Biology Test #2

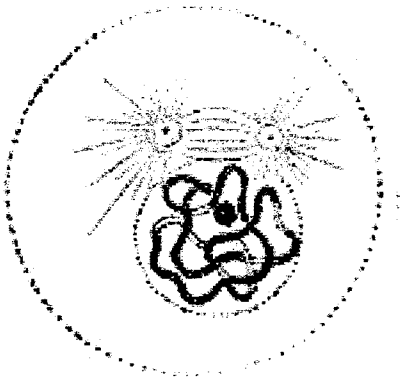
Cell Energy

- ATP's produced after respiration – a net energy production is 36 ATP
  - Adenosine triphosphate, sugar and a phosphate and a base
- Chloroplasts – contain chlorophyll, each "column" is called a grana and each layer of the grana is called a thylakoid.
- Fermentation (alcoholic) – glucose can be converted to ethyl alcohol + 2 ATP
- Fermentation (lactic acid) – glucose can be converted to lactic acid + 2 ATP
- Light reaction (light dependent reactions) – sunlight and chlorophyll react to form energized chlorophyll. Energized chlorophyll splits water into 2H and 1O, and adds a phosphate to ADP forming ATP, which is then used in the dark reactions. Oxygen is made and released during the light reaction. NADPH and ATP are made in the light and sent to the dark
- Mitochondria – power house of the cell
- Photosynthesis – start with sunlight, CO_2, H_2O and chlorophyll…end with glucose and oxygen
- Pigments/colors – objects appear green because they reflect green light and absorb all other colors. Black = absorbs all light. White = reflects all light.

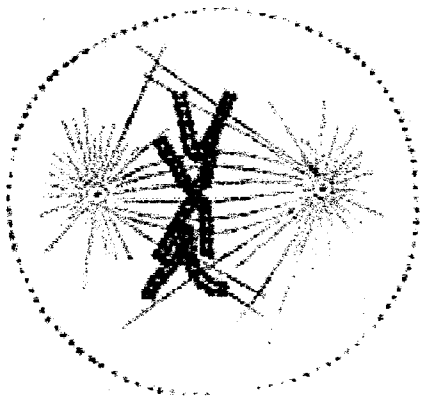
Cell Cycle

- Asexual reproduction – gives less diversity
- Cells divide to replace dead, damaged or worn out preexisting cells or to allow for the growth of an organism
- Cell cycle –
  - G_1 phase – initial growth phase, longest phase.
  - S phase – chromosome replication phase (synthesis phase) [copying]
  - G_2 phase – growth phase and preparation for division (makes proteins to help divide)
  - M phase – mitotic phase, includes prophase, metaphase, anaphase, telophase
  - Cytokinesis – the division of the cytoplasm
- Centromere – attaches the chromosomes
- Gamete (sex cells) – egg: female gamete, sperm: male gamete. Gametes have half of the chromosomes present in normal somatic (body) cells
  - Diploid – 100% (# in somatic cells) 46 chromosomes
  - Haploid – 50 % (# in sex cells) 23 chromosomes
- Cell phases of division
  - Interphase (G_1, S, G_2)– nuclear membrane present, (round) [nucleus evenly displaced], protein synthesized, chromatin evenly dispersed, centrioles present
    - Daughter cell interphase – cells are smaller than the other cells (1/2 the size)

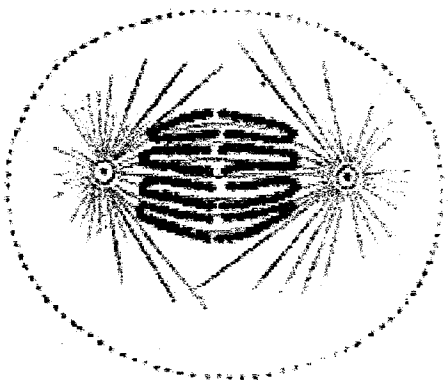
- Prophase (beginning to divide) – chromatin aggregate (clumps), nuclear membrane dissolves (not round), centrioles move toward the poles, spindle apparatus begins to form



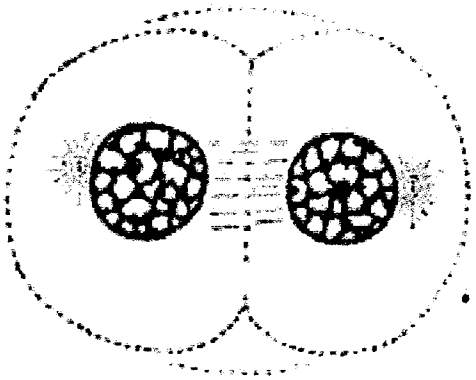
- Metaphase – centrioles reach poles, chromatids line up on the equatorial plate (2 chromosomes attached to a centromere), spindle apparatus is complete



- Anaphase – chromatids are pulled toward the poles by the spindle apparatus, centromeres break (small gap)

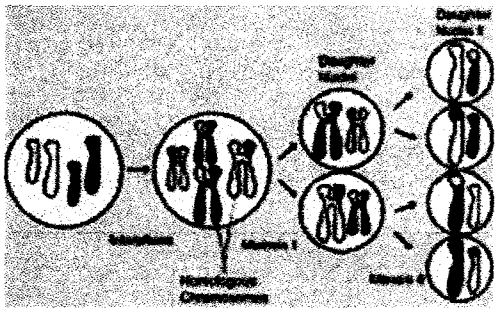


- Telophase – chromosomes reach poles (large gap), cell membrane beings to constrict in the center (a cleavage furrow develops)

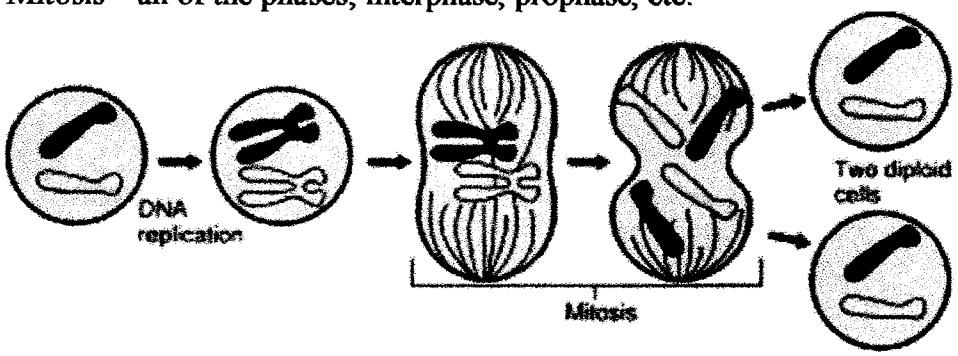


- Cytokinesis – cytoplasm is divided

- Meiosis – double mitosis that results in haploid cells, only gametes undergo meiosis



- Mitosis – all of the phases; interphase, prophase, etc.



- Respiration - all of the chemical processes in which energy is released
  - Anaerobic – without oxygen
  - Aerobic – with oxygen (in mitochondria)
- Zygote – union of a sperm and an egg

<u>Genetics</u>

- Allele – different forms of the genes that have contrasting traits, such at T for tall and t for short…or R for red and r for white
- Blood types and genetics
  - Karl Landsteiner developed the ABO blood typing system

    - Blood cells can have an antigen on the surface
    - Codominance – more than one gene is expressed (AB blood)
- Chromosome map – where genes are located on the chromosome
- Crossing over – when a piece of DNA on one chromosome exchanges with a piece of DNA on another chromosome
-
- Dominant/recessive – one gene may be stronger than another and mask the weaker one
- Down syndrome – trisomy 21, one extra chromosome on #21, rate increases for very young/old mothers
- Heredity – the genetic material inherited form parents
- Heterozygous –when a pair of genes is different (Tt or Yy)
- Homozygous – when both of a pair of genes are the same (TT or tt)
- Incomplete dominance – both alleles have an effect on the offspring, there is a blending of traits…you will see all lower case letters and different letters
- Mendel – father of genetics (classical genetics)
    - Concept of Unit Characters – inherited traits are controlled by genes which occur in pairs
    - Principle of dominance and recessiveness – one gene can be stronger than another and mask the weaker one
    - Law of Segregation – the pair of genes is segregated or divided in forming gametes
    - Law of Independent Assortment – the chance of receiving one gene is not affected by receiving another gene
- Non-disjunction – the failure of a pair (homologous) chromosomes to segregate during mitosis (resulting in one too many or one less chromosome
- P_1 – parent plants
- F_1 – kids of P_1
- F_2 – grandkids of P_1
- Phenotype – the visual effect of the genes (what you see)
- Genotype – genes present in the organism (letters)
- Punnet squares – able to predict the offspring in mating
- Roan cows – a reddish brown cow (rw), incomplete dominance
- Sex-linked traits – traits that are carried on the sex chromosome, especially the X chromosome
- Test Cross – mating an unknown organism with a homozygous recessive
    - If unknown is homozygous dominant then all offspring will have a dominant phenotype
    - If unknown is heterozygous then half of offspring will have dominant phenotype and half will have a recessive phenotype
- Drosophila melanogaster - famous fruit fly experimented on

Central Dogma of Molecular Biology

- 3' to 5' vs. 5' to 3' – two strands of DNA are said to be antiparallel, with one strand oriented in the 3' to 5' direction and the other in the opposite direction of 5' to 3' direction
- Amino Acids – about 20 different amino acids
- Andicodon – "mates" codon on the mRNA molecule
- Base pairing – adenine with thymine and guanine with cytosine
- Codon – base triplets in mRNA read by the ribosome and code for specific amino acids
- DNA – deoxyribonucleic acid, a double helix, found only in the nucleus, bases are ATGC, sugar is a deoxyribose
- DNA ladder components – DNA consists of a sugar (deoxyribose) and a phosphate which are called the rails and one of 4 bases: adenine, thymine, guanine, cytosine which are called rungs. The bases are held together by hydrogen bonding.
- Gene – unit of heritable information in DNA, transmissible from parents to offspring
    - A series of bases on the DNA molecule that codes for a particular polypeptide
    - 1 gene = 1 polypeptide = 1 protein
    - every cell except RBC's have 100% of our bodies genes
- Hershey/Chase – used virus' for experiments,
- Intron – sequences in the DNA that are not used to make mRNA or to make a protein
- Exon – sequences in the DNA that are expressed or used to make mRNA and ultimately are used to make a protein
- Karyotype – complete set of all chromosomes of a cell of any living organism
- Lagging strand – copies slow (has sectioned strand)
- Leading strand – copies fast (has a solid strand)
- Mutation – sudden change in a genetic trait
    - Somatic mutation – mutation in a non-sex cell
    - Germ mutation – mutation in the sex-cells
    - Mutagens – agents that cause mutations
- Nucleotides – composed of a base, phosphate, and a sugar
- Okizaki fragments – a relatively short fragment of DNA created on the lagging strand during DNA replication (discontinuous DNA replication)
- Polysomes – a series of ribosomes that are all translating the same mRNA molecule at the same time.
- Protein – organic compound consisting of one or more polypeptide chains
    - Structural – make up most body parts
    - Hormone – chemical that controls the body
    - Enzyme – catalyst, speeds up chemical reactions
- Radioactive elements used in DNA research such as N^{15} and S^{35} –
    - S^{35} – protein; P^{32} – DNA; N^{15} – "heavy" N^{14} – "light"
- Replication – the making of an exact copy of the DNA molecule

DNA replication – semi-conservative

semi-conservative

    - Result is 2 double strands of DNA
    - Each strand is 50% new and 50% old DNA
- Restriction endonucleases – recognizes specific DNA sequences and cut the DNA into pieces, also known as restriction enzymes
- Sense strand - the plan to make a protein, used to identify amino acids
- Antisense strand – only used for protection, never used for identifying amino acid
- Signal sequence – on the very beginning of the protein and tells it where to go.
- Stop codon – during termination, the last stage of translation, the mRNA's stop codon enters the ribosome, detaches the mRNA and the polypeptide chain from the ribosome.
- Transcription – the special copying of one side of the DNA molecule that results in a single strand of RNA
    - Original DNA is not altered
    - 1) Unzip DNA
    - 2) Copy DNA into RNA
    - 3) Replace U with T
    - 4) RNA detaches and DNA re-zips
- Translation – the reading of the RNA code to make proteins or polypeptides, often called protein systhesis
- RNA – ribonucleic acid, a copy of one single strand of DNA, found in ribosomes and nucleolus, single helix, bases are AUGC, sugar is a ribose
    - mRNA – messenger RNA, the message from the DNA for the construction of the new protein molecule
    - tRNA – transfer RNA, carries amino acids to ribosomes, contains an anticodon (3 bases), anticodon "mates" with codon on the mRNA molecule
    - rRNA – ribosomal RNA, reads the mRNA plan for the new protein

How Solve a Monohybrid Punnett Square Problem

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Updated: 9/13/11

Read the problem carefully!

Problem
Cross a pure black guinea pig with a white guinea pig, show all results clearly

- The problem tells you that only one trait is involved and it is black and white
- The letter for black is B (you need to know this)
- Black guinea pigs can be either:
  - BB (homozygous dominant – also known as PURE or
  - Bb (heterozygous also known as hybrid)
- White guinea pigs are always bb (homozygous recessive)

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There are six steps to almost all Dominant/Recessive Punnett Squares

1. Write the cross (shows genotypes of parents)
2. Make the Punnett square
3. List the phenotypes
4. Give phenotypic ratio (must equal 4)
5. List genotypes
6. Give genotypic ratio (must equal 4)

3

Step 1 - Write the cross

Problem
Cross a pure black guinea pig with a white guinea pig, show all results clearly

pure black = homozygous dominant = BB
white = homozygous recessive = bb

- cross = BB x bb

4

Step 2 – Make Punnett Square

- BB x bb

	b	b
B	Bb	Bb
B	Bb	Bb

5

Step 3 – List phenotypes

- There can be only two phenotypes in a black white guinea pig cross: black and/or white
- In the Punnett square to the right there are 4 black guinea pigs (Bb) so for phenotypes you would write:

	b	b
B	Bb	Bb
B	Bb	Bb

Phenotypes - black

do not write white because none of the offspring have bb which would make them white

6

Step 4 – Give Phenotypic ratio

- For phenotypes you should remember that you correctly wrote black in step 4
- To give the phenotypic ratio you need to ask "How many have the dominant phenotype (black) and how many have the recessive trait (white)?

dominant = 4 recessive = 0

	b	b
B	Bb	Bb
B	Bb	Bb

Phenotypic ratio is 4:0 Your answer should total 4

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Step 5 – List Genotypes

- The possible genotypes are:
  homozygous dominant (BB)
  heterozygous (Bb)
  homozygous recessive (bb)
- You have only heterozygous offspring in the Punnett square so:

  Genotypes – heterozygous
- You cannot list genotypes that are not found in the Punnett square!

	b	b
B	Bb	Bb
B	Bb	Bb

Hint: always list them in the order
1st homozygous dominant (BB)
2nd heterozygous (Bb)
3rd homozygous recessive (bb)

8

Step 6 – Give genotypic ratios

- To determine genotypic ratios answer these 3 questions:
  - How many homozygous dominant (BB)?
  - How many heterozygous (Bb)?
  - How many homozygous recessive (bb)?
- Genotypic ratio – 0:4:0 Your answer should total 4

	b	b
B	Bb	Bb
B	Bb	Bb

9

Solving ABO Blood Type Punnett Squares

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Updated: 8/1/11

Blood Type Genotypes

There are 4 blood types:

	possible genotypes		
Type A	$I^a I^a$	or	$I^a i$
Type B	$I^b I^b$	or	$I^b i$
Type AB	$I^a I^b$		
Type O	ii		

2

Read the problem carefully!

Problem – A child has a blood type of O and her mother has type B blood. The man claiming to be the child's father has type A blood. Could this child possibly be his?

Assume for this problem that dad is $I^a i$ and mom is $I^b i$

3

Make a Punnett square

- Each parent has two genes to possibly give to the child
- Place dad's genes on the outside on the left of the Punnett square
- Place mom's genes along the top
- Fill out the Punnett square

	I^b	i
I^a	$I^a I^b$	$I^a i$
i	$I^b i$	ii

- Always put the dominant gene 1st
- Always put the genes in alphabetical order

4

Evaluate the ABO blood phenotypes

- Type AB
- Type A
- Type B
- Type O

	I^b	i
I^a	$I^a I^b$	$I^a i$
i	$I^b i$	ii

5

Answer the original question

Problem – A child has a blood type of O and her mother has type B blood. The man claiming to be the child's father has type A blood. Could this child possibly be his?

- Since these parents could make children with type A, type B, type AB and type O blood types, **the father COULD have produced the child**

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You try one

- Mother has type O blood and father has type AB blood. Their newborn baby has type O blood. Is it possible that the hospital has made a mistake?
- Do the Punnett square and answer the questions before viewing the next slide

7

Answer

- The Punnett square shows two type A (I^ai) and two type B (I^bi)
- There are no type O offspring predicted
- The hospital probably made a mistake and THIS CHILD CANNOT BE THEIRS

	I^a	I^b
i	I^ai	I^bi
i	I^ai	I^bi

8