

1. In the snail *Limnaea*, Shell coiling is determined by the nuclear alleles S^+ (dextral) and s (sinistral). This gene acts in a fashion known as "maternal effect". Two sinistral snails (George and Martha) of unknown genotype are mated and all of the progeny were dextral. When these dextral offspring were crossed it was found that $3/4$ of the dextrals had dextral progeny, but $1/4$ had sinistral progeny.

What were the possible genotypes of:

- a) mother of George _____ father of George _____
b) mother of Martha _____ father of Martha _____
c) Offspring of George and Martha _____

2. Many genes in many organisms have homeobox domains.

Organism	Number of Genes with Homeobox domains
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<i>Saccharomyces cerevisiae</i>	9
<i>Arabidopsis thaliana</i>	118
<i>Caenorhabditis elegans</i>	109
<i>Drosophila melanogaster</i>	148
<i>Homo sapiens</i>	267

- a) What is a homeo domain and what purpose does it serve?
- b) How might so many different copies of it arise? (write as a list)
- c) Why do these different organisms have such different numbers of these gene? Be specific and think about function.

3. The “molecular clock” is a measurement of time since evolutionary divergence of related species based on the number of mutational differences. Unfortunately the molecular clock does not run at a steady pace for all DNA sequences equally. For each of the sequences below circle whether you would expect the clock would run faster, average, slow, or very slow compared to the average rate of DNA sequence changes in mammals. You may need to look up what some of these are online (Google or wikipedia is fine).

Histone H3 coding region	very slow	slow	average	fast
Histone H3 intron	very slow	slow	average	fast
Adh gene coding region	very slow	slow	average	fast
Microsatellite repeat length on chromosome 21	very slow	slow	average	fast

Random Review type problems

4. Draw the events (chromosomal) that produce an MII pattern for a gene (A) in *Neurospora*. Draw the chromosomes, alleles, and centromeres below the meiosis stages.

Prophase Meiosis I Telophase meiosis I Telophase Meiosis II

5. Gene g causes blue eyes in a breed of dogs, as does gene r. Both are autosomal recessive and unlinked. Embryos that are ggrr fail to develop and are never born.

If you breed a ggRR dog to a GGrr dog

a) What genotype and phenotype do you expect in the puppies.

b) What phenotypes, and in what proportions, would you expect in F2 puppies.