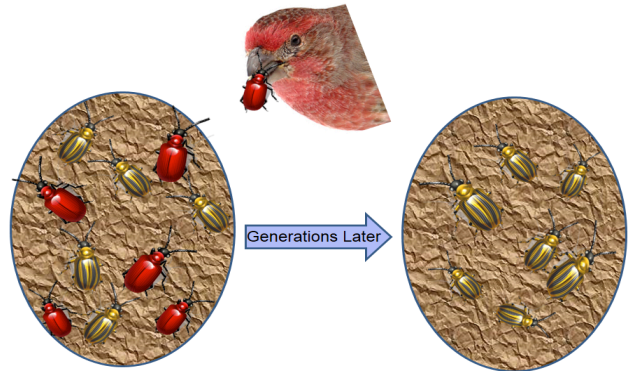




Differential Reproductive Success

Activity

Biological evolution is based on changes in the frequencies of alleles from generation to generation. Another way of saying this is that biological evolution is the process through which organisms' characteristics change over successive generations by means of genetic variation and natural selection. An allele is simply a version of a gene located at a specific position on a specific chromosome; it codes for a particular trait, such as color, fur length, height, etc. When organisms reproduce, one version of



an allele is provided by the father and another version of that allele is provided by the mother. Sometimes these alleles are the same, and sometimes they are different. If an organism has a dominant allele present, then the trait for that dominant allele will always be expressed. If an organism has a recessive allele present, then the trait for that recessive allele will only be expressed if recessive alleles from both the father and the mother are passed to the offspring. If the offspring inherits two of the same alleles (either both dominant or both recessive), that organism is known as homozygous, or true breeding. If the offspring inherits one dominant allele and one recessive allele from the parents, then that organism is heterozygous.

These alleles are passed from generation to generation. In some organisms, a single generation spans many years. Evolutionary time scales are generally measured in hundreds, or even thousands, of generations.

Part I: Breeding

Scenario:

There are two islands consisting of true breeding tortoises. Island A consists of true breeding long-neck tortoises. Island B contains true breeding short-neck tortoises. You are going to relocate half of the tortoise population from Island A and half of the tortoise population from Island B to a new island, Island C, where they will mate and produce offspring.





Differential Reproductive Success

Activity, continued

Part I: Breeding, continued

Procedure:

1. Obtain 2 envelopes containing True Breeding Tortoises (1 male envelope and 1 female envelope).
2. Without looking, select a male and a female tortoise from each envelope. These two tortoises will represent a breeding pair.
3. Record the neck type of each parent and the resulting genotypes (genetic makeup) and phenotypes (traits) of each offspring for eight mating pairs. Use the Punnett squares on page 3 to find the genotypic and phenotypic ratios.
4. Repeat the breeding procedure for a total of eight trials. In Part III of your *Student Journal*, record the neck type of each parent and the resulting offspring.

Trial	Mother (NN or nn)	Father (NN or nn)	Number of Offspring NN	Number of Offspring Nn	Number of Offspring nn
1					
2					
3					
4					
5					
6					
7					
8					



Differential Reproductive Success

Activity, continued

Part I: Breeding, continued

Trial 1

Trial 2

Trial 3

Trial 4

Trial 5

Trial 6

Trial 7

Trial 8

Phenotype Offspring Totals

	Total Number	% of Total
Short Neck		
Long Neck		
Total		

Differential Reproductive Success

Activity, continued

Part II: Breeding Analysis

1. In your trials, which genotype had the greatest representation in the offspring? Why?

2. In your trials, which phenotype had the greatest representation in the offspring? Why?

3. Pool all of the class data totals and add that information in the table below.

Class Offspring Totals

	Total Number	% of Total
Short Neck		
Long Neck		
Totals		

4. What difference, if any, did you notice with regards to the percent of total traits between your trial numbers and the total class numbers? Why do you think this may be, and what advantage do many trials give you with regards to the data?



Differential Reproductive Success

Activity, continued

Part III: Know Your A, B, Cs

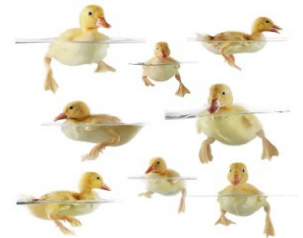
A. Genetic variation

Allele frequency changes in a population due to the variation, or differences, in alleles that are passed on. Different alleles are sometimes better suited to different environments than others. Allele frequencies change from generation to generation, as some are passed on more easily than others. The advantage or disadvantage of a given allele often depends on environmental conditions.



B. Potential for a population to produce more offspring than can survive on the available resources (overpopulation)

Each individual within a population will produce as many offspring as they can. This increases the chances that at least some of the offspring will survive to adulthood and reproduce. Hence, the population as a whole will often produce more offspring than the environment can support.



C. Finite supply of environmental resources

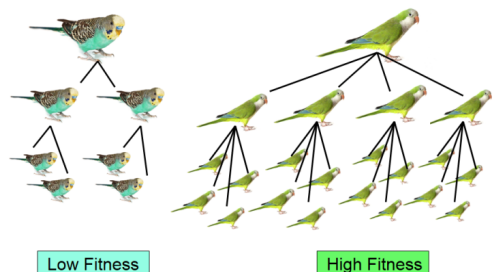
The environment provides a limited supply of food, water, shelter, and space. The amount of each resource provided by the environment fluctuates or changes over time. Those that are best suited to obtain resources in their environment (best adapted) are more likely to survive and reproduce.



A + B + C = Differential Reproductive Success

This is otherwise known as natural selection. Some individuals or variants produce more fertile offspring that survive to adulthood and reproduce than others. Those that are the most fit, or are best able to obtain resources, tend to reproduce and produce more offspring. This gives these individuals a greater chance to pass on their alleles to the next generation.

Individuals with the highest **fitness** are more likely to reproduce and pass on their traits to their offspring.



Differential Reproductive Success

Activity, continued

Part III: Know Your A, B, Cs, continued

1. Suppose a flock of gulls arrive on the island as newborn tortoises emerge from their shells. The gulls eat half of the total tortoise offspring: half of them were short neck tortoises and the remaining were long neck. How would this most likely affect the variation of alleles that are available to be passed on to the next generation? Be specific.

2. Which variety do you think will have the most representation in the second generation? Explain.

3. Which part(s) of the Differential Reproductive Success equation does this scenario fit, and why?

4. The island is isolated from the mainland, so food sources on the island are limited. The individuals with long necks have stronger, faster muscles. This trait gives the tortoises an advantage in catching insects. What does this imply about the long-necked allele in this population?



Differential Reproductive Success

Activity, continued

Part III: Know Your A, B, Cs, continued

5. How would this advantage affect the population of tortoises from the first generation of offspring, and how might that affect subsequent generations?

6. Which part(s) of the Differential Reproductive Success equation does this scenario fit, and why?

7. The females of this tortoise population lay around 15 eggs at a time. Why is this important to the tortoise population?

8. Which part(s) of the Differential Reproductive Success equation does this scenario fit, and why?

9. Keeping the three scenarios in mind, how would you expect differential reproductive success to affect the allele frequencies in this tortoise population? In other words, which allele has a distinct advantage, and how would this affect the population over many generations?
