

Genetic Mutation Superheroes Game

Lesson Overview

This is an assessment activity where a trio of students will use their knowledge of genetics. Each trio will create a male and female superhero based on genetic mutations. They will list the superhero's phenotypes and genotypes, as well as provide Punnett squares for them. In addition, they will create a possible offspring of the two superheroes in which they will identify the phenotype and genotype of the inherited traits.

SC Standards Addressed

7.L.4A.3 Develop and use models (*Punnett squares*) to describe and predict patterns of the inheritance of single genetic traits from parent to offspring (*including dominant and recessive traits, incomplete dominance, and codominance*).

7.L.4A.5 Construct scientific arguments using evidence to support claims for how changes in genes (*mutations*) may have beneficial, harmful, or neutral effects on organisms.

Disciplinary Literacy Strategies

Strategies Used: Elbow Partners, Chum Check, Thumbs up/Thumbs down

Computational Thinking

Tools:

Games

Cornerstone(s) Addressed:

- **Decomposition:** When students create their own games, they must first start with the goals. These goals must be broken down into actionable steps - this decomposition is a first step in any game creation scenario. In this particular lesson students must first break down the trait (characteristics) into their phenotypes and genotypes.
- **Pattern Recognition:** After completing several "playing" cards of possible combinations, a pattern emerges from the heterogenous and homogenous crosses that will allow students to be more efficient at creating their possible offspring.
- **Abstraction:** During game play, students must determine which phenotypes and genotypes to disregard and which to keep.
- **Algorithmic Thinking:** Developing the steps in how to play the game and how to create the traits, requires algorithmic thinking.

Lesson Plan

Time required: Two 70-minute class periods

Focus Question(s):

- How do genetic mutations affect the phenotype and genotype of offspring?
- How might a genetic mutation cause super-human abilities?

Disciplinary Vocabulary: Homozygous, Heterozygous, Allele, Gene, Dominant, Recessive, Gamete, DNA, Genetics, Heredity, Genotype, Phenotype, Bioengineering

Materials needed:

- 5 x 8 index cards (12 for each group of 3 students in the class)
- 1 penny for each group of 3 students in the class

Engage:

- Elbow partner trios (3/group – if needed, create one pair) – Students will remain in these trios for the remainder of the activity. Watch the Spider Man trailers and answer the questions that follow:
 - First Clip:
 - What made the spider that bit Peter Parker special?
 - What was a disadvantage of being bitten by the spider?
 - Second Clip: <https://youtu.be/kP8KWVsXK3k>
 - How did the spider’s bite change Peter Parker? What part of Peter was changed?
 - What benefits did Peter Parker get from the changes?
 - What other superheroes were created from mutations? (Possible answers include any of the XMen, the Hulk, the fantastic Four, and most Marvel characters except Thor and Iron Man.)

NOTE: The above works well embedded in a PowerPoint where you can control the video (pause, stop, reverse) and the appearance of the questions.

- Present the following scenario or one similar. (NOTE: *the questions are rhetorical*)
 “Have you ever wondered what the offspring of superheroes might be like? How about the offspring of Aquaman and The Little Mermaid? The Enchantress and Prometheus? Spiderman and Catwoman? Today you will be given a set of characteristics. It is up to you to determine how those characteristics come together to create a male and female superhero and what their offspring will be. The only catch is that you, as a Bioengineer (*an engineer of genetics*) must provide the correct genetic information about each creation: mother, father and baby superhero.”

Explore:

- Complete the scenario with a rationale for looking at real genetic mutations that have characteristics like superheroes.
 - Distribute P. Perry’s blog post, “7 Actual Superpowers certain humans have, due to Genetic Mutation” (attached - 1/student)
 - All students should read the blog post individually and either highlight, annotate or record the following:
 - One benefit of each mutation
 - One deficiency of each mutation (disease or disorder)
 - One superhero that has the benefit or something similar
 - Do a modified Chum Check – individuals in trios check for understanding and share superheroes.

Explain

- Ask a student to explain why the mutated gene is recessive (*If it is dominant, then it could be the norm, and not an abnormality.*).
- Then say, “Our superhero trait should be recessive too – otherwise everyone would be a superhero.”
- Distribute the Superhero Genetics Game Student Sheet (*attached*) - one to each student.

NOTE: At this point it best to use the game sheet for specific student instructions. What follows is for facilitation.

- Distribute one sheet of unlined paper (*or one whiteboard*) to each trio.
- Students create one “trait card” for Gender, on the paper (or board) and hold it up when completed.
 - Model if needed with gender, then eye color.
 - Assist struggling students as needed.
- Once students feel confident, distribute 12 index cards to each trio.

Elaborate:

- Trios complete the trait cards for the 10 given traits PLUS 2 of their choosing. (*Be sure to view the instructions for this.*)
- Teacher approves trait cards based on instructions.
- Once approved, trios receive their penny to play the game and create offspring.
 - Each player creates their own offspring based on the penny tosses for each trait
 - The offspring should be recorded on the game sheet and turned into the teacher.

Evaluate

- Students exchange cards with another trio group and create new offspring.
- Exit Ticket: The term co-dominant means that genes are expressed equally, i.e., there is no dominant or recessive trait. If a flower showed co-dominance for red and white, what color would it be if it were heterozygous? *NOTE: Have this posted so all can see (PowerPoint works well).* The answer is “pink”.

Assessment Notes:

The Superhero Genetics Game Student Sheet turned in for each student should contain: their offspring’s phenotype, genotype and Punnett square for each inherited trait. It can be used as an individual summative assessment, while the trait cards can be used a group assessment. If this is for grading, a peer evaluation might also be advisable.

Teacher Biographical Information

Lesson Author: Stacey Dortch

Science Teacher Hardeeville-Ridgeland Middle School

Resources:

For students:

Plastic Egg Genetics: Belasic, L. (2015, March 18). *Plastic Egg Genetics [Blog post]*. Retrieved from <https://middleschoolscience.com/2015/03/18/plastic-egg-genetics/>

Sno Ball Silles: <https://www.flinnsci.com/sno-ball-silliesgenetics-simulation/Document/?contentId=e7f40c6a-8b1a-4e62-ae97-ad683d504377>

Heredity Mix 'n Match: https://www.teachengineering.org/activities/view/duk_genetics_mary_act

For teacher:

<https://ghr.nlm.nih.gov/primer/mutationsanddisorders/genemutation> (US Library of Medicine – general definition of genetic mutations)

Perry, P. (2018, May 20). *7 actual superpowers certain humans have, due to genetic mutation [Blog post]*. Retrieved from <https://bigthink.com/philip-perry/7-actual-superpowers-certain-humans-have-due-to-genetic-mutation>

7 actual superpowers certain humans have, due to genetic mutation

A lot of the powers found in the comics exist in real life. They're just a bit different.

Philip Perry

20 May, 2018

If you could choose any superpower, what would it be? Disappointingly, most of us don't have a mutant gene that allows for superior capabilities. Turns out humans are 99.9% genetically identical. Yet, there's a lot of variation expressed within that remaining 0.1%. How tall or short we are, what skills we have, our hair and eye color, and even predispositions to certain diseases or conditions, are all encapsulated within our genes.

Lying deep within that tiny fraction of a difference are some really weird and downright uncanny capabilities in some, rare cases. Here are 7 actual "superpowers," due to genetic mutation. Which of these real-life superpowers would you want?

1. Unbreakable bones

Think Wolverine's adamantium skeleton is impressive? Well, it is. But there's a superpower in real life that's sort of like that, unbreakable bones. The LRP5 gene is responsible for many ailments, including a bone disorder, juvenile osteoporosis. What's remarkable is, a mutation associated with this exact same gene can have the opposite effect. Yale researchers discovered the mutation among one particular Connecticut family. They have bones that are super strong and extremely resistant to breaking. Understanding this phenomenon may help medical researchers work up a novel cure for osteoporosis.

2. Incredible vision

How many colors can the average person see? The answer: about 1 million. Those with tetrachromacy, however, are estimated to see up to 100 million colors. While most humans have three color receptors in their eyes, tetrachromats, usually women, have four. This is caused by a mutation of the opsin gene.

About 12% of women have it. But possessing the gene doesn't guarantee you'll develop the ability. What scientists have noticed is, those who carry the mutation and encounter a number of different colors, constantly, from a young age on, often develop it. Scientists are now just beginning to develop an understanding of this condition.

3. Super strength

Who wouldn't want to be stronger? Well, those with a mutation in the MSTN gene don't. Their muscles are already amped up, due to a lack of myostatin—a protein which tells the muscles when to stop growing. Animals who lack the protein often grow large, muscular bodies that contain very little fat. In humans, this mutation allows one to reach a muscle mass double that of the average person and stay muscular, without having to do much to keep it up.

4. Uncanny flexibility

Marfan syndrome is a condition, caused by genetic mutation, where a person has less connective tissue than they should. Our connective tissue keeps our limbs, organs, and other body parts firmly in place. Those who have Marfan syndrome often have long limbs, piano fingers, and incredible flexibility.

Javier Botet, has a mild variation, which allows him to put his body into strange poses—making him a perfect candidate for a horror movie. But those with more pronounced cases can experience severe, even life-threatening complications to their heart or other organs. It can also affect the eyes, bones, and blood vessels. Those with a mild case, however, like Botet, usually lead normal lives.

5. Resistance to poison

Imagine drinking enough arsenic to kill an ox, only to walk away whistling, without any health effects, whatsoever. In a small village in Argentina, the residents call this their daily life. 6,000 of them drink from a water supply laced with 80 times the amount of arsenic needed to kill anyone. This population has been drinking from the same source for thousands of years. As a result, they've developed a mutation of the gene AS3MT, which helps push potentially dangerous substances out of their system.

6. Super speed

Ever wanted to run incredibly fast? Although comic book powers are overly dramatic, there are folks in this world who display exceptional athletic ability, including running. The mutation here is located at gene ACTN3, also known as the "sports gene." This involves how fast muscles move, allowing them to flex faster for running and other physical activities. A 2008 study found that lots of top runners and athletes possess the mutation.

7. Perfect memory recall

In real life, there are those who remember every detail of every day they've ever lived. Know what you ate for breakfast on this date exactly ten years ago? What was in the news? Who did you speak to? What did you do? Those with hyperthymesia can tell you everything. Basically, it can be explained as having a super memory or an autobiographical one. So far, there are 25 confirmed cases. Actress Marilu Henner from the '70s sitcom *Taxi*, is one.

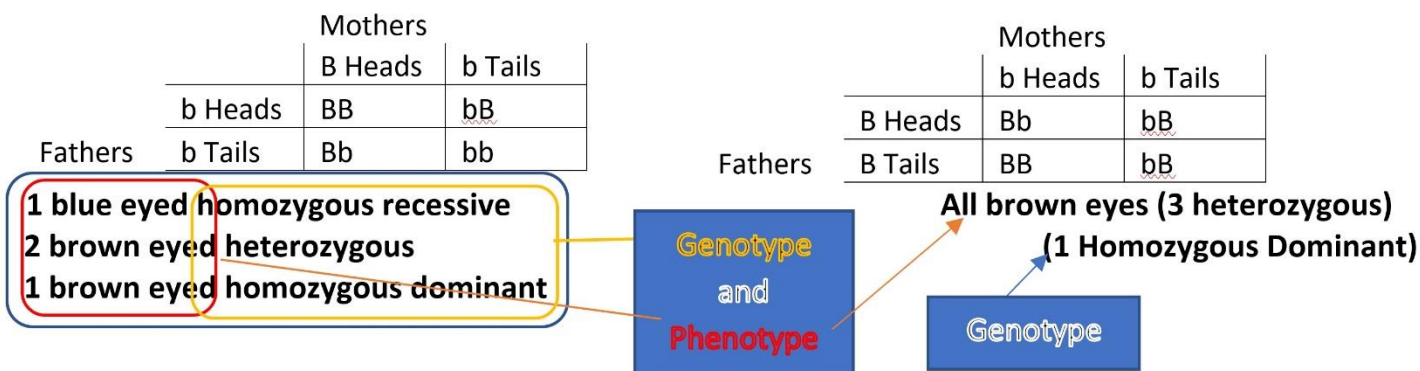
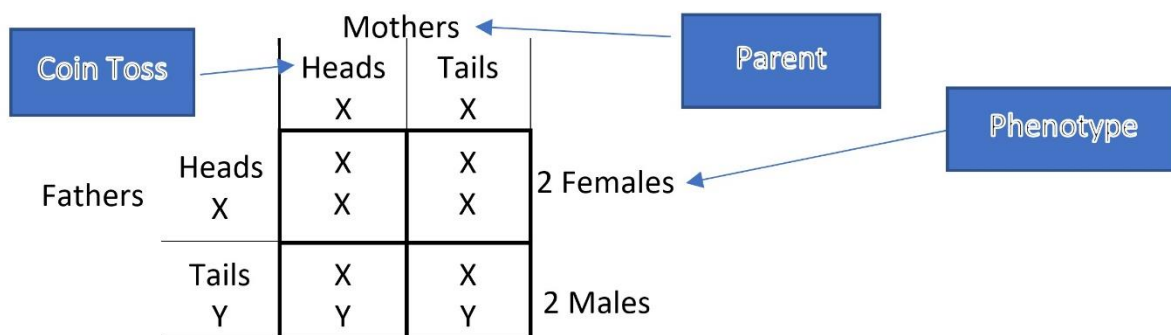
Although it's assumed that there's a genetic basis, so far no one has nailed it down. There are certain neurological phenomena that come with the condition, however. Each person with hyperthymesia has a larger caudate nucleus—a part of the brain which helps us process and store memories.

There may also be a strong link between the caudate nucleus and the temporal lobe, an area responsible for sensory input, emotion, language, memory, and comprehension. Those with hyperthymesia often exhibit obsessive-compulsive behaviors. In fact, some experts believe the condition may stem from a compulsion to constantly revisit one's memories.

Superhero Genetics Game

Name: _____

- Record the following character traits. Each on the front of a separate index card. You have been provided with all possible genotypes for the first six traits. You must complete the remaining six on your own.
 - o Gender – XX, XY (X female, Y male)
 - o Eye Color – BB, Bb, bb (Brown/blue)
 - o Hair Color – BB, Bb, bb (for your purposes Brown/black or Brown/blonde)
 - o Muscle Strength – SS, Ss, ss (S Normal Strength, s super strength)
 - o Bone Strength – OO, Oo, oo (O Normal Bones, o super strong bones)
 - o Color Vision
 - o Speed
 - o Memory
 - o Flexibility
 - o Poison Resistance
 - o Add 2 traits of you choosing to the remaining cards
- On the back of each index card draw 2 possible Punnett squares with at LEAST one HETEROZYGOUS parent (Below are the first 2; notice for gender there is only one possible Punnett square – but for eye color there are many. Here are the 2 possible (you can use 1 of these but you must come up with another)



When the Punnett Square is complete, use coin tosses to determine which genotype the offspring will inherit for each trait. You will have to choose one of the parent genotypes from the back of the card.

- Record the gene that the parent gives to the offspring below.

	Mother's Gene	Father's Gene
Gender		
Eye Color		
Hair Color		
Muscle Strength		
Bone Strength		

Your Trait above

	Mother's Gene	Father's Gene
Color Vision		
Speed		
Memory		
Flexibility		
Poison Resistance		

Your Trait above

Names: _____

Superhero Offspring

Traits	Genotype		Phenotype
1. Eye color			
2. Hair color			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
Gender	X	Y	Male

Exchange cards with another trio and create new offspring. Record below.

Superhero Offspring

Traits	Genotype		Phenotype
1. Eye color			
2. Hair color			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
Gender			

Return this page to the teacher when completed.