Mendelian Genetics

Name _____ Period _____ _____ / SBG

Gregor Mendel was known as the "Father of Genetics" because of his research on crossing different organisms and finding probabilities for what their offspring would look like. From all of his work he summarized all of his work into two main ideas.

Segregation:
1) For any trait, each parent's pairing of genes (alleles) split
2) One gene (allele) passes from each parent to the offspring
3) Which particular gene (allele) in a pair that gets passed on is random or chance

Independent Assortment:
1) Different pairs of alleles are passed on to the offspring
2) Independent of each other
3) Inheritance of genes at one location does not influence the inheritance of genes at another location

It's also important that you understand the vocabulary used in discussing Mendelian genetics. Define the following genetics terms in your own words:

Gene: Physical and functional unit of heredity; actual section on a chromosome; instructions to the cell

Allele: Variation of the same gene (example: green, blue, hazel, brown – different alleles for eye color)

Genotype: Set of alleles/genes that determine the physical expression of characteristics or traits

Phenotype: Set of observable (physical) characteristics from interaction of genotype with the environment

Dominant: Produces a dominant phenotype in individuals who have at least one copy of the allele. Overshadows or silences the expression of a recessive allele.

Recessive: Two recessive alleles must be present in order for the individual to express the recessive phenotype.

Homozygous: Two of the same allele, whether dominant or recessive.

Heterozygous: One each of different alleles, one dominant and one recessive.

<u>Practice Problems</u>

1. Each muscle cell of a human has 46 chromosomes. How many chromosomes would a human have in a liver cell? 46 in an egg? 23
    a. In a fertilized egg? 46 in a sperm? 23 in a skin cell? 46

2. In Pea plants, yellow (Y) is the dominant color of peas and green (y) is recessive. What are the phenotypes for the following genotypes?

   a. YY ___Yellow___

   b. Yy ___Yellow___

   c. yy ___Green___

3. Fill in the Punnett squares below to show the outcomes of the crosses. In each box, under the genotype, write the correct phenotype.

a. YY • Yy

	Y	Y
Y	YY Yellow	YY Yellow
y	Yy Yellow	Yy Yellow

b. YY • yy

	Y	Y
y	Yy Yellow	Yy Yellow
y	Yy Yellow	Yy Yellow

c. Yy • Yy

	Y	y
Y	YY Yellow	Yy Yellow
y	Yy Yellow	yy Green

d. Yy • yy

	Y	y
y	Yy Yellow	yy Green
y	Yy Yellow	yy Green

Use information from the squares above to answer the following questions.

4. If a male animal has the alleles Bb for some gene, what percentage of its sperm cells would you
   a. expect to get the B allele? ___50%___ the b allele? ___50%___

5. In mice, brown color is dominant over white. In a cross between a brown mouse and a white mouse, 6 of the offspring were brown and 5 were white. What were the genotypes of the parents for color? approx. 50/50 or 1:1 ratio

	Y	y
y	Yy Brown	yy White
y	Yy Brown	yy White

b. White parent yy Brown parent Yy

6. In guinea pigs, black color is dominant over white. Two black guinea pigs mate and produce 29 black and 9 white offspring. What were the genotypes of the parents for color? approx. 75/25 or 3:1 ratio

	Y	y
Y	YY Black	Yy Black
y	Yy Black	yy White

c. Father pig Yy Mother Pig Yy

We have worked with a normal hybrid cross between a single trait (monohybrid) in 2 parents. What would happen if we started figuring out the odds for offspring using 2 different traits at one time (a dihybrid cross)?

We're familiar with the yellow(Y) and green(y) color in peas. Let's add to that whether the gene that will determine if the pea would be round(R) or wrinkled(r). To do this we need to find all the possible combinations of the genotypes for each parent and add that to each side of a larger Punnett square.

7. What would be the phenotypes for the following genotypes?

   a. YYRR Yellow Round

   b. YyRr Yellow Round

c. yyRr Green Round

d. Yyrr Yellow Wrinkled

e. yyrr Green Wrinkled

8. Fill in the Punnett square for the following cross, write the phenotype under the genotype:

F (irst) - O (utside) - I (nside) - L (ast)

a. YyRr • YyRr

	YR	Yr	yR	yr
YR	YYRR Yellow Round	YYRr Yellow Round	YyRR Yellow Round	YyRr Yellow Round
Yr	YYRr Yellow Round	YYrr Yellow Wrinkled	YyRr Yellow Round	Yyrr Yellow Wrinkled
yR	YyRR Yellow Round	YyRr Yellow Round	yyRR Green Round	yyRr Green Round
yr	YyRr Yellow Round	Yyrr Yellow Wrinkled	yyRr Green Round	yyrr Green Wrinkled

b. YyRr • Yyrr

	YR	Yr	yR	yr
Yr	YYRr Yellow Round	YYrr Yellow Wrinkled	YyRr Yellow Round	Yyrr Yellow Wrinkled
Yr	YYRr Yellow Round	YYrr Yellow Wrinkled	YyRr Yellow Round	Yyrr Yellow Wrinkled
yr	YyRr Yellow Round	Yyrr Yellow Wrinkled	yyRr Green Round	yyrr Green Wrinkled
yr	YyRr Yellow Round	Yyrr Yellow Wrinkled	yyRr Green Round	yyrr Green Wrinkled

9. Brown eyes are dominant over blue and curly hair is dominant over straight. A brown eyed curly haired woman is married to a brown eyed straight haired man. They have 8 children with the following traits: approx. 75/25 (3:1) brown/blue and 50/50 (1:1) curley/straight

3 with brown eyes and curly hair
3 with brown eyes and straight hair
1 with blue eyes and curly hair
1 with blue eyes and straight hair

What are the genotypes for the parents? Mom BbCc Dad Bbcc

10. In rabbits, short hair (H) is dominant over long hair (h). Black color (B) is dominant over brown (b). Cross a heterozygous short hair/heterozygous black rabbit with a heterozygous short hair/brown rabbit. List all the possible genotypes and their phenotypes for the offspring: F (irst) - O (utside) - I (nside) - L (ast)

Genotypes for:

Parent 1: HhBb

Parent 2: Hhbb

	HB	Hb	hB	hb
Hb	HHBb Short Black	HHbb Short Brown	HhBb Short Black	Hhbb Short Brown
Hb	HHBb Short Black	HHbb Short Brown	HhBb Short Black	Hhbb Short Brown
hb	HhBb Short Black	Hhbb Short Brown	hhBb Long Black	hhbb Long Brown
hb	HhBb Short Black	Hhbb Short Brown	hhBb Long Black	hhbb Long Brown

Possible Offspring:

Genotype 2 HHBb Phenotype Short Black

Genotype 4 HhBb Phenotype Short Black

6 Short Black

Genotype 2 HHbb Phenotype Short Brown

Genotype 4 Hhbb Phenotype Short Brown

6 Short Brown

Genotype 2 hhBb Phenotype 2 Long Black

Genotype 2 hhbb Phenotype 2 Long Brown