

## Evolution: Mutation and Selection

## Answer Key

**Vocabulary:** adaptation, allele, chromosome, evolution, fitness, gene, genotype, mutation, natural selection, phenotype, trait

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

*[Note: The purpose of these questions is to activate prior knowledge and get students thinking. Students are not expected to know the answers to the Prior Knowledge Questions.]*

1. Imagine a white lizard and a brown lizard sitting on a brown rock. A hawk is circling overhead hunting for its next meal. Which lizard do you think the hawk would most likely try to catch? Explain your choice.

*Answers will vary. [The hawk will most likely try to catch the white lizard because it is not as well camouflaged as the brown lizard.]*

2. Now imagine that the same two lizards were sitting on a dune of white sand. Which lizard do you think the hawk would then most likely try to catch? Why?

*Answers will vary. [The hawk will most likely try to catch the brown lizard in this case because it is not as well camouflaged as the white lizard.]*

### Gizmo Warm-up

How long could a parrot survive in Antarctica? It would probably not survive long. Parrots do not have **adaptations**—or helpful characteristics—to survive icy cold weather. Because of this, a parrot is not fit for Antarctica. **Fitness** describes how well an organism can survive and reproduce in an environment.

In the *Evolution: Mutation and Selection* Gizmo™, you will see how a species' fitness can change over time as it becomes better adapted to its environment.



1. On the SIMULATION pane, what is the **Average fitness** of the population? **50%**
2. On the CONTROLS pane, experiment with the **Background color** sliders.
  - A. Which background color results in the highest fitness?  **$R = 255$ ,  $G = 255$ ,  $B = 255$**
  - B. Which background color results in the lowest fitness?  **$R = 0$ ,  $G = 0$ ,  $B = 0$**

# Mutation And Selection Gizmo Answers

**Noa Warren**

A red circular graphic with a gradient, appearing as a semi-circle or a partial circle, located to the right of the author's name.

## **Mutation And Selection Gizmo Answers:**

**Disentangling Mutation and Selection in Human Genetic Variation** Ipsita Agarwal, 2021 Through the two specific cases described this work illustrates the potential of large contemporary repositories of human genetic variation to inform human genetics and evolution as well as their limitations in the absence of suitable models of mutation selection and other aspects of the evolutionary process

**Evolving Ourselves** Juan Enriquez, Steve Gullans, 2015 Though these harbingers of change are deeply unsettling the authors argue that we are also in an epoch of tremendous opportunity New advances in biotechnology help us mitigate the cruel forces of natural selection from saving prematurely born babies to gene therapies for sickle cell anemia and other conditions As technology enables us to take control of our genes we will be able to alter our own species and many others a good thing given that our eventual survival will require space travel and colonization enabled by a fundamental redesign of our bodies Future humans could become great caretakers of the planet as well as a more diverse more resilient gentler and more intelligent species but only if we make the right choices now

**Mutation and Selection** Noa Warren, 2005 Mutation and Selection as Inferred by the Comparison of the Human and the Chimpanzee Genomes Ines Hellmann, 2005 *Species and Varieties* Hugo de Vries, 1904 *Mutation and Selection as Inferred by the Comparison of the Human and the Chimpanzee Genomes* Ines Hellmann, 2005 The course of evolution by differentiation of divergent mutation rather than by selection John Christopher Willis, 1974 Investigation of Mechanics of Mutation and Selection by Comparative Sequencing Michael C. Zody, 2009 **A Study of Mathematical Models of Mutation and Selection in Multi-locus Systems**, 1977 **Introduction to Natural Selection** Clifford Johnson, 1976 Genetic systems and fitness Evidence for selection The balanced polymorphism or the non neutral equilibria Selection coefficients in natural populations Varying fitness and the unit of selection Quantitative traits and the selection effect Selection in retrospect and prospect

**Models for Mutation, Selection, and Recombination in Infinite Populations** Oliver Redner, 2003 **The Mutation Factor in Evolution** Reginald Ruggles Gates, 1915 *Genetik und Evolutionsforschung* Genetik *Delineating the Evolutionary Dynamics of Mutation and Selection* Vijetha Vemulapalli, 2012 Transposable elements TEs have important effects on genome function ranging from functional exaptation and altered regulatory mechanism to large scale rearrangements of the genome How TEs evolve and what factors affect their ability to replicate is however not completely understood Furthermore large numbers of TEs are distributed throughout primate genomes and because of this TEs can be used to estimate the neutral substitution process and possible context dependent variation in this process The neutral substitution process is a reflection of the underlying mutation process identification of context effects leads to better understanding of factors affecting underlying mutational processes and leads to improved ability to detect selection

Abstract **Study of Mathematical Models of Mutation and Selection in Multi-locus Systems. Annual Progress Report, December 1, 1977--November 30, 1978**, 1978 A computer and analytic study of the interaction between genetic

drift and directional selection in multi locus systems has shown that when selectively favorable alleles are in low to moderate initial frequencies the process of selection in finite populations will cause a greater genetic divergence between identically selected populations than would occur with genetic drift alone The relation between population size selection parameters and initial genetic constitution of the populations for which this phenomenon occurs has been established A numerical and analytic study was made of effective density in populations that are non uniformly distributed over area A measure of effective density  $D_{sub p}$  the person weighted density has been related to the conventional density measure which is area weighted by the variances of area and population and their covariance The effective densities in the United States were computed from the county by county census figures of 1960 and it was shown that the effective density of occupation is 50 times higher than the conventional density measure shows

**Secular Changes in Sexual and Natural Selection Against Deleterious Genetic Mutations in Humans** Ruben Cem Arslan,2017 All genetic variation once arose by mutation Genetic variation is the substance on which natural selection can act but mutations are random Therefore new variations usually have negative or no effects on an organism s evolutionary fitness This dissertation is not about the exciting exceptions to this rule which drive evolutionary adaptation but about harmful mutations We know that the average human child is born with 70 100 genetic variants that its parents did not carry around 2 2 of which are estimated to be harmful Why don t these harmful mutations build up irreversibly Natura

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Natural Selection J. Phil Gibson,Terri R. Gibson,2009 In his groundbreaking book Natural Selection Charles Darwin explained his theory that evolution is driven by adaptation of species to their environmental surroundings From the tiniest microbe to the largest whale all organisms have changed over vast expanses of time due to the forces of natural selection This new title in the Science Foundations series provides an overview of the processes and causes that drive natural selection and the principles that explain how it operates using numerous diverse organisms as examples Natural Selection promotes a solid understanding of how organisms change over the course of generations and how current biodiversity came to be

Keeping the Red Queen in Check Daniel Joseph Balick,2012 In this dissertation we describe the microscopic behavior and emergent phenomena of evolutionary dynamics We introduce frameworks that explicitly incorporate the effects of beneficial and deleterious mutations and distributions of mutations We treat a full distribution of mutations in adapting populations providing a unified description of interference between

established mutations We compute experimentally observable parameters including the speed of adaptation and the distribution of fixed mutations for a general underlying distribution of available beneficial mutations We identify an equivalence between the adaptive dynamics using a distribution of mutations and the well known dynamics of mutations with a single fitness effect Treating beneficial and deleterious mutations simultaneously a dynamic mutation selection balance emerges which we argue is an evolutionarily stable state The dynamic balance state describes a population in which rare beneficial mutations are sufficient to halt the stochastically driven extinction of subclasses in the population This introduces a stationary state which we argue lies in an attractive basin such that any generic adaptive population or fitness degrading population will approach the same equilibrium The existence of this evolutionary attractor and its stability introduce this description as a new null expectation for any evolving population We suggest that more complicated biological effects such as changes in mutation rate may be viewed as effective perturbations away from this state

**The Statistics of Natural Selection on Animal Populations** Bryan F. J. Manly, 1985-09-19 In the concluding chapter of his famous book on the theory of evolution by natural selection Charles Darwin 1859 remarked that When the views entertained in this volume on the origin of species or when analogous views are generally admitted we can dimly foresee that there will be a considerable revolution in natural history This proved of course to be completely correct At present there is a great divergence of opinion about the general importance of natural selection in the evolutionary process Nevertheless biologists are on the whole united in their acceptance of the potential power of selection in changing populations Given this situation it is not surprising to find that many attempts to detect the effects of natural selection have been made since the time of Darwin This area of study has been called ecological genetics It involves the collection of data of various kinds and in many cases the development of special methods for analysing these data This book is a summary of methods for data analysis concentrating on those that are applicable to animal populations particularly wild populations

*Theoretical Studies on Genetic Limits to Natural and Artificial Selection with Mutation* Zhao-Bang Zeng, 1986

## Reviewing **Mutation And Selection Gizmo Answers**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is actually astonishing. Within the pages of "**Mutation And Selection Gizmo Answers**," an enthralling opus penned by a highly acclaimed wordsmith, readers embark on an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve in to the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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