Evolution Game

(Instructor)

Learning Objective: Students will simulate population evolution through natural selection (examining the roles of resource availability, competition, and predation) and mutation.

Game objective: Collect as much food as you can within the 15 second rounds with the utensil chosen for you at random.

**Supplies:**

|  |  |
| --- | --- |
| Phenotypes |  |
| * Chopsticks | One for each student |
| * Forks | One for each student |
| * Spoons | One for each student |
|  |  |
| Food Resources |  |
| * Paperclips | 100 per 10 students |
| * Pebbles | 100 per 10 students |
| * Pipe cleaners | 100 per 10 students |
|  |  |
| Dice | 1 per group |

Playing the Game:

**Scenario 1 - mutation only**

* Assign groups of 3-5 students.
* In front of each group place be an assortment of paper clips, pebbles, and pipe cleaners to be used as food supply for the utensils.
* Student will roll a dice to determine what utensil they will be using (the phenotype) during the first round.
  + Rolling a 1 or 2- Chopstick
  + Rolling 3 or 4- Spoon
  + Rolling 5 or 6- Fork
* Using the utensil chosen at random for each student in the group, students will collect as many paperclips, pebbles and pipe cleaners (one by one) within the first 15 second round.
* For round 2, students will roll the dice again. If any student rolls a 6, they will mutate by rolling the dice a second time to determine the type of utensil they will use for the upcoming round.
* Students will record their collections using the table on their instructional worksheet.
* After each round, the students will report out their consumption of each of the three food resources. The instructor can capture the totals for each round in the worksheet provided (manually or in excel).
* The totals are used to calculate how many of each phenotype persist at the end of the round. i.e. The “Number of utensils in next round before mutation”
* To calculate “Number of utensils in next round before mutation”, you must use the equation: Total food consumed for phenotype/ (Total number of food eaten by all phenotype / number of students playing). Be sure to round to the nearest whole number without going over the total number of students, as there cannot be a fraction of an individual ☺
* Review the results to determine how many of each phenotype has been lost or gained. For example. You may start the round with 5 chopsticks, 5 forks and 5 spoons. The number of utensils in the next round calculated as 3 chopsticks, 5 forks and 5 spoons. This means that two students who were chopsticks at the beginning of the round will now be assigned to forks. Be sure to make these assignments before moving to the next step
* At the end of each round, a dice roll done is made by each student (except those who have just been reassigned) to determine if there is a mutation. If the student rolls a 6, then they are able to roll again to determine the utensil they will use (reference the key at the top of their worksheet).
* The instructor records any mutations. A negative one (-1) is added for each individual that is lost through mutation. A positive one (+1) is added for each individual that is added through mutation.
* Note: if the table is filled in using an excel spreadsheet a chart is automatically generated on the sheet table “ABUNDANCE GRAPH”.
* Alternatively, the data can be distributed to students and they can create the graphs manually.
* This process is repeated for each round to determine which utensil(s) have the most stable populations under these conditions.
* Continue to play for 4-6 rounds (or as many rounds as necessary to see a change in the relative frequencies of the three utensils)

**Scenario 2 - A disease wipes out one of the food resources**

A storm wipes out most of the pipe cleaner food resource.

* Remove all but a handful of the pipe cleaners
* Continue to play the game for 2-3 rounds

**Scenario 3 -Presence of a Predator:**

As has occurred in many communities, a predator is introduced to UtensilLand

* Someone (an instructor or teacher’s aide) will be assigned to walk around and prey on the utensils during the 15-second rounds. When a utensil (student) is within reach, the predator will signal to the student that he/she has been captured and eaten by the predator.
* At the end of each round
  + First, assign students from the phenotype(s) that have lost members to the phenotype(s) that have gained members.
  + Second, to demonstrate that populations of prey may fluctuate if one phenotype of prey is more susceptible to the predator than others, a student who has been caught will be allowed to return to the game. That student will then have the opportunity to roll the die and become a new individual in the population.
  + Students can then mutate
* Continue to play the game for 2-3 rounds

**Other scenarios**

You may include other scenarios such as:

* The return of the pipe cleaner food resource. This simulates how a population of plants that have been decimated by a storm may slowly increase over time
* Removal of another food resource (pebble or paperclip). This simulates the how populations may be affected after a drought, ice storm, or other environmental disturbance
* Removal of a utensil (phenotype). This may simulate the effect of a disease that affects one of the consumers (e.g. a fungus may kill off the forks).

Discussion Questions

1. In Scenario 1:
   1. Which phenotype(s) increased in numbers? Why?
   2. Which decreased and why? (See your graph)
2. In Scenario 2:
   1. Which phenotype(s) increased in numbers? Why?
   2. Which decreased and why? (See your graph)
3. In Scenario 3:
   1. Which phenotype(s) increased in numbers? Why?
   2. Which decreased and why? (See your graph)
4. What features of this activity are similar to processes that take place in evolution?

OR

How is natural selection represented in this game?

1. Now imagine that the food resources (for example: pipe cleaners) could evolve too. What effect might this have had on this evolution exercise?
2. When some utensils randomly changed after dice were rolled, this was an example of \_\_\_\_\_?
3. What is the importance of mutations in evolution?
4. If the food resources used by different groups in class each were placed in different substrate (i.e. in trays of sand, black gravel, red rocks, etc.) how would this affect the outcome of the game? Would we see different dominant phenotypes? What about multiple dominant phenotypes?
5. What are some of the limitations and/or assumptions made in this game? How does it differ from a real population?