

# Teaching evolution through human examples: Evolution of human skin color

Grade Levels: 9-12      Duration: 10 class periods

## Overview:

**Lesson 1, Can Everybody Tan?:** The goal of this lesson is to evoke students' curiosity about human skin color and to elicit their ideas about how populations change and adapt over time. The lesson begins with students exploring data on tanning in sharks. Students then provide their own ideas to questions related to skin color and tanning in humans. One reason the unit starts with tanning is because it is a change that can be observed, which helps students understand the role of melanin and skin color. This sets the stage for students to eventually learn about change that is harder to observe—evolutionary change. Students then learn more about skin and the difference between baseline (constitutive) and facultative (temporary) skin color. Students learn about melanin, and there is an optional demonstration of how ultraviolet (UV) light affects melanin. To help students understand the arc of their learning throughout the unit, Lesson 1 introduces them to an end-of-unit project. In this project, students propose an explanation for how tanning fits into the evolutionary explanation of the variation in human skin color, and they also develop a research plan for determining whether their proposed ideas are valid.

**Lesson 2, The Melanin Connection:** The goal of this lesson is to explore the genetic basis for baseline skin color and begin to develop an explanation for skin color evolution in humans based on data. In Part 1, students start to reason about why people differ in skin color. They learn that skin color is inherited, under the influence of many genes, and also modulated by environmental factors. Genetic studies in various animals have shed light on the function of some of the genes that affect skin color. Students reflect on how common ancestry helps explain why studies of gene function in model organisms like fish give valuable insights into gene function in humans. In Part 2, students start to explore how differences in melanin production could affect fitness. First, students learn about an experiment in rock pocket mice in which scientists were able to make direct estimates of how different alleles for a gene that affects melanin production in fur affect fitness. Students compare the explanation in the rock pocket mice example with what they currently understand about human skin color evolution and discuss what additional data they need to further develop their explanations.

**Lesson 3, Developing a Fuller Explanation for Skin Color Evolution in Humans:** In Part 1, students explore two hypotheses for how folate protection and vitamin D production might affect fitness in humans. Students then explore the connection between skin color, amount of UV radiation, and geographic location on the planet. These relationships are then used to stimulate student inquiry into factors that might have caused skin color to change over evolutionary time. In Part 2, students learn how to link the UV-melanin relationship and the historical dispersal of some groups of people away from the equator to skin color evolution. They also relate dispersal data to allele frequency data for a gene that affects skin color in some humans.

**Lesson 4, More Evidence for Skin Color Evolution in Humans:** Students learn how to use the Hardy-Weinberg equilibrium model to make predictions about allele frequencies in populations and gain insight into how biologists use the model to understand population dynamics. Students apply their understanding of the Hardy-Weinberg equilibrium model to problems related to the

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skin color evolution in humans and fur color evolution in mice. They use a population genetics simulation to conduct and analyze an investigation on an evolutionary question of their choosing. In the process, students learn about genetic drift, another important evolutionary mechanism.

**Lesson 5**, Explaining Human Skin Color Evolution: As a summative assessment, students address how tanning fits into the evolution of human skin color. Students have been developing their abilities to accomplish this task since Lesson 1. Their end-of-unit project includes a research plan with concrete steps to validate their explanations of tanning.

## **Aims:**

**Lesson 1.** During this lesson, the student will:

- begin making conceptual links between their prior knowledge about tanning and core principles of natural selection,
- compare and contrast key elements of facultative versus baseline skin color,
- add background knowledge to their prior knowledge regarding the biology of skin color,
- begin to frame all lessons in this unit in the context of an end-of-unit project.

**Lesson 2.** During this lesson, the student will:

- use data to explain that skin color has a strong genetic component,
- use evidence and models to conclude that variation in human skin color depends on many genes,
- construct an understanding that a few genes may have a large impact on skin color,
- develop an argument involving common ancestry,
- use the principles of natural selection to analyze the evolution of fur color in mice,
- suggest further data needed to develop an argument for skin color evolution in humans.

**Lesson 3.** During this lesson, the student will:

- explain how folate protection and vitamin D protection affect fitness;
- investigate global UV intensity gradients and historical patterns of human skin color;
- explain how the evolution of less melanized skin in humans relates to patterns of human dispersal;
- develop an argument, using genotype and phenotype differences, that humans evolved less melanized skin multiple times;
- learn components of a scientific explanation and practice writing them.

**Lesson 4.** During this lesson, the student will:

- use their understanding of the Hardy-Weinberg equilibrium model to solve problems related to skin color evolution,
- be able to use a population genetics simulation to investigate and interpret evolutionary mechanisms such as genetic drift and natural selection,
- reflect on how mathematical models add to the evidence for evolution.

**Lesson 5.** During this lesson, the student will:

- learn a technique for the structured review of large amounts of biological knowledge,
- transfer their knowledge about baseline skin color to generating a research plan about facultative skin color,

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- demonstrate what they learned in the unit in ways other than traditional tests.

**Materials needed:**

Handouts, access to computer with internet access, coins, colored pencils/markers, chart paper, colored marbles, container for marbles; additional optional material detailed in lesson plans

**Keywords:**

evolution, human, Hardy-Weinberg equilibrium, skin color, melanin. DNA, genetic drift, natural selection, fitness

**Source:**

[Teaching Evolution through Human Examples Project](#), Smithsonian Institution

**[LINK TO LESSON](#)**

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