

S N A P S H O T
Mini-Lesson

Educational Resource for
Students & General Audiences

Are My Genes My Destiny? Examining Determinants of Health



PERSONAL
GENETICS
EDUCATION
PROJECT

ETHICAL, LEGAL, & SOCIAL ISSUES IN PERSONAL GENETICS



Guiding Questions:

- What roles do a person's genetic makeup and environment play in determining their traits?
- What are the determinants of health, and how do they affect a person's well-being?
- What can a person do to change their health risks?

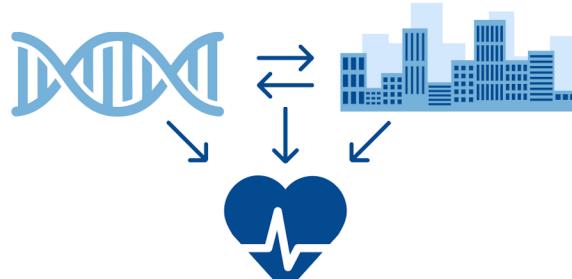
A person's DNA, or "genetic makeup", can contribute significantly to the development of certain physical traits, such as eye color and hair texture. But, what about their health?

What is genetic determinism?

It was once believed that a person's genetic makeup played a major role in defining all aspects of their being - from a person's height to how well they do in school, and from how fast a person can run to how much money they make. This idea that a person's genetic makeup is the only or most important contribution to their traits is called "genetic determinism". However, it has been found that a person's environment plays a crucial role in their development, thereby challenging the idea of genetic determinism.

For example, your height can be influenced by the foods you eat, how well you do in school can be influenced by your teachers, how fast you run can be impacted by the shoes you wear, and how much money you make can be influenced by the city you live in. The discussion about whether a person's environment or genetic makeup is the more influential factor in their development has been called "nature versus nurture". 'Nature' represents a person's genetic makeup, while 'nurture' refers to a person's environment, including external factors that can influence a person's traits, such as their physical environment, childhood experiences, social relationships, and culture.

The development of human traits, including health, is complex. Scientific studies have found that a person's traits are the result of their genetic makeup, environment, and interactions between these two factors. In other words: nature AND nurture both affect a person's health. So, how might a person modify these factors to alter the quality of their health?



What are the determinants of health?

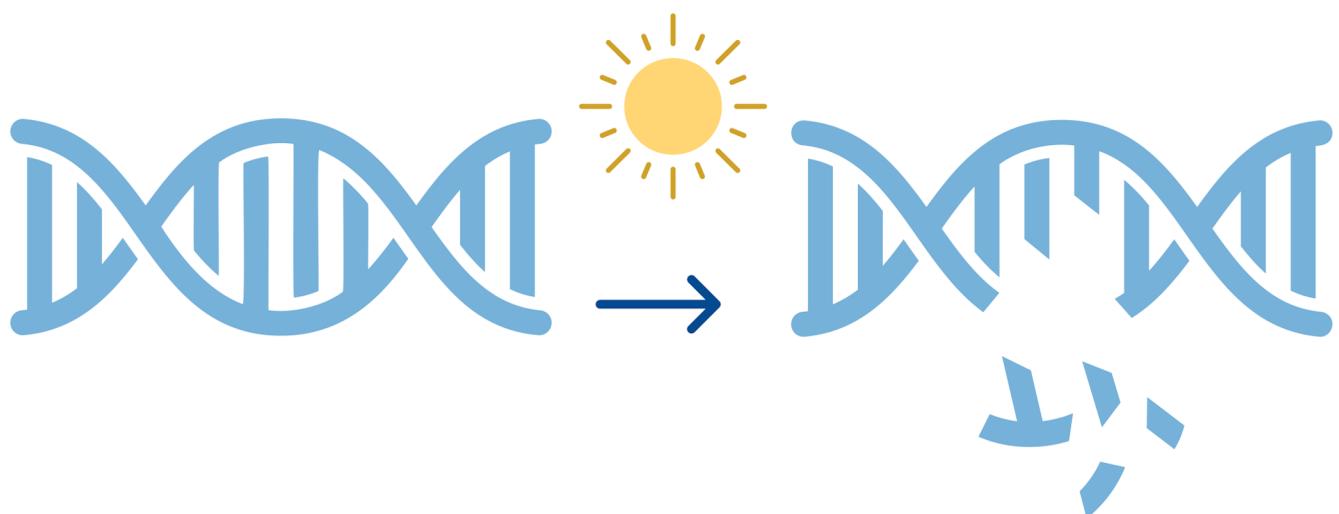
Determinants of health are elements of a person's life that can impact the quality of their well-being (Fig. 1). As shown in figure 1, determinants of health can include a person's genetic makeup ('genetics', shown in green), as well as factors that are influenced by their environment. Examples of environmental factors that can affect a person's health include their physical environment (e.g. allergens, UV rays, viruses, clean drinking water), access to health services (e.g. medications, doctor), their social and economic environment (e.g. neighborhood safety, government structure), their employment/working conditions (e.g. job stress, safe work environment) and more (Fig. 1).

Determinants of health can improve, support the maintenance of, or worsen a person's health. It is important to gather information about as many health determinants as possible in order to better understand a person's health risks. Sometimes, health determinants can be controlled by a person's actions (e.g. deciding to stop smoking or meeting with a counselor to manage stress). Other determinants are much harder or impossible to control (e.g. the environment a person was raised in or their genetic makeup).

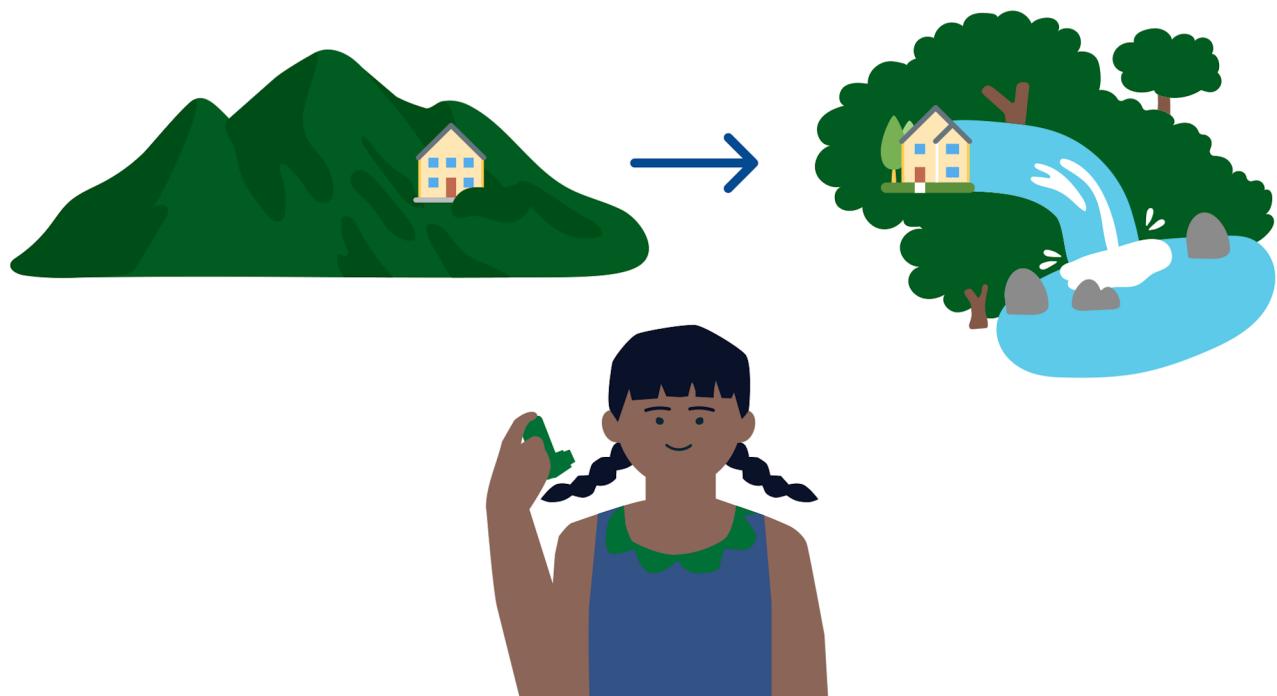


Figure 1: Determinants of Health (adapted from the World Health Organization)

Furthermore, a person's health determinants change throughout their lifetime, due to changes both in their environment and their genetic makeup. When we think about the role that our genetic makeup plays in our health, we often consider it to be a static or unchanging factor. However, our genetic makeup has the potential to change throughout our lifespan. For example, exposure to UV rays in sunlight can cause changes in a person's genetic makeup that can result in the development of skin cancer.



Moreover, a change in a person's environment can affect the presentation of certain genetic traits. For example, asthma is a health condition that is influenced by a person's genetic makeup. However, asthma symptoms can be eased by moving to a warmer and more humid climate at a lower elevation. This example illustrates the complexity of a person's health, and how it is influenced both by their genetic makeup and their environment. Therefore, to understand the big picture of a person's health, it is necessary to consider many health determinants.



Student Worksheet

Name: _____

Date: _____

Directions: Read the scenario and answer the questions to demonstrate your understanding of health determinants and how they can be impacted by OR unrelated to a person's genetics.

1) Read the scenario below. Then, answer the questions on the next page.

Ronaldo and Janet are a married couple with two small children. They moved away from their family in Maryland one month ago to live in New York City.

Ronaldo is an army veteran. Just like his father and one of his sisters, he has asthma, which he was diagnosed with when he was 5 years old. He takes medication to manage his asthma, and his symptoms are mild. However, since moving to NYC he has noticed that his symptoms have worsened.

Janet is a computer programmer who was recently diagnosed with arthritis (joint inflammation) in her fingers. Ronaldo and Janet moved their family to New York City because Janet was offered a job at a rapidly growing technology company. She enthusiastically accepted the position, and she enjoys her job; although, at times feels overwhelmed due to the intense workload. Her stress has increased since moving and starting her new job, especially because she no longer lives near her parents, who would often help Janet and Ronaldo take care of things at home by babysitting or buying groceries. Janet also worries that her high-stress job may increase her risk of heart disease. She has never been diagnosed with a heart condition but has wondered if she should be assessed by a doctor ever since her aunt had a heart attack last year.

One determinant of health is a person's genetic makeup or 'genetics' (Fig. 1). To find out if someone is at risk for certain health conditions, a doctor will ask a patient to discuss both their personal and 'family health history'. Because a person shares part of their genetic makeup with their biological relatives, they may be at risk for the same genetic health conditions as their family members.

Student Worksheet

In the table below, indicate which of the health conditions mentioned in the scenario seem to be shared by family members (sometimes, a condition is described as “running in the family”). When a condition is shared by biological relatives, this can indicate that it is affected by genetic makeup (‘genetics’, Fig. 1).

Health Condition	Is the condition shared by the family? Which family members are affected?
Ronaldo's asthma	
Janet's arthritis	
Janet's risk for heart disease	

Understanding a person’s family health history is one step towards assessing whether their genetic makeup might increase their health risks. It is important to note that a person without a family history of a particular health condition may still be at risk of developing that condition at some point during their life. Diagnostic genetic testing can be performed to identify whether or not a person’s genetic makeup puts them at risk for developing certain health conditions, regardless of their family health history information.

Student Worksheet

2) There are many other determinants of health, apart from genetic makeup ('genetics'), that can affect a person's health. Using Figure 1, identify additional determinants of health that can affect Ronaldo and Janet's health conditions. In the table below, there is a space for each health determinant you should be able to identify in the scenario. Explain why you selected each determinant in a few words. Remember - health determinants can improve, support the maintenance of, or worsen a person's health.

Health Condition	What health determinants can affect this condition (apart from 'genetics')?
Ronaldo's asthma	1. 2. 3.
Janet's arthritis	1.
Janet's risk for heart disease	1. 2.

3) Identify two health determinants of those listed in questions 2 and 3 that Ronaldo and Janet could change to improve their health. For each example, write what they could do to make the change, and how it could affect their health.

4) Reflect on the case example and what you've learned about the determinants of health. What will you personally do with this information?

Teacher's Guide

Additional Curricula

pgEd offers several educational resources that can be utilized in a classroom setting to foster learning about genetics and health. Some of these resources are highlighted below. You are welcome to integrate any of these lesson plans or the shorter, student-directed SNAPSHOTs into your curriculum. Check out [pgEd's lesson plan page](#) on our website for more options.

- [Genome Editing and CRISPR](#). In this lesson, students are introduced to the basic scientific concepts of genome editing, its potential for improving human health, as well as some of the ethical discussions surrounding the development and applications of the technique.
- [Personalized Medicine](#). In this lesson, students delve into the hopes and challenges of personalized medicine and consider the applications of genetic analysis in medicine.
- [After 10 Years of Testing All College Athletes for Sickle Cell Trait, What Have We Learned?](#) All athletes playing on college sports teams governed by the National College Athletic Association (NCAA) are required to confirm their Sickle Cell Trait (SCT) status by taking a blood test or by providing prior test results. This SNAPSHOT explores the history, successes, and limitations of this mandatory SCT screening program, which was put in place to improve safety for athletes with SCT.

Resources

- The VeryWellMind.com [Nature vs. Nurture](#) resource gives definitions and examples of factors that are considered to be 'nature' and 'nurture', and explores how these elements interact with each other to influence a person's traits.
- The World Health Organization's [Determinants of Health](#) resource provides examples of different factors to consider when trying to understand a person's holistic health "picture".

For more information about the health conditions mentioned in this SNAPSHOT, visit:

- [Is Asthma Genetic? | UpToDate](#)
- [Is Arthritis Genetic? | Cleveland Clinic](#)
- [Can Stress Cause Heart Disease? | Heart.org](#)

Teacher's Guide

Student Worksheet Answer Key

Question 1)

Health Condition	Is the condition shared by the family? Which family members are affected?
Ronaldo's asthma	Yes - father and sister
Janet's arthritis	No.
Janet's risk for heart disease	Yes - aunt.

Question 2)

Health Condition	What health determinants can affect this condition (apart from 'genetics')?
Ronaldo's asthma	1. Army service (employment/working conditions) 2. Medication management (health services) 3. Move to New York City (physical environment)
Janet's arthritis	1. Computer job (employment/working conditions)
Janet's risk for heart disease	1. Mental or emotional stress due to feeling overwhelmed with work (employment/working conditions) 2. Mental or emotional stress due to less parental support (social support networks)

Teacher's Guide

Student Worksheet Answer Key

Question 3)

Ronaldo could:

- Medication management (Health Services): Try a different medication to relieve his symptoms.
- Move to New York City (Physical Environment): Try anything that can decrease his exposure to air pollution, which might have caused his increase in symptoms. Examples include using an air purifier in the house, wearing a mask outside, moving to a less polluted location, etc.

Janet could:

- Computer job (Employment/Working Conditions): Reduce repetitive use of her fingers, which makes her arthritis worse. Examples include changing her work set-up to include an ergonomic (meaning, designed for efficiency and comfort) keyboard and mouse, taking time to rest her hands while working, using a hand brace, seeing an occupational therapist to learn hand stretches, taking anti-inflammatory medication to ease symptoms, finding a job that involves less typing, etc.
- Mental or emotional stress due to feeling overwhelmed with work (Employment/working conditions): Lower her workload or develop methods to cope. Examples include discussing workload management options with her colleagues and boss, finding a less demanding job, exercising, seeing a mental health counselor, exploring hobbies that she enjoys, etc.
- Mental or emotional stress due to having less support from parents (Social support networks): Find help with household responsibilities and child care. Examples include identifying local support groups, finding a babysitter, using delivery grocery/meal services, moving closer to home, etc.

Question 4)

This question is self-reflective; therefore, there are no right or wrong answers. Students should receive credit for providing an answer to the question.