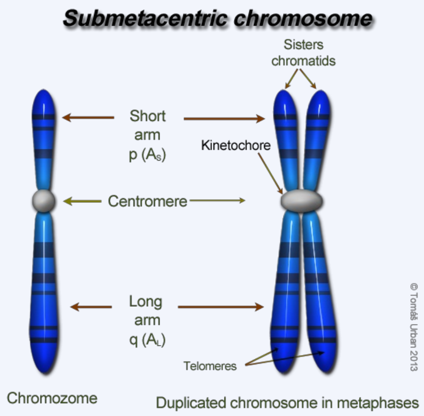
AP Biology Unit 4 - Mitosis & Meiosis Cheat Sheet

by njags21 via cheatography.com/122373/cs/22778/

why do cells divide

growth, repair, reproduction	
mitosis	produces 2 genetically identical daughter cells (called clones)
preserves diploid (2n) chromosome number	
passes a complete genome from parent to child	
genome	whole of its hereditary information encoded in its DNA, includes both the genes and the non-coding sequences of the DNA
meiosis	in sexually reproducing organisms, results in haploid cells (have half the chromosome # of the parent)(n)

structure of a replicated chromosome



replicated chromosome consists of two sister chromatis where one is an exact copy of the other.

centromere is a specialized region that holds the two chromatids together

kinetochore is a disc-shaped protein on the centromere that attaches the chromatid to the mitotic spindle during cell division

cell cycle basics

bone marrow cells	always dividing to produce constant supply of red and white blood cells
liver cells	arrested in G0 (have stopped dividing) can be induced to divide about/regenerate when liver tissue is damaged
human intestine cells	divide ab twice a day to renew tissue destroyed during digestion
specialized cell ex (nerve cells)	do not divide at all
process is regulated in any case by a complex mechanism involving kinases and allosteric interactions	
ratio of volume of cell to SA and capacity of nucleus to control the entire cell	limit cell size and promote cell division

ratio of cell volume to sa

as cell grows, sa increases as the square of the radius and volume increases as the cube of the radius

volume inside cell grows at faster rate than cell membrane

determines when cell divides

capacity of nucleus

nucleus must be able to provide enough info to produce adequate quantities of all substances to meet the cells needs	
bc of this metabolically active cells are usually small	
can be large active cells like paramecium	
-has two nuclei that each control diff cell functions	
human skeletal muscle cells	giant multinucleate cells
fungus slime molds	consist of one giant cell that has thousands of nuclei

cell division and cancerous cells

contact inhibition//density dependent inhibition	normal cells grow and divide until they become too crusaded then they stop and enter G0
anchorage dependence (ANIMALS)	to divide, cell must be attached or anchored to some surface
can be Petri dish (in vitro) or extracellular membrane (in vivo)	
cancer cells show none of these two things	
divide uncontrollably, and do not have to be anchored to any membrane	
^is why cancer cells can migrate or metastasize to other regions of body	

regulation and timing of the cell cycle

cell cycle control system	regulates the rate at which cells divide

check points act as stop signals that halt cell unless overridden by go signals

checkpoints in G1, G2, and M

G1 is most important, if receive go ahead, cell will most likely complete cycle

if it doesn't, it will go to G0 and become a non dividing cell

timing of cell cycle is initiated by growth factors and controlled by 2 molecules

cyclins and protein kinases

cyclins get name bc levels cyclicly rise and fall in dividing cells

synthesized during every S and G2 phase

broken down after M phase

kinases are and ubiquitous class of proteins that activate other proteins by phosphorylating them

only activated when bound to a cyclin

named cyclin dependent kinases (cdk)

when cdk binds to a cyclin, cyclin cdk compels is formed

ex of this is mpf which triggers cells passage from G2 to mitosis

maturation (mitosis) promoting factor

contributes to molecular events required fro chromosome condensation and spindle formation during prophases

after M phase, during anaphase, mpf switches off by initiating process that leads to the breakdown of cyclin

regulation and timing of the cell cycle (cont)

cdk persists in cell in inactive form until becomes part of mpf again

interphase

G1	intense **growth** and **biochemical activity**
s	synthesis/**replication of DNA**
G2	cell continues to **grow** and complete preparations for cell division

more than **90%** of cells life is in interphase

in interphase, **chromatin** is threadlike, not condensed

centrosome consisting of two centrioles may be seen in the cytoplasm of ANIMAL cell

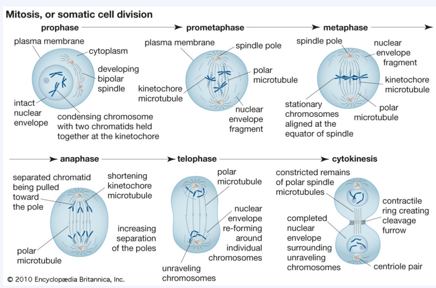
centrosome is **duplicated** during s phase

G2 - M transition	two centrosomes separate from one another and move to opposite poles

plant cells **lack** centrosomes but have microtubule organizing centers (MTOCs)

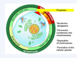
these have the same function

mitosis

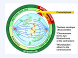


consists of the actual dividing of the nucleus

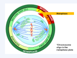
prophase



prometaphase



metaphase

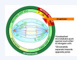


equatorial plate=metaphase plate

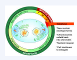
centrosomes at opp poles of cell

spindle fibers run from centrosome to kinetochores in the centromeres

anaphase

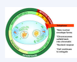


telophase



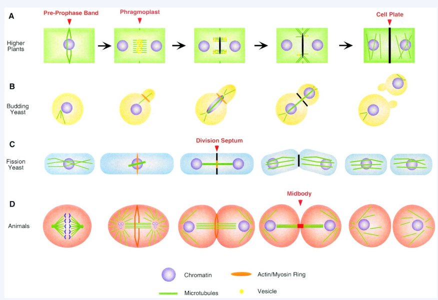
supercoiled chromosomes uncoil back to chromatin

telophase



supercoiled chromosomes uncoil back to chromatin

cytokinesis



dividing of the cytoplasm

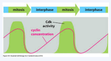
begins during anaphase

animal cells: cleavage furrow froms down middle of cell as actin and myosin microfilaments pinch in the cytoplasm

plant cells: cell plate forms during telophase as vesicles from golgi coalesce down middle of cell, daughter plant cell DO NOT separate

new cell wall forms and sticky middle lamella cements adjacent cells together

cyclin vs cdk



activity of cdk rises and falls depedning on changes in concen of cyclin

peaks of mpf activity correspond to rise in cyclin concentration

cyclin leves rise during S and G2 phases and then fall abrubtly during the M phase

meiosis

generates genetic diversity that is the raw material for natural selection and evolution

produces gametes (ova and sperm)

have haploid or monoploid chromosomes (n)

half genetic material of parent cell

nucleus divides twice

each gamete differs genetically from every other gamete

sexual reproduction involves fusion of two haploid gametes and restores diploid chromosome # to offspring

meiosis I reduction division	homologous chromosomes separate

each chromosome pairs up w homologue in synaptonemal complex by process called synapsis

forms structure called tetrad (set of 4) or bivalent (in pairs)

by aligning/binding crossing over is likely

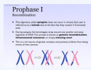
^process by which non sister chromatids exchange genetic material

results in recombination of genetic material

ensures greater variation among gametes

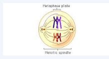
meiosis II like mitosis	sister chromatids separate into diff cells

prophase I



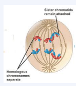
-synapsis, pairing of homologues occurs
crossing over, exchange of homologous bits of chromosomes
-chiasmata, visible manifestations of the crossover events are visible
-sets stage for separation (segregation of DNA)

metaphase 1

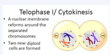


spindle fibers from poles of the cell are attached to the centromeres of each pair of homologues

anaphase 1



telophase 1 / cytokinesis 1



in telophase: each pole has haploid # of chromosomes

cytokinesis occurs simultaneously w telophase 1

in some species interphase occurs bet meiosis 1 and 2, in other none

NO chromosome replication in bet meiosis 1 and 2

meiosis 2

meiosis and genetic variation

3 types of genetic variation occur from meiosis and fertilization

independent assortment of chromosomes, crossing over, random fertilization of an ovum by a sperm

independent assortment of chromosomes

homologous pairs separate depending on the random way they line up on the metaphase plate during metaphase 1

each pair of chromosomes can line up in two possible orientations

50% chance receive maternal chrom	50% chance receive paternal chrom
possible # of combinations of chromosomes is 2^23	bc 23 pairs of chromosomes in humans

crossover

produces recombinant chromosomes that combine genes inherited from both parents

may be 2 to 3 crossover events in humans

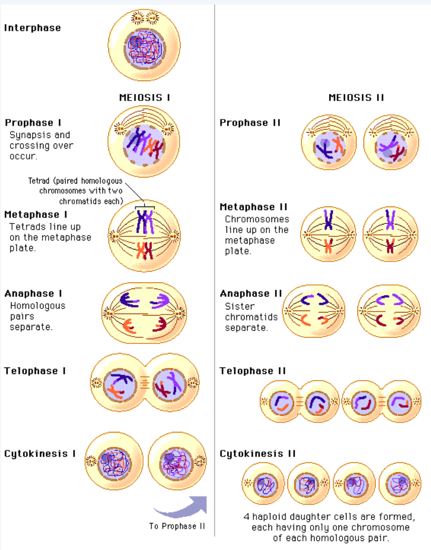
metaphase 2 recombinant chromosomes line up on metaphase plate in random fashion

^increases possible types of gametes even more

random fertilization

human ovum and sperm represent 8 million possible chromosome combinations **respectively**

when one sperm fertilizes one ovum	8 million x 8 million recombinations can occur



same as mitosis

chromosome # remains haploid

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By **njags21**
cheatography.com/njags21/