures (for instance, close proximity to a pizza oven exposes).



Apart from temperature, there are numerous other potential causes of abnormal sperm production, often resulting in a reduced sperm count. Stress, various medications, drug and alcohol use, environmental exposure to chemicals and/or radiation, hormonal changes, cigarette smoking, infections and testicular injury have all been implicated as causal factors in reduced and abnormal sperm production, as well as a sperm’s ability to “swim”, called motility. Moderate amounts of coffee, on the other hand, apparently stimulate sperm to swim faster, further and harder (Macdonald, 2005). Coffee aside, there is significant research evidence to indicate that sperm count has decreased significantly in adult men over the past decades by as much as 50% (Auger et al, 1995; Carlson et al, 1992), no doubt due to the causal factors noted above.

Sperm may develop abnormally in many different ways. They may develop 2 tails or 2 heads, or be malformed in other ways. Needless to say, reduced motility, low sperm count and a greater proportion of abnormal sperm will all potentially influence not only whether a man can successfully produce children, but how genetically healthy any children he does produce will be.

FEMALE STRUCTURES AND PROCESSES



External Genital Structures

Vulva

Collectively known as the vulva or vulval area, the external female genital structures are richly supplied with neural connections, making them very sensitive to touch and thus potentially responsive to sexual arousal. The mons pubis is the mound of fatty tissue covering the female pubic bone, which after puberty, is covered with varying amounts of hair.

Labia Majora & Labia Minora

Two sets of skin folds, one inside the other, are found directly below the mons pubis and comprise the opening leading to the internal sex organ of the vagina. The outer lips are known as the labia majora and are homologous to the male scrotum. In an unaroused state, they loosely cover and thus protect the urethra and the vaginal canal. The process of delivery stretches the labia majora significantly, thus subsequent to giving birth the labia majora doesn't completely close (Slupik & Allison, 1996).

The inner set of skin folds are smaller and are known as the labia minora. They fuse together at the top with the mons pubis to form the clitoral hood, a small flap of skin protecting the clitoris. In a state of arousal, both the labia majora and labia minora engorge with blood and pull back and out, effectively exposing the clitoris and the vaginal opening.

Clitoris

The clitoris is located just below the mons pubis where the lips of the labia minora join together to form the clitoral hood. It is homologous with the head of the penis, and as such is composed of the glans, the observable apex of the clitoris, and the shaft, the rest of the structure. Internally, it is composed of erectile tissue called corpora cavernosa, which engorge with blood and swell during arousal in a manner similar to a male erection. This engorgement is not as obvious because much of the clitoris is under the skin surface and thus not visible. Although it appears to be the size of a pea, the average clitoris is approximately 1 x ½ inches and like the male penis, varies in size from person to person. The clitoris is densely packing with neural receptors, making it highly sensitive.

Introitus

Also called the vaginal opening, the introitus connects the external genitalia with the internal genitalia and is the opening which allows for both sexual intercourse and, in some cases, for birth 9 months later. Two small bean-shaped structures called Bartholin's glands (homologous to Cowper's gland in males), are proximate to the vaginal opening and secrete lubricating fluid during arousal.

Perineum

Extending from the vaginal opening to the anal opening is an area of skin-covered muscle called the perineum. It is this area that may be cut during delivery to prevent tearing. Called an episiotomy, this procedure allows for the vaginal delivery of larger babies and has become somewhat common as the birth-weight of babies has gotten larger.

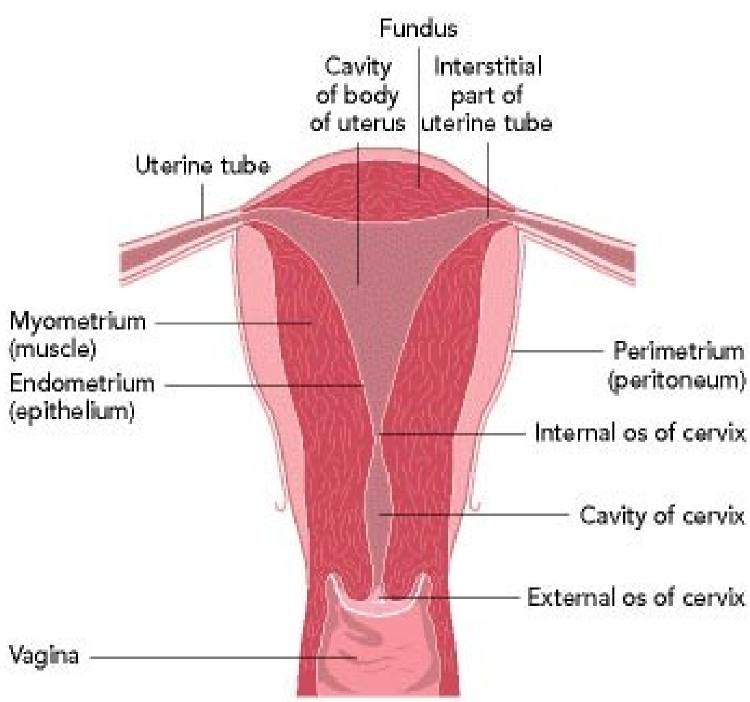
Internal Genital Structures

Vagina

Immediately within the vaginal opening is the vagina, a tubular organ that lengthens to the cervix and is approximately 4 inches in length (in an unaroused condition). Located internally between the rectum below and the bladder and urethra above, it is composed primarily of mucous membrane-lined smooth muscle. These muscles have the capacity for the extensive stretching to accommodate both sexual intercourse and birth. The outer third is enervated and thus sensitive to touch, unlike the inner two-thirds. The inside of the vagina remains moist due to ongoing secretions necessary to support "friendly" bacteria which contribute toward the maintenance of an acidic environment, which in turn protects a women from infection from "unfriendly" bacteria and other pathogens. Antibiotics can kill off the "friendly" bacteria, increasing the alkalinity of the vaginal environment, and resulting in a yeast infection. Sperm are considered to be "unfriendly" and pathenogenic by a woman's body and when present in the vagina, are attacked and dispatched by her immune system. Fortunately for all of us, some sperm do survive!

Cervix

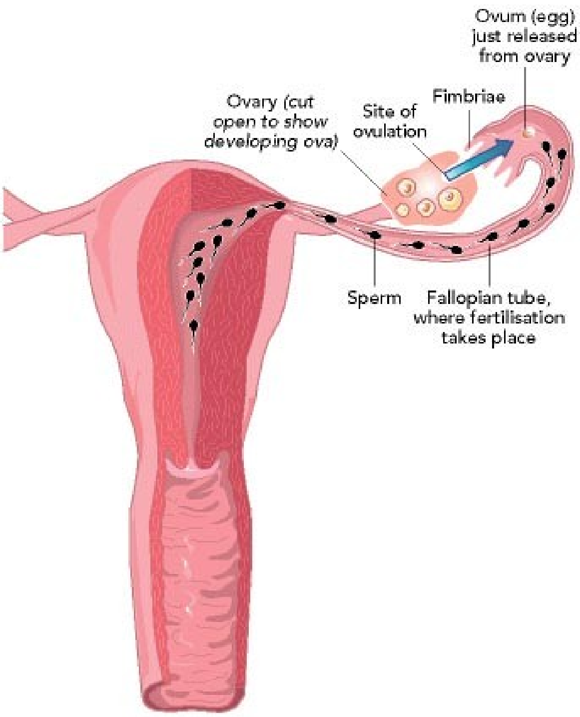
At the inner-most end of the vagina is the *cervix*, which through the *cervical os*, connects the vagina to the lower end of the uterus. When sexual intercourse occurs and sperm are deposited into the vagina, they must swim through the cervical opening into the uterus and finally into the Fallopian tubes to have any chance of fertilization. Cervical glands produce a mucous which normally "plugs" the opening to protect the uterus from bacterial infection. During ovulation, hormonal changes occur in a woman's body which thin out the consistency of the cervical mucous, effectively allowing for the sperm to swim through. This is not the only "help" that sperm get from the cervix. It contains small sacs (called crypts), which help protect sperm from the acidic-like vaginal environment by secreting alkaline mucus.



Uterus

The uterus is an approximately 2 x 3 inch pear-shaped organ located directly above the vagina and cervix with the lowest part being the most narrow (called the uterus isthmus). It tapers out in the middle (the uterus corpus) with the roundish dome-like top (the uterus fundus) being the widest. Like the vagina, it is capable of remarkable stretching, which will be needed during the nine months of pregnancy when it becomes the womb. Subsequent to birth, it will shrink back to its original size.

The uterus fundus and corpus are comprised of three layers. The thin outermost layer is called the perimetrium, or serosal layer. It secretes the serous fluid that acts as a lubricant preventing friction between the uterus and surrounding organs as a woman goes about her day to day activities. The middle layer, called the myometrium, is what provides the powerful contractions so important during labor. During sexual maturity (from puberty to menopause), the innermost layer of the uterus (the endometrium) goes through a constant process of thickening and thinning. It becomes most substantial in the days immediately after ovulation, when a fertilization of a ovum by a sperm is most likely to have occurred. This thickening is caused by hormonal changes and is composed of blood and nutrient-rich tissue, maximizing the chances of survival of any blastocyst that implants in the uterine wall. If implantation does not occur, the enriched endometrial tissue sloughs off and produces the menstrual flow.



Fallopian Tubes

At the top and to either side of the uterus extend the two Fallopian tubes. Also called oviducts, they are approximately 4 inch long. The fallopian tubes connect the uterus with the ovaries and the channel which allow sperm to swim up, and ova and zygotes to float down. Narrow at the uterine end (called the isthmus), they gradually widen toward the ovarian end (called the ampulla). At the very end of the fallopian tubes are finger-like projections called fimbriae that “hover” over the ovaries. During ovulation, the ovum is released from the ovary and helped by the subtle waving movement of the fimbrae are gently propelled down the channel of the Fallopian tube. Also assisting the uterine-bound movement of the ovum are cilia, tiny hair-like projections within the inside wall of the fallopian tubes, as well as rhythmic contractions of the muscular walls of the tube. If sperm are present, fertilization takes place at some point in the Fallopian tube in the few days that the ovum is floating down toward the uterus.

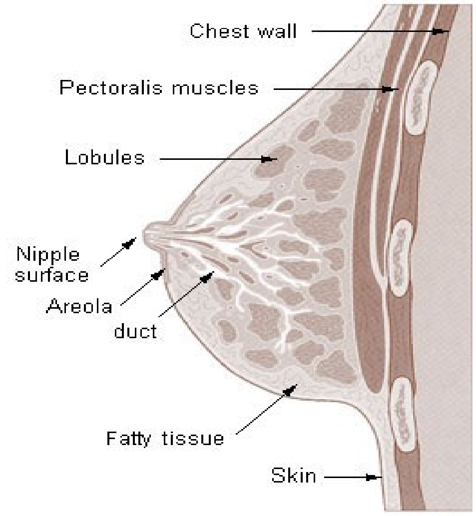
Ovaries

At the filibriaeted end of the fallopian tubes are the 2 almond-shaped ovaries (one on either side of the uterus), homologous with the male testes. Approximately ¾ to 1.5 inches in length, they are not directly connected to the Fallopian tubes, but are held in place by ovarian ligaments which attach to the wall of the uterus. The ovaries have two main functions, the first as part of the endocrine system. They produce and release female sex hormones, including estrogen and progesterone. The second ovarian function is the storage and production of ova.

Following the changes that occur during puberty, the ovaries have a wrinkled, uneven surface and are covered with epithelial tissue. Beneath this tissue are numerous minute primary follicles, embedded in connective tissue called stroma. The follicles both store the ova (which have been present since the mother’s own fetal development), and in sexually mature females, produce mature ova.

Breasts

While not technically part of the female reproductive system, they do contain alveolar glands which produce milk and thus ideal nourishment to the newborn after birth. The breasts, also called mammary glands, respond to the hormonal changes of the ovulatory cycle and pregnancy. The fatty tissue of the breast, called adipose tissue, rests on a muscular base called the pectoralis major. Normal variability in adipose tissue in various women is what accounts for the assorted shapes and sizes of women's' breasts. Functionally speaking (milk production), size does not matter. While most women (and men) are born with one set of breasts, there is a condition known as polythelia. In this condition, humans are born with more than 1 pair and as many as 8 pair (Jones, 1991).

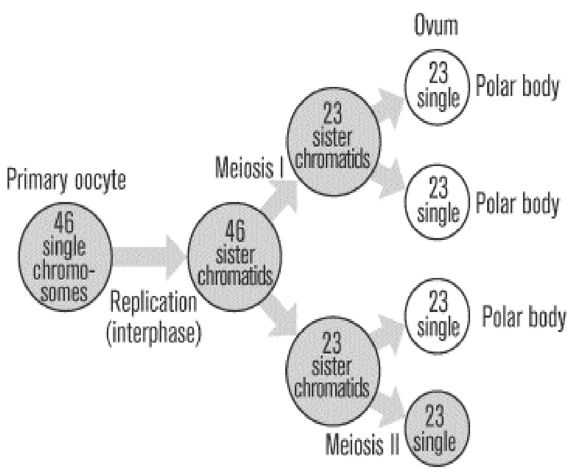


At the peak of each breast is the pigmented round areola, with the nipple in the center. The nipple has an opening, connected to the lactiferous duct, which stores and releases milk. Connected to this duct are the 15-20 lobules of the alveolar glands, which actually produce the milk. The pituitary gland secretes the hormone prolactin, which initiates and maintains milk production in the period following birth.

Ova Production

Oogenesis occurs in the ovaries, and begins while still in the womb. As early as the 50th day after a woman's own conception, her ovaries produce primitive cells which begin to multiply at a great rate. By about the 5th month in utero, these cells number almost 7 million, but degenerate down to a still-impressive 700,000 to about 2 million at birth. This further decreases to around 400,000 by puberty. Most of these immature ova will never become mature, primarily due to the measured once-every-28-days-or-so release of one or maybe two ova. Thus, in a typical woman's lifetime, only 200-400 fully developed ova are released.

The process of ovum production begins with the primary oocyte, which has 46 chromosomes. In a process called mitosis, the 46 chromosomes replicate and each half of the resulting 92 chromosomes split into 2 separate cells with 46 chromosomes each. In a process called meiosis, these cells split again, replicate, and split again. Of the four "daughter" cells resulting from this process, three (called polar bodies) come out much smaller than the fourth and eventually disintegrate. The fourth is left as the final product of oogenesis, which we call the ovum.



The follicles of the ovaries store the ova. But the follicles themselves also develop through a process that takes over a year (375 days). A group of dormant and undeveloped primordial follicles grows and gradually becomes a mature or Graffian follicle containing one ovum. In the first half of the 28-day or so menstrual cycle, called the follicular phase, the Graffian follicle will begin to change. This process, called cumulus expansion, is stimulated by the secretion of hormone called (logically enough) follicle stimulating hormone (FSH). The follicle, and the ovum within, gradually mature, and in response to a spike in FSH and another hormone called LH (luteinizing hormone), will eventually burst. Both hormones are crucial for the process of ovulation (Siklósi et al, 2001). The hole produced, called the stigma, allows the ovum to escape the ovary and into the fallopian tube. This process occurs at the midpoint of the menstrual cycle, and is called ovulation.

Ovulation

The hypothalamus controls the processes of ovulation by directing the pituitary gland to release hormones in varying amounts and at varying intervals, particularly the LH and FSH noted earlier. Along with the estradiol and progesterone released by the ovaries, these four hormones rise and dip throughout the 28-day (or so) menstrual cycle, guiding processes in the ovaries and in the endometrium of the uterus.

During the second half of the menstrual cycle, called the luteal phase, the ovum travels down the fallopian tubes toward the uterus. If not fertilized, it will degrade in the fallopian tubes within 24 hours and be eventually expelled in the menstrual flow. However, if fertilized by sperm, it will implant in the wall of the uterus 5-12 days later. The hormones released in the first half of the menstrual cycle have signaled the endometrium of the uterus to begin thickening with oxygen and nutrient-rich blood. Thus, the uterus is ideally prepared 6-12 days after ovulation for any blastocyst that may implant in the wall of the uterus.

Ovulation is also accompanied by slight elevations in body temperature, and in some women, pain, and a heightened sense of smell (*Navarrete-Palacios et al, 2003).* This heightened sense of smell may help explain research findings that women's preferences for certain male smells and features changes over the menstrual cycle. Around ovulation, women tend to prefer masculine traits (and smells). This changes during the rest of the menstrual cycle when women tend to prefer traits (and smells) that signal stability over sheer masculinity. Men also report great preference for women's scent's around ovulation than at other times (Haselton, 2006; Roberts et al, 2003).

PRE-FERTILIZATION

Someone has estimated that at any given moment, there are about 2000 couples having sexual intercourse (right now), which comes out to about 200 million acts of sexual intercourse per day (Sex trivia, 2006). In the great majority of cases, the result will not be conception, pregnancy or birth. This is due to issues of fertility, timing, environmental factors, birth control and abortion. In fact, so many things can "go wrong" that it is a miracle that any of us were ever born.

Whether conception and pregnancy are intentional or not, female and male reproductive systems and the act of sexual intercourse are wonderfully designed to maximize the chances of conception. Both the form and function of the male and female sex organs serve to increase the likelihood that a sperm will "hook up" with an ovum.

As noted earlier, the sperm are sequentially blended with various fluids from the seminal vesicles, prostate and Cowper's glands during the several seconds of orgasm. These fluids provide energy (fructose) and other nutrients (enzymes, salts, nitrogen, creatine, cholesterol, & vitamin B12) for the sperm. They also are alkaline in chemical composition, protecting the sperm from the acidic vaginal setting.

During sexual intercourse, the forward-thrusting action of the penis within the vagina increases the likelihood the sperm will be "deposited" toward the cervical end of the vagina. The muscular contractions of orgasm and the spurting pressure of ejaculation have the same result. Sperm closer to the cervical opening have that much less area to swim and thus conserve energy and minimize their chances of demise in the hostile environment (at least for them) of the vagina. Women's muscular contractions during orgasm also "help" the sperm. Immediately after orgasm ends, the cervix drops into the vagina and, if semen is present, dips into the fluid several times. The net effect is like an elevator, assisting the sperm into and through the cervical opening to the uterus.

But the cervix also provides several other helpful actions. As we noted earlier, during ovulation the cervix releases an alkaline mucus, thus duplicating the "help" of the various glands in the male's body which contribute toward the blend of semen. The cervix also contains small sac-like crypts that function as temporary sperm reservoirs (rest areas?). Another adjustment that the cervix makes during ovulation is to "thin" out the cervical plug which protects the uterine environment from the vaginal one. This augments the chances of sperm to be able to traverse the cervix into the uterus. Finally, the cervical canal has small hair-like cilia, which gently sweep the sperm forward.

The uterus also functions to maximize the likelihood of fertilization. The smooth muscles of the uterus contract, effectively propelling the sperm toward the fallopian tubes. Similar to the cervix, uterine cilia also sweep forward the sperm. Finally, striations in the endometrial wall provide" canals" which direct the swimming sperm toward the fallopian tubes.

The net effect of male and female orgasm, along with the assistance of the cervix and uterus, is to greatly enhance the chances of pregnancy. Sperm are speedy swimmers and can cover about 1/10 of an inch per minute. (Macdonald, 2005). Given their small size, a comparative speed of an adult man would be 21/5 minute mile (Macdonald, 2005). But this speed requires about 2000 tail whips to swim an inch and uses up a lot of precious energy, so every bit of assistance helps. With cervical and uterine assistance, sperm can swim about 8 inches in an hour (vs. 6 inches without help).

What is the rush, you might ask? Unlike the Olympics, there is no silver or bronze medal in the up to 10-hour swimming "ultra-marathon" that sperm are competing in. Out of the 200 to 500 million sperm that start the race, there can potentially only be 1 winner. All the other sperm are losers and will die, some almost immediately and some lasting as long as 1 week (Macdonald, 2005). In this race, it is truly “do or die”. The positive benefit to this process is the likelihood that the strongest and fittest sperm are most likely to win, increasing the chances of healthy fertilization.

Two different types of sperm are produced, those with an X chromosome and those with a Y. The Y-chromosome-carrying sperm are faster swimmers than X-chromosome-carrying sperm, and therefore are more often the “winners”. Studies have typically shown that out of 1000 conceptions, 511 males and just 489 females are the result. Recent research in Italy has discovered that this rate fluctuates seasonally, higher (535 boys/465 girls) in the fall and lower (487boys/513girls) in the spring (Cagnacci, 2003). The result is that more baby boys are born than baby girls. This phenomenon was noted as early 1662 by John Graunt and statistically studied in 1710 by John Arbuthnot. In the last data available in the United States (2002) the ratio was 524/476 (CDC, 2005). Worldwide, the ratio is about 530/470.

But other factors, including age and ethnicity also influence the likelihood of whether a girl or a boy is conceived and eventually born. In the United States, older mothers (over 40) have the lowest total sex birth ratios (519/481) and younger mothers (15 to 19) have highest sex birth ratio (527/473). Chinese (537/463) and Filipino (536/464) mothers (1,072) had the highest differences between the number of boys born versus girls, while non-Hispanic African-American (515/485) and Native American (515/485) had the lowest. (CDC, 2005).

A trend that has been noted recently has found gradual declines in the proportion of male to female births in the US, Canada, Denmark, Russia, Taiwan and the Netherlands. The causes are multiple and are said to include industrial accidents, occupational exposure, and air pollution. (Davis et al, 1998; Mocarelli et al, 1998; Møller, 1996, 1998).

But how do the sperm find the ovum? At least part of the answer to this question is smell. Sperm contain olfactory receptor proteins, particularly one known as hOR17-4, which respond to various scents. One floral scent in particular, called bourgeonal, cause sperm to both change directions and to speed up, almost doubling its speed in high enough concentrations. At this point, researchers don’t yet know if it is the ovum or some other structure which release the scents. (Spehr et al, 2003).

Once sperm reach the top end of the uterus, they come to a dead end and must either turn right or left into one of the fallopian tubes. About half swim each way, thus effectively reducing potential fertilizers by 50%. This number is reduced by 100% if no ovum is present in one (or in some cases, both) of the fallopian tubes. All the sperm will eventually expire and no possibility of fertilization or pregnancy exists.

But if an ovum is present in a fallopian tube, it has already been in transit for up to four days, having been “released” by one of the ovaries during ovulation. Usually just one ovum is released, but in about 1 out of 80 times, 2 are released and three ova are released in about 1 out of 6500 times (Nathanielz, 1992, p. 14). This is one reason why twins and triplets are so rare. Like the sperm, ova are assisted in their progress by both the waving movement of the ovarian fimbrae and fallopian cilia, and the rhythmic contractions of the fallopian walls.

FERTILIZATION

Fertilization is the result of the smallest cell in the human body (the sperm) fusing together with a cell 85,000 times larger and the largest cell in the human body (the ovum) to produce not 2 cells, but one, a zygote (Foulk, 2001). Over time, this 1 cell will multiply into the trillions of cells which make up all the cells of a full-grown adult. While the numbers are quite amazing, it gets even more incredible (Macdonald, 205). This 1 cell will multiply itself into over 200 types of specialized cells, constituting the cells of the brain, bones, skin, liver, heart, eyes, kidneys, teeth and so on. The actual moment of fertilization almost always takes place somewhere in the 4-inch fallopian tubes, usually toward the uterine end and away from the ovarian end. In rare cases fertilization can also occur in the uterus or even rarer, in a test tube or Petri dish somewhere.

As the sperm have been swimming, the layer of enzyme inhibitors just above the acrosome have gradually been worn away, exposing the enzymes just at the time when they will be needed to chemically “drill” into the outer layer of the ovum. Several sperm usually arrive at the ovum at once and quickly attach themselves to special receptor sites located on the zona pellucida, the outermost layer of the ovum. This binding process capacitates the enzymes contained in the acrosome at the very tip of the sperm head. The sperm tail continues to wave while these enzymes work and both produce a burrowing process through the outside layer of the ovum. Once through, the sperm arrives at a space separating the outside membrane from the plasma membrane. In a split second of time, the sperm fuses with the plasma membrane and is literally pulled into the ovum by ovum-produced contractions. As soon as this happens, ovum-produced enzymes are released into the space separating the zona pellucida and the plasma membrane of the ovum. The instantaneous result is the deactivation of all of the sperm receptor sites and a hardening of the outside membrane, effectively blocking out all other sperm from entry.

CONCLUSION

Over the next several hours, the "winning" sperm and the ovum fuse together the genetic content that each has carried within their respective nuclei, producing the genetic blueprint so determinative to the person that will potentially result. Whether this person will be tall or short, have blue eyes or brown eyes, be happy or depressed, have a predisposition for musical, artistic, athletic or mathematical abilities, be a teacher or a psychologist, live to 100 or even survive the next few moments, are all determined to a degree by this process. It can be rightly argued that this is THE single most influential day of our lives and it is the topic of our next chapter.

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