

## EDUCATOR EXPLAINER

# Genomics in the High School Classroom

### Project Details

#### GRADE RANGE

9–12

#### TIMING

45–60 minutes

### GENETICS VS. GENOMICS

Genetics, the study of genes and their role in inheritance, is a critical foundation of the life science curriculum in secondary life science classrooms, yet the study of **genomics** is still relatively overlooked. Learning about the genome provides teachers and students a broader view of DNA, and the many applications of genomics in the world around us.

The new and developing field of **genomics** involves the study of the genome, the entirety of a person's genes. Genomics is revealing how genes are influenced by the environment, how genes interact with each other, and the role they play in complex diseases. Breakthroughs in genomics are continuing to help scientists develop new diagnostic tools, therapies, and treatments for disease. Along with improvements in personal health, genomic studies are also helping to make advances in other areas such as agriculture, space travel, and epidemiology.

### WHY IS IT IMPORTANT?

Genomic studies in medicine are showing that interaction between genes and environmental factors and lifestyle choices can have a major influence on a person's risk of developing diseases such as cancer, heart disease, and diabetes. New information in genomics also uses a person's genetic information to help develop personalized medical and drug treatments and reveal the connection between the microbiome and health.

As we work together globally to understand, develop treatments for, and prevent the spread of the COVID-19 pandemic, genomics is being used to help understand the origins of and transmission of viruses. A greater

understanding of the genome of viruses is allowing us to better predict and identify viral mutations and develop technologies that will help prevent the spread of disease in a pandemic.

In Illumina’s **DNA Decoded** Educator series, teachers can help their high school students make personal connections to genomics by exploring the impact of the genome on mental health, the impact of genetic screening as a predictor of athletic performance, and the surprising results that the genome can reveal about race and its connection to medicine and human health.

## WHERE TO START?

The **DNA Decoded** educator resources (<https://dnadecoded.org/educator-resources.html>) have been divided into three sections: “Cracking the Code” classroom activities to introduce students to genomics, “Investigating the Code” digital lesson bundles for deeper exploration of technology used in genomics, and “Exploring the Code” two-day project activators. Lessons are also used to help students understand the impact genomic breakthroughs have had on human health issues, and show them new developments in medicine and industries such as agriculture. In the first section of **DNA Decoded**, “Cracking the Code,” educators can choose to use a single class period or 45-minute lesson to get their (and their students’) feet wet in the field of genomics.

- 1 As the COVID-19 pandemic and the emerging Delta variant are important topics in news headlines and global human health, **“Why Bats? Disease Transmission to Humans”** is one suggested lesson to start with. In this lesson, students will look at the connection between bats and humans in the transmission of pathogens, such as SARS-CoV-2. They will learn about the mechanism that allows the virus to make the jump between different species and explore the idea that bats may have an evolutionary advantage and a “super” immune system that allows them to carry and handle pathogens more effectively than humans can. Once this initial lesson is completed, teachers who want to further explore the impact genomics is having on the fight against COVID-19 may move to the digital lesson bundle **“Breaking the Chain—Viral Transmission.”** In these lessons, students will spend four days learning how genetic mutations allow for the spread of viruses and the ways technology is used to fight disease.
- 2 **“Secrets of Sequencing”** is another lesson that can help students make a personal connection to genomics as they are introduced to a teenager in the opening of the lesson who is suffering from a mysterious illness. They will learn what Next Generation Sequencing (NGS) is and then work together in a hands-on activity that models NGSS technology to sequence a DNA sample. They will use a



bioinformatics database to identify the pathogenic genetic material in the sequence, revealing the pathogen that is causing the teenager’s illness. After completing **“Secrets of Sequencing”** students can use what they’ve learned about genomic sequencing in **“Targeting Cancer,”** a digital lesson bundle. In **“Targeting Cancer,”** students will learn how targeted therapy is changing treatment for cancer patients by using gene sequencing. They will explore various types of targeted therapy and help fictional doctors create personalized treatments to save lives.



- 3 A final suggested starting point for the teacher in **DNA Decoded** is the student activity **“Medicine of the Future.”** In this activity, students will explore what genome testing entails, explore a genetic database, and be introduced to precision medicine and how it can help treat and cure disease. Students will play the roles of hospital administrators and work together to develop a plan for changes their hospital will make to begin the practice of precision medicine. Teachers who want to further explore personalized medicine in their classroom can use the two-day **“Functional Genomics and Individualized Medicine”** lesson as a good next step. In this STEM project activator, students will investigate the human genome to understand how genetic mutations can lead to disease, explore genomic screening for mutations, and learn how mutations are used as a starting point for personalized treatment.



### Additional Resources

A collection of career videos highlights the diverse career opportunities in the field of genomics. Employees will give students the inside scoop on what their day-to-day looks like, share what they work on, who they work with, and just how varied the wide world of genomics really is. Use this collection to introduce students to some of the faces and stories behind the genomics applications they investigated in the instructional resources.

**YouTube Playlist** (<https://www.youtube.com/playlist?list=PLKRu7cmBQlahf0hdVL8H7tCUhXYrrPwyM>)

### Instructional Resources Sorted by Applications of Biotechnology

The table below can be used as a guide for educators who want to add various applications of biotechnology in genomics to their classroom curriculum through Illumina’s **DNA Decoded** lessons.

APPLICATIONS OF BIOTECHNOLOGY IN GENOMICS				
MEDICINE and TREATMENT	BIOTECH IN INDUSTRY	PATHOGENS and DISEASE	HUMAN HEALTH	MICROBIOLOGY
<ul style="list-style-type: none"> <li>• <b>Classroom Activity:</b> <a href="#">“Race and Medicine”</a></li> <li>• <b>Classroom Activity:</b> <a href="#">“Secrets of Sequencing”</a></li> <li>• <b>Classroom Activity:</b> <a href="#">“Medicine of the Future”</a></li> <li>• <b>Digital Lesson Bundle:</b> <a href="#">“Targeting Cancer”</a></li> <li>• <b>STEM Project Activator:</b> <a href="#">“Functional Genomics and Medicine”</a></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Digital Lesson:</b> <a href="#">“Agriculture Revolution”</a></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Classroom Activity:</b> <a href="#">“Why Bats? Disease Transmission to Humans”</a></li> <li>• <b>Classroom Activity:</b> <a href="#">“Disease Detectives”</a></li> <li>• <b>Digital Lesson Bundle:</b> <a href="#">“Breaking the Chain – Viral Transmission”</a></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Classroom Activity:</b> <a href="#">“Genes or the Gym?”</a></li> <li>• <b>Digital Lesson:</b> <a href="#">“Deep Space Genomics”</a></li> <li>• <b>STEM Project Activator:</b> <a href="#">“Sickle Cell Trait and Reducing Risk in Sports”</a></li> </ul>	<ul style="list-style-type: none"> <li>• <b>Digital Lesson Bundle:</b> <a href="#">“The Microbiome and Mental Health”</a></li> <li>• <b>Digital Lesson Bundle:</b> <a href="#">“Your Other Genome”</a></li> </ul> 