



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Student Exploration: Evolution: Mutation and Selection

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

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

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.

**The white lizard, as it would be easier both to see and to track from high up in the sky.**

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?

**The brown lizard for the same reasons.**

### 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? **0.5**
2. On the CONTROLS pane, experiment with the **Background color** sliders.
  - A. Which background color results in the highest fitness? **white**
  - B. Which background color results in the lowest fitness? **black**



# Mutation And Selection Gizmo Answers

**Oliver Redner**



## **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 as Inferred by the Comparison of the Human and the Chimpanzee Genomes Ines Hellmann, 2005

**Natural Selection** Mario A. Fares, 2014-11-21 This book summarizes the knowledge in the field of methods to identify signatures of natural selection A number of mathematical models and methods have been designed to identify the fingerprints of natural selection on genes and genomes Such methods are provided in a simple and direct way so that students of different disciplines can navigate through molecular fitness landscapes using complex methods with a basic knowledge on bioinformatics A collection of the main methods to detect selection in protein coding genes and amino acid sequences is given at different levels of complexity from nucleotides to proteins and molecular networks The importance of identifying natural selection in genes and genomes through the methods described in this book transcends the bioinformatics and computational biology fields presenting applications for experimental biologists in a straightforward and understandable way

**Explicit Estimation of Both Mutation and Selection Bias for the Purpose of Understanding Protein Function and Evolution** Wei Zhang, 2004

**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

**The Mutation Theory: The origin of species by mutation** Hugo de Vries, 1910

**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

*Paradox of Evolution* Stephen Rothman, 2015-12-01 This book examines a little noted contradiction inherent in the two essential elements of Darwin's theory of biological evolution natural selection and reproduction Physiologist Stephen Rothman makes the revolutionary claim that the evolution of life's complex and diverse reproductive mechanisms is not the consequence of natural selection In so doing he exposes the deepest

question possible about life's nature its reason for being In meticulously detailed but accessible terms he lays out the crux of the paradox and offers an intriguing solution within a naturalistic framework In an ostensibly purposeless universe somehow purposeful life has evolved For all living things there are two overarching purposes survival and the creation of new life Natural selection is about the survival of existing life but has no interest in life's future about whether it persists or perishes By contrast reproduction is only about the future of life and has no interest in existing life except as a means to that end Where do these purposes come from As Rothman demonstrates at every level life is wired to react to danger Counterintuitively without the danger to its existence life would not have come into being As for reproduction nature's destructive forces drive the creation of new life Written with great clarity and informed by deep learning this elegant thoughtful work tackles some of the most challenging questions raised by the theory of evolution while calling to mind Darwin's famous words from the conclusion of *On the Origin of Species* There is a grandeur in this view of life The Paradox of Evolution Stephen Rothman, 2015 In this book psychologist Stephen Rothman exposes a major through remarkably almost completely neglected problem with Darwin's theory of evolution Its two essential elements natural selection and reproduction are in important respects contradictory In considering their relationship Rothman makes the revolutionary claim that the evolution of life's complex and diverse reproductive mechanisms is not the consequence of natural selection In so doing he exposes the deepest question possible about life's nature its reason for being In meticulously detailed but accessible terms he lays out the crux of the paradox and offers an intriguing solution within a naturalistic framework In an ostensibly purposeless universe somehow purposeful life has evolved For all living things there are two overarching purposes survival and the creation of new life Natural selection is about the survival of existing life but has no interest in life's future whether it persists or perishes By contrast reproduction is only about the future of life and has no interest in existing life except as a means to an end Where do these purposes come from As Rothman demonstrates at every level life is wired to react to danger Counterintuitively without danger life would neither have come into being nor evolved In the same way death drives the creation of new life and has propelled the evolution of the mechanisms of reproduction Written with great clarity and informed by deep learning this elegant thoughtful work tackles some of the most challenging questions raised by the theory of evolution Page 4 Cover 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

**Models for Mutation, Selection, and Recombination in Infinite Populations** Oliver Redner, 2003 *Investigation of Mechanics of Mutation and Selection by Comparative Sequencing* Michael C. Zody, 2009

**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

**A Study of Mathematical Models of Mutation and Selection in Multi-locus Systems**, 1977 *Mutation Accumulation in Finite Populations* Damian David Greville Gessler, 1995

**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

**How Science Proves That The Theory Of Evolution Is Impossible, Why Humans Can Never Evolve From Mutations Transpiring, And How Humans Can Be Augmented By Becoming Cyborgs** Dr Harrison Sachs, 2020-02-08 This essay sheds light on

how science proves that the theory of evolution is impossible and also elucidates why humans can never evolve from mutations transpiring Moreover how humans can be augmented by becoming cyborgs is delineated in this essay In spite of what you were indoctrinated to believe it is not only easier than anytime in history to utilize science to vindicate the existence of God the quintessential divine creator and master of the multiverse but it is also easier to disprove the illogical theory of evolution Human beings were created by God and are sheer and utter consciousness as multidimensional spiritual beings who vicariously experience this simulated reality through their earthly avatars receivers vessels or bodies as most people like to call them Humans were created by God and have profusely devolved overtime from mutations transpiring Mutations are always deleterious and are never beneficial to the human species Mutations always cause you to lose genetic information and never gain genetic information The theory of evolution makes the irrational contention that mutations are beneficial when in fact the polar opposite is true The occurrence of mutations is never salubrious but rather is always deleterious Mutations to the genes are always adverse changes which bastardizes the original genetic code A human being s earthly vessel can never organically change it something outside the parameters of its DNA in this simulation If the human genome can be thought of as a book then the occurrence of a mutation can always be thought of as outright ripping a chapter out of a book hence bastardizing the original genetic code and devolving the earthly vessel of the being Humans are a maladaptive species that can never possess the ability to physically evolve in this simulated reality because unlike the fictitious Pokemon characters human beings only have the anatomy to physically devolve into lesser humans beings if they succumb to genetic mutations These genetic mutations cause humans beings to loose more and more of their original sacrosanct genetic code and bastardizes their genomes In other words genetic mutations will always adversely impinge on your original genetic code in all facets and will devolve you as you loose more and more of your irreplaceable genetic code in this simulated reality Nothing salubrious nor fruitful can ever ensue from mutations transpiring Another fallacy of the theory of evolution beyond mutation being falsely perceived as beneficial is the groundless notion that something can come from nothing The contention that something can come from nothing in a cause and effect simulated reality does not make any rational sense There is a cause behind every effect and every effect can be traced back to a cause If this fallacy of life emerging from nothing were the case then humans would be spawning out of nowhere In spite of its sheer asininity most people mistakenly believe that humans can come from nothing and are not their own separate species The theory of evolution is a groundless theory that does not offer a modicum of scientific merit in any facet Human beings have devolved overtime due to the deleterious occurrence of genetic mutations Moreover humans beings do not have the anatomy to ever physically evolve in this simulated reality unlike the fictitious Pokemon characters Humans are a maladaptive species that are perhaps preordained to further devolve overtime as they succumb to more and more adverse genetic mutations due to living insalubrious lives fraught with calamitous issues that eminently impinge on their health happiness and well being In other

words humans are not even living salubrious lives and it would behoove humans to focus on living salubrious lives which are conducive to optimizing their health so that they can safeguard the structural integrity of their sacrosanct genetic code and mitigate risks for mutations transpiring

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