Genetic Practice Problems

1. In pea plants, yellow seeds are dominant over green seeds. Show a cross between a heterozygous plant with yellow seeds and one with green seeds, and the give the e.g.o (expected genotypic outcome) and the e.p.o (expected phenotypic outcome).

2. Show a cross between a two pea plants with yellow seeds (one is homozygous dominant and the other is heterozygous).

3. In snapdragons, a gene that affects flower color has two alleles – red and white. In heterozygous individuals, the phenotype is pink. What type of inheritance pattern is this?

4. Show a cross between two pink snapdragons and give the e.g.o. What is the expected phenotypic outcome of this cross?

5. In humans, the ABO blood type is controlled by a gene that has three alleles, represented with the symbols I^A, I^B, and i (or I^O). Show a cross between two heterozygous people – one who has A blood, and one who has B blood. Give the e.g.o. and e.p.o. of this cross.

6. Yellow coat color in mice is caused by an allele that is lethal in the homozygous condition. The yellow phenotype shows up in individuals that are heterozygous – they have the yellow allele and the wild type "agouti" allele, which produces the normal gray coat color. Show a cross between two yellow mice and give the e.g.o and e.p.o. of the cross.

7. In shorthorn cattle, coat color may be red, white, or roan. In roan cattle, their coats are a mixture of red and white hairs, although the animals appear a light rust color from a distance. What type of inheritance pattern is this?

8. Show a cross between two roan cattle and give the e.g.o. and e.p.o.

9. In fruit flies, a gene that helps determine the eye color is located on the X chromosome. The dominant wild type allele produces red eyes, but there are several other alleles that produce other colors, including scarlet, apricot, and white. These three alleles exhibit a dominance hierarchy, with scarlet dominant over both apricot and white, and apricot dominant only over white. What are good symbols to use for each of these alleles?

   Red = _____ Scarlet = _____ Apricot = _____ White = _____

   Show a cross between a scarlet male and a female who has one apricot and one white allele.

10. In foxes, a gene has two alleles which will call P and p. The genotype **PP** is lethal, **Pp** produces platinum coat, and **pp** produces silver coat. Show a cross between two platinum foxes and give the e.g.o. and e.p.o. of the cross.

11. Colorblindness, a recessive trait, is more common in males than females because the gene is located on the X (sex) chromosome. This is known as a sex-linked trait. Show a cross between a guy with color blindness and a normal female. Show both the e.g.o. and e.p.o. Also, what is the probability that an offspring will be colorblind?

12. Hemophilia is a recessive sex-linked trait caused by a defective gene. The normal allele produces a protein called Factor VIII that allows blood to clot. Without injections of synthetic Factor VIII, hemophiliacs are at risk of dying due to excessive bleeding. Make a Punnett square to show a cross between a normal male and a female who is heterozygous. Give the e.g.o. and e.p.o for this cross.

13. Red-green colorblindness is also a recessive sex-linked trait. Make a Punnett square to show a cross between a colorblind male and a homozygous normal female. Give the e.g.o. and e.p.o. of this cross.

15. Although it's rare to have females with the recessive phenotype for sex-linked traits (like hemophilia and colorblindness), it does sometimes happen. That said, females with colorblindness are much more common than females with hemophilia. How do you get a female with this type of disease and why are you more likely to have a colorblind female than a hemophiliac female?

16. The genes that control height and the seed texture in pea plants are on different chromosomes. There are two alleles for height: the dominant tall, and the recessive short. For seed texture, round is dominant over wrinkled.

   i. Write symbols for the alleles. Tall = _____; short = _____; round = _____; wrinkled= _____

   ii. A homozygous tall/homozygous wrinkled plant is crossed with a homozygous short/homozygous round plant. Write down the genotypes of the two parental plants.

   _____ x _____

iii. Make a Punnett square to show the cross between these two plants.

iv. Give the expected genotypic and phenotypic outcomes of this cross.

v. Looking at one of the members of the F_1, what allelic combinations could it produce for these two genes when it makes its gametes?

vi. Make a Punnett square to show the cross between two members of the F_1 generation.

vii. Give the expected genotypic and phenotypic outcomes of this cross.

viii. What proportion of the offspring is homozygous for both traits?

17 . In chickens, the comb shape is controlled by two genes – Pea (P/p) and Rose (R/r). Depending upon the combination of dominant and recessive alleles for these two genes, 4 different phenotypes can be produced. Having at least one dominant P and one dominant R allele produces the "walnut" phenotype. Having at least one P and two small r's produces the "pea" phenotype. Having two recessive p's and at least one dominant R produces the "rose" phenotype, and having all recessive alleles (pprr) produces the familiar "single" phenotype. Show a cross between two chickens with the genotypes PPrr x ppRR. Give the e.g.o. and e.p.o.

18. Genealogy of the Gods

The Greek god, Zeus, was notorious for his affairs with women, goddesses, and beasts other than his wife, Hera. As a result, many paternity suits were brought against him. These cases were either supported or disproved based upon blood tests. See if you can deduce the blood types and settle the suits.

Zeus *and* ***Hera*** *(who had O blood) had* ***Ares****, the God of War, who also had O blood.*

Zeus had an affair with the ***Leto,*** *the Titan Goddess of Invisibility. She had A blood. They had twins,* ***Apollo*** *– God of Music, and* ***Artemis****, the Goddess of the Hunt. Apollo had AB blood and Artemis had A blood. Leto had numerous offspring, all of which had A or AB blood – none had B or O blood.*

Zeus and ***Maia****, daughter of Atlas, had* ***Hermes****, the Messenger God. Hermes had B blood. Maia had offspring with A, B, AB and O blood, but none of Hermes numerous offspring had O blood.*

Zeus came to the mortal woman ***Semele*** *in the form of a shower of gold. When she became pregnant, the jealous Hera suspected that she carried Zeus' child. Hera tricked Semele into asking Zeus to reveal his true self to her. Being mere mortal, Semele was struck dead by the sight of Zeus in his terrible glory, but Zeus snatched the baby from her womb and implanted it within his thigh. After what must have been a difficult-to-explain gestation period,* ***Dionysus****, the God of Wine and Revelry, sprung forth fully formed. He had A blood. Dionysus' half-brother (born before him, obviously) had O blood.*

The parentage of ***Persephone****, the Goddess of the Spring, is also in dispute. Some say that she is the daughter of* ***Zeus*** *and* ***Demeter*** *(Goddess of Fertility and the Harvest) who had B blood. Others say that the Sea God,* ***Poseidon****, saw Demeter running along the beach in the form of a horse. He allegedly changed himself into a horse and fathered Persephone (she had AB blood). Who was the likely father, Zeus or Poseidon?*

Determine the genotypes of these characters and write them in the spaces below. You may find it helpful to make small pedigrees like the one below.

_?_?_ Zeus ------ Hera _?_?_
_?_?_Ares

1. Zeus _____ 2. Hera _____ 3. Ares _____

4. Leto _____ 5. Apollo _____ 6. Artemis _____

7. Maia _____ 8. Hermes _____ 9. Semele _____

10. Dionysus _____ 11. Demeter _____ 12. Persephone _____

13. Was Zeus the father of Persephone? _____