ALE 8x: Genetics Practice Problems

Please Take Note.....

- There is a list of genetic terms and definitions on page 8 that you may find useful.
- The following six problems sets are for <u>your</u> practice (and enjoyment too!) and will <u>not</u> be collected for stamping or grading, but you will be tested on similar kinds of questions.
- Once you become proficient at solving a certain kind of problem, go on to another kind—don't spend a lot of time solving problems that are easy for you to do—go on to those that are more challenging!

Practice Problem Set I: Making Gametes and Using the Probability Method

1. How many different types of gametes could be generated from individuals with the following genotypes?
   A) AaBb B) AaBbCc C) AaBbCcDd

2. How many different types of gametes could be generated from individuals with the following genotypes?
   A) AABBCc B) AaBBCC C) AABbCC

3. How many different types of gametes could be generated from individuals with the following genotypes?
   A) AABbCc B) AaBbCC C) AaBBCc

4. Given AaBbcc x AabbCc. What are the chances of producing the following genotypes?
   A) AaBbCc B) aabbcc C) AABbCC

5. Given AaBbCC x aabbCc what are the chances of producing the following genotypes?
   A) AabbCC B) aaBBCc C) aabbcc

6. Given the following AaBbCcDD x AAbbccDd what would be the chances of producing
   A) AabbccDD B) AAbbccDD C) AABbCcDd

7. Suppose A = Red and a = White. B = Tall and b = Short. Given the following cross AaBb x aaBb what are the chances of producing the following phenotypes?
   A) Red Tall B) Red Short C) White Short

8. Suppose A = Red, and a = White; B = Tall, and b = Short; C = Round seed, and c = wrinkle seed. Given the cross of AaBbcc x AabbCc what are the chances of producing the following phenotypes?
   A) Red, Tall, and Round Seed

   B) White, Short, and Wrinkled Seed

   C) Red, Short and Wrinkled Seed

9. Suppose you cross a heterozygous red, homozygous tall, heterozygous round seed with a homozygous white, heterozygous tall, homozygous wrinkled seed, what would be the chances of producing the following: (Assume dominance is the same as question 8)
   A) Red, Tall, Round Seed

   B) Homozygous red, Homozygous tall, heterozygous wrinkled

   C) Heterozygous red, Heterozygous tall, Heterozygous wrinkled

Genetics Practice Problem Set 2: Monohybrid Crosses

1. Assume that a single gene determines hair color in humans as follows:
   BB individuals have black hair; Bb have brown hair; and bb have blonde hair.
   a) If two brown hair people marry, what is the probability that their first child will have brown hair?

   b) Assume that their first child did have black hair. What is the probability that the next child will also have black hair?

2. a) A red tomato plant is self-fertilized. 25% of the offspring are green. What is the genotype of the parent? (Indicate the genotype and dominant allele.)

   b) If a plant heterozygous for the red/green alternative alleles is crossed to another tomato plant and all the progeny are red, what is the genotype of the second plant?

   c) In a cross between a red tomato plant and a green tomato plant, if 50% of the progeny (offspring) are red and 50% are green, what are the genotypes of the two parents?.

3. In cattle the polled (hornless) trait is dominant and is determined by the dominant gene D. The horned trait is recessive. A certain polled bull is mated to three cows. Cow A, which is horned, gives birth to a polled calf. Cow B, also horned, produces a horned calf. Cow C, which is polled, produces a horned calf. What are the genotypes of the four parents?

   Bull: Cow A: Cow B: Cow C:

4. In summer squash, white fruit color is dominant; yellow is recessive.
   a) If a squash plant that is homozygous for white is crossed with a homozygous yellow, what will be the phenotype of the F1 generation?

   b) What phenotypes and their fractional amounts would be expected in the F2 generation?

   c) What would be the appearance of the offspring of a cross between an F1 individual and a homozygous yellow individual? (include the fractional amounts of each type)

   d) What is the name of the type of cross that was performed in c?

5. Lithuanian lima beans have inflated pods, but you have discovered a mutant variety with flat pods (how exciting!!!). If a recessive gene determines flat pod, what phenotypes and their fractional amounts would be expected in the F1 and the F2 of a cross between a true breeding flat and a true breeding inflated?

Genetics Practice Problem Set 3: Dihybid and Sex-Linked Crosses

1. In the land of Magumba there grows the fabled Bungula. In Bungulas, Red Fur color, A, is incompletely dominant over Purple Fur, a, the heterozygous condition being Green Fur. Long Wings, B, are dominant over short wings, b.

   a. If a pure breeding Red, short-winged Bungula is mated with a pure breeding Purple, long-winged one, what will be the Phenotypes and their expected occurrences in the F1 generation?

   b. What will be the phenotypes and their expected occurrences in the F2?

2. In *Drosophil*a (fruit fly) yellow body color is sex linked --- yellow is recessive to normal body color. If a yellow bodied female is crossed with a normal male and (a) an F1 female from this cross is mated with her father and (b) an F1 male is mated with his mother, what will be the phenotypes (as to body color) and their expected occurrences in the offspring of cross (a) and cross (b)? Don't Panic! State results for the two sexes separately.

   a.

   b.

Genetics Practice Problem Set 4: Multiple Alleles and Blood Groups

1. What are the possible blood types of the children in the following families?
   a. Mother: Type A blood and Father: Type A.

   b. Mother: Type B blood and Father: Type AB.

   c. Mother: Type A blood and Father: Type O.

2. A mother has Type A, Rh- blood and the father has A, Rh+ blood.
   a. What are all the possible genotypes of the offspring these two could produce?

   b. What are all the possible phenotypes of their potential offspring?

3. A mix-up happened in the maternity ward of a hospital. Baby A (Blood type A) and Baby B (Blood type O) lost there ID tags!! If the suspected parents have the following blood types, match the babies with the correct parents.
   Couple 1: Type B and Type A; **Couple 2**: Type A and AB

4. A mother has Type AMRh- blood and the father has ANRh+ blood
   a. What are all the possible genotypes of the offspring these two could produce?

   b. What are all the possible phenotypes of their potential offspring?

Genetics Practice Problem Set 5
Crossing over, Linkages, and Independent Assortment

For problems 1 - 6 assume the following allelic relationships exist in fruit flies:

- Normal body (N) is dominant to fat body (n).
- Red eyes (R) is dominant to purple eyes (r).
- Straight wings (S) is dominant to curved wings (s).
- Long legs (A) is dominant to short legs (a).
- Yellow body color (B) is dominant to black body color (b).
- Long feelers (F) is dominant to short feelers (f).

Use this information about genes in fruit flies to decide whether the given crosses and their results given below represent:

A. Crossing Over.
B. Linkage.
C. Sex Linkage.
D. Independent Assortment.

1. Crosses between flies with genotype NnRr and flies with genotype nnrr produce offspring as follows:

   50% normal body, red eyes
   50% fat body, purple eyes

2. Offspring from the cross RrSs x rrss were:

   25% red eyes, straight wings
   25% red eyes, curled wings
   25% purple eyes, straight wings
   25% purple eyes, curled wings

3. Offspring from the cross AaSs x aass were:

   50% short legs, straight wing
   50% long legs, curled wing.

4. Given what you know from the cross results in problem one (NnRr x nnrr) what would be illustrated if that same cross yielded the following results:

   49% normal body, red eyes
   49% fat body , purple eyes
   1% normal body, purple eyes
   1% fat body, red eyes

5. A black female is mated to a yellow male results in:

   25% yellow females
   25% yellow males
   25% black females
   25% black males

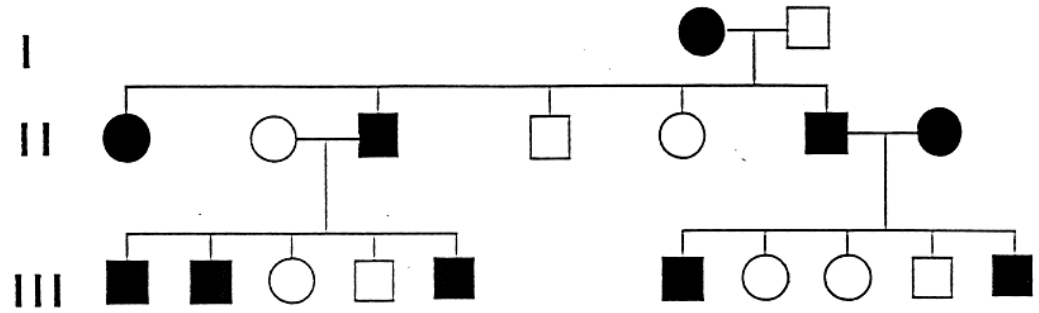
6. A female with long feelers is mated to a male with long feelers resulting in:

   females: 100% with long feelers
   males: 50% with long feelers and 50% with short feelers.

Genetics Practice Problem Set 6: Human Pedigrees

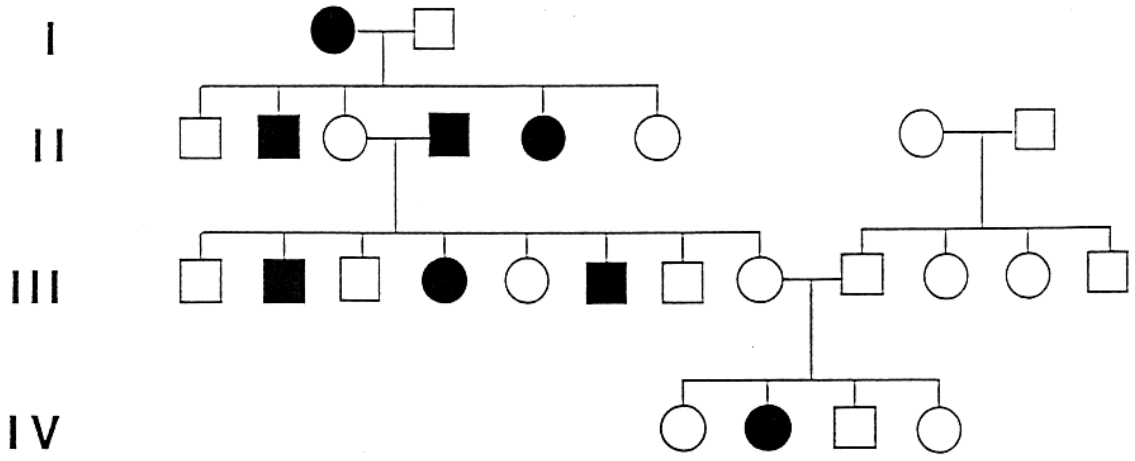
In the following four human pedigrees the individuals that are solid possess the trait mentioned. In the blank following the title of the pedigree state whether the trait is dominant or recessive. In the corresponding blanks below the pedigree complete the requested genotypes as fully as possible but do not include any genes that cannot be determined with certainty. Disregard the possibility of such things as environmental influence and mutations.

1. STREAK HAIR (Use **H** and **h**) _____



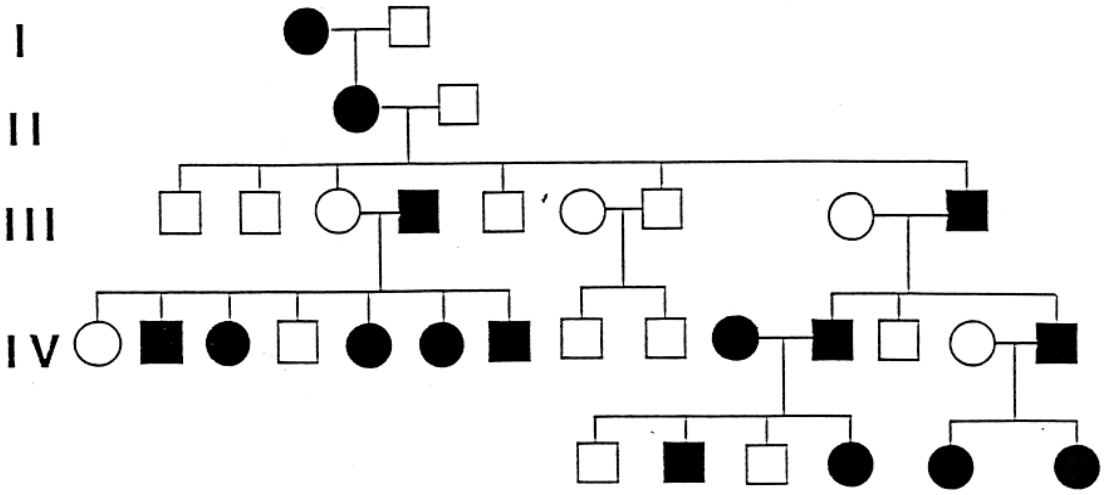
Generation I: 1 ___ 2 ___
Generation II: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___
Generation III: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___
6 ___ 7 ___ 8 ___ 9 ___ 10 ___

2. LEFT-HANDEDNESS (Use **R** and **r**) _____



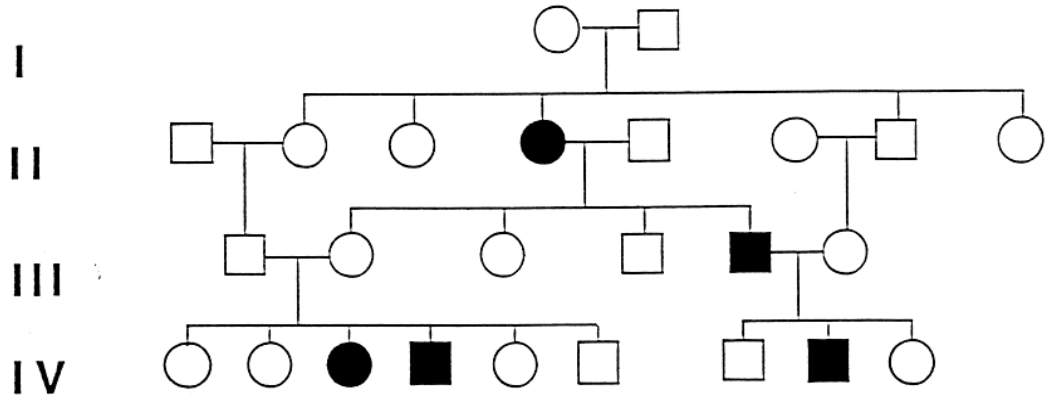
Generation I: 1 ___ 2 ___
Generation II: 1 ___ 2 ___ 3 ___ 4 ___
5 ___ 6 ___ 7 ___ 8 ___
Generation III: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___
7 ___ 8 ___ 9 ___ 10 ___ 11 ___ 12 ___
Generation IV: 1 ___ 2 ___ 3 ___ 4 ___

3. **POLYDACTYLY** (Six Fingers) (Use **B** and **b**) _____



Generation I: 1 ___ 2 ___
Generation II: 1 ___ 2 ___
Generation III: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___
7 ___ 8 ___ 9 ___
Generation IV: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___
8 ___ 9 ___ 10 ___ 11 ___ 12 ___ 13 ___ 14 ___
Generation V: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___

4. **MUSCLE ATROPHY** (Use **A** and **a**) _____



Generation I: 1 ___ 2 ___
Generation II: 1 ___ 2 ___ 3 ___ 4 ___
5 ___ 6 ___ 7 ___ 8 ___
Generation III: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___
Generation IV: 1 ___ 2 ___ 3 ___ 4 ___ 5 ___
6 ___ 7 ___ 8 ___ 9 ___

Terms And Definitions Used In Genetics

ALLELE: One of two or more (mutant: i.e. chemically different) different forms of a gene. Example: A = wild type allele; a = a different (mutant) allele of R

CENTROMERE: The specialized part of a chromosome where the spindle fibers are attached during cell division.

CHROMOSOME: A thread of DNA (Deoxyribonucleic acid)

SISTER CHROMATIDS: Two genetically identical daughter strands of a replicated chromosome, joined by a single centromere.

GENE: The basic hereditary unit that occurs at a certain place (locus) on a chromosome. It can mutate into various allelic forms. Also, a specific DNA coding for one function.

LOCUS (plural **LOCI**): The location of a gene on a chromosome. Example: A pair of alleles has the same loci on homologous chromosomes.

HOMOLOGOUS CHROMOSOMES: Chromosomes having the same kinds of genes in the same arrangement. Example: Human Paternal Chromosome #22 is homologous to the Human Maternal Chromosome #22.

DOMINANT ALLELE: An allele that masks the expression of another allele of the same gene. Example: A masks (is dominant to) a.

RECESSIVE ALLELE: An allele that is masked by another allele of the same gene. Example: a is masked by (is recessive to) A.

F_1: The first filial generation; the offspring resulting from the first experimental crossing of plants or animals.

F_2: The offspring produced by the crossing of two F1 individuals.

GENOTYPE: The genetic composition or formula for one or more genes (allelic pairs). Examples: formula (genotype) is Aa, AA or AATt.

HOMOZYGOUS: Used in reference to a genotype. Having a pair of like alleles for any one gene. Examples: AA, aa, tt.

HETEROZYGOUS: Used in reference to a genotype. Having a pair of unlike alleles for any one gene. Examples: Aa or Tt.

PHENOTYPE: The visible or detectable properties of an organism produced by the combined effect of the genotype and the environment.

MONOHYBRID: A cross between parents differing with respect to one specified pair of alleles of a given gene. Examples: AA crossed with aa, or Aa crossed with Aa.

DIHYBRID: A cross between parents differing with respect to two specified pairs of allelic genes. Examples: AABB crossed with aabb, or aaBB crossed with AaBb.

TEST CROSS (BACKCROSS): A cross between a homozygous recessive critter and a critter showing the dominant trait. This allows the genotype determination of the dominant critter if it is unknown. Example: Cross a short (recessive) with a Tall (dominant) If F_1 are 100% Tall then Tall parent is AA; if F_1 are 50% Tall, then Tall parent is Aa.

PUREBRED or TRUE BREEDING: Having all specified alleles homozygous. Examples: AA, aa, AAbb, AABB, aaBB, aabb.