Genetics Homework Assignment Key
BI-102, Fall '08, Dr. C. S. Tritt

1. A man with AB blood has three children with a woman with type A blood. The children's blood types are A, AB and B. Can the genotypes of the parents be determined using only the given information and, if so, what are they? Explain the reasoning you used to obtain your answer.

The genotype of man must be I^AI^B in order for his phenotype to be AB. The genotype of the woman could be either I^Ai or I^AI^A. Hypothesizing that the woman is I^AI^A, she could only produce type I^A gametes resulting in the following Punnett square for their children:

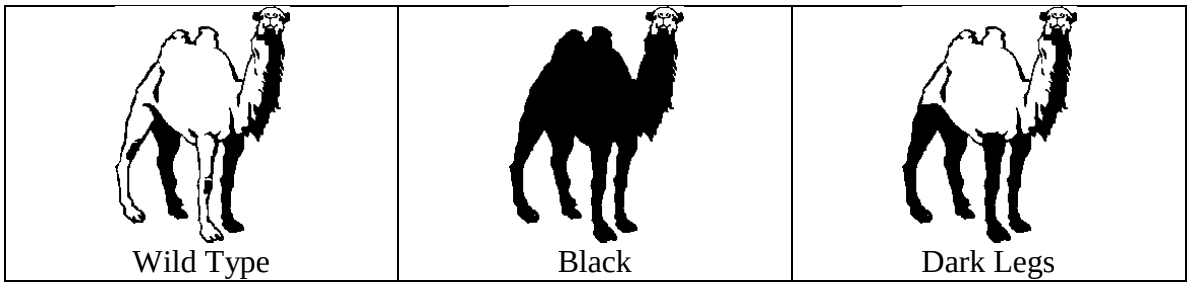
	I^A	I^A
I^A	(A) I^AI^A	(A) I^AI^A
I^B	(AB) I^BI^A	(AB) I^BI^A

The existence of the type B child refutes this hypothesis. Trying the other possible genotype for the woman results in the following Punnett square:

	I^A	i
I^A	(A) I^AI^A	(A) I^Ai
I^B	(AB) I^BI^A	(B) I^Bi

This result is consistent with the blood types of the children so the conclusion is the parents' genotypes are I^AI^B for the man and I^Ai for the woman.

The following problem deals with *Camelus mozeus* a rare animal native to Wisconsin's north woods and Michigan's Upper Peninsula. MSOE tried to development a miniature variety of these animals for sale as house pets, but they never become popular or commercially successful. In the process, biologists at MSOE developed a rather complete understanding of their (the camels', not the biologists') genetics. Currently identified phenotypes are:



 Dark Rear	 Dark Humps	 Dark Neck
 Zebra strips	 Big Ears	 Big Tail

2. When true breading Dark Neck animals are breed with wild type animals, the F_1 generation is all phenotypically wild type. When these F_1 animals are self crossed, the resulting F_2 generation consists of wild type and dark necked animals in a 3:1 ratio, respectively. Explain this result in terms of what type of trait Dark Neck is (dominate or recessive). Use Punnett squares to illustrate and support your explanation.

The fact that all the F_1 animals are wild type indicates that dark neck is recessive relative to the wild type. Use the symbols *d* for dark neck and *D* for wild type neck. The P generation can then be indicated as *dd* (dark neck) × *DD* (wild type) so the F_1 animals are all *dD* (wild type). The Punnett square for the self-cross of the F_1 to product the F_2 is then:

	d	*D*
d	(dark neck) *dd*	(wild type) *dD*
D	(wild type) *Dd*	(wild type) *DD*

Which gives the observed 3:1 ratio of wild type to dark neck animals.

3. Assume that Black is an autosomal dominate trait and that it is epistatic with respect to Dark Rear, in that dark rear coloring would be obscured by the overall black color. Assume that Dark Rear is also an autosomal dominate trait and that it assorts independently of Black. Predict the phenotype ratios for the F_1 and F_2 generations of a cross between true breeding Black animals (known to be homozygous wild type at the Dark Rear loci) and true breeding Dark Rear animals. Use Punnett squares to support your answers.

Use the following symbols: *B* – black, *b* – wild type overall color, *D* – dark rear, *d* – wild type rear color. The cross is then between *BBdd* (black) × *bbDD* (dark rear) to produce an F_1 of *BdDd* (black) animals. The Punnett square for the self-cross of the F_1 to produce the F_2 would then be:

	BD	*Bd*	*bD*	*bd*
BD	(black) *BBDD*	(black) *BBDd*	(black) *BbDD*	(black) *BbDd*
Bd	(black) *BBdD*	(black) *BBdd*	(black) *BbdD*	(black) *Bbdd*
bD	(black) *bBDD*	(black) *bBDd*	(dark rear) *bbDD*	(dark rear) *bbDd*
bd	(black) *bBdD*	(black) *bBdd*	(dark rear) *bbdD*	(wild type) *bbdd*

This explains the observed 12:3:1 black to dark rear to wild type ratio in the F_2. Note that this 12:3:1 ratio is a really a modified version of the 9:3:3:1 ratio expected for a dihybrid cross.

4. Assume Zebra Strips is an X linked dominate trait. Use Punnett squares to predict the expected phenotypic ratios in the F_1 and F_2 generations resulting from *a*) crossing a Zebra Stripped male with a wild type female and *b*) crossing homozygous Zebra Stripped female with a wild type male. Be sure to differentiate between male and female offspring.

I'll use the following symbols: X^S – zebra stripes, X – wild type (black). The part a) cross would then be YX^S (striped male) × XX (black female) and produce YX (black male) and XX^S (striped female) F_1 offspring. The part b) cross would then be YX (black male) × X^SX^S (striped female) and produce YX^S (striped male) and XX^S (striped female) F_1 offspring. The result of self crossing these F_1 generations to produce F_2 generation is given in the following Punnett squares.

$YX^S \times XX$ cross F_2 –

	X	X
Y	(black ♂) YX	(black ♂) YX
X^S	(striped ♀) X^SX	(striped ♀) X^SX

$YX \times X^SX^S$ cross F_2 –

	X^S	X^S
Y	(striped ♂) YX^S	(striped ♂) YX^S
X	(striped ♀) XX^S	(striped ♀) XX^S