Name: Key

Genetics Problem Pack

The following problems deal with many different real-world genetics situations. Some will be easy others may be very difficult. Remember to follow the basic rules of genetics problems to solve each problem. Follow these steps for EVERY problem:

1. Define alleles
2. Define phenotypes associated with genotypes
3. Write out cross
4. Produce gametes
5. Perform cross (Punnett square)
6. Determine genotypic and phenotypic ratios of offspring
7. Use the above to answer the problem

Each Problem = 5 pts.
5 = All work shown, easy to follow and correct
4 = All work shown and correct
3 = All work shown and incorrect
2 = Only correct answer given
1 = Only incorrect answer given
0 = Problem not solved

Monohybrid Crosses:

1. Assume that white color is dominant over yellow color in squash. If pollen from the anthers of a heterozygous white-fruited plant is placed on the pistil of a yellow-fruited plant, what would be the ratios among the genotypes and among the phenotypes of plants grown from the resulting seeds?

1. W = white w = yellow
2. WW, Ww = white
   ww = yellow
3. Ww x ww
4. (W) (w) (w) (w)
5.

	W	w
w	Ww	ww
w	Ww	ww

6. Genotypic 1Ww : 1ww
   Phenotypic 1white : 1yellow

2. In human beings, brown eyes are usually dominant over blue eyes. Suppose a blue-eyed man marries a brown-eyed woman whose father had blue eyes. What proportion of their children would you predict will have blue eyes? *Note: The use of eye color as a simple Mendelian inheritance is a simplification. For a better description of eye color inheritance see this link:* http://www.ncbi.nlm.nih.gov/omim/

1. B = Brown b = blue
2. BB Bb = Brown
   bb = blue
3. Bb x bb
4. (B) (b) (b) (b)
5.

	B	b
b	Bb	bb
b	Bb	bb

6. Genotypic 1Bb:1bb
   Phenotypic 1Brown: 1blue

7. 50% of their kids would be expected to have blue eyes.

3. If a brown-eyed man marries a blue-eyed woman and they have 10 children, all with brown eyes, can you be certain that the man is homozygous for eye color? If the eleventh child has blue eyes, will that prove what the father's genotype is? Why?

1+2: See above

3. Bb x bb or BB x bb
4. (B) (b) x (b) (b) or (B) x (b)
5. - Same as #2 or

	b
B	Bb

6. " — all Bb, all Brown

Each child is BUT an independant probibility. The dominant phenotype is only known, not the genotype. The recessive phenotype shows the genotype so ten brown eyed children do NOT prove the man's genotype, only a possible blue eyed child could prove the man is Bb.

4. Sickle cell anemia is an autosomal recessive disorder caused by changing a single amino acid in the protein hemoglobin. This hemoglobin becomes "sticky" when oxygen is low in the blood and causes red blood cells to form a sickle shape and get stopped up in blood vessels. It is most prevalent in African Americans. One in six hundred African Americans is born with sickle cell anemia and 1/12 blacks carry the allele. An African American couple comes in for genetic counseling, they are both carriers of sickle cell anemia (heterozygotes) and they want to know the likelihood that their child could have sickle cell anemia. What do you tell them? Support your answer by showing a cross. What is the likelihood that their child would be a carrier? What is the probability that a child would not have the sickle cell allele?

1. H= normal h= sickle cell
2. HH, Hh = normal
   hh = sickle cell
3. Hh x Hh
4. (H) (h) (H) (h)
5.

	H	h
H	HH	Hh
h	Hh	hh

6. Genotypic 1HH:2Hh : 1hh
   Phenotypic 3 Normal : 1 sickle cell
7. 25% chance their child would have sickle cell; 50% of a carrier and 25% of not getting the allele.

5. Cystic fibrosis (CF) is a disorder that causes abnormal body secretions. Of particular concern is heavy mucous in the lungs that makes the individual more susceptible to pneumonias and other lung diseases. CF is the most common genetic disorder of whites of Northern European ancestry, with about 1/25 carrying the allele for CF and 1/3000 white babies having the disease. A normal couple has their first baby and it has CF. What is the likelihood that a second baby born to this couple would have CF? Show all work below.

1. N = normal n = C.F
2. NN, Nn = normal
   nn = C.F.
3. Nn x Nn
4. (N) (n) (N) (n)
5.

	N	n
N	NN	Nn
n	Nn	nn

6. Genotypic 1NN: 2Nn : 1nn
   Phenotypic : 3 Normal : 1 C.F.
7. 25% chance that a second child will have C.F.

Dihybrid Crosses:

1. In the fruit fly Drosophila melanogaster, vestigial wings and hairy body are produced by two recessive alleles carried on different chromosomes. The normal alleles, long wings and hairless body, are dominant. If a vestigial-winged, hairy male is crossed with a female homozygous for both of the normal traits, what would be the phenotypes and genotypes of their progeny? If the F_1 generation was allowed to mate randomly among themselves, what phenotypes and genotypes would be expected among the F_2's, and in what proportions?

1. L = Long l = vestigial
H = hairless h = hairy

2. LL, Ll = Long ll = vestigial
HH, Hh = hairless hh = hairy

3. hhll x HHLL

4. (hl) (HL)

Only possibility

5.

	HL
hl	HhLl

6. Genotypic = All HhLl Phenotypic All Hairless + Long

3b. HhLl x HhLl

4b. (HL) (Hl) (hL) (hl) ; (HL) (Hl) (hL) (hl)

5b.

	HL	Hl	hL	hl
HL	HHLL	HHLl	HhLL	HhLl
Hl	HHLl	HHll	HhLl	Hhll
hL	HhLL	HhLl	hhLL	hhLl
hl	HhLl	Hhll	hhLl	hhll

Genotypic: 1HHLL : 2HHLl : 1HHll : 2HhLL : 4HhLl : 2Hhll, 1hhLL : 2hhLl : 1hhll

Phenotypic: 9 Hairless + Long : 3 Hairless + Vestigial : 3 Hairy + Long : 1 Hairy + Vestigial

2. If a hairy female heterozygous for vestigial wing is crossed with a vestigial-winged male heterozygous for hairy body, what will be the characteristics of the F_1 generation?

1+2 : See #1

3. hhLl x Hhll

4. (hL) (hl) + (Hl) (hl)

5.

	Hl	hl
hL	HhLl	hhLl
hl	Hhll	hhll

6. Genotypic
1HhLl : 1hhLl : 1Hhll : 1hhll

Phenotypic
1 Hairless + Long : 1 Hairy + Long : 1 Hairless + vestigial : 1 Hairy + vestigial

3. In peas, a gene for long stems (L) is dominant over its allele for short stems (l). The gene for smooth seeds (W) is dominant over the allele for wrinkled seeds (w). Calculate the genotypic and the phenotypic ratios that would be expected among the progeny of the following crosses:

   a) LLWW x llww
   b) A F_1 cross from above

1. L=Long l=short
   W=smooth w=wrinkled

2. LL Ll = Long ll=short
   WW, Ww = smooth

3. LLWW x llww

4. (LW) (lw)

5.

	lw
LW	LlWw

6. Genotypic: All LlWw
   Phenotypic: All Long + smooth

3b. LlWw x LlWw

4b. (LW)(Lw)(lW)(lw) ; (LW)(Lw)(lW)(lw)

5b.

	LW	Lw	lW	lw
LW	LLWW	LLWw	LlWW	LlWw
Lw	LLWw	LLww	LlWw	Llww
lW	LlWW	LlWw	llWW	llWw
lw	LlWw	Llww	llWw	llww

6b. Genotypic
1LLWW:2LLWw:1LLww:2LlWW:4LlWw:2Llww:1llWW:2llWw:1llww

Phenotypic
9Long+Smooth:3Long+wrinkled:3Short+Smooth:1short wrinkled

4. In hogs, a gene that produces a white belt around the animal's body is dominant over its allele for solid color. Another gene produces a fusion of the two hooves on each foot, a condition known as *syndactyly.* The syndactyl allele is dominant over the allele that produces normal hooves. If a solid-colored hog homozygous for syndactyly is mated with a normal-footed hog homozygous for the belted character, what would be the genotypes and phenotypes of the progeny? If the progeny are allowed to breed freely among themselves, what genotypes and phenotypes would you predict among their offspring, and in what proportions?

1. B=Belt b=solid
   S=Syndactyl s=normal

2. BB Bb = Belt
   SS Ss = syndactyl ss=normal

3. bbSS x BBss

4. (bS) (Bs)

5.

	Bs
bS	BbSs

6. Genotypic: All BbSs
   Phenotypic: All Belted + Syndactyl

3b. BbSs x BbSs

4b. (BS)(Bs)(bS)(bs) ; (BS)(Bs)(bS)(bs)

5b.

	BS	Bs	bS	bs
BS	BBSS	BBSs	BbSS	BbSs
Bs	BBSs	BBss	BbSs	Bbss
bS	BbSS	BbSs	bbSS	bbSs
bs	BbSs	Bbss	bbSs	bbss

6b. Geno
1BBSS:2BBSs:1BBss:2BbSS:4BbSs:2Bbss:
1bbSS:2bbSs:1bbss

Pheno
9Belted+Syndactyl:3Belted+normal:3solid+syndactyl:
1Solid+normal

5. In watermelons, the genes for green color and for short shape are dominant over their alleles for striped color and for long shape. If a plant producing long, striped fruit is crossed with a plant that is heterozygous for both these characters, what would be the phenotypes of plants grown from the resulting seeds, and in what ratios?

1. G = Green g = striped
   S = Short s = Long
2. GG Gg = Green gg = striped
   SS Ss = Short ss = long
3. ggss X GgSs
4. (gs) ; (GS)(Gs)(gS)(gs)
5.

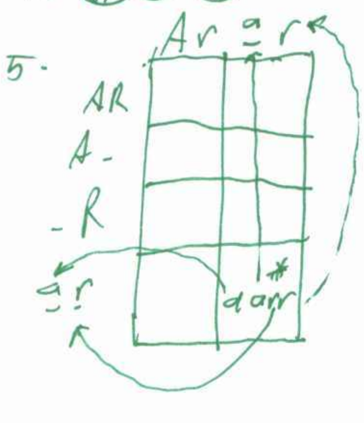
	GS	Gs	gS	gs
gs	GgSs	Ggss	ggSs	ggss

6. Geno: 1GgSs : 1Ggss : 1ggSs : 1ggss
   Pheno: 1 Green&Short : 1 Green&long : 1 striped&short : 1 Striped & Long

6. A dominant gene, A, causes yellow color in rats. In another, independent gene, the dominant form (R) produces a black coat color. When the two dominants occur together (A_R_), they interact to produce grey. Rats with the genotype aarr are cream-colored. If a grey male and a yellow female, when mated, produce a litter of five consisting of 3/5 grey, 1/5 cream and 1/5 black individuals, what are the genotypes of the parents?

" Key: aarr *

1. A = yellow a = not yellow
   R = black r = not black
2. A_ = yellow aa = not yellow
   R_ = black rr = not black
   A_R_ = grey aarr = cream
3. A_R_ X A_rr
4. (AR)(A_)(_R)(__) X (Ar)(_r)
5.



6. not important
7. AaRr X Aarr