1. You measure the genotype of a population of fish, and find the following. Is the population in Hardy-Weinberg equilibrium at this gene?
HH: 361
Hh: 126
hh: 13

2. You're tracking the frequency of a specific allele in an experimental population of fruit flies. The population is carefully isolated from any other flies, and no selection is occurring under your controlled conditions. You notice that the frequency of this allele decreases for three generations in a row. What evolutionary force is causing that change? Can you predict what will happen in the next generation?

3. Coat color in squirrels is controlled by a single gene, *Mc1R*. This gene has two alleles, E and e. EE homozygotes are grey; ee homozygotes are brown, and the Ee heterozygotes are black. What type of dominance controls this trait? If we found that black squirrels had the highest fitness, what kind of selection would that be, and what would we expect to happen to allele frequencies at that gene?

4. You know the allele frequencies of a population; f(B) = 0.23, f(b) = 0.77. Assuming the population is in Hardy-Weinberg at this gene, what will the genotype frequencies be in the next generation?

5. Which of the forces of evolution is most likely acting in each case? If it's selection, can you figure out which kind?

> A landslide kills half of a population of flowers that used to be half white and half yellow. The survivors are mostly white with only a few yellow ones.
>
> In a mountain range where climate change is making snow melt earlier, plant populations are showing a genetic change to flower earlier in the year.
>
> In a population of widlflowers, very tall plants are likely to be eaten by deer, while very short plants can't get enough light to flower; plants that are intermediate in height produce the most seeds.

A population of flickers (a type of bird) used to be 100% yellow, but ever since a big storm carried a few red flickers east into their territory a couple of generations ago, the population is partly yellow and partly red.

In a vial of red-eyed fruit flies that someone is keeping in a lab, a single new fly is born with white eyes.

A species of coastal bird was nearly wiped out from use of the pesticide DDT a few decades ago (DDT poisoned their food, which poisoned them). Before that, this bird had 5 different color patterns that could be found. After DDT was banned, the population rebounded and got larger again, but only 2 color patterns are present.

6. In a hypothetical population of beetles, the size of their horns is variable, and controlled by a single gene. Horns can be either short or long; long is completely dominant to short. You collect data on the population, and find that 89 individuals have short horns and 164 have long horns. Assuming that the population is in Hardy-Weinberg equilibrium, what are the frequencies of the two alleles? (hint: what is the genotype of the individuals with the short horns? How can you use that to figure out the allele frequencies?)

7. You measure the genotypes of a population of fish, and find the following. Is the population in Hardy-Weinberg equilibrium at this gene?
RR: 49
Rr: 387
rr: 164

8. Let's look at what happens if one allele is rare. Using the allele frequencies below, calculate what the genotype frequencies will be if the population is in Hardy-Weinberg equilibrium. Can you make any kind of general statement about where the copies of an allele will be found if it's very rare, and how that might affect how the trait is expressed?
$f(A) = 0.001$
$f(a) = 0.999$

9. The version of the Hardy-Weinberg equation that we've talked about is for two alleles. What would the equation be for three alleles? Use the symbol "r" for the allele frequency of the third allele. (hint: think back to how we got to that equation in the first place)