Natural Selection

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Material Proyectable

Simulating Natural Selection ExpandTo begin, cut the white, black, and gray pipe cleaners into quarters, which should produce a total of 100 pieces that are 3 inches long. Then, cut the green pipe cleaners in the quantities and lengths specified in the video, taking care to minimize waste. This approximates a normal distribution of lengths and should result in an additional 100 pieces total. NOTE: One 12-inch pipe cleaner should yield multiple lengths, for example, a 5-inch piece and a 7-inch piece. Use this advantage to reduce waste. Now, cut one sheet of black and one sheet of white construction paper into approximately 3-inch strips measured along the long edge of the paper. Tape these strips down to cover the base of a dissecting tray to create an alternating pattern of black and white strips. NOTE: In the first simulation, you will use the white, gray, and black pipe cleaner segments against a black and white background to simulate different selection pressures due to predation on a population. You will select your prey using two different strategies, eyes-open and eyes-closed. For each of these strategies, you will perform four rounds consisting of 25 selections, alternating between two partners. After each round you will restore the population back to its original size using the proportions of phenotypes present after selection. To begin the first scenario, count out 12 white, 12 black, and 26 gray pipe cleaner segments with your partner. Hypotheses: Here the experimental hypothesis might be that different predation strategies, such as having the eyes open or closed, will result in distinct selection pressures on the populations. Further, different phenotypes may be positively selected in the alternate scenarios. The null hypothesis might be that different predation strategies will have no effect on the populations or phenotypes. Mix the pipe cleaner segments together as best as possible. Then, sprinkle them into the papered tray. NOTE: Ideally, the pipe cleaners will be spread out. However, this may not occur due to their self-adhering nature. Once the segments are in the tray, separate them as best as possible without moving them too far from where they landed. As few segments as possible should be touching. Have the first partner close their eyes. When given an audible signal by the second partner, the first should open their eyes and grab the first pipe cleaner they see from the tray as quickly as possible. Set the removed pipe cleaner to the side. Alternating partners, repeat this process a total of 25 times (steps 8 - 9). Count the remaining pipe cleaners by color and record this in the data collection table for Scenario 1. Click Here to download Tables 1 and 2 Then, restore the population to 50 by adding one pipe cleaner of the same color for each of the remaining pipe cleaners. Hold these to the side until they are all gathered. Then, sprinkle the pipe cleaners into the tray as previously described (steps 6-7). Repeat this process for three more rounds consisting of 25 selections each and record the counts for each of the rounds in the data collection table for Scenario 1. Remove all pipe cleaners from the tray after the fourth round. For Scenario 2, again count out 12 white, 12 black, and 26 gray pipe cleaner segments and sprinkle them randomly into the tray. Follow the same protocol as in Scenario 1. However, when given the signal, the grabbing partner should keep their eyes closed. To aid in accuracy, it may help to position the hand near to the tray before grabbing. Repeat this process 25 times, switching partner roles, and record the remaining pipe cleaner amounts in the data collection table for Scenario 2. Then, restore the population to 50 based on that count. Do this for all four rounds. NOTE: In the second simulation, you will be using the eyes-open and eyes-

closed predation strategies as previously described to select pipe cleaners of various lengths. For Scenario 3, gather all 100 of the pipe cleaners that have been cut to varying lengths to represent different phenotypes. One partner should hold all the pipe cleaners upright and loosely in one hand resting on the tabletop, such that the bottom end of each pipe cleaner rests against the tabletop. Now, the partner that is not holding the pipe cleaners should close their eyes. When given an audible signal, the partner should open their eyes and grab the first pipe cleaner they see from their partner's hand. Repeat this process 50 times (step 21). However, the partners should not switch roles during the round this time. The partner holding the pipe cleaners should always be the one giving the signal and never grabbing from the bunch. After the first round consisting of 50 selections, count the remaining pipe cleaners by length. Then, record this information in the data collection table for scenario three. Click Here to download Tables 3 and 4 Add one pipe cleaner of the same length as each of the remaining ones to restore the population to 100. This will likely require more pipe cleaners than were originally cut. Try to use scraps from the class to reduce waste. Repeat this for three more rounds, alternating which partner holds or grabs each round. To perform Scenario 4, gather the varied-length pipe cleaners in their original proportions. Now repeat the grabbing process, as described in Scenario 3. However, only remove 30 pipe cleaners instead of 50. Divide the count at the end of each round by two for each phenotype 4 inches or below, rounding fractions down. Then, record these values in the data recording table for Scenario 4. Use the relative proportions of the phenotypes in the final population to restore the population to 100. When restoring the population to 100, it may be necessary to calculate relative proportions of phenotypes. Repeat this for three more rounds, again alternating holding and grabbing the pipe cleaners. For each scenario calculate the survival for each phenotype, that is the proportion of the phenotype surviving. Then, calculate the relative fitness, or w, between each round. As reproductive rate does not vary in this simulation, this should always be considered equal, or 1. Also, calculate the selection coefficients for each phenotype. Now, use the relative frequencies of each phenotype to create histograms with appropriately labeled axes for each scenario showing the population before any selection took place and then alongside these in a different color after four rounds of selection. Identify the type of selection taking place in each scenario and label the graphs. Develop a hypothesis to explain your observations

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