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Scavenger Hunt: Simulating Natural Selection

By: Paul Narguizian, California State University Los Angeles, 5151 State University Drive, Los Angeles, CA 90032 e-mail: pnargui@calstatela.edu

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Introduction:

To help students learn, in a more concrete way, how natural selection operates, I came up with an activity that simulates evolution by natural selection. In this simulation, students take on the roles of crab-like predators that have variations in the shape of their "claws." These feeding appendages catch prey (pinto beans), and come in four variants: spoons, forks, knives, and chopsticks. Groups of students go hunting/scavenging for beans on grass lawns with their feeding appendages. The hunt continues for three rounds or "generations," with extinction and reproduction occurring between generations. To study evolution by natural selection in this predator population, the class will track the frequency of each appendage type through three generations.

Materials Needed:

Prey:
Pinto Beans (1 bag)

Various Appendages:
Plastic Knives (9)
Forks (9)
Chopsticks (9)
Spoons (9)

Other:
Calculator (at least one calculator per each variant group)
Data collection sheet (one class set)

Class Activity:

1) Start with a population that contains 25% of each of the four variants or “species.” Record this number on your data sheet as your Starting Population Size for generation 0. [Recording can be done by the class as a whole, by species, or each student can tabulate results on personal data sheets.] The entire experiment will be

repeated for each successive generation, starting with the population at the end of the previous generation.

2) The teacher randomly throws food (beans) onto the grass. All predators begin searching for the food and capturing it with their feeding appendages. The hunt is over when the teacher calls TIME (usually between 30 - 60 seconds).
3) Count the number of prey caught by each student, then sum up and tabulate the results by species.
4) Calculate the average number of prey caught per participant, using the formula:

Formula for Calculating Average: $$\frac{\text{(Total Prey from Forks) + (“” Spoons) + (“” Chopsticks) + (“” Knives)}}{\text{\# of participating students}}$$

5) All individuals below the average “die” without reproducing, and must turn in their utensils at that point.
6) Record the number of surviving individuals in each species.

Generation _#_____			
Variants	**Starting Population Size**	**Surviving Pop. Size**	**Final Pop. Size (post reproduction)**
Chopsticks			
Forks			
Knives			
Spoons			

7) All those who survived (those individuals above the average) produce an “offspring.” This means that they keep their utensil, and also receive a second set of identical utensils that they give to another student of their choosing, from among those eliminated in the previous round.
8) The “Final Population Size” for each species is recorded. Be sure to remind students to label each species’ appendage when they are counting the members in each group.
9) Repeat steps 2-8 for generations two and three.

Discussion

Two important processes influence the evolution of organisms: variation and natural selection. Variation within species is caused a by random process of genetic mutation. The environmental selection pressures, (food availability in space and time, mediated by competition), determine the survival rate or “fitness” of individual organisms. Eventually, the species whose adaptations have the greatest competitive advantage, on average (i.e., the most “fit” for that particular environment), survive and reproduce. Evolution describes an effect on an entire population, whereas the mutation and natural selection processes act on individual organisms.

Applications to Everyday Life

Most genetic mutations are harmful. However, from the experience of this simulation, a “wild” variant, such as an individual having a human hand as an appendage, might actually have a competitive advantage. Depending on the selection pressures imposed by the environment, mutations can either be advantageous or not. Thus, the survival rate of any species, including humans, relies on both a population’s genetic make-up and the selection pressures of the environment.

Genetic research is the science of the 21st century. With the Human Genome Project close to completion, scientists will be able to target genes to find causes and cures for chronic and lethal disorders brought on by harmful mutations within the population. A more controversial question is how societies should treat efforts to produce “advantageous” mutants, among food crops, domesticated animals, or some day, possibly even people.