Name _____ Period _____ Date _____

Topic 10.2 Inheritance

10.2.U2 Unlinked genes segregate independently as a result of meiosis.

1. Mendel's Law of Independent Assortment
2. Describe the situation in which two or more genes will sort and therefore segregate independently of each other.

10.2.A2 Completion and analysis of Punnett squares for dihybrid traits. AND 10.2.S1 Calculation of the predicted genotypic and phenotypic ratio of offspring of dihybrid crosses involving unlinked autosomal genes.

3. Distinguish between dihybrid and monohybrid crosses.
4. When Mendel came upon his law of independent assortment, he was studying sweet-pea color and shape. These traits are carried on separate chromosomes. The color yellow (Y) is dominant over green (y). Smooth peas (S) are dominant over rough (s).
   a. State the possible genotypes for the following phenotypes:

Yellow, Smooth		green, Smooth	
green, rough	y y s s only	Yellow, rough	

   b. Use the Punnett grid to predict the ratio of phenotypes of offspring in a cross between two peas that are heterozygous for both genes (SsYy x SsYy).

	S Y	S y	s Y	s y
S Y				
S y				
s Y				
s y				

Phenotype	Smooth Yellow	Smooth green	Rough Yellow	Rough Green
Ratio				

Nature of science: Looking for patterns, trends and discrepancies - Mendel used observations of the natural world to find and explain patterns and trends. Since then, scientists have looked for discrepancies and asked questions based on further observations to show exceptions to the rules. For example, Morgan discovered non-Mendelian ratios in his experiments with Drosophila. (3.1) AND 10.2.A1 Morgan's discovery of non-Mendelian ratios in Drosophila.

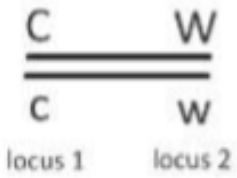
5. Morgan's experiments (1909 - 1914) with fruit flies produced results that could not be explained by Mendel's work on heredity as it stood. Morgan's key insight came after breeding a white-eyed male mutant with red-eyed female flies. Complete the table to outline his observations and where the explain the conclusion:

Observation	Deduction – consistent or inconsistent with Mendelian theory?
The 1st generation offspring all had red eyes	
The 2nd generation contained a small number (roughly 25% of flies) with white eyes	
However all the white-eyed flies were male	

<u>10.2.U1 Gene loci are said to be linked if on the same chromosome. AND 10.2.S2 Identification of recombinants in crosses involving two linked genes.</u>

6. Mendel's law of independent assortment makes the assumption that genes for a pair or group of traits are being carried on separate chromosomes, and therefore the presence of one allele in a gamete is not connected to the presence of another. However, with hundreds of genes per chromosome, it is likely that some genes will be physically linked and therefore alleles will be inherited together.
   a. Define linkage groups.
   b. State the consequence of gene linkage in terms of the movement of alleles in anaphase I. Linkage groups will not…
   c. The term linkage is used in various ways in genetics. Distinguish between autosomes and sex chromosomes.
   d. Distinguish between gene linkage and sex linkage.
   e. The notation shows genes of Zea mays (corn). It is described as "heterozygous at both loci". These are both traits related to the corn kernels.
      Key: C = color, c = no color; W = waxy, w = no wax.
   f. Draw some other possible combinations of these linked genes:

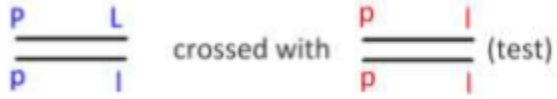
Homozygous dominant at both loci	
Homozygous recessive at locus 1	
Your choice	



   g. Complete a Punnet grid to show the possible phenotypes produced by a cross between the corn that is heterozygous at both loci. Use correct notations and show your working.

Phenotype				
Ratio .				

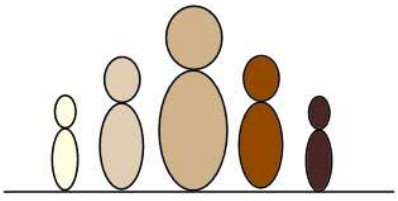
h. List the combinations of alleles that are not possible in the cross above (unless recombination takes place at Prophase I).
i. A small number of kernels that are colored but not waxy appear in the offspring. Explain the process that must have occurred for this to be the case.
j. State the stage of meiosis during which crossing over and exchange of alleles can occur.
k. Complete the Punnet grid below:
What are the possible genotypes of this cross (including recombinants)?



	P L	p l		
p l	P p L l			
p l				
	No recombination		With crossing over (recombinants)	

<u>10.2.U3 Variation can be discrete or continuous. AND 10.2.U4 The phenotypes of polygenic characteristics tend to show continuous variation.</u>

7. Polygenic inheritance gives rise to continuous variation.
   a. Define polygenic inheritance.
   b. Distinguish between polygenic inheritance and multiple alleles.
   c. List one human and one plant example of polygenic inheritance.
   d. Define contributing allele.
   e. Explain how polygenic inheritance gives rise to continuous variation within a population using skin color as an example.
8. Assume that two genes (A and B) are responsible for inheritance of skin color, with two alleles each and that they are unlinked. The dominant alleles code for melanin production.
   a. Calculate the number of possible genotypes.
   b. Apply the possible genotypes to the range of phenotypes below:



aabb	Aabb			

   a. Using a Punnet grid, explain why it is possible for children to have skin that is darker or lighter than both parents.
   Mother genotype: Father genotype:

9. Two unlinked genes control a characteristic with two alleles. Deduce the number of possible genotypes and phenotypes.
10. Three genes control a characteristic with two alleles each. Calculate the number of genotypes possible in a cross between a homozygous recessive father and a homozygous dominant mother.

10.2.A3 Polygenic traits such as human height may also be influenced by environmental factors.

11. Most traits, including polygenetic traits such as height, maybe influenced by the environment of the organism. Complete the table to give examples of the ways in which this can happen.

Human Trait	**Influencing Environment factors**
Height	
Skin color	