Questions for Exam I

Fall 2005

1. Wild-type humbugs have no spots, have red eyes and brown bodies. You have isolated mutations in three new autosomal humbug genes. The mutation Sp gives a dominant phenotype of spotted bodies. The mutation p gives the recessive phenotype of pink eyes. The mutation gr gives a recessive phenotype of green bodies. You cross a spotless, red eye, green body humbug with a spotted body, pink eye, brown bodies to produce F1 females heterozygous for Sp, p, and gr. These F1 females are then test-crossed and the phenotypes of 3000 progeny are scored as shown below. Draw a map showing the order and distances between the Sp, p and gr genes.

Phenotypes	**# of bugs in each class**
spotless pink eyes brown bodies	4
spotless red eyes green bodies	1347
spotted bodies pink eyes green bodies	53
spotted bodies pink eyes brown bodies	1390
spotted bodies red eyes green bodies	2
spotless pink eyes green bodies	74
spotless red eyes brown bodies	61
spotted bodies red eyes brown bodies	70

2. In Mollies (fish) gold color is believed to be controlled by a single gene with two alleles, recessive g for gold color and dominant G for black color. Suppose that in a monohybrid cross generated the following results. Use Chi-Square to test the hypothesis that the gold color gene obeys Mendels principle of random segregation?

P1 Gold X Black

↓

F1 100% Black(X)

↓

F2 99 Black and 77 Gold

Useful Critical Values at P=0.05

Degrees of Freedom	1	2	3	4	5	6	7	8
Critical Values	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51

3. A rabbit farmer is interested in improving his profits by increasing the weight of his rabbits. His rabbits have an average weight of about 3kg. He decides to try improving their weight by genetically selecting the largest rabbits. He selects his 10 largest rabbits that have an average weight of 4kg and he interbreeds them.

   A. What size would you predict the progeny of these large rabbits will be if heritability is 0%?
   B. Suppose after conducting the experiment he estimated heritability to be 70%. From this he erroneously concludes that 70% of his rabbit's weight is due to genes and 30% is due to the environment. What would be a better understanding of the meaning of 70% heritability?

4. Two genes (Red and Bleached) control flower color in 4 o'clocks. The Red gene has two alleles, R for red flowers, r for white flowers. Heterozygous plants Rr have pink flowers. The Bleached gene has two alleles. The dominant B allele prevents any pigment accumulation in flowers which results in white flowers no matter what the genotype at Red. The recessive b allele allows pigment accumulation in the flowers. Suppose a double heterozygous plant was generated by mating Red 4 o'clock (RRbb) with a white 4 o'clock rrBB.

   A: If this plant were testcrossed with a rrbb plant, what % of the progeny would you expect to be pink?

   B: Suppose the Red gene and Bleached gene are linked and 20mu apart. How many of the testcross progeny would be pink?

5. (Suppose) In dalmatians spot size is genetically controlled. Spot sizes can either be large, medium or small. Males can either have small or large spots. Medium spot male dalmatians do not exist. Females can have small, medium or large spots. True breeding varieties of large spot and small spot dalmations have been established. However, a true breeding variety of medium spot dogs has not been established. To investigate the inheritance of the trait, medium spot females were breed with either small spot males or large spot males. The results are summarized below.

   A. What are the genotypes of the parents of cross I
   B. What is the genetic explanaition for why there are not medium spot male dalmations?

6. A true breeding strain of laboratory mice has been established with twisted ears. The twisted ear trait is recessive to the normal ear trait.

   A. Design a single experiment to test whether the twisted ear gene is autosomal or sex linked.
   B. What results would support the hypothesis that twisted ear is an autosomal gene?
   C. What results would support the hypothesis that twisted ear is a sex linked gene?
   D. What results would your experiment generate if the twisted ear gene was on the mitochondrial chromosome?

Spring 2004

1. The following mutant traits are all controlled by genes on the X chromosome in *Drosophila*: orange eyes, short wings and dark body. The dominant wildtype traits are red eyes, long wings and tan body. A trihybrid female was generated by mating an orange eye short wing female with a dark body male. This female was testcrossed on the following progeny were generated. Draw a genetic map indicating the relative genetic distances of these three genes

Phenotypes	# of progeny
Dark body	1350
Orange eye, Short wings	1346
Dark body, Orange Eyes	102

Short wings	90
Orange eyes	52
Dark body, Short wings	48
Dark body, Orange eye, Short wings	3
Wildtype	1

*2. Using the data in question 1, test the hypothesis that the orange eye gene and the dark body gene obey Mendel's principle of independent assortment.

Useful Critical Values at P=0.05

Degrees of Freedom	1	2	3	4	5	6	7	8
Critical Values	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51

3. In sheep the formation of horns is a sex-influenced trait. The horn trait is controlled by a single autosomal gene with two alleles, the horned allele and the hornless allele. The horned allele is dominant in males and recessive in females. Suppose that a horned ram was mated with a hornless ewe and the first offspring were a horned ewe and a hornless ram. What is the probability that their next offspring will be hornless?

4. Calico cats are often cited as a demonstration of the Lyon hypothesis of X chromosome inactivation. In class we briefly discussed one type of aneuploid, the calico male cat who was XXY.

A mating of a black female and an orange male could also result in a second type of aneuploid, XXX. Assume that this aneuploid inherited two X chromosomes from its mother and one X chromosome from its father. Based on the Lyon hypothesis, what pattern of fur color would you predict for this XXX cat?

*5. The purple pigment that accumulates in pea flowers is synthesized by a short metabolic pathway involving several different enzymes. These different enzymes are synthesized from independent genes, each of which has a **wildtype allele** producing functional enzyme or a **defective allele** not producing the enzyme. For each gene, the wildtype allele is always dominant to the defective alleles. A plant homozygous for defective alleles in any one of these genes has white flowers.

Suppose you obtained two true breeding strains of peas with white flowers. When you interbred these strains, all the offspring had purple flowers. In the F2 generation, 430 were white and 575 were purple. What were the genotypes of the original white flowered parents?

6. In garden peas, several different genes affect pod characteristics. A gene affecting pod color (green is dominant to yellow) is approximately 7 mu away from a gene affecting pod width (wide is dominant to narrow). Both genes are located on chromosomes 5. A third gene affecting pod length (long is dominant to short) is located on chromosome 4. True-breeding plants with green, wide and long pods were mated with a plant with yellow, narrow and short pods. This plant was test crossed. If 800 testcross progeny are examine, how many are expected to have green wide and long pods?

7. In canaries there are two types of beaks: the flat-beak, where the upper and lower beaks are approximately the same size, and the hooked beaks, where the upper beak is much longer than the lower beak. This trait is controlled by a single gene with two alleles, the dominant hooked allele and the recessive flat allele. Assume you have access to true-breeding varieties of canaries with these beak types.

a. Design and experiment to test whether this beak shape gene is autosomal or sex linked.
b. What results would support the hypothesis that the beak shape gene is sex linked?
c. What results would support the hypothesis that the beak shape gene is autosomal?

Spring 2003

1. In *Drosophila*, three recessive mutant traits (black body, vestigial wing and purple eye) are each encoded by genes on chromosome 2. Mating a vestigial wing fly with a black body, purple-eyed fly, generated a trihybrid female fly. This trihybrid fly was testcrossed and the following progeny were obtained. Draw a genetic map indicating the relative genetic distances of these three genes on chromosome 2.

Phenotype	Number of Progeny
Vestigial	409
Black, Purple	386
Wildtype	70
Black, Vestigial, Purple	66
Purple	32
Black Vestigial	30
Black	5
Vestigial, Purple	2

2. Using the data in problem 1, use Chi-Square analysis to test the hypothesis that the vestigial gene obeys Mendels Law of Segregation.

Useful Critical Values at P=0.05

Degrees of Freedom	1	2	3	4	5	6	7	8
Critical Values	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51

*3. In mice two genes control coat color, the yellow gene and the black gene. The yellow fur gene has two alleles, Y^- and y^+. Mice homozygous for the Y^- allele die as embryos and are never born. Heterozygous mice have yellow fur, regardless of the black gene alleles. Mice homozygous for the y^+ gene have coat color as determined by the black gene. The black fur gene also has two alleles, the dominant B allele for black fur and the recessive b allele for agouti fur. (Note: expression of the black gene alleles can only be detected when mice are homozygous for y^+ at the yellow fur gene.) If mice heterozygous for both genes were interbred, what percentage of the progeny would have agouti fur?

4. True-breeding *Drosophila* strains exist for the mutant phenotypes curly wings and orange eyes. The curly wing trait is dominant to wildtype wings and the orange eye trait is recessive to wildtype eyes. A dihybrid cross was setup for these two traits. In the P1 generation, a curly wing female was mated with an orange-eyed male. In the F1 generation all the flies had curly wings and wildtype eyes. These F1 flies were interbred and the following F2 phenotypes were obtained. What are the genotypes of the **male** and the **female F1 flies**?

Phenotypes of F2 Progeny

Phenotypes	Male	Females
Wildtype	63	125
Curly	190	377
Orange	65	0
Orange Curly	180	0

5. Suppose you isolated a new phenotype in tomatoes which you name furry, because it results in tomatoes covered with a fine layer of hair. A single gene controls this trait and the furry allele is recessive to the wildtype allele. To identify which chromosome contains the furry gene, you begin crossing your furry tomatoes with other mutant tomatoes varieties. For example, the yellow fruit color gene is located on chromosome 6. The recessive allele generates yellow tomatoes and the dominant allele generates wildtype red tomatoes.

a. Outline the genetic crosses you would conduct to investigate whether the furry gene is on the same chromosome (#6) as the yellow gene.

b. What results would support the hypothesis that the two genes are both on chromosome 6?

c. What results would support the hypothesis that the two genes are on different chromosomes?

6. In humans Red-Green colorblindness is due to an X-linked recessive allele. A woman was diagnosed with colorblindness in her right eye, but normal vision in her left eye. It is known that her father was colorblind and that her mother had normal vision. Explain how the phenomena of dosage compensation could explain this woman's condition.

Fall 2001

*1. A man and a woman that plan to have children are both heterozygous for the following five genes: the ABO locus (I^A/I^B), Bombay Phenotype (H/h), Secretor Locus (Se/se) Rh locus (Rh/rh) and MN locus L^M/L^N). Each of these genes is autosomal and independently assorts. What is the probability that the first child will have the same phenotype as the parents, Type AB blood, Secretor, Rh positive, MN?

2. In Drosophila a mutant wing phenotype has been identified called the small wing trait. Flies with this trait have wings with about half the surface area of wild type flies. True breeding stocks have been established where both males and females have small wings. In preliminary results of interbreeding small wing and wildtype flies, female flies seem more likely to have small wings. Two hypotheses were proposed to explain these initial observations.

a. The small wing allele is a dominant sex linked trait and therefore females are more likely to carry the allele.

b. The small wing trait is a sex influenced trait, heterozygous females have small wings but heterozygous males have wildtype wings.

A) Describe a reciprocal cross experiment to distinguish between these two hypotheses.

B) What results would support hypothesis #I

C) What results would support hypothesis #II

*3. (Suppose) In dogs some forms of deafness are genetically controlled. One gene that controls deafness is the D locus. It has two alleles, the dominant D allele which results in deafness and the recessive d allele which results in normal hearing. Additionally, homozygosity for the D allele will cause embryonic lethality with 25% penetrance. (Heterozygotes have no measurable increase in lethality.) If two dogs heterozygous for the D locus mate, what percentage of their live born pups will be deaf?

4. Answer one of the following two questions:

a. Explain how non-disjunction during spermatogenesis could result in Klinefelter's syndrome.
b. Outline the evidence that the synaptonemal complex plays a role in recombination during meiosis.

5. Many of the genes that control fur color in cats have been identified. For example the sex linked orange gene has two alleles, the orange allele and the black allele. Cats heterozygous for the orange gene are calicos with orange and black spots. The autosomal tabby gene has two alleles, the dominant allele results in tabby stripes, the recessive alleles has no stripes. The autosomal faded gene has two alleles, the dominant I allele results in fading of fur pigmentation, the recessive i allele results in dark pigmentation. (For example cats with a dominant I allele have grey instead of black fur and light orange instead of dark orange fur.)

A neighbor adopted a stray calico cat with a with grey and pale orange spots and no tabby striping. The stray cat had kittens a short time after she was adopted. Of the four kittens, two were solid grey female kittens with no stripes, one was a female calico (orange and black) kitten with tabby stripes and the last was a solid grey male kitten with no stripes. What are the **possible** phenotypes of the male parent to these stray kittens?

*6. One of Mendel's experiments involved a dihybrid cross between plants with green round seeds and yellow wrinkled seeds. The F1 plants all had yellow round seeds. The F2 seeds had the following distribution of phenotypes. Use chi square goodness of fit to test the hypothesis that the **pea color gene** obeys Mendel's Law of Segregation.

315 Round Yellow
108 Round Green
101 Wrinkle Yellow
32 Wrinkle

7. (10pts) A four point testcross was conducted to investigate the linkage relationship of four genes on chromosome 2 of D. melanogaster. The four genes were black body, curved wing, speckled, purple eyes. For each gene the mutant trait was recessive to the wildtype trait. To generate a tetrahybrid, a mutant fly homozygous for all four traits (black body, curved wing, speckled, purple eyed) was mated with wildtype fly. The tetra-hybrid females generated by this cross were then testcrossed with homozygous mutant males. The following progeny were obtained. Choose any two of the four genes and estimate the genetic distance between those two genes.

Wildtype	320	Black	14
Black, Curved, Speckled, Purple	315	Curved, Speckled, Purple	10
Black, Curved, Purple	115	Black, Speckled	7
Speckled	95	Curved, Purple	4
Black Purple	43	Black Curved Speckled	4
Curved, Speckled	41	Purple	2

Curved	16	Speckled, Purple	2
Black, Speckled, Purple	12	Black Curved	0

8. (15pts) In corn the black tassel trait is controlled by a single gene with two alleles, the dominant allele for tan tassels and the recessive allele for black tassels. The leaf stripe trait is controlled by a second gene with two alleles, the dominant allele for plain leaves and the recessive allele for striped leaves. A dihybrid plant was generated by mating a black tasseled plant with a striped leaf plant.

A. Assume that these genes obey Mendels Law of Independent Assortment. If this dihybrid plant were testcrossed, what percentage of the offspring would you expect to have both black tassels and striped leaves?
B. Assuming that these two genes are 15 map units apart on a chromosome. What percentage of the testcross offspring would you expect to have both black tassels and striped leaves?

Spring 2000

*1. In many plants, such as in peas or 4 o'clocks, flower color is controlled by a single gene. In other plants flower color is controlled by the interaction of several genes. To determine how flower color in snapdragon is controlled, a red flowered strain was bred with a white flowered strain. All of the F1 plants had pink flowers. In the F2 generation 176 plants had pink flowers, 91 had red flowers and 95 had white flowers. Use chi-square to test the hypothesis that in snapdragon the flower color trait is controlled by a single gene with two alleles that obey Mendel's Law of Segregation.

*2. A woman with phenylketonuria, a rare **recessive** disorder associated with intolerance to phenylalanine, had been treated with a low phenylalanine diet. She was told by her doctor that because her husband didn't have the disease, it was unlikely that her children would be affected. However, her first child had phenylketonuria. What assumption did her doctor make and how was it wrong? What is the probability that her next child will have phenylketonuria?

*3. One of the first epistatic interactions observed was in mice. Two separate genes (Yellow and Albino) were known to control pigmentation of the fur. The Yellow gene has two alleles, the y+ and y-. Homozygous y+ mice have agouti fur; mice heterozygous at the Yellow gene have yellow fur; and the homozygous y- condition is an embryonic lethal producing no mice. The Albino gene has two allele, A and a. The dominant A allele allows pigmentation as determined by other genes, the recessive a allele prevents any pigment accumulation in the homozygous condition resulting in white mice. If mice heterozygous for both the Yellow and Albino gene were interbred, what phenotypic ratio would be expected in the offspring?

4. In class, I discussed mutations in genes encoding components of the synaptonemal complex. I mentioned in class how some of these mutations resulted in a reduction in the rate of recombination. Further analysis of these mutants has demonstrated that they have an increase the rate of non-disjunction. From your knowledge of meiosis, predict the type of non-disjunction these mutant synaptonemal complexes would cause, primary or secondary. Explain your reasoning.

5. During mitosis sister chromatids are genetically identical. However, during meiosis sister chromatids of a dyad may have subtle genetic differences. Discuss how meiosis causes differences in sister chromatids?

6. (Suppose) An abandon farm was discovered near Chenobyl with an unusual population of feral chickens. These chickens lacked any feathers and were described as nude. To study the genetics of this unusually phenotype some of these nude chickens were bred with a red feathered breed of chicks. In the F1 generations all of the chicks had white feathers. In the F2 generation 209 chickens were nude, 148 chickens had red feathers and 444 chickens had white feathers. Assuming these feather phenotypes were controlled with two genes, describe the likely genotypes corresponding to the phenotypes of each generation.

*7. A male fly from a true breeding stock with furrowed eyes and balloon wings was mated with a female wildtype fly from a true breeding stock. All of the F1 offspring were wildtype. These flies were interbred and the F2 progeny had the following phenotypes.

3/8 female wildtype

1/8 female balloon wings

3/16 male wildtype

1/16 male balloon wings

3/16 male furrowed eyes

1/ 16 male furrowed eyes and balloon wings

Assuming that these genes are not linked, outline the genotypes associate with the P1, F1 and F2 flies.

*8. Two different genes controlling pod morphology in peas are found on chromosome 5. The narrow pod trait is recessive to normal pods and yellow pods is recessive to green pods. A heterozygous plant was testcrossed and the following progeny were obtained.

144 narrow green pods

150 normal yellow pods

110 narrow yellow pods

90 normal green pods

Use Chi-Square analysis to determine if the pod shape and pod color gene are assorting independently.

9. Coat color in cats is controlled by the sex linked Black gene which has two alleles "B" and "b". Cats homozygous for B are black and cats homozygous for b are orange. Heterozygous cats are calico with black and orange patches. What mechanism generates this patching of color associate with calico cats?

10. The BRCA-2 gene has a dominant allele which lead to breast cancer in women. The recessive healthy allele is associate with no increase risk for breast cancer. The cancer causing allele demonstrates about 80% penetrance. If a man heterozygous for the cancer causing allele has a child with a women homozygous for

the healthy BRCA-2 allele, what is the probability that there first child will be a daughter who will develop cancer?

11. Two true breeding strains of chickens, white strain and blue strain were interbred. A male white chicken and female blue chicken produce offspring with the following phenotypes.

50% female white
50% male blue

Two hypotheses were proposed to explain these results.

A. The color gene is sex-linked and has two alleles, the blue allele which is dominant to the white allele.

B. Feather color is a sex-influenced trait controlled by two alleles, the blue allele and the white allele, where female heterozygotes are white and male heterozygotes are blue.

Outline a single cross experiment that can distinguish between these two hypotheses. What experimental results would support each hypothesis?

Spring 99 exam

1. (25pts) In 1922, Hutchinson reported the results of a testcross for alleles at three loci on chromosome 9 of corn. The heterozygous parent had a colored, starchy and full kernel; the other parent was colorless, waxy and shrunken. The following results were obtained from this testcross.

Colored, starchy, full	4
Colored, starchy, shrunken	2538
Colored, waxy, full	113
Colored, waxy, shrunken	601
Colorless, starchy, full	626
Colorless, starchy, shrunken	116
Colorless, waxy, full	2708
Colorless, waxy, shrunken	2

a. What is the order of these three loci on chromosome 9?
b. What are the genetic distances between these three genes?

c. Calculate Interference. What does this level of interference indicate?
d. Diagram the genotypes of the parents using a nomenclature that indicates the allelic associations on the chromosome?

2. (10pts) In cattle, a true-breeding red-spotted male is crossed with a true-breeding mahogany-spotted female. In the F1 the females are all red-spotted and the males are all mahogany-spotted. In the F2 $3/4^{th}$ of the males are mahogany-spotted and $1/4^{th}$ are red-spotted. The situation is reverse in F2 females: $3/4^{th}$ of the females are red-spotted and $1/4^{th}$ of the females are mahogany-spotted. Is this trait sex linked, sex limited or sex influenced? Assuming the trait is controlled by one gene with two alleles, outline the genotypes corresponding with each phenotype in the F2 cattle.

*3. (10pts) Remember that for pea flowers purple is dominant to white flower and for pea height tall is dominant to dwarf. When a plant heterozygous for both genes was selfed the following progeny were generated. Use the Chi-Square analysis to test the hypothesis that the height gene obeys Mendels law of segregation.

Purple Tall	100	Purple Dwarf	22
White Tall	24	White Dwarf	7

Useful Critical values P=0.05

Degrees of Freedom	1	2	3	4	5	6	7	8
Critical Values	3.84	5.99	7.82	9.49	11.07	12.59	14.07	15.51

4. (10pts) In class we contrasted the mechanisms of sex determination in two taxa, humans and fruit flies, which use the Lygaeus mode (XX/XY) of sex chromosomes. Could a Protenor mode species use a mechanism of sex determination similar to humans? Could a Protenor mode species use a mechanism of sex determination similar to fruit flies? Explain your answer.

5. (15pts) The cinnabar gene and the brown gene both control eye color in Drosophila. The cinnabar gene encodes an enzyme producing the brown pigment called ommochrome. Flies with two mutant alleles at the cinnabar gene have orange eyes, because they lack ommochrome. The brown gene encodes an enzyme producing the orange pigment called pteridine. Flies with two mutant alleles at the brown gene have brown flies because they lack the pteridine. The wildtype alleles at both loci are dominant to the mutant alleles. A fly homozygous mutant for both genes has white eyes because it accumulate neither ommochrome or pteridine. The cinnabar gene and the brown gene are 40 map units apart on chromosome II. Suppose you generated a heterozygous fly by mating a homozygous recessive cinnabar fly with a homozygous recessive brown fly. What phenotypic ratio would you expect if you testcrossed this heterozygous fly?

6. 15pts)In guinea pigs, short hair (L) is dominant to long hair (l). For coat color the yellow allele (cy) and the white allele (cw) show partial dominance and heterozygotes have a cream colored fur. A short haired, cream guinea pig is bred to a long-haired white guinea pig and a single long haired cream offspring is produced. When this offspring matures it is mated with the short haired cream parent. What phenotypic ratio would you expect in the offspring if the two genes are unlinked? What phenotypic ratio would you expect in the offspring if the two genes are completely linked?

*7. (15pts) The Manx trait in cats is believed to be an example of a lethal allele. A student set-up experiments with the CATLAB software to test this hypothesis. When she mated a manx cat with a tailed cat the program generated both manx and tailed offspring in a 1:1 ratio. The student then selected two of these offspring as parents, a male manx offspring and a female tailed offspring. When she interbred these offspring she generated 89 manx kittens and 111 tailed kittens. She rejected the hypothesis that the manx allele was lethal because she did not get the 2:1 ratio she was expecting. Explain the error the student made in analysis of the final progeny. Outline a simple experiment which would be a better test of the hypothesis that the Manx trait is lethal.

Fall 1997 exam

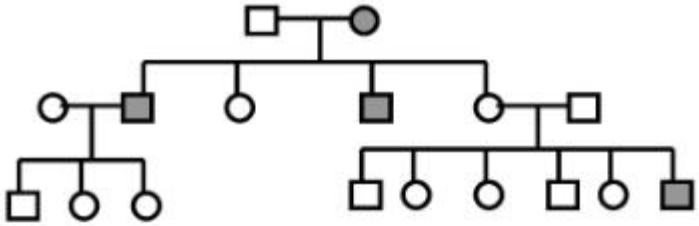
1. In Drosophila, kidney bean eye, cardinal eye and ebony body are three recessive alleles. When heterozygous F1 females were mated with kidney cardinal ebony males the following 2000 progeny were generated. Draw a genetic map indicating gene order and genetic distance. Calculate interference. What does this level of interference mean?

Kidney Cardinal	800
Ebony	887
Kidney Ebony	104
Cardinal	107
Kidney	49
Ebony Cardinal	46
Kidney ebony cardinal	3
Wildtype	4

2. In a breeding laboratory population, some mice seem susceptible to bad dandruff, while other mice have healthy skin. Preliminary experiments suggest this trait is controlled by a single gene and that the dandruff phenotype is recessive. However, it oftern seems that more male mice have dandruff phenotype than female mice, suggesting that the trait may be sex linked or sex influenced. Outline an experiment which can distinguish whether this trait is sex linked or sex influencec. What results would support each result?

3. From the Pedigree below:

A. Does this trait show dominant or recessive inheritance? Cite two different types of phenomena apparent in this pedigree which supports your conclusion..
B. Is this trait sex linked or autosomal? Cite two different types of phenomena which supports your conclusion.



4. In Drosophila the white gene controls the accumulation of pigment in the eye. The wildtype allele (W), which allows pigment accumulation is dominant to the mutant allele (w) which allows prevents pigment accumulation. A second gene purple controls pigment color. The dominant allele causes purple eyes the recessive allele gives normal eye color. Assume both genes are 20 mu apart on the same autosome. What phenotypic ratio would you expect from a testcross of a dihybrid fly with the following genotype?

$$\frac{Wp}{wP}$$

a. Answer only one of the two following questions.
b. Cite three pieces of evidence that suggest that the synaptonemal complex is involved in genetic recombination between homologous chromosomes.
c. Could the term homogametic and heterogametic be used for a species that uses the protenor mode of sex determination? Explain your answer.

*5. A test cross of a tryhybrid resulted in the following distribution of genotypes. Use the Chi-square goodness of fit test to statistically test the hypothesis that the A gene obeys Mendels Law of Segregation.

20 AaBbCc	20 AaBbcc
20 aabbCc	20 aabbcc
5 AabbCc	5 Aabbcc
5 aaBbCc	5 aaBbcc

*6. On a fox ranch in Wisconsin, a mutation arose that gave a platinum coat color. The platinum coat color proved very popular with buyers of fox coats , but the ranchers could not develop a pure breeding platinum strain. Every time they bread two platinum foxes some of the progeny were always red. For example one repeated matting of two platinum foxes produced 82 platinum and 32 red foxes. Similar matings always produced similar results. Explain the genetic phenomena which could cause all mating between platinum foxes to generate this type of phenotypic ratio.

Spring 1996 exam

1. In Drosophila the following three genes are linked on the second chromosome; cinnabare (cn) (Bright red eyes), plexus (px) (extra wing veins) and curved (c) (curved wings). The three dominant wildype traits

are brick red eyes, standard veins and normal wings. In a text cross of a trihybrid for these three genes the following progeny were counted.

Cn	px	c	296
Cn	+	c	63
Cn	+	+	119
Cn	px	+	10
+	px	c	86
+	+	c	15
+	+	+	329
+	px	+	82
		Total	1000

a. What is the genotype of the trihybrid parent in this testcross? (Use a nomenclature that indicates allelic combinations on the chromosome. 5pts)
b. What is the order of the genes on the chromosomes?
c. What is the genetic distances between these three genes?
d. How much interference is there in this region of the chromosome?

Using the data from question 1, statistically test the hypothesis that the cinnabar gene and curled wing gene obey Mendels Law of Independent Assortment.

2. Hemophila and colorblindness are sex linked traits about 20 mu apart on the X chromosome. If a normal womean who had a colorblind mother and hemophilic father mates with a normal man, what is the probability that their first child will be a son who is colorblind and hemophiliac?

*3. Dr. Snyder has been long interested in the genetics of stickleback fish. (Suppose) Last year one of his graduate students brought Dr. Snyder a very unusual sticklebakc fish that he had caught in Lake Cayuga. It had bright blue eyes instead of the normal green eyes. Dr. Snyder carefully bread this blue eye stickleback with one of his green eye sticklebacks from his laboratory population. From the first breeding he observed 323 blue eyed offspring and 340 green eyed offspring. He separated the offspring by eye color and bred them another generation. From random interbreeding of the blue eyed offspring he obtained 425 green eyed fish and 860 blue eyed fish. From random mating of the green eyed offspring he obtained 1200 green eyed fish. Propse a simple genetic relationship to explain the inheritance of eye color in stickleback fish. Be sure it accounts for the phenotypic ratios observed in each generation.

4. Recently the human gene BCA1 was described which has alleles that predispose women to breast cancer. What else would you need to know about this gene before you could describe it as: a. sex linked, b. sex limited, c. sex influenced.

*5. In Drosophila two independently assorting genes, ebony and black control body color. The ebony gene has two alleles, the dominant llele for wild type color and the recessive allele with produces a dark body

color. The black gene has similar effects. It has two alleles, the dominant allele produces wildtype color and the recessive allele produces a dark body color. The dark body color product by ebony and black are very similar. Suppose you crossed true breeding ebony flies with true breeding black flies.

a. What would be the genotype and phenotype of F1 flies?
b. What would be the genotypic and phenotypic ratio in the F2 flies?
c. What phenotypic ratio would you predict if you backcrossed an F1 fly with the ebony parent?

6. Discuss how the study of aneuploids supports the hypothesis tht the Barr body is a condense X chromosome associated with dosage compensation.

Spring 1995 exam

1. A triple homozygous recessive corn plant displayed the recessive phenotypes, glossy leaves, pale leaf color, and spiny stems. This plant was crossed with a triple heterozygous plant which had dull leaves, dark leaf color and spineless stems. A random sample of 1000 of the progeny were germinated and scored for the three traits.

Dull leaves, dark color, spineless	28
Dull leaves, dark color, spiny	179
Dull leaves, pale color, spineless	69
Dull leaves, pale color, spiny	250
Glossy leaves, dark color, spineless	198
Glossy leaves, dark color, spiny	70
Glossy leaves, pale color, spineless	183
Glossy leaves, pale color, spiny	23

a. Determine the genetic distances between the genes and construct a linkage map of these loci. (gl = glossy, pl = pale, sp = spiny)
b. Determine the level of interference
c. The triple heterozygous plant used in this experiment was the progeny of two homozygous plants, What were the phenotypes of these two homozygous plants?

2. How have studies of aneuploids supported the hypothesis that bar bodies are inactivated X chromosomes?

3. In humans the ABO blood type is under the control of autosomal multiple alleles. Color blindness is a recessive sex-linked trait. If two parents who both have type A blood and normal vision produce a son who is colorblind and has O type blood, what is the probability that their next child will be a daughter who is normal visioned and type A blood? Show how you determined this probability.

*4. (Suppose) In brazilian primrose, two pigments can accumulate in flower petals. The B gene controls the production of a blue pigment, the Y gene controls the production of a yellow pigment. The epistatic relationship between B and Y is outlined below:

Genotypes	Phenotypes
B-Y-	Green Petals
B-yy	Blue Petals
bbY-	Yellow Petals
bbyy	White Petals

A third gene, D, controls the synthesis of a dark black pigment. Plants with a dominant D allele synthesize the dark pigment and have black petals regardless of B and Y. Plants homozygous recessive for the D gene have petal colors as determined by B and Y.

a. If a plant heterozygous for B, Y and D was selfed, what proportion of the offspring would have blue flowers?
b. IF the heterozygous plant was testcrossed, what proportion of the progeny would have blue flowers?

*5. Using the data in question 1, statistically test the hypothesis that the alleles of the pale gene and the spiny gene obey Mendel's law of independent assortment.

6. A genetic student was given a culture of fruit flies with white eyes. She isolated virgin female white eyesd flies and mated them with male wildtype flies (red eyed). When she examin the progeny of this cross, all the females had red eyes and all the males had white eyes. She proposed two alternative hypotheses to explain these results. First the white eye trait could be a sex linked recessive trait or the white eye trait could be an autosomal sex influenced trait. How would a reciprical cross (wildtype female X white eyed male) distinguish these possibilites?

7. The A, B and C genes are all autosomal and each as two alleles, the uppercase letter designating the dominant allele and the lower case letter designating the recessive allele. Genes A and B are on one chromosome and are 20 mu apart. The C gene is on a second chromosome. A heterozygous individual with the following genotype was testcrossed.

$$\frac{A\ B\ C}{a\ b\ c}$$

What percentage of the offspring will have each of the following phenotypes?

a. ABC
b. ABc
c. aBc