Traits in Context

How environments shape inherited variation

GEN.5.6 "Enrichment: Apply the concept of natural selection to analyze differences in human populations (e.g., skin color, lactose persistence, sickle cell anemia, and malaria)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each environmental condition, circle the inherited trait linked to it, and number the explanations that connect the trait to survival or reproduction.

When a Trait Has an Advantage

1. Imagine two families whose ancestors lived for many generations in regions with very different sunlight. Natural selection can change how common inherited traits become in a population, but only when a trait affects survival or reproduction in a particular environment. Human skin contains melanin, a pigment that helps limit damage from ultraviolet (UV) radiation. In places with intense UV, more melanin can help protect folate, a nutrient important for healthy fetal development. In places with weak UV, less melanin can help the body make enough vitamin D from sunlight. Skin color varies widely within populations; sunlight does not change a person's inherited genes.

2. Now imagine a community that begins keeping cattle and drinking their milk. Most young mammals make the enzyme lactase to digest lactose, a sugar in milk, but production usually drops after weaning. Some people inherit a DNA variant that keeps lactase production high into adulthood, called lactase persistence. Where fresh milk provided a dependable source of food and water, adults with this variant could use its nutrients without the digestive trouble some other adults experience. If that advantage helped them raise more surviving children, the variant could become more common across generations. Several populations developed lactase persistence through different genetic changes.

3. A different trade-off appears in regions where malaria, a disease spread by mosquitoes, has been common. A person with one copy of a particular hemoglobin variant and one usual copy has some protection against severe malaria. A person with two copies of the variant develops sickle cell disease, which can cause serious illness. Where malaria is common, the protection for people with one copy can help keep the variant in the population despite the harm of having two copies. Where malaria is rare, that protection brings little benefit. These patterns reflect local conditions and ancestry, not fixed biological categories of people.

2 ANSWER WITH EVIDENCE

Use the passage

1. How could natural selection favor different amounts of melanin in places with strong versus weak UV?

2. Why could lactase persistence become more common after a community began relying on fresh milk?

3. Why can the hemoglobin variant remain common where malaria occurs even though two copies cause serious illness?

4. Compare how the environment affects the advantage of lactase persistence and the advantage of having one copy of the hemoglobin variant.

3 YOUR TURN

Your own words

In a fictional island community, an inherited variant helps some people get more energy from a local starchy root. Write four sentences predicting how the variant's frequency might change if storms make the root the main food, then explain what happens to its advantage if other foods return; include survival or reproduction and generations.

ANSWER KEY

Traits in Context

HIGH SCHOOL · GEN.5.6

PART 1 · READ AND MARK

Underline each environmental condition, circle the inherited trait linked to it, and number the explanations that connect the trait to survival or reproduction. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How could natural selection favor different amounts of melanin in places with strong versus weak UV?	**In strong UV, more melanin can protect folate. In weak UV, less melanin can help the body make enough vitamin D.**
2	Why could lactase persistence become more common after a community began relying on fresh milk?	**Adults with the variant could use milk's nutrients without digestive trouble. If they raised more surviving children who inherited the variant, it could become more common.**
3	Why can the hemoglobin variant remain common where malaria occurs even though two copies cause serious illness?	**People with one copy gain some protection against severe malaria. That advantage can help keep the variant in the population despite the harm caused by two copies.**
4	Compare how the environment affects the advantage of lactase persistence and the advantage of having one copy of the hemoglobin variant.	**Lactase persistence can be advantageous where fresh milk is an important resource. One copy of the hemoglobin variant can be advantageous where malaria is common. Each advantage depends on local conditions.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

After storms, the starchy root becomes the island's main food. People with the inherited variant might get more energy from it, helping them survive and raise more children. If their children inherit the variant, it could become more common over generations. If other foods return, that advantage may shrink, so selection for the variant may weaken.

Accept answers that connect an inherited trait to a specific environmental advantage and explain a possible change across generations. The predicted change is not guaranteed, and an environmental change does not alter an individual's inherited variant.