

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

L, E, B, IV

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.

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