Genetics

Primary TEKS Supported

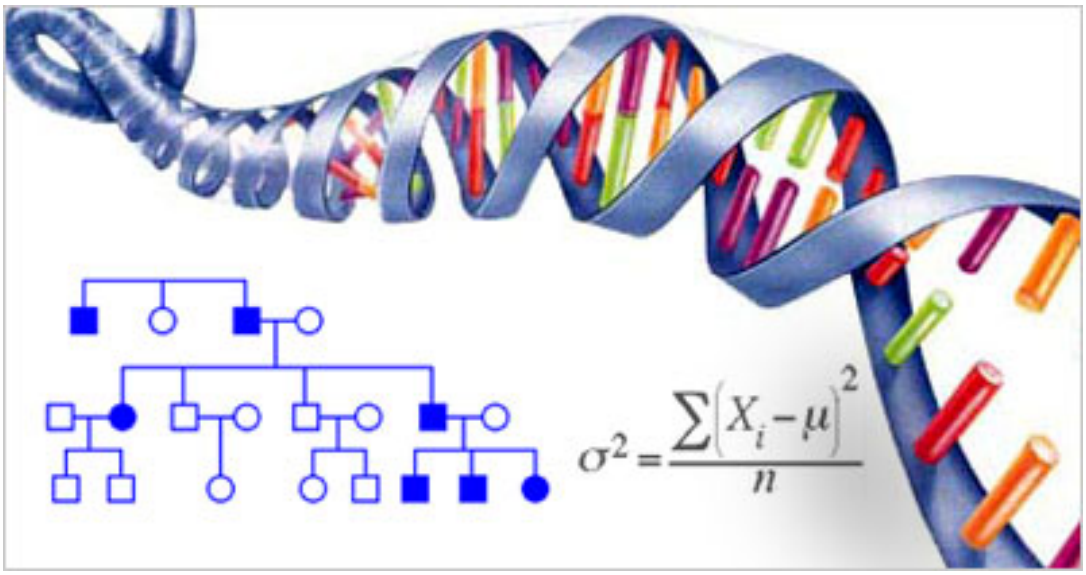
6E – [Reporting Category 2] – identify and illustrate changes in DNA and evaluate the significance of these changes [nondisjunction]

6F – [Reporting Category 2] – predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses and non-Mendelian inheritance

6G – [Reporting Category 2] – recognize the significance of meiosis to sexual reproduction

6H – [Reporting Category 2] – describe how techniques such as DNA fingerprinting, genetic modifications, and chromosomal analysis are used to study the genomes of organisms

Contents of This Packet

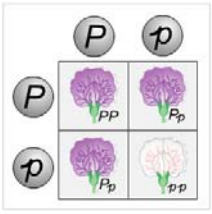


Genetics- Punnett Squares: predicting the probability of a trait

Each organism gets its traits from mom (1/2) and dad (1/2). You can predict the probability of an organism receiving a trait by using punnett squares.

1. Phenotype: Physical traits (what you can see)
2. Genotype: Genes or alleles
    a. Homozygous: Purebred; same alleles
        i. Example: EE, ee, AA, aa, HH, hh
    b. Heterzygous: Hybrid; different alleles
        i. Example: Ee, Aa, Hh

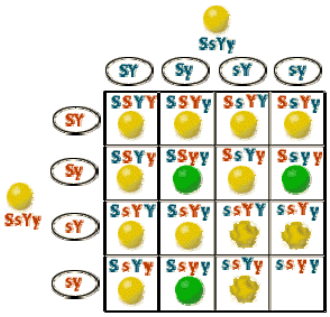
3. Mendelian Traits (discovered by Mendel and his pea plants)
    a. Simple Dominance and Recessive Traits: One trait is more dominant and masks than the other.
        i. Example: P = Purple; p = white



PP = Purple → 1 of 4 = 25%
Pp = Purple → 2 of 4 = 50%
pp = white → 1 of 4 = 25%

Purple = 3 of 4 = 75% White = 1 of 4 = 25%

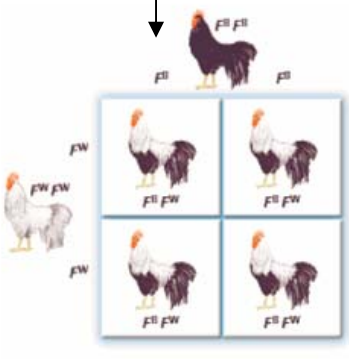
    b. Dihybrid: Looking at the probability of two traits; You must FOIL the parent genotypes before using a punnett square
        i. Example: S = Smooth, s = wrinkled; Y = yellow, y = green



SSYY = Smooth Yellow → 1 of 16
SSYy = Smooth Yellow → 1 of 16
SSyy = Smooth Green → 2 of 16
SsYY = Smooth Yellow → 2 of 16
SsYy = Smooth Yellow → 4 of 16
Ssyy = Smooth Green → 2 of 16
ssYY = Wrinkled Yellow → 1 of 16
ssYy = Wrinkled Yellow → 2 of 16
ssyy = Wrinkled Green → 1 of 16

Smooth Yellow = 9 of 16
Smooth Green = 3 of 16
Wrinkled Yellow = 3 of 16
Wrinkled Green = 1 of 16

4. Non-Mendelian Traits
    a. Co-dominance: Both traits are dominant and you will see both traits appear
        i. Example: A Blood + B Blood = AB Blood
        ii. Example: Black + White Cow = Spotted Black and White Cow

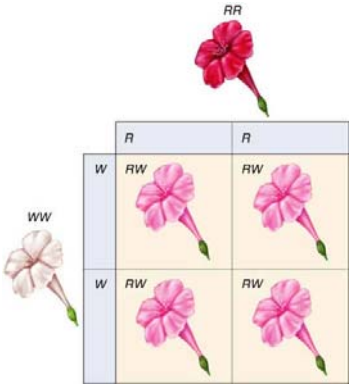


Co-dominance

BB = Black

WW= White

BW= Black and White



Incomplete Dominance

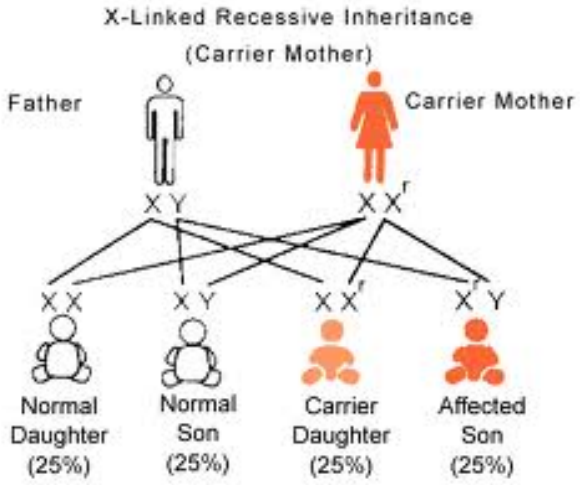
RR = Red

WW = White

RW = Pink

    b. Incomplete Dominance: One trait is not more dominant than the other- they blend to form a new trait.
        i. Example: Red + White Flower = Pink Flowers
        ii. Example: Black + White cats = Gray Cats
        iii. Example: Tall + Short = Medium

5. Sex-Linked Traits
    a. In this case, an inheritable trait is carried on one of the sex chromosomes (the X chromosome or the Y chromosome).
    b. Y-linked traits only show up in male offspring (because females don't have Y chromosomes).
    c. X-linked traits are twice as likely to show up in male offspring as in female offspring. This is because females have two X chromosomes, and X-linked recessive traits would be masked by the other dominant X chromosome. Look at the following hemophilia example.

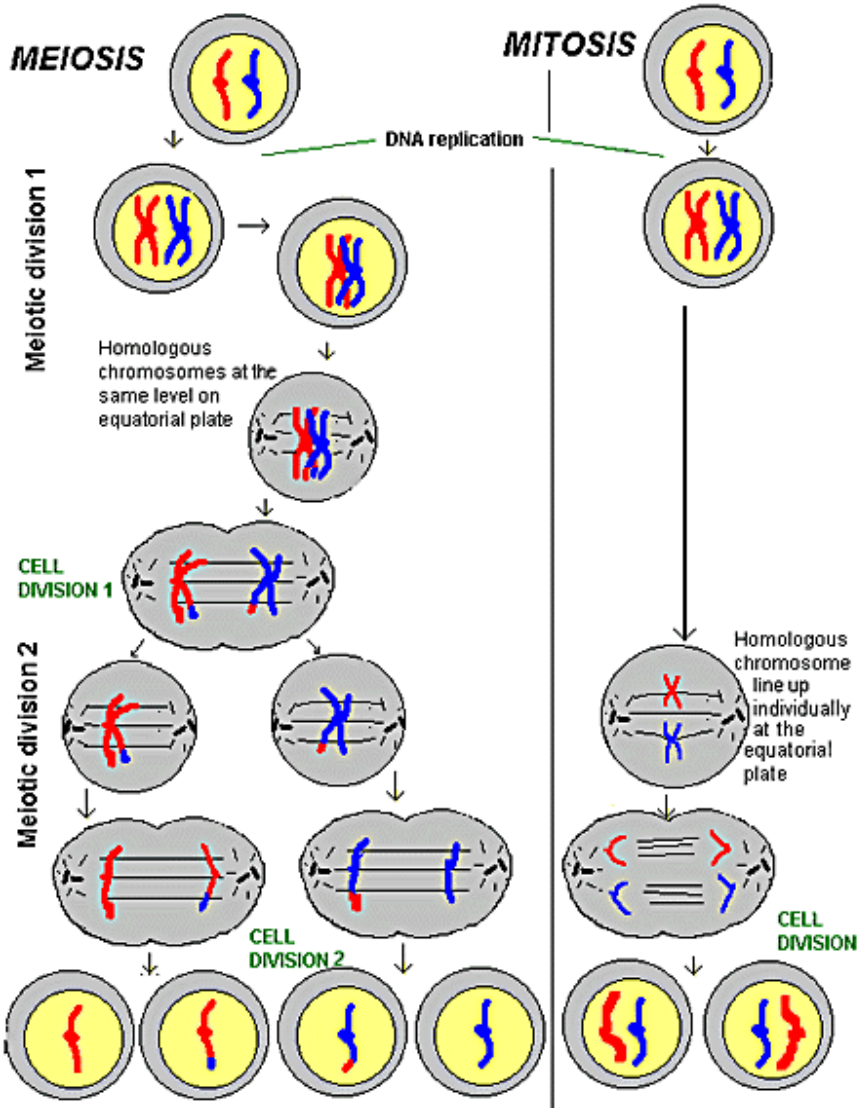


In this case, a father has a normal genome with a normal X and Y chromosome. A mother, however, is a carrier for a disease. This means she has one normal X chromosome and an X^r chromosome that carries a disease trait.

As you can see in the diagram to the right, the father passes his normal X chromosome to both of his daughters, but the mother passes one of her X chromosomes to a daughter who will not be a carrier and the other daughter who will be a carrier.

For the sons, one will be a normal son, receiving his Y chromosome from his father and a normal X chromosome from his mother. The other son, however, will have the disease because he will have gained the affected X^r chromosome from his mother.

Meiosis: the process of cell division which produces the gametes (sex cells, sperm and eggs)



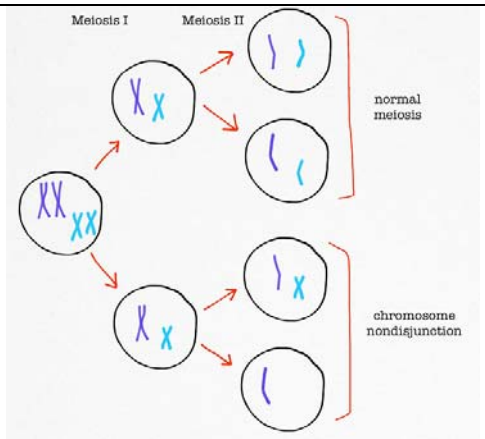
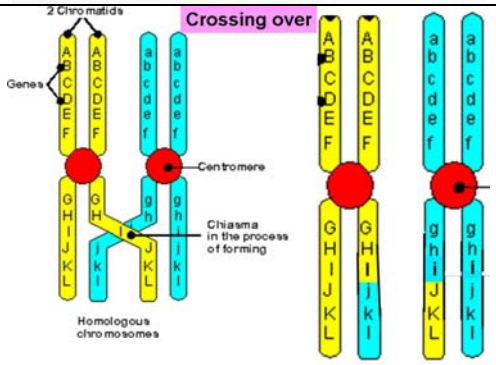
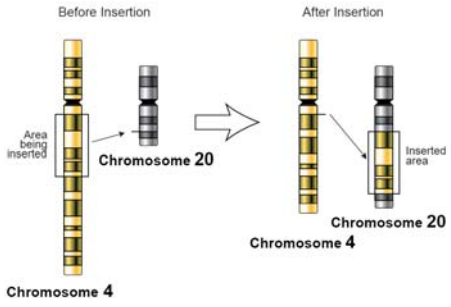
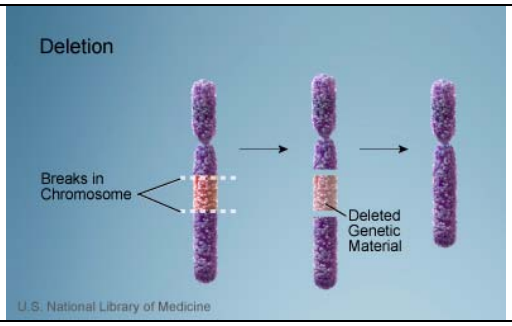
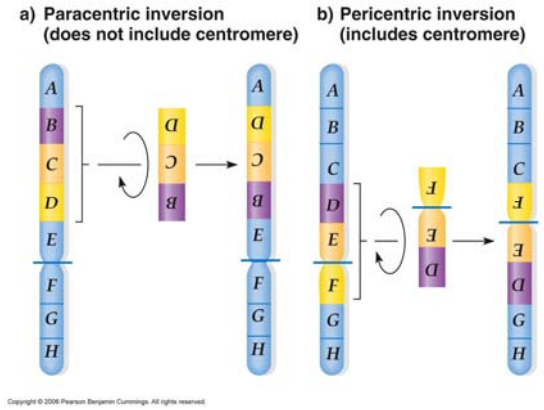
1. Meiosis and Mitosis start out the same way. The chromosomes in the nucleus of the cell are duplicated in preparation for division.

2. Both cells then undergo cell division, creating two copies of the original cell.

3. However, in meiosis, the cells divide for a second time. Since each human cell starts out with two copies of every chromosome (diploid), the gametes produced by meiosis now only have half as many (haploid).
    a. Humans have 23 pairs of chromosomes for 46 chromosomes total.
    b. The gametes that are produced only have one copy of each, and thus 23 chromosomes.

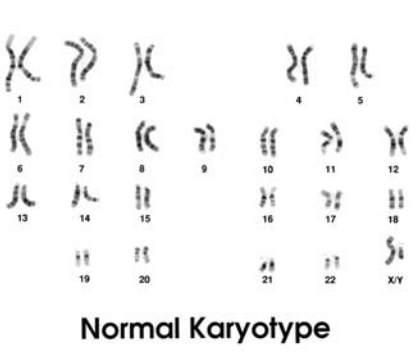
4. Before the second cell division, the chromosomes can get tangled up with each other. This can result in nondisjunction, insertion, deletion, or crossing over.

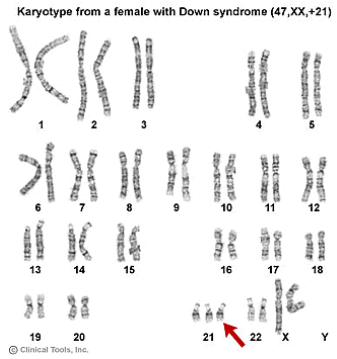
The following table describes what can happen to chromosomes during meiotic cell division. This is a normal and beneficial process because it helps contribute to the genetic diversity of organisms by mixing up the genes even more.

Nondisjunction – In this case, chromosomes fail to separate. This results in some gametes having an extra copy of a chromosome. This can lead to some genetic disorders, such as trisomy 21 (shown below in the karyotype).	
Crossing over – In this case, parts of different chromosomes get tangled up and trade parts with each other. This helps contribute to the genetic diversity of organisms by mixing up the genes a little.	
Insertion – Though it can happen through other means, such as infection with a virus or through gene technology, sometimes crossing over results in the transfer of whole sections of a chromosome to another one without exchange of material.	
Deletion – In this case, a whole section of a chromosome goes missing.	
Inversion – In this case, a portion of the DNA is cut, inverted, and then reinserted into the same spot. This can cause issues with the way genes are read and can render some genes unexpressable.	

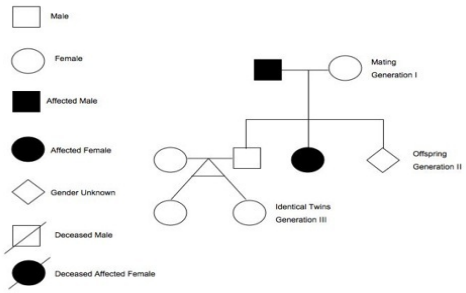
Gene Technology: using technology and looking at our genes

1. Karyotype: a picture of chromosomes used to identify chromosomal mutations; For every pair, there are two chromosomes (1 from Mom, 1 from Dad); Girls are XX and Boys are XY





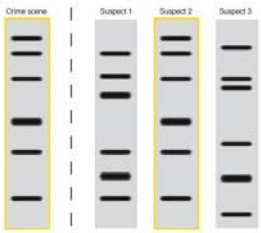
2. Pedigree: family tree that traces genetic traits



3. Genetically Modified Organisms: organism whose genetic material has been altered using genetic engineering

4. Gene Therapy: using DNA as a pharmaceutical agent to treat disease

5. DNA Fingerprinting/Identification: sequencing DNA to identify and evaluate genetic information



6. Cloning: process of producing genetically identical individuals that occur in nature

7. Transgenic Animals/Recombinant DNA: deliberately inserting a foreign gene into an organism