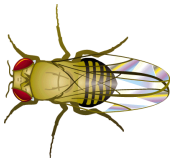
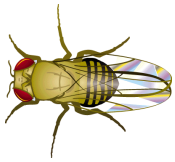


Genetics Problem Set #3

Sex linkage and other stuff Mendel never dreamed of…



Sex-Linked vs. Autosomal Traits:

1) Hemophilia or "bleeder's disease" is a **recessive, sex-linked condition.** It is possible for women to be hemophiliacs, but it is more common among men.

A) For a woman to be a hemophiliac, what must her dad's phenotype and genotype have been?
B) There are two possibilities for her mother's genotype & phenotype – give both.
C) Of the 2 possibilities in part A, which one is most likely for the mother? Why?

2) At least one type of colorblindness is a **sex-linked, recessive condition.** A colorblind man marries a woman with a long family history of normal color vision. What would you predict for the vision of their children? (Genotype and phenotype ratios)

3) A husband and his wife both have normal vision, but their baby girl is colorblind. Because he knows that colorblindness is a **sex-linked, recessive trait,** the husband is FURIOUS and immediately sues his wife for divorce on grounds of infidelity. YOU, as a world-famous GENETICS COUNSELOR, have been served a subpoena to testify in court as an expert witness! Could the baby have been theirs, or must she have been unfaithful to him?

4) One type of baldness is a ***sex-influenced trait.*** The gene for baldness (B = has hair, b = bald) is NOT on a sex chromosome, but the person's sex does influence the expression of this trait. All BB individuals have hair, and all bb individuals go bald, but (due to hormonal differences) Bb women have hair while Bb men go bald. A bald man and a seemingly normal woman have a son who keeps his hair as he ages, and a daughter who loses hers. What are the genotypes of the man, his wife, their son, and their daughter?

5) In cats, the allele B leads to black fur and b leads to yellow fur. However, Bb is tortoise-shell color (in other words, B and b are **codominant**). **The gene for color is on the X chromosome.** A tortoise-shell female is crossed with a black male.

A) What kinds of kittens would be expected? (genotype and phenotype ratios, including sex!)
B) Would you expect to find any tortoise-shell males?

6) A man with hemophilia (a recessive, sex-linked condition) has a daughter of normal phenotype. She marries a man who is normal for the trait.

A) What is the probability that a daughter of this mating will be a hemophiliac?
B) That a son will be a hemophiliac?
C) If the couple has four sons, what is the probability that all four will be born with hemophilia?

7) Pseudohypertrophic muscular dystrophy is a disorder that causes gradual deterioration of the muscles. It is seen only in boys born to apparently normal parents and usually results in death in the early teens.

A) Is this disorder caused by a dominant or a recessive allele?
B) Is its inheritance sex-linked or autosomal? How do you know?
C) Explain why this disorder is seen only in boys and never in girls.

8) Freckles are dominant to plain skin and the freckle gene is on an autosome; hemophilia (a disease in which blood doesn't clot properly) is a sex-linked, recessive trait. A woman with plain skin and normal blood clotting (long family history of plain skin, but her dad was a hemophiliac) marries a man with freckles and hemophilia. They have a hemophiliac son with plain skin.

A) What is the son's genotype?
B) What were the parents' genotypes?
C) What is the chance that they will have a daughter who has hemophilia and who has freckles?

Linkage, Recombinant, and Gene Mapping Problems:

9) A wild-type fruit fly (heterozygous for gray body color and normal wings) was mated with a black fly with vestigial wings. The offspring had the following phenotypic distribution:

Wild type: 778 black-vestigial: 785
Black-normal: 158 gray-vestigial: 162

What is the recombination frequency between these genes for body color and wing type? (HINT: compare the phenotypes of the offspring to those of the parents…which phenotypes show a NEW combination of traits that was not present in either parent?)

10) Determine the sequence of genes along a chromosome based on the following recombination frequencies:

A – B: 8 map units
A – C: 28 map units
A – D: 25 map units
B – C: 20 map units
B – D: 33 map units

11) A space probe discovers a planet inhabited by creatures who reproduce with the same hereditary patterns as those in humans. Three phenotypic characters are height (T = tall, t = dwarf), head appendages (A = antennae, a = no antennae), and nose morphology (S = upturned snout, s = downturned snout). Since the creatures were not "intelligent," Earth scientists were able to do some controlled breeding experiments using various heterozygotes in testcrosses. (REMEMBER: a test cross involves crossing one organism with a homozygous recessive!).

When a heterozygous tall individual with antennae (TtAa) was crossed with a dwarf individual without antennae (ttaa), the offspring were:

Tall-antennae: 46 Dwarf-no antennae: 42
Dwarf-antennae: 7 Tall-no antennae: 5

When a heterozygous individual with antennae and upturned snout (AaSs) was crossed with a no antennae-downturned snout (aass), the offspring were:

Antennae-upturned snout: 57 No antennae-downturned snout: 48
Antennae-downturned snout: 2 No antennae-upturned snout: 3

Calculate the recombinant frequencies for both experiments. (see hint in problem #9)

12) Using the information from problem #11, a further testcross was done using a heterozygous individual who was tall with upturned snout (TtSs) who was crossed with a dwarf-downturned snout (ttss).

The offspring were:

Tall-upturned snout: 40 Dwarf-downturned snout: 42
Dwarf-upturned snout: 9 Tall-downturned snout: 9

Calculate the recombinant frequency from these data.

***THEN* use your answers from problems 11 & 12 to determine the correct sequence of the three linked genes…draw them on a chromosome map below!!!**