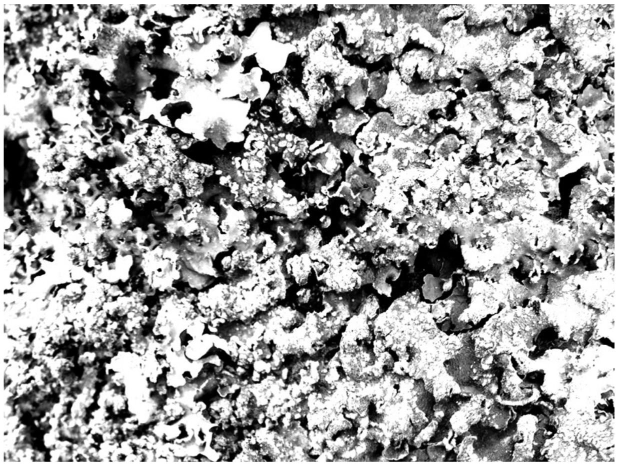
Moth Evolution Simulation Cheat Sheet

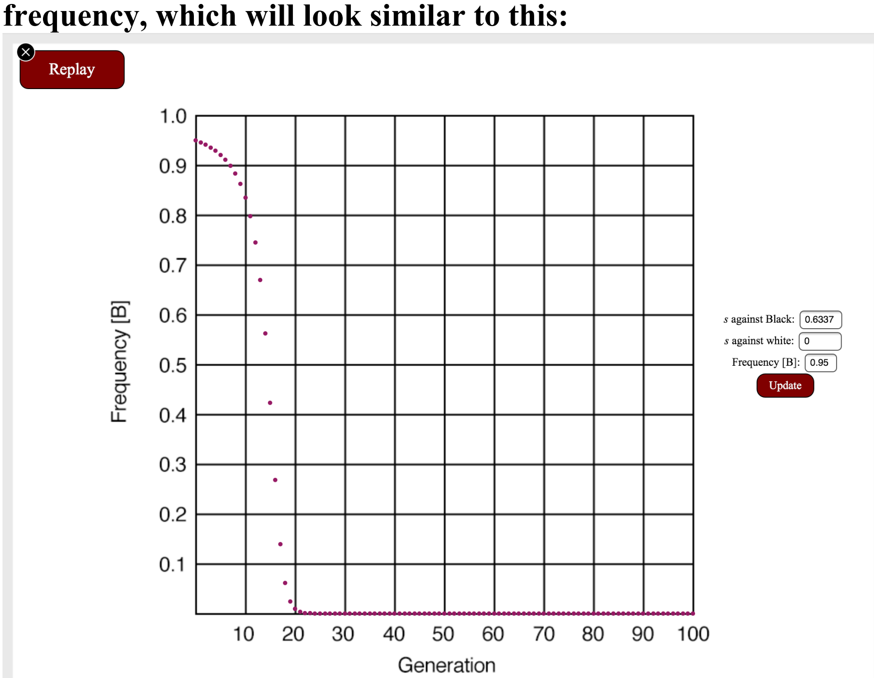
Read lab manual pages 193-196, and watch the optional three videos on natural selection and evolution posted on Canvas for this week, which is week 10.

Do the Moth Evolution simulation, found in the lab manual in widget 7.F.2.

7.F.2 Now play the game with the moths settled on lichens. Simulation Ryan Peterson



Go through the simulation, which takes a couple minutes. Try to find the moths and click on them as they move down on the screen. You are pretending that you are a predator eating the moths off of lichen-covered tree trunks. The idea is that the white moths are more easily seen on a darker background and therefore will be predated on more often when there is a dark background behind them. Likewise, the black moth is more easily seen on a lighter background and will be predated on more often if they are on a lighter background. **You'll then get to the end where you will have the option in the top left hand corner (the red button) to run 100 generations of your results. You'll then be taken to a screen with a graph of allele frequency, which will look similar to this:**



The idea here is that if the tree trunks are covered in a light colored lichen, then the light predated on less, then they are more likely to survive to reproductive age and pass on that trait for light coloration, and this trait can then persist in the population and become more frequent. The dark moths will stand out against the light background and will be predated on more often, and as a result, will not be able to pass on the dark trait as often, so that trait will become less common/less frequent in the population. Conversely, if these moths lived in a polluted area, the lichen would become polluted and turn a dark color, making the dark trait more advantageous than the white.

The Graphs

s = selection coefficient
Frequency [B] = the starting frequency of allele B (black)

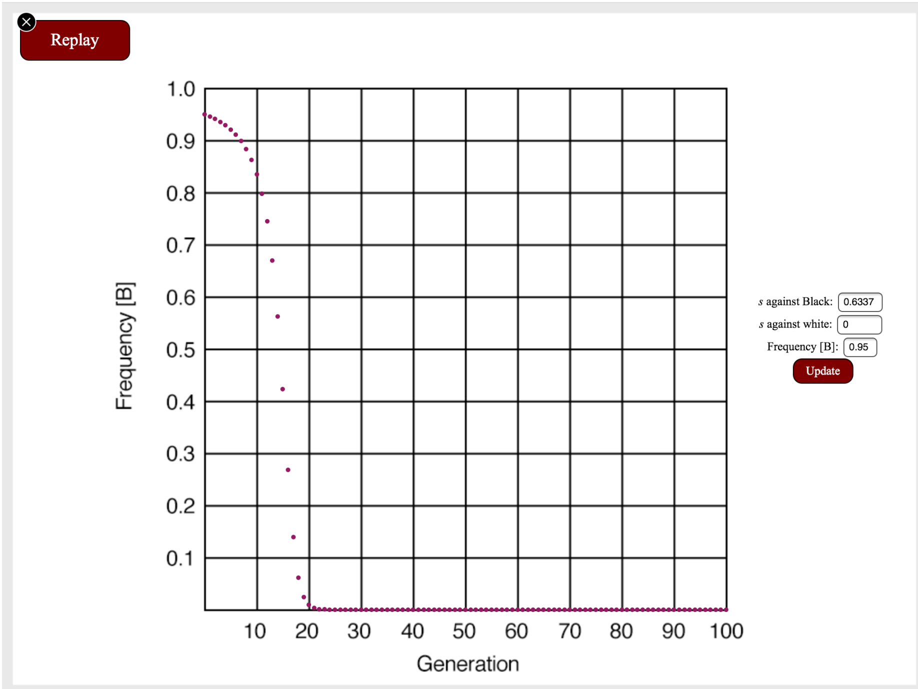
Allele is basically another word for gene or trait. So, the graph is showing us the frequency of the traits (black or white coloration) in the population after the moths have reproduced for 100 generations. A high frequency of allele B (black) means a low frequency of white (b) in the population.

A selection coefficient is a measure of the extent to which natural selection is acting to reduce the contribution of a trait to the next generation. So, if you change this number, you are changing the relative strength of selection acting against a trait (either black B or white b). If the environment is a lighter color, natural selection is selecting *against* the dark trait since the dark moths will not survive as well as the white moths in a light environment. Putting in a higher value will lead to the trait being much less frequent.

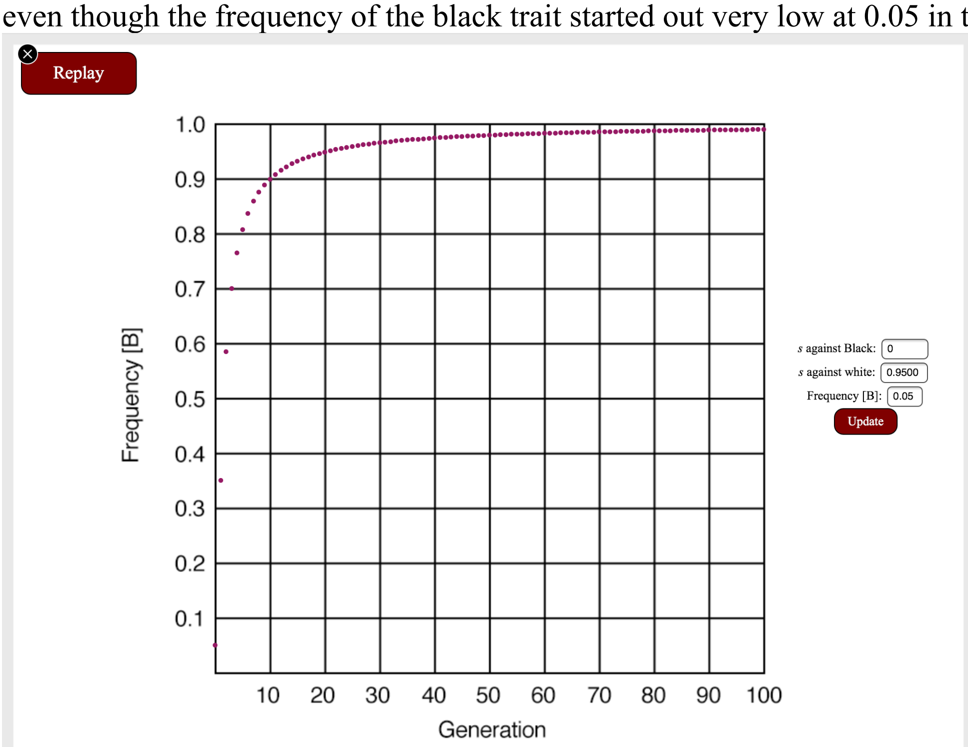
Messing around with the Frequency [B] will just change how frequent the traits are in the population in the first generation.

I'll include a few screenshots from when I ran the simulation myself:

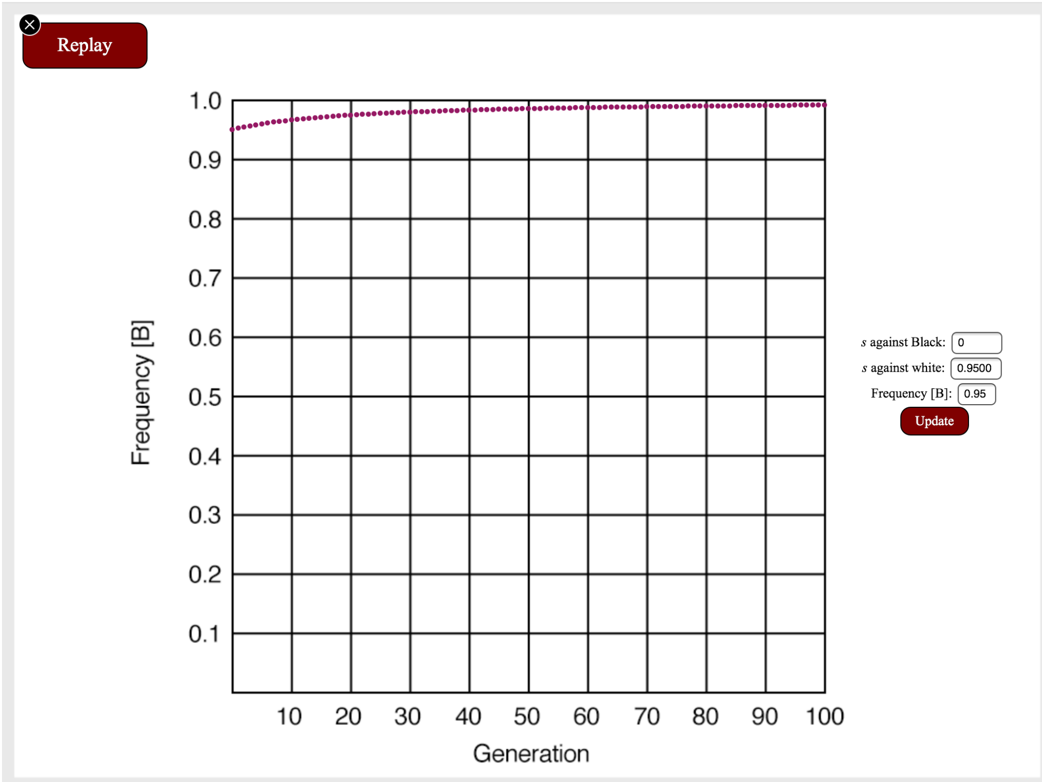
Here is what my graph looked like immediately after the simulation before I made any adjustments. You can see that I, as the predator, ate more black moths than white moths. I know this because, looking at the graph, the frequency of the black allele in the population after 100 generations dropped down to 0. This means that the frequency of the white allele rose to 1.0, or 100%, meaning that the white trait became the most frequent in the population. You can also see that the selection coefficient against black is high, because it was not as advantageous to be a black moth on light colored lichen, since it was easier for me to see them.



Now, I’ll adjust selection pressure against the white trait, and change the frequency of the black trait by clicking in the appropriate box and typing in my number. After changing selection against black to 0 and selection against white to 0.95, you can see that selection is not against the white trait anymore. This allowed the black trait to increase in frequency over 100 generations, even though the frequency of the black trait started out very low at 0.05 in the first generation.



I adjusted the settings again, this time increasing the frequency of allele B from 0.05 to 0.95. You can see by looking at the graph that allele B (the black trait) started out at a high frequency in the population. Because selection was against the white allele (b), the frequency of allele B continued to increase in the population over 100 generations.



You can adjust the settings however you would like to. The point is to explain how the changes affect the graph, and to then interpret the resulting graph to explain what traits are most frequent in the population and why.

Remember, **the directions and questions are already within the assignment submission on canvas,** but this is just in addition to those directions to help clear up any confusion. Try taking the time to really understand the reading in the lab manual and what I just gave you in this document. There are also videos to watch on these topics on Canvas. If you've gone through all of these resources and are still having trouble, you can email me with questions, ask me questions during my Zoom office hours (Wednesdays 2-3pm), or we can set up a Zoom appointment if that time doesn't work for you.