

## STUDENT ACTIVITY

# Genes or the Gym?

### Project Details

#### GRADE RANGE

9–12

#### TIMING

45–60 minutes

### OVERVIEW

In this activity, students will investigate if genetics can influence higher levels of various types of performance. Students will examine the concept of heritability estimates to determine how much of the difference between themselves and other people is because of their genes. To understand how their DNA may affect their fitness, students will work in small groups of three to explore different genes that influence aerobic fitness, muscular power, motivation to exercise, and the size and shape of their body. Students will use the new information presented and discussed to finish this activity with a Claim, Evidence, Reasoning summary that answers the question: “Does evidence support that my genes could guarantee me an Olympic Gold medal?”

### OBJECTIVE

Students will learn that some of our genes have a direct impact on our fitness, weight, how we use oxygen, how quickly our muscles work, among other things. They will explore whether athletic ability is determined by genetics, environment, or a combination of both and discover that we can estimate which of these factors seems to be more at play by estimating heritability. Students will work together to complete research as they examine the role a particular gene plays in fitness and ability, and evaluate evidence to help them support a claim about the influence genetics has on one’s hopes of becoming an elite athlete.

#### **Suggestions on transferring this to virtual classroom/ distance learning model:**

Teacher modifications for distance learning or use in virtual classrooms are included throughout the activity.

## MATERIALS NEEDED

- Device with the ability to project videos or share videos and links virtually with students
- Student devices (laptop, iPad, etc.)
- Group Chart: Traits of Elite Athletes (displayed in the front of the classroom)
- 3-2-1 Heritability Estimates Capture Sheet (1 per student)
- Genes Or The Gym? Gene Research Capture Sheet, one per small group
- Genes Or The Gym? CER - Claim, Evidence, Reasoning, one per small group

## STANDARDS

### Next Generation Science Standards

#### Asking Questions and Defining Problems

HS-LS3-1 Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

### Disciplinary Core Ideas

#### LS1.A: Structure and Function

All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins.

### Crosscutting Concepts

#### Cause and Effect

Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.

### Common Core ELA Standards

#### Grades 9–10

- CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- CCSS.ELA-LITERACY.SL.9-10.1.D Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

Grades 11–12

- CCSS.ELA-LITERACY.RST.11-12.2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- CCSS.ELA-LITERACY.RST.11-12.6 Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
- CCSS.ELA-LITERACY.SL.11-12.1.D. Respond thoughtfully to diverse perspectives; synthesize comments, claims, and evidence made on all sides of an issue; resolve contradictions when possible; and determine what additional information or research is required to deepen the investigation or complete the task.

## PROCEDURE

### 1. **Warm-Up Activity:** Traits of Elite Athletes: Due to Genes or Environment?

Select and project a short video for the class to view an assortment of athletes in action.

**Virtual/Remote Learning adaptation:** To show videos to students in a virtual lesson, the instructor can use Zoom (<http://zoom.com/>) to record a lesson and use screen sharing to show, pause, and give commentary on an online video. This recorded zoom meeting can then be posted as a link for students to view.

After viewing the video, ask students to brainstorm and create a list of the traits that they think elite athletes possess. Traits may include height, muscle mass, endurance, body type, hand-eye coordination, etc. Project or display the “Traits of Elite Athletes” chart on the front board. (This chart can be digitally displayed or copied using dry-erase markers onto the front white board or other large paper or poster board.) The instructor should record the students’ list of traits on the chart.

**Virtual/Remote Learning adaptation:** A virtual idea board can be created by using Padlet (<https://padlet.com/>). In this, students can share their ideas by adding their answers and ideas to the driving question by posting via a shared link.

Next, ask students to think about whether each of the listed traits are influenced or determined by genes or by the person’s environment. Allow students to engage in friendly debate if they do not agree, and place a checkmark or “X” in the column that the class determines for each listed trait. Students should discover that it is difficult to determine to what degree genetics or environment plays in athletic success.

2. Direct students to the following online article “One Reads And The Other Runs: Identical Twins And Sports” (<https://www.wbur.org/onlyagame/2016/08/05/identical-twins-sports-ability>) on their student devices. Ask students to take a few minutes to read through the article on their device. (Note: There is an audio version of the article available as well for students who may need accommodations, or the instructor may choose to play the audio for the class rather than having them read the article.)
3. When students have finished, ask for their answer to the question, “Is athletic ability determined more by environment or by genetics?” Once they have given their answers, ask them why they think identical twins were being compared in the story to try to answer this question. Allow students to share their thoughts and ideas with the whole class.
4. Explain to students that one way that we can try to determine or measure the role that genetics plays in the explanation of differences in individuals is by using something called a heritability estimate.
5. Give each student a copy of the “3-2-1 Estimating Heritability” capture sheet.

**Virtual/Remote Learning adaptation:** The “3-2-1 Estimating Heritability” capture sheet can be posted as a shared google doc that all students have access to on the google classroom platform, or as a shared document on a preferred online platform.

6. Explain to students that for the first part of this activity, they should listen and evaluate information as the instructor reads an article aloud to them. Next, they will watch a video clip. As they listen and watch, students should complete the 3-2-1 capture sheet by writing down three things they learned about the topic, two things they found interesting and would like to learn more about, and one question they have on the topic.
7. Display and read the article “What Is Heritability?” (<https://ghr.nlm.nih.gov/primer/inheritance/heritability>) to the whole group. If students have individual questions, remind them that they should write them down under the “2” category of their capture sheet.
8. When students have completed their 3-2-1 capture sheets, ask them to turn to the person(s) sitting beside them and take five minutes to share what they learned, what they found interesting, and what questions they have. Give students the opportunity to share some of these with the whole class when the five minutes are over. If you are in a digital learning environment, use break out groups.

**Virtual/Remote Learning adaptation:** The instructor can create breakout groups during a zoom meeting to allow students to discuss and collaborate with each other.

9. Explain to students that next they will look at the connections between genetics and athletic ability. To introduce this idea, play the video “Talent or Training” (<https://youtu.be/2ZiRZrYo5tA>). Allow students to share their initial reaction to the video with the class.
10. Ask the class to form small groups of three or four. Assign or allow each group to choose one of the following genes that have an impact on a person’s health and fitness:

### Genes Or The Gym CER Gene Assignments

- Gene 1—ACTN3
- Gene 2—FTO
- Gene 3—UCP2
- Gene 4—ACE
- Gene 6—AKT1
- Gene 7—PPARA
- Gene 8—EGLN1

**Virtual/Remote Learning adaptation:** The instructor can create breakout groups for each gene assignment during a zoom meeting to allow students to discuss and collaborate with each other.

11. Give each group a copy of the “Genes Or The Gym Gene Research” capture sheet. Explain to students that their job is to follow the instruction on the research capture sheet to discover how their gene is related to fitness and/or athleticism and review an article that they will summarize.

**Virtual/Remote Learning adaptation:** The “Genes or the Gym Research” capture sheet can be posted as a shared google doc that all students have access to on the google classroom platform, or as a shared document on a preferred online platform.

12. Once students have their assignments and research capture sheets, give groups 15 minutes to use their student devices to do their research and compile information on their research sheet.
13. When each group has finished their research, give each group a copy of the “Genes Or The Gym? CER (Claim, Evidence, Reasoning)” capture sheet and ask each group to choose a spokesperson to share the information about their gene with the class.

**Virtual/Remote Learning adaptation:** The CER—Claim, Evidence, Reasoning capture sheet can be posted as a shared google doc that all students have access to on the google classroom platform, or as a shared document on a preferred online platform.

14. Display the following definitions of claim, evidence, and reasoning on the overhead screen and have a brief discussion with students on how each term applies to the activity if necessary.

CER Vocabulary:

- A **CLAIM** is a statement that answers the question
- **EVIDENCE** is data used to support the claim
- **REASONING** is an explanation of how or why the evidence supports the claim

*Mention to students that while the claim is first on the CER sheet, they may want to wait until they have evidence to fully formulate their claim.*

15. As each group’s spokesperson presents to the class, all other groups should write down the presented evidence on their own sheet. Groups should take turns sharing and summarizing until all groups have had a turn and all evidence sections are completed in the CER sheet.
16. Groups should then evaluate their evidence and discuss what they think the claim should be or should they modify their original claim (if they have one). They should work to come to a consensus and record their claim at the top of the CER sheet.
17. Finally, students should think about how their evidence connects to and supports their claim to complete the reasoning section of the CER.
18. When the groups have finished their CER, each group should choose a representative to share their claim, evidence, and reasoning to the whole group. Students can give feedback to each other and determine what additional evidence from other groups may support or refute their claim.

**Virtual/Remote Learning adaptation:** For real-time class collaboration during a virtual lesson, the instructor can invite students to join a scheduled zoom meeting (<http://zoom.com/>).

19. **Wrap-Up:** Conclude by posing the question: Should athletes, or anyone for that matter, use gene editing in the future as a way to enhance their athletic performances and skill? We can screen for genes using genomic technology, and scientists are getting closer and closer to editing and repairing damaged genes for medical purposes using gene therapy. It is likely that we would also be able to edit genes (much like the ones you learned about earlier) that might enhance a person’s fitness and athletic ability. Show students the following video “Can We Make Super Athletes By Modifying Genes?” (<https://youtu.be/mheUAZsi5V8>) and engage in a debate that looks at whether we, as a society, should explore this or not and what the positive and negative consequences could be if we do.

*The instructor should copy this down on the front white board using dry-erase markers, or on paper or poster board if not using a digitally display and editable copy to record student responses.*

## Traits of Elite Athletes

List of Traits	Genetic?	Environmental?

**3**

What are three things you learned about heritability estimates from the article and video?

1.
2.
3.

**2**

What are two things you learned about heritability estimates from the article and video?

1.
2.

**1**

What is one question you still have about this topic?

1.
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Go to <https://ghr.nlm.nih.gov/gene> to help you with the following information about your assigned gene. You may need to type the gene into the search bar:

Name of the gene:

Function of the gene:

How this gene may enhance athletic performance or fitness:

What sports or activities might this gene or version of the gene be ideal for or detrimental to:

**Next, use a web search to find one article or video that relates to your assigned gene and athletic ability or fitness of a person.**

Title of the Article or Video:

Summarize the information about your gene from the article or video in the space below:

**QUESTION:** “Does evidence support that my genes could guarantee me an Olympic Gold medal?”

<b>CLAIM</b> (Your answer to the question written as a complete sentence):	
<b>EVIDENCE</b> (Data, facts, examples that support the claim and help to answer the question):	
<b>Gene 1 Name:</b> <b>What this gene influences:</b>	<b>Gene 2 Name:</b> <b>What this gene influences:</b>
<b>Gene 3 Name:</b> <b>What this gene influences:</b>	<b>Gene 4 Name:</b> <b>What this gene influences:</b>

<p><b>Gene 5 Name:</b> What this gene influences:</p>	<p><b>Gene 6 Name:</b> What this gene influences:</p>
<p><b>Gene 7 Name:</b> What this gene influences:</p>	<p><b>Gene 8 Name:</b> What this gene influences:</p>
<p><b>REASONING</b> (An explanation of evidence—<i>how</i> or <i>why</i> the evidence supports the claim)</p>	