Biodiversity - Genetic Drift & Natural Selection

INSTRUCTOR:
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Background:

In addition to natural selection, one of the mechanisms of evolution is genetic drift. Genetic drift is the change of allelic frequencies in the gene pool due to random sampling. This simulation will explore how sample size can influence the effect on genetic drift on the gene pool using different types of beans to represent individuals in the population.

Vocabulary

- Genetic drift
- Gene pool
- Allele (allelic frequency)
- Evolution
- Speciation
- Genetic Variation

Materials

- 100 beans; 30 kidney, 40 black, and 30 pinto
- One cup (this will be used to hold your beans.

Safety

- Choking hazard: Do not put the beans in your mouth! Do not eat the beans!

Pre-lab Questions: Read the procedures before you answer the pre-lab questions.

1. Define evolution.

2. Define genetic drift.

3. What do I mean when I say that I saw a change in “allelic frequencies”?

4. Could genetic drift lead to evolution of a population? Explain.

5. Predict: Will the effects of genetic drift on the gene pool differ with sample size? Explain.

6. Look over the procedures: Why does the teacher want you to take random samples? Would you be illustrating genetic drift if you selected the individuals non-randomly?

Simulation I (Large sample):

	Original Population		Trial #1		Trial #2		Trial #3	
Phenotype	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**
Bead Totals =								

1. Count out the numbers of each phenotype in your large population (container received from the teacher). Determine your phenotypic ratio (depict your ratios of each phenotype as percentages).

2. Randomly take a sample from the population (roughly 40-50).

3. Determine the ratio in the sample- did any of the allelic frequencies change?

4. Repeat three times (after returning the sample back to your main population to 'restock' each time).

Simulation I (Small sample):

- For simulation II follow the same procedures as in simulation I above, but use a smaller sample size of 10 beans.
- Record your data in the table below.

	Original Population		Trial #1		Trial #2		Trial #3	
Phenotype	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**	**# Beads**	**Ratio(%)**
Bead Totals =								

Post-lab Questions

5. Compare your results from simulation I and II. Did genetic drift have more of an effect on the allelic frequencies in the *larger* or *smaller* samples?

6. An environmental change gave one phenotype an *adaptive advantage* over the others, increasing its *fitness*. This would cause a shift in *allelic frequencies* as the fittest beads are best able to survive and reproduce. Would this be an example of *genetic drift*? Why or why not?

7. Could genetic drift eventually lead to speciation? Explain why or why not.

Student Handout: Natural Selection Inquiry Simulation

Background:

In addition to natural selection, one of the mechanisms of evolution is genetic drift. Genetic drift is the change of allelic frequencies in the gene pool due to random sampling. This simulation will explore how sample size can influence the effect on genetic drift on the gene pool using different types of beans to represent individuals in the population.

Vocabulary

- Natural Selection
- Gene pool
- Allele (allelic frequency)
- Evolution
- Speciation
- Genetic Variation

Suggested Materials

- Beans
- Paper
- Timer
- Cups
- Spoons
- Tweezers

Safety

- Choking hazard: Do not put the beans in your mouth! Do not eat the beans!

Pre-lab Questions: Read the procedures before you answer the pre-lab questions.

1. Define evolution.

2. Define natural selection.

3. What four pre-conditions must be present in order for evolution by natural selection to occur?

Procedures

Your group will be creating your own simulation to illustrate the concept of natural selection. You will be testing this idea in bean populations (but you are not limited to the phenotypes we used in the last simulation).

1. On a separate sheet of paper, write out your planned procedures for this simulation. Be sure to consider all the characteristics that make good science. Draw diagrams if needed.
2. Get teacher approval before you do the simulation.
3. Create your own data tables to keep track of your results.
4. Run the simulation according to your procedures.

Conclusion

Answer the following questions after you perform your simulation.

1. Did your simulation produce results that supported the idea of natural selection? Why or why not?

2. Do you think your simulation could have been improved in any way? What would you do differently?

3. Compare your simulation with other groups in the class. Describe how one group's simulation was similar or different from yours. Compare and contrast the two simulations.

4. What did you learn from this simulation?

Post Lab Questions:

5. Poison dart frogs are found in a variety of habitats, from rainforests to savannas. How might gene flow between populations in different habitats impact the evolution and diversity of poison dart frogs?

6. Genetic drift can have a significant impact on small populations, such as those found on small islands. How might genetic drift affect the evolution and survival of poison dart frogs in these isolated populations?

7. Some species of poison dart frogs are known to exhibit high levels of color variation within populations. How might genetic drift and natural selection interact to produce this variation, and what advantages might it provide for the frogs?

8. The toxins produced by poison dart frogs are known to vary widely between species and populations. How might gene flow and genetic drift contribute to this variation, and what implications might it have for the conservation and management of these species?