Shravana Ramgoolam April 8th 2017

BIO LAB 1140 EXAM REVIEW

- Go through all labs and make notes
- Go through pre presentations of all labs note structures
    * Amoeba proteus structure
- Go through mathematical concepts & labelling of microscope
- Review more on Saturday

Lab #1 Observation of Eukaryotic and Prokaryotic Cells

- Prokaryotic cells belong to two types
    * archaea & eubacteria (unicellular organisms)
    * have membrane bound organelles
    * Has circular chromosomes plus extra chromosomal elements plasmids
- Eukaryote cells
    * multicellular and unicellular
    * Has a membrane bound nucleus
- An Elodea plant is a Eukaryotic cell
    * the chloroplast in the eukaryotic Elodea cell is undergoing **cytoplasmic streaming** or **cyclosis**
    * You cannot see the plasma membrane in plant cells because it is too thin to be resolved with the compound microscope
    * To see the plasma membrane you have to place it in a strong salt solution to cause osmosis to happen, letting water to leave the cell decreasing the volume which allows you to see the space between the cell wall and the boundary of the protoplast
    * The protoplast is the cell minus its cell wall
    * Plasmolysis: the process of adding a plant cell in a strong salt solution to make water flow out, causing large swollen vacuoles
- Prokaryotic Cells: Oscillatoria (eubacteria)
    * Not moving
    * Looks like filaments

Lab #2: Permeability of Red Blood Cells

- Studying tonicity
- Tonicity is the study of muscle tone in cells
- Erythrocytes are good to measure tonicity because
    1. It's cell membrane permeability
    2. Can obtain large quantities of homogenous cells
    3. Can be kept in isolated areas for a long time
    4. Contain large quantities of hemoglobin (can cause hemolysis)

<u>Osmosis</u>

- Osmosis: the spontaneous movements of water molecules across the semi permeable membrane such like RBC's
- Osmosis water molecules move from high concentration to low concentration

- Osmosis can occur because of aquaporins
- Osmosis regulates tonicity
- Tonicity remember is the muscle tone in cells
    * isotonic
    * hypotonic
    * hypertonic
- Tonicity is the ability of a water to move via osmosis creating the different types of solutions
- The ability for a substance to create movements of water is called tonicity
- Hypotonic solution
    * tears the plasma membrane
    * releases intracellular content outside the cell
    * RBC's call this hemolysis
- Hypertonic solution
    * water flows from inside the cell to outside
    * volume of the cell decreases
    * plasma membrane starts to fold

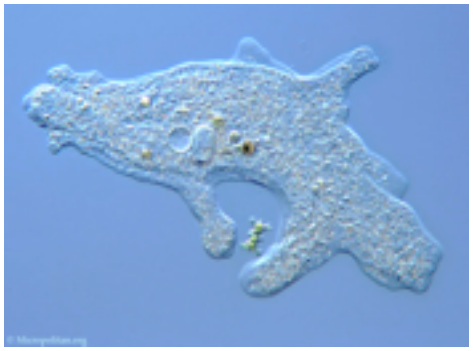
<u>Diffusion</u>
- Diffusion is when molecules on its own spontaneously crosses the membrane depending on its concentration gradient
- Diffusion is therefore dependant on concentration gradients
- Solutes can diffuse through a membrane at different rates; some can whereas some just simply cannot

<u>Hemolysis</u>
- Hemolysis is called by a hypotonic solution in Red Blood Cells causing the cell to rupture
- Caused when too much water flows inside the cell and causes a rupture in the plasma membrane
- Hemolysis can be reached by placing the cells in a isosmotic solution of a penetrating substance
    * isosmotic = is considered isosmotic if it has the same concentration of solutes
- When the RBC is placed in the penetrating substance with the same pressure or same concentration of the solute (isosmotic solution) then as the penetrating substance enters the cell, it will change the tonicity and osmotic pressure
- This means that inside the cell, pressure will increase and the volume outside the cell becomes hypotonic.
- In consequence of this, water will flow inside the cell trying to decrease the pressure and hemolysis will occur.
- The time that it takes to do all of this informs us of how permeable the membrane is
- Different types of RBC have different resistances to hemolysis
- When 75% of the RBC's in a population have undergone hemolysis then all red blood cells will be suspended and becomes transparent

Lab #3: Cellular Processes in *Amoeba proteus*

- An *Amoeba proteus* is a protist but it is a single celled eukaryotic organism
- Found typically at the bottom of freshwater ponds and lakes
- Very motile and changes shape due to its pseudopodia
- Uses its pseudopodia to catch food and its prey to be digested in food vacuoles
- Membrane protrusions = pseudopodia "fake feet"
- Pseudopodia moves
    * by its extensions of long polymers of actin present in the cytoskeleton called microfilaments
    * Microfilaments are present in eukaryotic cells and are involved in muscle contractions of animal cells
- Formation of Pseudopodia
    * Molecules of free acting (G-actin) bound to each other to create a series of long polymers fibers called in this form F-actin
    * As these F-actin fibres grow more and more they push out the plasma membrane and extends into the pseudopodia
    * Adhesion molecules attach the newly formed molecules to the substratum (ground of something)
    * The same adhesion molecules detach the uroid (the back) from the substratum
    * Contractions at the uroid occur so the cell contents can be pushed forward
- Remember that *Amoeba proteus* does not actually have front and back but it is okay to use these terms relative to direction
- *Amoeba proteus'* are very sensitive to light and heat
    * Need to turn light down
    * Ensure there is enough water on the mount so it does not dry out

- LABEL
    * Plasmalemma
    * Granular endoplasm
    * Ectoplasm
    * Contractile Vacuole
    * Pseudopodia
    * Uroid
    * Hyalin Cap
    * Food Vacuole
    * nucleus
    * Not on here, but endocytic canals used for endocytosis



<u>Contractile Vacuoles</u>

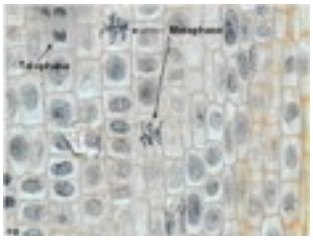
- Since Amoeba proteus live under water, they must fight off excess water entry by osmosis
- The *Amoeba proteus* lives in an hypo osmotic environment compared to its cytosol

- The *Amoeba proteus* and many other protist release their excess water by using a contractile vacuole
- The contractile vacuole filled of excess water goes through a cycle where it fills the vacuole in the cytosol ad releases its content in the extracellular space
- The *Amoeba proteus* only has one contractile vacuole
- Systole
    * When the vacuole is ejected outside the cell (t=0)
- Diastole
    * The time it takes for the vacuole to fill up
- A typical contractile vacuole cycle lasts up to 4-6 minutes

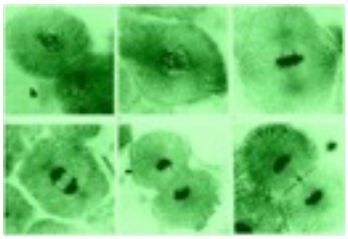
Endocytosis
- Endocytosis was first described in an *Amoeba proteus*
- Endocytosis refers to pinocytosis and endocytosis
- Bulk-Phase
    * Also non-specific
    * induced by a large variety of substances
    * proteins, amino acids, salts (cations), basic stains,
    * Once the cell is in contact with the inducing agent, the cell will stop moving and becomes rounder; endoplasm flow stops; small protrusions appear; endocytosis canals can be observed more easily in those small protrusions
    * Endocytic vesicles will form canals and accumulation of alcian blue dyes

Phagocytosis
- Phagocytosis may occur depending on how hungry the *Amoeba proteus* is

Lab #4 Mitosis
- Cellular division is what permits a cell to divide in two
- Prokaryotes and unicellular eukaryotes rely on cell division to produce new individual
- There are two types of cell division in eukaryotic cells
    * Mitosis: give rise to two identical daughter cells to the mother cell where the genetic material is evenly separated into two
    * Meiosis: Produces gametes and are different from the original cell and contains different genetic material



Onion



Whitefish Blastula

Broad Bean = Squish

The Cell Cycle

- The cell cycle can last up to a few minutes or hours or years
    * hours in plant meristems or animal embryos
    * years in adult bone marrow
- The cell cycle is broken down into M phase and then interphase
- M phase = Mitosis and cytokinesis
    * Mitosis is the nuclear division
    * Cytokinesis is the cytoplasmic division
- Interphase = G1 (G0) + Sphase and then G2
    * This is essentially the period of growth and preparation for the M phase
    * Cells spend most of its time in interphase since it is where most cellular processes are carried out
    * G1 sub-stage
        - the first gap or stage of interphase
        - Period of growth and active synthesis of all groups of macromolecules
        - Growing of proteins, RNA, lipids etc
        - Organelles are replicated
        - Time of this stage depends on the physiology condition of the cell
    * Synthesis Stage
        - Second stage of interphase
        - Where the precise replication of DNA is made
        - DNA associated proteins like histones are also synthesized here
        - Microtubules are also synthesized here (ex: centrioles in animal cells)
        - At the end of this: there will be 2 chromatids joined by a protein complex called cohesins
        - The connection of chromatids are tighter in the centromere region
        - Duplicated chromosomes look narrower in the centromere region
    * G2 sub stage
        - Involves the protein synthesis and production of the structures needed for mitosis
        - Production and synthesis of spindle fibres

Mitosis

- This is a part of cell division that refers specifically to nuclear division
- Occurs primarily in somatic cells
- Occurs in both animals and plants but seen better in plants
- Plants have growth confined to certain areas and mitotic cells are most abundant there
    * Growth enters occur primarily in roots tips and stem tips (apical meristems)
- Simplest way to view chromosomes in root tips is by a squash rather than a section with a Feulgen Stain
- This is where the chromosomes are equally distributed between two daughter nuclei
- After mitosis and cytokinesis both daughter cells are identical to each other and parental cell
- After mitosis and cytokines three possible scenarios can occur
    1) Cells continually divide like cells in the gut epithelial or germinal layers

2) Cells that enter G0 and do not divide again
3) Cells that enter a resting state (G1, G0, G2) but can return to cell cycle
    * ex: partial removal of the liver and then stimulated by an antigen

- Mitosis is divided into 5 stages (but really its just one continuos stage)
    * Prophase
    * Premetaphase
    * Metaphase
    * Anaphase *cytokinesis starts here // cleave furrow (see below)
    * Telophase

- Then proceeds with the division of the cytoplasm; cytokinesis
    * begins in late anaphase and continues through telophase
    * you can notice cytokinesis when you see a cleave furrow
    * A cleave furrow forms in the middle of animal cells or cell plate and at the equator of plant cells

<u>Interphase</u>
- Cell is in-between mitotic division
- Consists of G1, G0, Synthesis phase, G2
- Longest stage of the cell cycle
- G1 = reproduces organelles and macromolecules
- G0 = where the cell goes into if it is not ready to move on to the next step
- S-Phase = synthesizing DNA and histones
- G2 = reproducing spindle fibres and other things for mitosis to occur

* In this phase you can see a clear cut nucleus with heterochromatin in the nucleus

<u>Prophase</u>
- The microtubules of the cytoskeleton disassemble into tubulin subunits that begin to reassemble forming mitotic spindles
- Nucleoli gradually disappears
- Chromosomes are thickened and consists of two chromatids attached by a centromere
- Chromosomes have the same information
- In animal cells, the two centrosomes separate and migrate towards opposite end of the poles of the cell
- Centrosomes are also the site of where microtubules of the mitotic spindles are produced

<u>Prometaphase</u>
- Marked by the breakdown of the nuclear membrane
- centrosomes found at opposite ends of the spindle poles
- A protein complex forms on the centromere of each chromatid called the kinetochore
- The kinetochore of one sister chromatid attaches to a polar microtubule from one pole

- The kinetochore of the other sister chromatid attaches to polar microtubule on the other end of the pole
- As chromosomes are being pulled towards opposite poles they migrate towards the metaphase equatorial plate
- The metaphase equatorial plate is the imaginary plane located midway between each pole of the cell

Metaphase
- Metaphase is the phase where spindle microtubules are formed between poles
- All centromeres are at the poles of the metaphase plate
- Seperase is the enzyme that separates the cohesin complexes separating the junctions between sister chromatids
- In metaphase the centromere separate

Anaphase
- In anaphase chromatids are now daughter chromosomes
- The daughter chromosomes move to the opposite side of the poles
- The daughter chromosomes are pulled to the opposite side of the poles by the shortening of the microtubules
- Shortening of microtubules occurs by the depolymerization at the kinetochores

Telophase
- Chromosomes are now at its proper poles and become longer and thicker
- The nuclear membrane starts to reappear
- The nucleolus reforms in telophase as well
- Spindle fibers dissapear in telophase
- In Animal cells, a cleave furrow pinches the two cells in two (cytokineses)

The Feulgen Stain
- The feulgen stain specifically colours DNA in magenta red
- “Schiff Base” reacts with aldehyde groups forming the coloured reaction
- DNA does contain deoxyribose sugar molecules that contain aldehyde groups to purine to pyrimidine bases so thats what will help react (but not freely)
- To make it freely react the DNA is hydrolyzed with 1N HCl, removing the purine base and frees the aldehyde group from the deoxyribose sugar creating **apurinic acid**
- The Apurinic acid left behind after removing the purine base from the DNA freeing the aldehyde group is what reacts specifically with the Feulgen stain
- This acid hydrolysis technique basically softens the tissue which is crucial to have to make a squish preparation
- The acid hydrolyisis to create apurinic acid must only last for 10 minutes because
    * not enough hydrolysis will not free the aldehyde groups
    * too much hydrolysis will destroy the apurinic acid
- Steps: Remove the fixation, wash the root with alcohol, use HCl to hydrolyze it to remove the purine base freeing the aldehyde group to create the apurinic acid to react with the Feulgen stain and then finally stain it ********* THIS IS THE OVERVIEW

How is Root Growth Accomplished? ANATOMY

- We know that many cells in the root tip are undergoing mitosis
- Root tips have a lot of squared cells (a lot are undergoing mitosis)
- At the end of the root tip is the **root cap**
    * Mass irregular dead cells (thicker)
    * protects the apical meristem of the root tip as it is pushed into soil
    * Root cap is site to detect gravity and controls direction of root growth
- After the root cap is the region of the **apical meristem**
    * Zone of cell division/ site of apical growth of root
- Base of Apical Meristem is **Quiescent centre**
    * inactive region of growth
    * where cells are arrested in G1 of interphase (almost like G0)
- Above the Apical Meristem is the **Region of Elongation**
    * This is where cells are basically more elongated and increases the lengths
- After Region of Elongation is the **Region of Maturation**
    * This is where most of the cells of primary tissue mature
    * Root hairs are produced in this region
- Vascular bundles = **Xylem Cells**
    * Near the centre of the root
    * Narrow thick cells into vascular bundles
    * Xylem cells transport water and salt from soil to the rest of plant
- **Phloem Cells**
    * Phloem cells transport carbohydrates from photosynthetic regions of the plant roots. NOTE: Roots do not have chloroplast and cannot synthesize its own food so it needs phloem cells to transports the nutrients

Animal Mitosis

- Aminal mitosis is essentially the same as plant mitosis except
    * There is not cell wall around the membrane
    * No cell plate is formed in telophase
- At the end of mitosis (nuclear division)
    * The cell pinches in the middle to divide the two new cells
- Animal cells have an **aster**
    * an aster is a semicircle of fibrils around each spindle finer
    * there are no asters in plant cells
- In animal cells
    * Nerves, muscles, RBC's do not divide
    * Embryo cells however of divide rapidly and can be seen in mitotic (ex: whitefish embryos 'blastula')

Lab #5 Meiosis

- Meiosis means to make smaller
- Occurs primarily in germ cells
- Meiosis is a nuclear deduction division
- Interphase : Duplicates the DNA
- Followed by 2 nuclear divisions

- The outcome of Meiosis is 4 daughter cells not identical to each other nor the mother cell; each cell has half the amount of chromosome than the mother cell (n chromosomes)
- Fertilization restores it back to 2n
- Meiosis ensures
    * Number of chromosomes will be stable from generation to generation
    * Each offspring will receive two new sets of genetic instructions
    * Genetic diversity will be promoted

Life Cycle of Plants/ Sporic Meiosis
- The life cycle of plants are characterized of alternating generations between haploid (n) and diploid
- Starts off with a **Sporophytes** diploid (2n) generation
- The Sporophyte undergoes meiosis and forms **haploids spores** (n)
- The Haploid spores then divide mitotically to **Gametophytes** (multicellular haploid individuals) which eventually turn into **gametes**
- The gametes than fuse with others to form diploid **zygotes**
- Zygotes will then divide mitotically to form a multicellular diploid organism

Life Cycle In Animals/ Gametic Meiosis
- In animals this process can occur but **ploidyy levels** occurs
- Ploidy levels is when the diploid multicellular organism can produce haploid gametes by meiosis (**gametogenesis)**
- After being able to do gametogenesis, gametes are divided into male and female and when they fuse to form a zygote they can undergo **gametic meiosis**

Stages of Meiosis I
- Premeiotic Interphase
    * Has the same sub-stages as mitosis interphase (G1, S, G2)
    * S phase however is 20x longer because it needs more DNA replication
    * Outcome of premeiotic interphase is 2 identical sister chromatids attached at the centre with a centromere
    * In animals, centrioles also replicate
- Prophase I
    * Prophase one; RNA and proteins are synthesized and can be represented in 5 sub stages; crossing over occurs in this stage
    * Chiasmata is the part of homologous chromosome that is visible after the crossing over
    * In prophase I the nucleoli disappears & RNA transcription stop
- Metaphase I
    * the nuclear membrane breaks down
    * paired homologues line up at the equatorial plate (metaphase plate)
    * The maternal and paternal ordering is very random = genetic diversity
    * Microtubules attach to the kinetochores of the centre of the sister chromatids to each pole
- Anaphase I

    * The complete homologue is pulled to each side of the poll
    * KEY DIFFERENCE: in mitosis, the centromere is split apart and the sister chromatid is pulled to each side of the pole, here you do not split it apart and this is the importance to keep genetic diversity
- Telophase I
    * Chromosome decondense, spindle fibers break down, nuclear membrane reforms
    * Cytokinesis occurs
    * RESULT: two daughter cells with half the amount of chromosomes but with both chromatids
- Interkinesis
    * Stage in-between meiosis I and II
    * Centrioles or asters divide if present
    * Centrioles do not duplicate
- Prophase II
    * nuclear envelop breaks down
    * Chromosomes condense
    * Spindle fibres attach to the kinetochores of the homologues
- Metaphase II
    * Homologues line up at the equatorial plate or metaphase plate
- Anaphase II
    * Sister chromatids split apart and each chromatids move to opposite side of the spindle poles
- Telophase II
    * Chromosome decondense/ Nuclear membrane reforms
    * Cytokinesis happens
    * END RESULT: There are 4 haploid cells that are completely different

<u>Meiosis in Plants</u>
- Angiosperms are watering plants
- Angiosperms are involved in the formation of both male and female spores
- Female spores = megaspores
- Male spores = microspores
- Male gametophytes are produced in the anthers in the **microsporangia or pollen sacs**
- In the microsporangia or pollen sac
    * there are 4 fertile group of cells (sporogenous cells)
    * The innermost: tapetum which provides nutrients to the microspores
    * outermost form the walls of the microsporangium
    * the sporogenous cells produce microsporocytes
    * Microsporocytes (2n) divide by meiosis producing microspores (n, single cell)
    * After meiosis the microspore reproduce further by mitosis and form a tube cell and a generative cell
    * The two tube cell and generative cell make up a pollen grain

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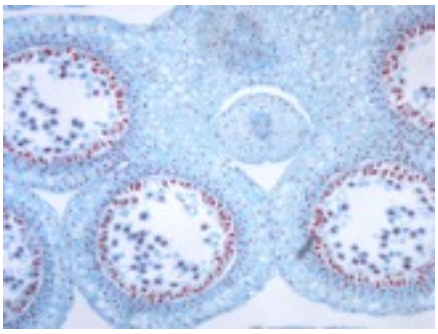
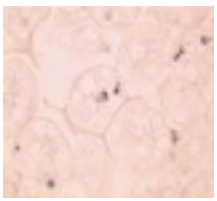


LABEL
* Epidermis
* Filament
* Parenchyme
* Pollen Cell precursor
* Pollen sacs (microsporangia)
* Anther
* Tapetum

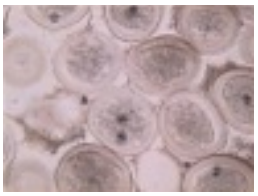
Meiosis in Animals
- Males gametes are called spermatogenesis
  * Where in meiosis 4 viable sperm is created
- Female gametes are called oogenesis
  * Where cytoplasm and food is stored for the developing embryo
  * First division of meiosis : a nucleus without its cytoplasm
  * Second divison of meiosis : same thing, but theres one large egg and two small polar bodies and those ones do not survive, just the one with the egg and the polar body

Observation of Meiosis in *Ascaris // Fertilization*
- Van Beneden made the earliest study on egg formation in round worms
- In worms there are only 4 diploid chromosomes so it was easy to follow
- In prophase I in Ascaris, eggs are shedded from the ovary and travel down the oviduct
- Once the sperm enters into the egg, the sperm loses its membrane leaving dark masses of chromatin within the egg
- The sperm stimulates the egg to resume meiosis and then it enters metaphase I
- In metaphase I egg nuclear membrane breaks down, spindle fibres form at the periphery of the egg, homologous chromosomes are paired as tetrad and align at the metaphase phase
- Anaphase I: the homologous pairs are separated and pulled away where one migrates towards the periphery of the egg and expelled as the first polar body
- Second meiotic division preparations is to form more spindles
- In Anaphase II the sister chromatids are separated where one set is expelled is a second polar body, where the other half remains an egg & some times the first polar body divides again to form a total of 3 polar bodies

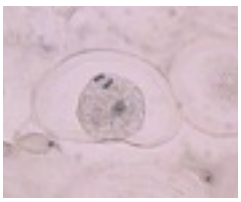
The haploid egg and sperm (both male and female) are called pronuclei and remains in interphase



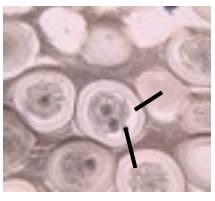
Sperm Entrance



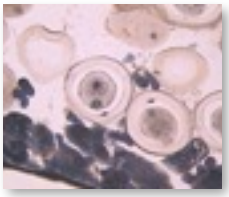
Metaphase I



Anaphase I



Metaphase II



Anaphase2

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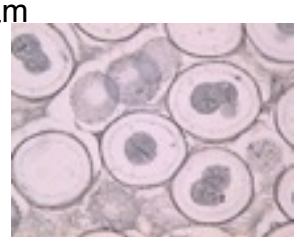
Interphase/ fusion



Mitotic Cleavage of the embryo

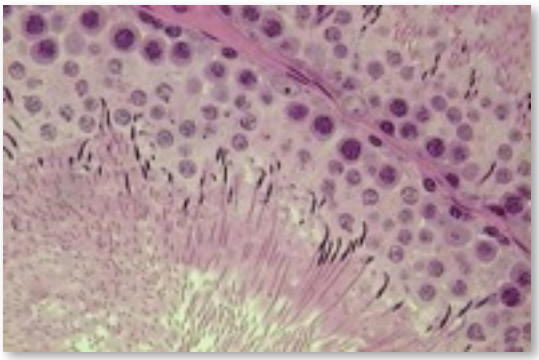
LABEL: polar body,perivitelline space, pronucleus, spermatozoid

Spermatogenesis // Rat

- Look back at the given diagram
- Everything and all steps occur in an orderly fashion
- Spermatogonia
    * This is the first diploid cell that has a well defined nuclei
    * Divides by mitosis
    * Half spermatogonia undergo meiosis to create sperm cells and the other half continue to undergo mitosis to keep the spermatogonia population
- Primary spermatocytes
    * Still diploid cells undergoing the first meiotic division
- Secondary spermatocytes
    * Now these spermatocytes are haploid after the first meiotic division \
    * Secondary spermatocytes are hard to see because they are rapidly going through meiosis II
- Spermatids
    * These are also haploid and are small circular cells that are differentiating into functional spermatozoa
- Spermatozoa
    * Haploid cells that upon maturity have gained their flagella
- Nurse Cells
    * Also called sertoli cells
    * Found in the walls of the seminiferous tubules to help the spermatids mature into the spermatozoa cells

LABEL

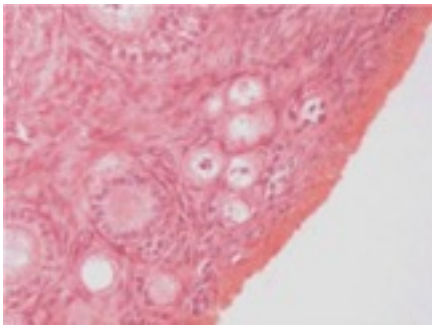
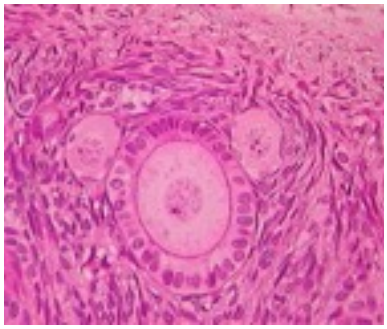
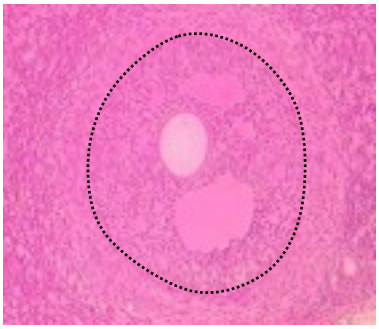
* Basal lamina
* Lumen of the tubule
* Sertoli cell nucleus
* Spermatogonia
* Primary Spermatocyte
* Secondary Spermatocyte
* Spermatids
* Sperm Cells



Oogenesis // Rabbit

- Mammalian ovaries are solid in structure
- Egg forming cells grow into small cell lined cavities called follicles
- Newborn mammalians have ovaries with all the **ovocytes** they will ever need to reproduce

- Each oovocyte is surrounded by a **follicular cell**
- An oovocyte and follicular cell around it forms a **primary follicle**
- The oovocytee will then enlarge to form a primary oocyte
- A growing follicle will produce
- At the end of cytokinesis, the primary oocyte releases a polar body
- The growing follicle will stop producing and will initiate growth when a female hormone initiates it to enlarge and form into a **mature follicle**
- **After the** mature follicle is produced, it will stop in metaphase II and will rupture at times (ovulation) and will only continue and finish metaphase II if it is penetrated by a spermatozoa

LABEL: Which ones is Graafian follicle (last one), Primary Unilaminar Follicle (middle) & Primordial Follicle (first).

* Follicular cells
* Primary Oocyte
* Secondary Oocyte (only in Graafian follicle)
* Oocyte pronucleus
* Fluid filled cavity
* Interstitial cells (in first picture only)
* Primordial follicles (near the epithelial; first picture only)

Labelling

<u>Amoeba proteus</u>

- Pseudopodia
- Granular endoplasm
- Ectoplasm
- Trichet Crystals
- Contractile Vacuole
- Food Vacuole
- Uroid
- Hyaline Cap
- Endocytic Canals
- Plasmalemma

Meiosis in Plants (Microsporogenesis: formation of male gamates)
- Tapetum
- Pollen Cell Precursor
- Filament
- Anther
- Parenchyme

Meiosis in Animals
- Spermatozoid
- Nucleus
- Pronucleus (in metaphase I)
- Shell (in metaphase I)
- Equator (in metaphase I)
- Polar Body (Metaphase II)
- Perivitelline Space (Metaphase II)
- Anaphase II (centromeres split, and chromatids are at different ends)
- Interphase (both pronuclei are in the cell prior to fusion)
- Mitotic clevage of the embryo

Rat testes Spermatogenesis
- Occurs in the seminiferous tubules
- Basal Lamina
- Lumen of tubule
- Sertoli Cell Nucleus
- Spermatogonia (smaller and clear nucleus)
- Primary Spermatocyte (darker, further out)
- Secondary Spermatocyte (ligher, further in)
- Spermatids
- Sperm Cells

Rabbit Oogenesis
- Ovary Epithelial
- Primordial follicle
    * located underneath ovary epithelial
    * surrounded by follicular cells and interstitial cells
- Primary Unilaminar Follicle
    * Primary Oocyte
    * Follicular cells
    * Oocyte pronucleus
- Growing Follicle
    * More Follicular cells
    * Oocyte pronucleus
    * Primary Oocyte
- Graafian Follicle
    * A lot more follicular cells
    * Presence of a Fuild filled cavity

* Secondary Oocyte
* Stops at Metaphase II until penetration of spermatozoid
* Graafian follicles comes near epithelial prior to ovulation

Run Down Of Each Lab & Purpose To Organize Thoughts During Exam

- Lab 1
  * Microscopes
  * Eukaryotic (Elodea Leaf cells)
  * Prokaryotic (Oscillatoria)
- Lab 2
  * Red Blood Cells
  * Hemolysis
  * Osmosis, Tonicity, Diffusion,
  * During hemolysis, RBC's go transparent
- Lab 3
  * Amoeba proteus
  * Anatomy of the Amoeba
  * Movement of the Amoeba proteus, (actin, G-actin to F-actin)
  * Contractile Vacuole cycle time relates to its ability to stay in excess water
  * Endocytosis & Phagocytosis
- Lab 4
  * Mitosis to visualize DNA staining
  * Cell Cycle
    - M phase & Interphase
  * Feulgen stain
  * Root Tip Squash of a Broad Bean Root tip (plant)
  * Root Tip of Onion Root (plant)
  * Whitefish Blastula (animal)
  * Anatomy of the Root tip
  * We looked at this because mitosis occurs rapidly in the apical meristem of the root tips and in embryos of animal cells
- Lab 5
  * Meiosis
  * Stages Meiosis in both cellular divisions
  * Meiosis in plants looking at a Lilium plant (angiosperm)
    - sporogenesis
  * Meiosis in Ascaris (animal) Fertilization
    - Round worm fertilization
    - Harder to notice diagram (with two circular rings, look at the one nucleus which is the egg and then the other is just the spermatozoid
  * Spermatogenesis in Rats
    - Know the different sperm cells in its process of becoming sperm cells
    - Basal lamina, spermatogonium, primary spermatocyte, secondary spermatocyte, spermatid, sperm cell, Sertoli cell nucleus
    - The rat testes

* Oogenesis
    - The Rabbit Ovary Diagram
    - The primordial follicle, primary follicle, secondary follicle, Graafian follicle

GOODLUCK!!!