Lab 13 Natural Selection

(June 2014)

Section 1 – Significance of Natural Selection to Biology

[2] Well look who survived Bio 3! Here we are at the last lab and I know you've learned quite a lot of biology if you've made it to this point. Congratulations! Just one more topic to go and it's a very important one to biologists – evolution.

[3] Have you ever heard anyone say that evolution is "just a theory"? Well that doesn't make too much sense because a theory is one of the most powerful ideas in science. A theory is an idea that

Section 2 – Sample Squares and Frequencies

[17] Okay, if you really have a good grasp of all these terms, it's time to get started. To simulate what happens in a natural population, let's say some mice, we have to realize that the population has variation, in this case we'll look at color. Some mice are dark colored, some mice are medium, and some are light. This variation doesn't have to be this dramatic, but let's keep the variation easy to see because this variation is the key to Natural Selection. Since we can't use live mice in the lab, we're going to use colored beads to represent each color of mouse.

[18] The colors of dark, medium and light are, of course, their phenotypes. The combinations of genes that result in these colors are the genotypes. To have a nice variety, we'll use a pattern of incomplete dominance between the A and A' alleles. Answer the questions below the table at the beginning of Section 2 before you go on.

[19] Our population will live and grow in a field of grass. As time goes by, different mice will mate with each other and we can use our trusty punnett squares to predict the offspring. A dark mouse is represented by the dark green bead and has a genotype of AA. All of its offspring will receive one A allele from him or her since this is the only allele it can pass on in its haploid gametes.

[20] The medium mouse will be represented by the yellow bead, and can pass on either the A or A' allele, since it is heterozygous. The light mouse will be represented by the colorless bead, and have two A' alleles.

[21] Take a moment and fill in the punnett squares and offspring ratios in Section 2 of your lab. This will be a big help when we get the population going, because we're going to assume that each mating pair of mice have four offspring, just like the punnett square shows.

Section 3 – Selection Pressure – The Predator

[26] We're now going to gather up our population. Go up to the demo table and collect the following beads to represent our little mouse population – 10 green, 10 yellow and 10 colorless beads. Place the beads in the plastic container at your booth, so they don't roll away. This group of beads will be our "parental" or "P" generation.

[27] Fill in the table showing your population and complete the allelic frequency calculation at the beginning of Section 3 before we go on.

[28] I hope you found the allelic frequency to be .50 and .50, in other words, 50% of the alleles are A, the other 50% are A'. A quick way to check this calculation is to add up the two frequencies and make sure they add up to 1.00, or 100% of the alleles.

[29] Our population of 30 little mice are having a wonderful time, living in a field of grass that we will represent with this crummy old yellow carpet. Now I'm afraid I have some very bad news for our 30 little mice. An owl has just moved into the neighborhood and he just loves mice. Swallows 'em whole. Now let's see some Natural Selection.

[30] Take your plastic container with the 30 little mice beads to the demo table and follow the instructions in your lab manual for the "Darwin Box" exercise. A couple of hints on the box – make sure you are **looking** in the box when you hunt down your little beads, just like an owl would. Remember that if you picked up a bead, it died. The survivors are the ones still in the box. Continue when you have Section 3 completed and the instructor has signed your book.

Section 4 – The Next Generation

[31] Well that wasn't very pleasant for our little mouse families, was it? Oh well, circle of life and all that. But I think they've calmed down enough to get to the next important step of population change – reproduction. You'll be glad you completed all those punnett squares a while ago, because we're going to need them next.

[32] So after predation, we have our 20 terrified mice left. Place your 20 survivors in the plastic container and pull them out two at a time, forming mating pairs. Record the numbers of each type of pair in the table at the beginning of Section 4. You may have several pairs of the same type, or you may not have any of a particular pairing. Everyone gets different answers. Come back to the program when you have recorded the mating pairs.

[33] Each pair will have four offspring, in the ratios that the Punnett square predicts. These offspring will represent the F1, the next generation after the "P" generation. Because you might get multiples, let me show you an example of how to calculate the right number of offspring. If you have 3 mating pairs of yellow crossed with yellow, it's like having three families. You could do the punnett square three times, but wouldn't it be easier to multiply the results of the square by the number of pairs? The square shows a 1:2:1 ratio, but we will actually have a ratio of 3 green beads to 6 yellow beads to 3 colorless beads when we account for all the offspring of the three families.

[34] Fill in the rest of the table with the correct number of offspring from each pair, then total the alleles as we did before. This table reflects our next generation of mice, the F1. When the table is complete, have the instructor sign off your table. Continue when you are ready to begin Section 5.

Section 5 – And the Next Generation

[35] When we last saw our mice, they all had nice little families. The parents (our original 20 mice that survived the owl attack) have died of old age and the kids have grown up. Copy the F1 totals from Section 4 into the table at the beginning of Section 5.

[36] You should have 40 little mice that represent the F_1 generation. In fact, there are so many tasty little mice running around, it has attracted the attention of the owl. Our predator is acting as a constant selective pressure, and he'll do his part in our drama coming up.

[37] The F1 generation contains the same varieties of dark, medium and light mice, and the owl has no trouble seeing the dark mice against the light grass field. We will assume the owl will swoop down once again and take the same percentage of dark mice he was able to catch before. Calculate the number of dark mice surviving and complete the F_1 generation survivor table, then return to the program.

[38]

[42] The gene frequency has changed, and you've just watched evolution happen. Most importantly, you measured it. Now if you had just walked up to the field of grass every once in a while, it is very unlikely that you would have noticed the change, but because we now have the numbers in front of us, it's pretty obvious what has happened.

[43] Here's a graphic that might put the whole lab into perspective for you – all the generations at once. Notice how you wouldn't ever be able to see the genetic change happening because the change does

you to know that they've been going back to the island every year since 1973. That's what it takes to study evolution.

[51] The Grants were on hand to watch what happened to the bird population in 1977 when a terrible drought occurred. 1200 of the 1400 marked birds died. But the important question is who survived to reproduce the next year? Look at this data and find the answer.

Section 9 – Extinction

[59] But evolution can't always keep up with environmental change. There have been many, many loser species in the millions of years life has been on this planet. One type of organism