

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

Student Resources 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

Biologist

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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.

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Holt Biology Holt Rinehart & Winston,2003-08 Holt Biology Chapter Resource File 15 Holt Rinehart & Winston,Holt, Rinehart and Winston Staff,2004 *AGS Biology* ,2000 **Chapter Resource 13 Theory/Evolution Biology** Holt Rinehart & Winston,Holt, Rinehart and Winston Staff,2004 *Globe Biology* Globe Fearon,1999 *Biology a Guide to the Natural World* David Krogh,Laurel Robeerts,2002 **Biology** Kenneth Raymond Miller,Prentice Hall (School Division),1999-02 Marine Fisheries Review ,1988 **Social and Communicative Functioning in Populations with Intellectual Disability: Rethinking Measurement** ,2023-10-12 Social and Communicative Functioning in Populations with Intellectual Disability A Developmental Perspective Volume 65 in the International Review of Research in Developmental Disabilities series focuses on social and communicative functioning with a particular emphasis on people with intellectual disability The volume brings together international researchers across disciplines to highlight innovative approaches to holistically describe social and communicative abilities in this population including teleassessment self report and community engaged research designs Through a lifespan approach key issues are raised related to social and communicative functioning across a range of communication modalities from infancy through adulthood Additional chapters cover Adaptation of in person tools for remote assessment of infants and toddlers with social communication concerns in community based settings Measuring social communication in people with ID who use minimal speech Differences across the lifespan and Social Inclusion of Adults with IDD Toward Belonging Building a Life Examining the advocacy and social experiences of students with IDD in inclusive postsecondary education Focuses on social and communicative functioning in people with intellectual disability Provides a holistic perspective to describing social and communicative abilities Includes a lifespan approach from infancy through adulthood Forum ,1982 The Software Encyclopedia 2000 Bowker Editorial Staff,2000-05 **Biology Trending** Eli Minkoff,Jennifer K. Hood-DeGrenier,2023-07-24 Biology Trending is a truly innovative introductory biology text Designed to combine the teaching of biological concepts within the context of current societal issues Biology Trending encourages introductory biology students to think critically about the role that science plays in their world This book features many current and relevant topics including sea level changes and ocean acidification CRISPR Cas9 opioid abuse Zika Ebola and COVID 19 threats to biodiversity and cancer immunotherapies It is accompanied by digital Instructor and Student Resources to support teaching and learning Key Features Adopts an issues approach to teaching introductory biology Up to date sections throughout including climate change CRISPR new hominids COVID 19 and new cancer therapies among many others Suitable for both major and nonmajor courses More succinct for ease in teaching and more affordable for students High quality illustrations help to elucidate key concepts This book is extended and enhanced through a range of digital resources that include Long form and open response self testing resources to test understanding and apply knowledge Visual simulations to demonstrate evolutionary processes Web links and bibliographic resources to expand knowledge Time saving

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sectors and target groups Questions relevant to OL include Which knowledge produced by whom to share and how Who to target and how to effectively reach those targeted How to design OL initiatives including by mobilizing those targeted via living lab approaches e g to ensure effective OL and pave the way for behavior change What are the knowledge gaps that limit our capacity to design effective OL As scientists it is likely you have many more questions to offer and discuss

Understanding DNA Ancestry Sheldon Krinsky,2021-11-04 An accessible introduction to how DNA ancestry tests work what they can be used for and the associated ethical issues **Leaders in the Study of Animal Behavior** Donald A. Dewsbury,1985 This is a collection of autobiographical essays written by nearly two dozen scientists in the field of animal behavior Each chapter is devoted to one individual and includes details regarding family life and early experiences with an emphasis on the individual s career as a scientist *Biology Today* Eli C. Minkoff,Pamela J. Baker,2001 Biology as a subject not only plays a major role within the scientific world but has broader implications that cross many boundaries This work takes a modern and innovative approach to teaching introductory biology it presents fundamental biological concepts within the context of current social issues How do scientists affect our society at large How are ethics and morals applied to the scientific world Why are we racing to complete the human genome project and who are we racing against How do economic disparities between people and nations influence habitat destruction Can plant science feed the world Are the causes of cancer more genetic or environmental The book seeks to help students think critically about these questions and to explore and assess the role that science plays in their world

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