

17.2 Evolution as Genetic Change in Populations

THINK ABOUT IT Ever since humans began farming, they have battled insects that eat crops. Many farmers now use chemicals called pesticides to kill crop-destroying insects. When farmers first used modern pesticides such as DDT, the chemicals killed most insects. But after a few years, many pesticides stopped working. Today, farmers fight an ongoing “arms race” with insects. Scientists constantly search for new chemicals to control pests that old chemicals no longer control. How do insects fight back? By evolving.

At first, individual pesticides kill almost all insects exposed to them. But a few individual insects usually survive. Why? Because insect populations often contain enough genetic variation that a few individuals, just by chance, are resistant to a particular pesticide. By killing most of the susceptible individuals, farmers increase the relative fitness of the few individuals that can resist the poison. Those insects survive and reproduce, passing their resistance on to their offspring. After a few generations, the descendants of the original, resistant individuals dominate the population.

To understand completely how pesticide resistance develops, you need to know the relationship between natural selection and genetics.



How Natural Selection Works

How does natural selection affect single-gene and polygenic traits?

Pesticide-resistant insects have a kind of fitness that protects them from a harmful chemical. In genetic terms, what does fitness mean? Each time an organism reproduces, it passes copies of its genes on to its offspring. We can, therefore, view evolutionary fitness as success in passing genes to the next generation. In the same way, we can view an evolutionary adaptation as any genetically controlled trait that increases an individual's ability to pass along its alleles.

Key Questions

How does natural selection affect single-gene and polygenic traits?

What is genetic drift?

What conditions are required to maintain genetic equilibrium?

Vocabulary

directional selection
stabilizing selection
disruptive selection
genetic drift
bottleneck effect
founder effect
genetic equilibrium
Hardy-Weinberg principle
sexual selection

Talking Notes

Preview Visuals Before you read, look at Figure 17-6. What evolutionary trend does it seem to show?

Getting Started

Objectives

17.2.1 Explain how natural selection affects single-gene and polygenic traits.

17.2.2 Describe genetic drift.

17.2.3 Explain how different factors affect genetic equilibrium.

Student Resources

Study Workbooks A and B, 17.2 Worksheets

Spanish Study Workbook, 17.2 Worksheets

Lab Manual B, 17.2 Data Analysis Worksheet, Hands-On Activity Worksheet

Lesson Overview • **Lesson Notes** • **Activity: Art in Motion** • **Assessment: Self-Test, Lesson Assessment**

For corresponding lesson in the **Foundation Edition**, see pages 409–413.

Activate Prior Knowledge

Based on what they learned in Chapter 16 about Darwin's theory of evolution, have several students in turn state a fact about, or give an example of, natural selection.

Ask: If Darwin had known what you know about genes, how do you think he would have defined fitness? (Sample answers: possession of genes that enhance survivability; ability of an individual to pass copies of its genes to its offspring)



NATIONAL SCIENCE EDUCATION STANDARDS

UNIFYING CONCEPTS AND PROCESSES

1, 2, 3, 4

CONTENT

C.2.c, C.3.a, C.3.b, C.3.c

INQUIRY

A.1.b, A.1.c, A.2.a, A.2.d

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U2D Teach for Understanding

ENDURING UNDERSTANDING The diversity of life is the result of ongoing evolutionary change. Species alive today have evolved from ancient common ancestors.

GUIDING QUESTION What causes a population's gene pool to change?

EVIDENCE OF UNDERSTANDING After the lesson, give students the following assessment to determine whether they understand the role of chance events in the evolution of small populations. Have pairs of students use coin tosses to simulate the effects of chance on the allele frequencies in a population of 10 individuals. In the first generation, there are 10 “heads” alleles and 10 “tails” alleles. Students should assume that there are 10 individuals in the next generation. Students should toss the coin twice for each individual in the next generation and record the outcomes of the tosses. After pairs compare their new allele frequencies, have each student write a brief explanation of whether genetic drift has occurred.

Biology Workbook Answers Chapter5 Populations

**M.A. Burgman, S. Ferson, H.R.
Akçakaya**



Biology Workbook Answers Chapter5 Populations:

Mathematical Models in Population Biology and Epidemiology Fred Brauer, Carlos Castillo-Chavez, 2013-03-09 As the world population exceeds the six billion mark questions of population explosion of how many people the earth can support and under which conditions become pressing Some of the questions and challenges raised can be addressed through the use of mathematical models but not all The goal of this book is to search for a balance between simple and analyzable models and unsolvable models which are capable of addressing important questions such as these Part I focusses on single species simple models including those which have been used to predict the growth of human and animal population in the past Single population models are in some sense the building blocks of more realistic models the subject of Part II Their role is fundamental to the study of ecological and demographic processes including the role of population structure and spatial heterogeneity the subject of Part III This book which includes both examples and exercises will be useful to practitioners graduate students and scientists working in the field *Biology Coloring Workbook* I. Edward Alcamo, 1998 Following in the successful footsteps of the Anatomy and the Physiology Coloring Workbook The Princeton Review introduces two new coloring workbooks to the line Each book features 125 plates of computer generated state of the art precise original artwork perfect for students enrolled in allied health and nursing courses psychology and neuroscience and elementary biology and anthropology courses

Conservation of Wildlife Populations L. Scott Mills, 2012-12-17 Population ecology has matured to a sophisticated science with astonishing potential for contributing solutions to wildlife conservation and management challenges And yet much of the applied power of wildlife population ecology remains untapped because its broad sweep across disparate subfields has been isolated in specialized texts In this book L Scott Mills covers the full spectrum of applied wildlife population ecology including genomic tools for non invasive genetic sampling predation population projections climate change and invasive species harvest modeling viability analysis focal species concepts and analyses of connectivity in fragmented landscapes With a readable style analytical rigor and hundreds of examples drawn from around the world Conservation of Wildlife Populations 2nd ed provides the conceptual basis for applying population ecology to wildlife conservation decision making Although targeting primarily undergraduates and beginning graduate students with some basic training in basic ecology and statistics in majors that could include wildlife biology conservation biology ecology environmental studies and biology the book will also be useful for practitioners in the field who want to find in one place and with plenty of applied examples the latest advances in the genetic and demographic aspects of population ecology Additional resources for this book can be found at www.wiley.com/go/mills_wildlifepopulations *ISC Biology Book I for Class XI* Dr. P.S. Verma & Dr. B.P. Pandey, Well labelled illustrations diagrams tables figures and experiments have been given to support the text wherever necessary

Conservation and Biology of Small Populations James N. M. Smith, 2006 This book explores the factors affecting the survival of small populations As the human impact on Earth expands populations of many

wild species are being squeezed into smaller and smaller habitats As a consequence they face an increasing threat of extinction The authors review these theoretical ideas the existing data and explore the question how well do small and isolated populations actually perform

Evolutionary Ecology Anne E. Magurran, 2005-08-25 The Trinidadian guppy represents a uniquely tractable vertebrate system which has raised key questions in evolutionary ecology and supplied many of the answers This work discusses this study and incorporates significant new findings and insights

Risk Assessment in Conservation Biology M.A. Burgman, S. Ferson, H.R. Akçakaya, 1993-01-31 This book is a cohesive guide to the available methods that can be used in population viability analysis It is therefore extremely valuable to both the practitioner of conservation biology and the theoretical population biologist

Molecular Biology of the Cell 6E - The Problems Book John Wilson, Tim Hunt, 2014-11-21 The Problems Book helps students appreciate the ways in which experiments and simple calculations can lead to an understanding of how cells work by introducing the experimental foundation of cell and molecular biology Each chapter reviews key terms tests for understanding basic concepts and poses research based problems The Problems Book has been

Metapopulation Ecology Ilkka Hanski, 1999-03-18 Written by a world renowned biologist this volume offers a comprehensive synthesis of current research in this rapidly expanding area of population biology It covers both the essential theory and a wide range of empirical studies including the author's groundbreaking work on the Glanville fritillary butterfly It also includes practical applications to conservation biology The book describes theoretical models for metapopulation dynamics in highly fragmented landscapes and emphasizes spatially realistic models It presents the incidence function model and includes several detailed examples of its application Accessible to advanced undergraduate and graduate students Metapopulation Ecology will be a valuable resource for researchers in population biology conservation biology and landscape ecology

Demographic Methods Across the Tree of Life Roberto Salguero-Gómez, Marlène Gamelon, 2021 This novel book provides the reader with the fundamentals of data collection model construction analyses and interpretation across a wide repertoire of demographic techniques and protocols clearly guided throughout with fully reproducible R scripts

Problem Book for First Year Calculus George W. Bluman, 2013-12-01

Applied Environmental Genomics Oliver F. Berry, Clare E. Holleley, Simon N. Jarman, 2023-12 DNA is the essence of life and the original big data New technologies are allowing scientists to access and make sense of this information like never before and they are using it to solve the world's greatest environmental challenges Applied Environmental Genomics synthesises the latest and most exciting uses of genomic technologies for environmental science and management With an emphasis on diversity of applications and real world demonstrations leading researchers have contributed detailed chapters on innovative approaches to obtaining critical management relevant information about the natural world These chapters are complemented by perspective sections written by environmental managers who describe their experiences using genomics to support evidence based decisions Ideal for students researchers and professionals working in natural resource management and

policy Applied Environmental Genomics is a comprehensive introduction to a fast moving field that is transforming the practice of environmental management with profound relevance to industry government and the public *Darwinian Populations and Natural Selection* Peter Godfrey-Smith, 2009-03-26 In 1859 Darwin described a deceptively simple mechanism that he called natural selection a combination of variation inheritance and reproductive success He argued that this mechanism was the key to explaining the most puzzling features of the natural world and science and philosophy were changed forever as a result The exact nature of the Darwinian process has been controversial ever since however Godfrey Smith draws on new developments in biology philosophy of science and other fields to give a new analysis and extension of Darwin's idea The central concept used is that of a Darwinian population a collection of things with the capacity to undergo change by natural selection From this starting point new analyses of the role of genes in evolution the application of Darwinian ideas to cultural change and evolutionary transitions that produce complex organisms and societies are developed *Darwinian Populations and Natural Selection* will be essential reading for anyone interested in evolutionary theory

Animal Social Networks Dr. Jens Krause, Richard James, Daniel W. Franks, Darren P. Croft, 2015 This book demonstrates the application of network theory to the social organization of animals *The Molluscan Shell* Donald C. Rhoads, 1981

Endocrine-Disrupting Chemicals Andrea C. Gore, 2007-06-08 This book provides comprehensive coverage of the three most important themes in the field of Endocrine Disrupting Chemicals EDC research the basic biology of EDCs particularly their effects on reproductive systems EDC effects on humans and wildlife including biomedical considerations and potential interventions and practical advice for dealing with the problem of EDCs **Ten Thousand Birds** Tim Birkhead, Jo Wimpenny, Bob Montgomerie, 2014-02-16 A beautifully illustrated history of modern ornithology *Ten Thousand Birds* provides a thoroughly engaging and authoritative history of modern ornithology tracing how the study of birds has been shaped by a succession of visionary and often controversial personalities and by the unique social and scientific contexts in which these extraordinary individuals worked This beautifully illustrated book opens in the middle of the nineteenth century when ornithology was a museum based discipline focused almost exclusively on the anatomy taxonomy and classification of dead birds It describes how in the early 1900s pioneering individuals such as Erwin Stresemann Ernst Mayr and Julian Huxley recognized the importance of studying live birds in the field and how this shift thrust ornithology into the mainstream of the biological sciences The book tells the stories of eccentrics like Colonel Richard Meinertzhagen a pathological liar who stole specimens from museums and quite likely murdered his wife and describes the breathtaking insights and discoveries of ambitious and influential figures such as David Lack Niko Tinbergen Robert MacArthur and others who through their studies of birds transformed entire fields of biology *Ten Thousand Birds* brings this history vividly to life through the work and achievements of those who advanced the field Drawing on a wealth of archival material and in depth interviews this fascinating book reveals how research on birds has contributed more to our understanding of animal biology than the study

of just about any other group of organisms *Pesticide Resistance* National Research Council, Board on Agriculture, Committee on Strategies for the Management of Pesticide Resistant Pest Populations, 1986-02-01 Based on a symposium sponsored by the Board on Agriculture this comprehensive book explores the problem of pesticide resistance suggests new approaches to monitor control or prevent resistance and identifies the changes in public policy necessary to protect crops and human health from the ravages of pests The volume synthesizes the most recent information from a wide range of disciplines including entomology genetics plant pathology biochemistry economics and public policy It also suggests research avenues that would indicate how to counter future problems A glossary provides the reader with additional guidance *Examining Ecology* Paul A. Rees, 2017-11-27 *Examining Ecology* Exercises in Environmental Biology and Conservation explains foundational ecological principles using a hands on approach that features analyzing data drawing graphs and undertaking practical exercises that simulate field work The book provides students and lecturers with real life examples to demonstrate basic principles The book helps students instructors and those new to the field learn about the principles of ecology and conservation by completing a series of problems Prior knowledge of the subject is not assumed the work requires users to be able to perform simple calculations and draw graphs Most of the exercises in the book have been used widely by the author's own students over a number of years and many are based on real data from published research Exercises are succinct with a broad number of options which is a unique feature among similar books on this topic The book is primarily intended as a resource for students academics and instructors studying teaching and working in zoology ecology biology wildlife conservation and management ecophysiology behavioural ecology population biology and ecology environmental biology or environmental science Students will be able to progress through the book attempting each exercise in a logical sequence beginning with basic principles and working up to more complex exercises Alternatively they may wish to focus on specific chapters on specialist areas e.g. population dynamics Many of the exercises introduce students to mathematical methods calculations use of formulae drawing of graphs calculating simple statistics Other exercises simulate fieldwork projects allowing users to collect and analyze data which would take considerable time and effort to collect in the field Facilitates learning about the principles of ecology and conservation biology through succinct yet comprehensive real life examples problems and exercises Features authoritatively and consistently written foundational content in biodiversity ecophysiology behavioral ecology and more as well as abundant and diverse cases for applied use Functions as a means of learning ecological and conservation related principles by doing e.g. by analyzing data drawing graphs and undertaking practical exercises that simulate field work and more Features approximately 150 photos and figures created and produced by the author *Nuclear Cardiology and Multimodal Cardiovascular Imaging, E-Book* Marcelo Fernando Di Carli, 2021-11-17 Recent years have seen numerous advances in cardiovascular nuclear medicine technology leading to more precise diagnoses and treatment and an expanded understanding of the molecular basis for cardiac disease Nuclear

Cardiology and Multimodal Cardiovascular Imaging is a one stop comprehensive guide to the diagnostic and clinical implications of this complex and increasingly important technology Part of the Braunwald family of renowned cardiology references it provides cutting edge coverage of multimodal cardiac imaging along with case vignettes and integrated teaching content ideal for cardiologists cardiology fellows radiologists and nuclear medicine physicians Features all the latest cardiovascular nuclear medicine studies with practical evidence based implications for personalized patient evaluation and treatment Presents a consistent patient centered approach using integrated case vignettes correlated with specific nuclear medicine imaging findings Discusses patient assessment criteria risk factor criteria pathology evaluation criteria outcomes and other clinical implications Covers a full range of imaging technologies including SPECT CT PET CT and CT MR hybrid radionuclide cardiovascular imaging studies Addresses emerging clinical applications of nuclear imaging techniques for precision based medicine including targeted molecular imaging and cell therapies Includes sections on instrumentation principles of imaging protocols and interpretation applications in coronary artery disease special populations and heart failure artificial intelligence and more Contains guidelines and appropriate use documents to provide appropriate context for clinicians Features hundreds of high quality figures including multimodal cardiac imaging studies anatomic illustrations and graphs Provides Key Point summaries 50 procedural videos and 100 multiple choice questions and answers to reinforce understanding and facilitate review Enhanced eBook version included with purchase which allows you to access all of the text figures and references from the book on a variety of devices

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