NAME: ALAWODE IKEOLUWA IFUNANYACHUKWU

LEVEL: 200 LEVEL

DEPARTMENT: MEDICINE AND SURGERY

ASSIGNMENT TITLE: Embryology

COURSE TITLE: Integrated Core Basic Sciences - Anatomy, Biochemistry & Physiology

COURSE CODE: ICBS

1) Discuss ovulation

Ovulation is the release of an egg from one of a woman's ovaries. After the egg is released, it travels down the fallopian tube, where fertilization by a sperm cell may occur.

This event occurs when the ovarian follicles rupture and release the secondary oocyte ovarian cells

Ovulation typically lasts one day and occurs in the middle of a woman's menstrual cycle, about two weeks before she expects to get her period. But the timing of the process varies for each woman, and it may even vary from month to month.

Menstrual cycle and ovulation

At birth, a female fetus has 1 to 2 million immature eggs called oocytes inside her ovaries, which is all the eggs she will ever produce, according to the Cleveland Clinic. By the time a girl enters puberty, about 300,000 of these eggs remain. Approximately 300 to 400 of the remaining eggs will be ovulated during a woman's reproductive lifetime.

With every monthly menstrual cycle, a woman's body prepares for a potential pregnancy. The cycle is regulated by hormones, including the sex hormones estrogen and progesterone, as well as follicle-stimulating hormone and luteinizing hormone (the release of these hormones and the whole process of ovulation is controlled by the hypothalamus of the brain). Hormones play a key role in all stages of the menstrual cycle, allowing the ovum (egg) to mature and eventually be released.

When a mature egg leaves a woman's ovary and travels into the fallopian tube, a sperm cell can fertilize the egg (this happens after ovulation during the luteal phase). Sperm can live inside a woman's reproductive tract for about 3 to 5 days after sexual intercourse. For pregnancy to take place, a sperm cell must fertilize the egg within 12 to 24 hours of ovulating. The fertilized egg then travels to the uterus, or womb, where it can attach to the lining of uterus and develop into a fetus.

During ovulation, the walls of the uterus also thicken to prepare for a fertilized egg. But if the egg is not fertilized, the uterine lining is shed about two weeks later, causing menstrual flow to begin. But simply having her period does not always indicate that a woman is ovulating.

Timing / ovulation clues

A woman does not always menstruate 14 days after her last period because the timing of ovulation varies for each woman and depends on the length of her menstrual cycle.

If a woman typically has 28-day menstrual cycles, she usually ovulated between days 13 to 15; If her cycle ranges between 27 and 34 days, ovulation usually occurs between days 13 to 20.

Most women do not know when they ovulate but one can always chart their timing using a calendar but asides from this method, a woman may have other clues that she could be ovulating. Her body may have one of the following three signs:

1. Change in vaginal secretions.

A few days before a woman ovulates, her cervix, which is the lower part of the uterus, produces a type of mucus that is thin, clear, slippery and stretchy. This change in cervical mucus occurs when ovulation is approaching and her ovaries are getting ready to release an egg. The day after ovulation occurs, cervical mucus undergoes another change and it becomes thicker and cloudy.

2. Change in basal body temperature.

Keeping track of a woman's basal body temperature, which is taken in the morning before she gets out of bed, for two to three menstrual cycles may help predict when she is fertile. Shortly after ovulating, many women show a slight increase (about 1 degree F) in early morning body temperature. A woman is most fertile during the 2 to 3 days before her temperature rises.

3. Rise in luteinizing hormone.

About 24 to 36 hours before a woman ovulates, her levels of luteinizing hormone increase. A rise in luteinizing hormone is a signal for the ovary to release an egg. This hormone increase can be detected by using an ovulation predictor kit, which can test a sample of urine in the days leading up to ovulation. When a rise in luteinizing hormones is detected, the test will show a positive result.

Ovulation problems

There are many reasons why a woman may have ovulation problems.

Some women, for example, have blocked fallopian tubes due to pelvic inflammatory disease, endometriosis or surgery for an ectopic pregnancy.

An abnormal level of hormones can cause ovulation to be irregular or not occur at all. For example, polycystic ovary syndrome (PCOS) is a condition in which levels of certain hormones are abnormal and a woman does not get her period or it is irregular.

Thyroid problems can also make the ovaries less likely to release an egg.

A woman who is underweight with a body mass index (BMI) of 18.5 or less may have irregular menstrual cycles and it could also cause ovulation to stop. At the opposite end of the weight spectrum, obesity may also lead to irregular periods and irregular ovulation.

In addition, the timing of ovulation can be affected by factors, such as stress and excessive exercise. Emotional or physical stress may delay ovulation or prevent a woman from ovulating. Getting too much intense physical activity can also inhibit ovulation.

Fertile window

A woman is fertile — able to become pregnant — only during a certain part of her monthly cycle. The "fertile window" spans a 6-day period, the 5 days before ovulation and the day a woman ovulates. Studies suggest that intercourse is most likely to result in a pregnancy when it occurs in the three days leading up to and including the day of ovulation.

2) Differentiate between meiosis 1 and meiosis 2

	MEIOSIS I	MEIOSIS II
Homotypic/Heterotypic division	Meiosis 1 is a heterotypic division, reducing the chromosome number in the daughter cell by half, compared to the parent cell.	Meiosis 2 is a homotypic division, equalizing the chromosome number of both parent and daughter cells.
Chromosomes	Homologous chromosomes are present at the beginning of meiosis 1.	Individual, bivalent chromosomes are present at the beginning of meiosis 2.
Phases	Prophase 1, metaphase 1, anaphase 1 and telophase 1 are the four phases in the meiosis 1.	Prophase 2, metaphase 2, anaphase 2 and telophase 2 are the four phases in the meiosis 2
Result	Individual chromosomes are present in the daughter nuclei.	Sister chromosomes, which are derived from sister chromatids are present in the daughter nuclei.
Number of daughter cells at the end	Two diploid daughter cells are produced from a single parent cell	The two daughter cells produced at meiosis 1 are separately divided to produce four haploid cells
Cross-over	Chromosomal crossover occurs during prophase 1, by exchanging the genetic material between non-sister chromatids.	No chromosomal crossover occurs during prophase 2
Complexity and time taken	Meiosis 1 is a more complex division. Thus, it takes more time.	Meiosis 2 is comparatively simple and less time is taken for the division.
Interphase	Interphase is followed by meiosis 1	No interphase takes place prior to the meiosis 2. A resting phase, interkinesis can occur.
Cleavage of the Cohesin Complex	Cohesin protein complexes at the arms of the homologous chromosomes are cleaved.	Cohesins at the centromeres are cleaved in order to separate the two sister chromatids

3) Discuss the stages involved in fertilization

Fertilization is more a chain of events than a single, isolated phenomenon. Indeed, interruption of any step in the chain will almost certainly cause fertilization failure. The chain begins with a group of changes affecting the sperm, which prepares them for the task ahead.

Successful fertilization requires not only that a sperm and egg fuse, but that not more than one sperm fuses with the egg. Fertilization by more than one sperm - polyspermy - almost inevitably leads to early embryonic death. At the end of the chain are links that have evolved to efficiently prevent polyspermy.

Steps involved in the process of fertilization are:

1. Sperm Capacitation

Freshly ejaculated sperm are unable or poorly able to fertilize. Rather, they must first undergo a series of changes known collectively as capacitation. Capacitation is associated with removal of adherent seminal plasma proteins, reorganization of plasma membrane lipids and proteins. It also seems to involve an influx of extracellular calcium, increase in cyclic AMP, and decrease in intracellular pH. The molecular details of capacitation appear to vary somewhat among species.

Capacitation occurs while sperm reside in the female reproductive tract for a period of time, as they normally do during gamete transport. The length of time required varies with species, but usually requires several hours. The sperm of many mammals, including humans, can also be capacitated by incubation in certain fertilization media.

Sperm that have undergone capacitation are said to become hyperactiviated, and among other things, display hyperactivated motility. Most importantly however, capacitation appears to destabilize the sperm's membrane to prepare it for the acrosome reaction.

2. Sperm-Zona Pellucida Binding

Binding of sperm to the zona pellucida is a receptor-ligand interaction with a high degree of species specificity. The carbohydrate groups on the zona pellucida glycoproteins function as sperm receptors. The sperm molecule that binds this receptor is not known with certainty, and indeed, there may be several proteins that can serve this function.

3. The Acrosome Reaction

Binding of sperm to the zona pellucida is the easy part of fertilization. The sperm then faces the daunting task of penetrating the zona pellucida to get to the oocyte. Evolution's response to this challenge is the acrosome - a huge modified lysosome that is packed with zona-digesting enzymes and located around the anterior part of the sperm's head - just where it is needed.

The acrosome reaction provides the sperm with an enzymatic drill to get throughout the zona pellucida. The same zona pellucida protein that serves as a sperm receptor also stimulates a series of events that lead to many areas of fusion between the plasma membrane and outer acrosomal membrane. Membrane fusion (actually an exocytosis) and vesiculation expose the acrosomal contents, leading to leakage of acrosomal enzymes from the sperm's head.

As the acrosome reaction progresses and the sperm passes through the zona pellucida, more and more of the plasma membrane and acrosomal contents are lost. By the time the sperm traverses the zona pellucida, the entire anterior surface of its head, down to the inner acrosomal membrane, is denuded.

Sperm that lose their acrosome before encountering the oocyte are unable to bind to the zona pellucida and thereby unable to fertilize. Assessment of acrosomal integrity of ejaculated sperm is commonly used in semen analysis.

4. Penetration of the Zona Pellucida

The constant propulsive force from the sperm's flagellating tail, in combination with acrosomal enzymes, allow the sperm to create a tract through the zona pellucida. These two factors - motility and zona-digesting enzymes- allow the sperm to traverse the zona pellucida. Some investigators believe that sperm motility is of overriding importance to zona penetration, allowing the knife-shaped mammalian sperm to basically cut its way through the zona pellucida.

5. Sperm-Oocyte Binding

Once a sperm penetrates the zona pellucida, it binds to and fuses with the plasma membrane of the oocyte. Binding occurs at the posterior (post-acrosomal) region of the sperm head.

The molecular nature of sperm-oocyte binding is not completely resolved. A leading candidate in some species is a dimeric sperm glycoprotein called **fertilin**, which binds to a protein in the oocyte plasma membrane and may also induce fusion. Interestingly, humans and apes have inactivating mutations in the gene encoding one of the subunits of fertilin, suggesting that they use a different molecule to bind oocytes.

6. Egg Activation and the Cortical Reaction

Prior to fertilization, the egg is in a quiescent state, arrested in metaphase of the second meiotic division. Upon binding of a sperm, the egg rapidly undergoes a number of metabolic and physical changes that collectively are called *egg activation*. Prominent effects include a rise in the intracellular concentration of calcium, completion of the second meiotic division and the so-called cortical reaction.

The cortical reaction refers to a massive exocytosis of cortical granules seen shortly after sperm-oocyte fusion. Cortical granules contain a mixture of enzymes, including several proteases, which diffuse into the zona pellucida following exocytosis from the egg. These proteases alter the structure of the zona pellucida, inducing what is known as the zona reaction. Components of cortical granules may also interact with the oocyte plasma membrane.

7. The Zona Reaction

The zona reaction refers to an alteration in the structure of the zona pellucida catalyzed by proteases from cortical granules. The critical importance of the zona reaction is that it represents the major block to polyspermy in most mammals. This effect is the result of two measurable changes induced in the zona pellucida:

1. **The zona pellucida hardens**. Crudely put, this is analogous to the setting of concrete. Runner-up sperm that have not finished traversing the zona pellucida by the time the hardening occurs are stopped in their tracks.

2. **Sperm receptors in the zona pellucida are destroyed**. Therefore, any sperm that have not yet bound to the zona pellucida will no longer be able to bind, let alone fertilize the egg.

4) Differentiate between monozygotic twins and dizygotic twins

	Monozygotic Twins	Dizygotic Twins
Development	Monozygotic twins are developed by the splitting of a fertilized embryo into two.	Dizygotic twins are developed by two separate fertilization events occurring at the same time.
Causes	The cause for monozygotic twins is not known	Dizygotic twins are caused either by IVF, certain fertility drugs or hereditary predisposition due to the hyper ovulation.
Called as	Monozygotic twins are called identical twins.	Dizygotic twins are called fraternal twins.
Genetic Code	The genetic codes of the monozygotic twins are nearly identical.	The genetic codes of the dizygotic twins are same as any other sibling.
Gender of Twins	The genders of monozygotic twins are same.	The genders of dizygotic twins are different
Blood Type	The blood type of monozygotic twins is the same.	Dizygotic twins may have different blood types.
Appearance	Monozygotic twins are extremely similar. But, they may vary depending on the environmental factors.	The appearance of dizygotic twins is similar as any other sibling.
Likelihood	The likelihood of the monozygotic twins is uniform around the world.	The likelihood of the dizygotic twins varies by country.
Occurrence	One-third of the twins in the world are monozygotic twins.	Two-third of the twins in the world are dizygotic twins.
Hereditary	Monozygotic twins are not hereditary.	Dizygotic twins are hereditary.
Inside the Uterus	Monozygotic twins can be DiDi, MonoDi or MonoMono twins.	Dizygotic twins are only DiDi twins.
Risk of TwintoTwin Transfusion Syndrome (TTTS)	Monozygotic twins bear high risk for TTTS.	Dizygotic twins bear a low risk for TTTS com pared to monozygotic twins.