

STUDENT ACTIVITY

Medicine of the Future

Project Details

GRADE RANGE

9–12

TIMING

45–60 minutes

OVERVIEW

Students will role-play they are administrators at a leading hospital. They have decided that their hospital will be moving toward the practice of precision medicine, and they need to determine what their hospital must do in order to implement this transition successfully. To gain a better understanding of this subject, students will watch a video that explains what genome testing entails, explore a genetic database to understand the sheer scope of genes, and read an article that presents the concept of precision medicine. Students will then work in pairs to develop a plan of the changes their hospital will make to begin the practice of precision medicine.

TIMING

45–60 minutes

OBJECTIVE

After exploring the process of genome editing and precision medicine, students will develop a plan for its implementation.

MATERIALS NEEDED

- Device with the ability to project
- Unlocking My Genome [video](#)
- Precision Medicine [article](#), one for each student
- Precision Medicine Plan handout, one for each student
- Devices with internet access, one for every 2 students:
Optional—See steps #6 and #9

NEXT GENERATION SCIENCE STANDARDS: THREE DIMENSIONS

Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
<p>Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.</p>	<p>ETS1.B: Developing Possible Solutions</p> <p>When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.</p>	<p>Influence of Science, Engineering, and Technology on Society and the Natural World</p> <p>New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.</p>

STANDARDS FOR TECHNOLOGICAL LITERACY

Standard 14: Medical Technologies

K. Medical technologies include prevention and rehabilitation, vaccines and pharmaceuticals, medical and surgical procedures, genetic engineering, and the systems within which health is protected and maintained.

M. The science of biochemistry and molecular biology have made it possible to manipulate the genetic information found in living creatures.

PROCEDURE

- Warm-Up Activity:** Begin by telling students that for this class period they will pretend they are hospital administrators. Explain that like their school administrators—the principal, assistant principal, etc.—lead and oversee their school, hospital administrators lead and oversee the hospital.

Ask students to brainstorm other jobs that work at a hospital, and create a list on the board. Encourage them to think beyond doctors and nurses! Keep this list available until the end of the class period.
- Tell the students that, as the hospital administrators, they recently decided that their hospital will be switching to the practice of precision medicine. Reference the list on the board, and explain that they will have to develop a plan on how to transition the hospital to this new future of medicine. But before they develop this plan, they must understand what precision medicine entails!
- Explain that the first step in understanding precision medicine is to understand the concept of genome sequencing. Direct students to listen for details about genome sequencing as they watch this [video](#). Once the video is complete, ask students to share what they learned. Make sure students understand that while 99.9 percent of our genes are identical, it is the 0.01 percent that makes

us unique—and it is this small fraction of our genome that doctors analyze. Having our genome sequenced enables us to receive a personal guide to our DNA. This guide may be able to show us our genetic mutations, including our predisposition to certain diseases.

4. Next, project NIH’s Genetics Home Reference [website](#). Explain that this is a database of human genes. Scroll through all of the genes that exists for one or two letters to give students an idea of the scope of the human genome. Explain that every single gene has: 1) A specific function, and 2) A health consequence that could occur if the gene mutates or changes from its normal state.
5. Click on one gene to project the gene’s function (found under the “Normal Function” header) as well as the possible consequences associated with gene mutation (found under the “Health Conditions Related to Genetic Change” tab).
6. Then go back to the main menu, and ask for student suggestions on other genes to explore. Spend about 5 minutes investigating the normal function and health conditions related to the genetic changes of various genes. Students who have their own devices may explore the website independently at this time.
7. Segue back to the concept of precision medicine. Take a moment to explain that the practice of precision medicine uses the advances made in understanding the human genome to treat patients in a new way. Rather than relying on more traditional methods of treatment that follow research-driven protocols (e.g. “X” type of cancer is always treated by chemotherapy followed by radiation), this approach allows healthcare providers to consider a patient’s genes as well as their environment and lifestyle while devising treatment and/or prevention plans specific to their needs and genetic makeup.
8. Distribute one Precision Medicine article and one Precision Medicine Plan handout to each student. First direct students’ attention to the handout. Explain that in order to put together a plan to help the hospital transition to precision medicine, pairs of students will each focus on a specific hospital role. Randomly assign pairs one of the roles in Step One’s list. If there are more student pairs than there are roles, students may select another hospital role that they brainstormed at the beginning of class or double-up on roles.
9. Next, explain that student pairs will read the Precision Medicine article with the goal of annotating for key details that will help them complete Step #2 on the handout. Read Step #2 together and answer any questions the students have. Then direct them to get to work!

Note: If extra devices and time is available, students may perform further internet research on the role they have been assigned in order to better understand how it may be affected by precision medicine.

- 10. Wrap Up:** When there are about 10 minutes left in the period, encourage each pair to briefly share the second part of their response: What will need to be done to help this role transition to precision medicine? If time allows, encourage students to ask questions and share their thoughts from the viewpoint of hospital administrators who want to make the transition as seamless as possible.
Conclude by thanking the class for their hard work: With their leadership, the hospital will be well on their way to implementing precision medicine!



PRECISION MEDICINE PLAN HANDOUT

Step 1: Put a star next to the hospital role on which you will focus. Then proceed to Step 2.

Note: While these roles are not inclusive of all hospital positions, they are a selection of the roles that will be affected by a transition to precision medicine.

HOSPITAL ROLES

Patients are treated everyday by our hospital, and many of the patients we already treat as well as those we will see in the future could benefit from precision medicine. ____

Doctors work to prevent, diagnose and treat diseases, sicknesses and injuries in patients. ____

Nurses promote patient health by collaborating with doctors and provide support (both physical and psychological) to patients and their loved ones. ____

Geneticists test, diagnose and treat patients with health issues that relate to the human genome. ____

Genetics counselors collaborate with doctors and work with patients to help them understand the risks, benefits and limitations of genetic tests and treatments. ____

Research scientists work to make advancements in all health-related areas, including genetics. ____

Insurance companies help patients pay for doctor visits, prescriptions, operations and hospital stays. Different insurance plans have different levels of coverage depending on a patient's needs and budget. ____

Other: _____



Name _____ Date _____

Step 2: Work with your partner to assess and predict how this role will be impacted by a transition to precision medicine. While you may be creative and make inferences, you must use your article annotations as well as other information learned during this class period to guide your thought process.

1 How will this role will be affected when your hospital moves into precision medicine?

2 What could be done to ease the transition for this role? Think about training, research, meetings, or additional information that may help this role switch to the practice of precision medicine.
